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TIME LAGS AND THE EFFECTIVENESS OF MONETARY POLICY IN AUSTRALIA

by

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CONTENTS

SUMMARY

Reliance upon monetary policy for economic stabilization involves three main assumptions:

(a) That the monetary authority will be quick to recognize the need for a change in the stance of monetary policy, and to act upon its diagnosis.

(b) That monetary actions taken are effective in influencing the behaviour of the economy.

(c) That the influence of monetary policy on the economy takes effect with a relatively short, and invariant, time lag.

Thinking on these matters has been greatly influenced by Milton Friedman. His views on them are well known and he has assembled much evidence to support them.

No comparable body of evidence exists for Australia, and our objective is to examine these three assumptions in the Australian context, using Friedman's views as a backdrop.

Our examination of the first assumption seeks to determine whether the stance of monetary policy adjusts in a predictable fashion to the state of the economy, and what lags are involved in this response. After a survey of the central bank's views about the transmission mechanism of monetary policy and an examination of various indicators of monetary policy, a numerical index of the intended stance of policy is constructed, based on the tone of monetary policy statements. Use of this index in empirical reaction functions enables us to explore the association between policy goals and formulated policy, and estimate the 'inside' lag.

Measurement of the other lags of monetary policy ('intermediate' and 'outside' lag) proceeds along different lines. Unlike the inside lag, which

must be measured with variables which matter to the central bank, the other lags have most meaning if measured with variables which exert a reliable impact on the economy. Thus we examine these lags concurrently with the question of the effectiveness of monetary policy.

There are two basic ways of assessing the effectiveness of monetary policy. One is to examine the structure of the financial system with a view to establishing whether it is feasible for monetary policy to exert a predictable impact upon the economy. To this end we examine the characteristics of money, the demand for liquid assets, the substitutability of non-bank deposits for bank deposits, and the supply of liquid assets. The other way of investigating the effectiveness of monetary policy is to look at the historical record, and in the remainder of the thesis we examine the role of money in Australian business cycles. This is in part in the time domain, when we compare the respective roles of money and autonomous spending in the cycle, but is also in the frequency domain, using a combination of spectral and correlation analysis to examine the character of Australian business cycles since 1880, the association of cycles in the money supply with income, and the nature of the lead-lag relationship.

If the money supply is exerting an independent role in business fluctuations, we should expect the transmission mechanism to operate at least partly through financial markets. The spectral and correlation analysis is extended to the share and bond markets, and an extensive examination is made of the velocity of money. The results of these analyses lead us to question Friedman's analysis of the velocity of money as well as many of the ideas implicit in other studies of the demand for money, and an alternative way of modelling short-run adjustments in the monetary sector is suggested.

A contrast is found between the results of the structural approach and the examination of the actual behaviour of the money supply and monetary velocity. The former yields results generally favourable to an extreme 'monetarist' position, the time series evidence is less one-sided. Specifically, an important role is found for variations in autonomous spending to influence the course of the cycle. Also, the lead-lag of money relative to income varies with the period of the cycle, and money appears to be in a subsidiary position during long cycles. This latter finding is a major challenge to future Australian econometric model-building.

One possible explanation of the previous finding is offered when, finally, the sources of cyclical changes in the money supply are studied in the context of cycles in the balance of payments. An attempt is made to reconcile the behaviour of the money supply during post-war business cycles with the earlier analysis of the ways in which monetary policy in Australia has been formulated and implemented. In doing so, we argue that monetary policy has had an important role in moderating the severity of Australian business cycles.

DECLARATION

This thesis contains no material which has been accepted for the award of any other degree in any University, nor material previously published or written by another person, except where due reference is made in the text.

M.K. Lewis

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My former teachers, Professor M.J. Artis, Mr. R.R. Hirst and Mr. R.H. Wallace, are thanked for stimulating what seems likely to be a life-long interest in monetary economics. They have helped in other ways. Many of the ideas in sections I and II have their origins in long and stimulating conversations with Bob Wallace, and during the writing of articles with him on related topics. My research with Mike Artis in the U.K. during 1973/74 provided the key which made sense of findings about the velocity of money which until then were a stumbling block in the analysis. Ron Hirst provided patient advice and read the final draft in its entirety, itself a major feat.

Among the many others who have provided assistance, special thanks go to Dr. Peter Praetz for giving tuition in spectral methods and adapting his programs for my purposes. Professor Geoff. Harcourt and the late Professor Eric Russell provided encouragement to complete the study when my enthusiasm waned, as well as creating a congenial atmosphere for research. Mrs. Kath Cheshire and Mrs. Helen Wickens helped with proof-reading and figures, and Miss Kerry Clift and Mrs. Marilyn Wilkin did most of the typing.

Finally, without the encouragement and forebearance of my wife, Kay, this study would certainly not have reached completion.

<u>Note</u> Certain parts of the study have been published, and these are recorded.

Chapter 8 Tables 8.6 and 8.7 and some of the associated discussion is published in M.K. Lewis and R.H. Wallace, "The Savings Banks", in Hirst and Wallace, *The Australian Capital Market*, Cheshire 1974.

Chapter 9 Figure 9a is reproduced, and some of the discussion is used, in G. McL. Scott, "Instalment Credit Institutions", in Hirst and Wallace, *op. cit.*

Chapter 11	Part of the discussion dealing with autonomous expenditures is published in "Friedman-Meiselman and Autonomous Expenditures", *American Economic Review*, June 1967.
Chapter 15	An article "Monetary Activity and Interest Rates Re-examined" based on the latter part of this chapter, is published in *Quarterly Review of Economics and Business*, Winter 1976.
Chapters 16, 17	An article "Interest Rates and Monetary Velocity in Australia and the United States" based on these chapters, is scheduled to be published in the *Economic Record* in 1978.

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Chapter 1

Introduction

Much, if not most, of the present controversy about the appropriate role for monetary policy centres around the views of Milton Friedman. In particular, his argument that the quantity of money is "the most important single instrument available to the government to affect total spending and to control inflation",[1] yet at the same time that it should *not* be used to fine-tune the economy is widely discussed. Also controversial is his view that the monetary authorities are responsible for economic performance ("inflation is made in Canberra").[2] Their significance for Australian discussion is illustrated by the last two Winter Schools of the Economic Societies of N.S.W. and Victoria. In 1975, Sharpe used the occasion of Friedman's visit to Australia to examine the broad evidence for monetarism. From a visual examination of time series of the money supply, employment and prices he concluded that "the Australian evidence .... is consistent with most of the 'monetarist' propositions" and that "the instability in the money supply over recent years is attributable directly to government actions." In the following year, Jüttner (1977) attributed "policy failures" and the "dismal performance of the economy" to the "tainted monetary policy record", and like Sharpe argued the Friedmanite (or monetarist) case for substituting a fixed monetary growth rate rule for discretionary policy actions.

In the light of these views it is pertinent to ask what preconditions must be met if discretionary monetary policy is to be used. Three main assumptions are involved:[3]

(a) that the monetary authority will be quick to recognize the need for a change in the stance of monetary policy, and to act upon its diagnosis.

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1 Friedman (1972b)

2 Friedman (1975b)

3 These are based on Johnson (1963) and Rowan (1965)

(b) that monetary actions taken are effective in influencing the behaviour of the economy.

(c) that the influence of monetary policy on the economy takes effect with a relatively short, and invariant, time lag.

No guarantee exists that policy undertaken will be successful even if these conditions are met, for policy may move in the wrong direction, but the chances of success are much reduced if they are not.

Obviously assumption (b) is critical, and is a precondition for any effective monetary policy. Friedman does not question it; indeed he is the architect of the view that "money does matter and matters very much" (Friedman, 1964). In his view the relationship between money and income is not only close, and highly stable in form and character, it is also characterized by a predominant influence running from money to business. This is so for both physical output and prices, although the emphasis given to each has varied over time. Initially the debate surrounded the limitations of monetary policy in curing a recession, now it revolves around the ability to control inflation. This reflects in part changing fashions and in part different conceptions of short run and long run policy impacts.

> "In the short-run, which may be as much as five or ten years, monetary changes affect primarily output. Over decades, on the other hand, the rate of monetary growth affects primarily prices". (Friedman, 1973)

Although Friedman has always argued the desirability of directing monetary policy towards stabilising prices rather than employment, and lags in formulating, implementing and effecting monetary policy obviously assume greater importance if the time scale of the impact upon employment is limited, his prescription about the use of monetary policy stems more from judgements about the assumptions (a) and (c) above, than from the thought(popularised nowadays in the notion of rational expectations)[4]

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[4] See Sargent and Wallace (1976)

that economic policy is futile.

> "If these time lags were short relative to the duration of the cyclical movements government is trying to counteract, they would be of little importance. Unfortunately it is likely that the time lags are a substantial fraction of the duration of the cyclical movements". (Friedman, 1951)

By time lags, Friedman includes both (a) and (c).

> ".... the relevant lag for policy must include the time required to recognize the need for action and translate this recognition into action". (Friedman, 1961)

And even if the lags are short, their variability would pose a problem.

> "It would be cold comfort to know that on the average action taken today would have its mean effects four to five months later if in some instances the relevant time period is negligible, in others, ten to twelve months, and there is no way of telling which is likely to be the case in a particular instance". (Friedman, 1961)

The result is that even with the best will, fine-tuning is likely to do more harm than good.

> ".... monetary authorities have on occasion moved in the wrong direction - as in the episode of the Great Contraction .... More frequently, they have moved in the right direction, albeit often too late, but have moved too far. Too late and too much has been the general practice .... The reason for the propensity to overreact seems clear: the failure of monetary authorities to allow for the delay between their actions and subsequent effects on the economy. They tend to determine their actions by today's conditions - but their actions will affect the economy only six or nine or twelve or fifteen months later. Hence they feel impelled to step on the brake, or the accelerator, as the case may be, too hard". (Friedman, 1968b)

Unlike assumption (b) regarding the effectiveness of monetary actions, lags in monetary policy may not mean that monetary policy, broadly interpreted, is rendered inoperative, but they alter the type of policy pursued. A useful distinction might be drawn between the defensive and the dynamic dimensions of policy, that is between actions designed to maintain financial conditions in the face of unwanted influences and actions to alter financial conditions, and the latter can be further sub-divided into automatic responses and actions which remain at the discretion of the authorities. Given (b), failure to meet either condition (a) or (c) casts doubt upon the effectiveness of discretionary monetary policy, and suggests the wisdom of limiting the scope of monetary policy to other dimensions.

The objective of this study is to examine the three assumptions underlying reliance upon discretionary monetary policy, using Milton Friedman's views about them as a backdrop. No evidence even comparable to that presented by Friedman and others for the U.S. has been provided for Australia, but his adherents appear to assume implicitly that much the same sort of relationships and time lags exist for Australia, and it is appropriate that we use Friedman's findings as a benchmark. In doing so, we investigate several matters which are potentially of relevance to the effectiveness of monetary policy and the time lags involved, but which turn out on closer examination to be blind alleys and not after all central to the analysis. As examples we cite the search for an indicator of monetary policy, the substitutability of non-bank intermediaries' claims for money, the substitutability of government securities for cash in the money supply process, and the mechanism of Tucker (1966) for an overshooting of interest rates in the short-run. It is desirable to clarify at the outset the major themes pursued in each section and the techniques used.

Section I deals with the first assumption, and we seek to determine whether the stance of monetary policy is adjusted in a predictable fashion to the state of the economy, and what lags are involved in this response. Measurement of these (inside) lags is different in principle from measurement of the lag in the effect of monetary policy (the outside lag). Whereas the outside lag can only be measured with variables which have an effect on the economy, the inside lag must be measured with variables which matter to the central bank - that is, which adequately reflect the way policy is formulated - and in chapter 3 we survey the central bank's views about the modus operandi of Australian monetary policy. It is found that while the emphasis given to various instruments of monetary policy has altered substantially since the mid 1950's, the monetary policy package remains complex and draws upon a number of elements. This necessitates that in measuring the inside lag a different type of indicator of policy be used, one more relevant to what we term the formulation stage of the monetary policy process. Our examination of the central bank's thinking also serves to highlight that certain assumptions about the behaviour of non-bank intermediaries, instability of the demand for money and the definition of and control of the money supply have shaped the Bank's policies, and these are examined further in section II.

There are two basic ways of assessing the effectiveness of monetary policy. One examines the structure of the financial system with a view to establishing whether it is feasible for monetary policy to exert a predictable impact upon the economy. The other looks to the historical record to see whether such an impact has in fact occurred. In section II the former approach is followed. We begin by asking in chapter 7 whether 'monetary' assets have characteristics which distinguish them from other assets and which give them special significance for stabilization policies. Recent work on this question by general equilibrium theorists is assessed. An empirical investigation is then made of the demand for liquid assets (chapter 8), the substitutability of non-bank deposits for bank deposits (chapter 9), and of the factors which determine the supply of liquid assets (chapter 10). In the latter connection, Australian discussion of the supply of bank deposits has never resolved whether the constraint upon bank intermediation is a cash base or an L.G.S. assets base, and we present evidence bearing on this issue.

Evidence pertaining to the second way of investigating the effectiveness of monetary policy is presented in section III, when we replicate for Australia two of the more important facets of Friedman's statistical analysis of the role of money in the economy. The first is the study by Friedman and Meiselman of the respective roles of money and autonomous expenditures in the cycle (chapter 11), the other is the study by Friedman and Schwartz of the turning points of the money supply relative to peaks and troughs in general business (chapter 12). For the latter, some of the ambiguities which still surround the dating of cyclical turning points in Australia have first to be resolved. In both cases we endeavour to take the analyses a little further than has usually been the case in other studies. In the study of money and expenditures, we attempt to interpret the meaning of the results in the context of the widely used Hicks - Hansen model of the economy, while in the latter chapter we attempt to determine to what extent the various comparisons of turning points are complementary or competing.

At the end of chapter 12 (which replicates Friedman's turning point type evidence) we look into the conceptual difficulties involved in measuring the outside lag of monetary policy, and conclude that the lag cannot usefully be measured unless the type of lag structure can be first identified and unless a more efficient means of extracting information about cyclical processes is used. It is argued that the answer to the problem lies in the use of spectral models, and in the remainder of the study we switch from analysis in the time domain to analysis in the frequency domain. Section IV and VI analyze the cyclical behaviour of the money supply, section V analyzes the cyclical behaviour of the velocity of money.

The first chapter of section IV describes the theory of spectral methods and their application to econometric models. Particular attention is given to the phase diagram and to the models which we fit to it in order to identify the form that the outside lag assumes. In chapter 14 we use spectral and cross-spectral analysis to explore the nature of cyclical fluctuations in Australian business activity and the relationship of the money supply to them. Using Friedman's analysis as a basis for comparison, we ask whether there is a close connection between money and other economic variables, whether the inter-relationship is stable in form over time, and whether money is a leading or lagging factor. Measures of income, prices, expenditures and employment (twelve in all) are used, and the period covered is 1880-1970 (but not all of the data series can be sampled for the full period). Such a long time period enables us to study the behaviour of money during both severe and mild business cycles, while by crossing the money supply separately with series of income, physical output, and prices the existence of different timing sequences over the cycle can be determined. If the money supply is exerting an independent role in the business cycle, we should expect it to operate at least partly through financial markets, and in chapter 15 the cross-spectral analysis of the preceding chapter is extended to incorporate the share market and the bond market.

To our knowledge no study has, as yet, examined the demand to hold money in the frequency domain, and in section V we do so. Chapter 16 uses spectral analysis to discover the cyclical content of the velocity of money and cross-spectral analysis to investigate the impact of measures of the cost of holding money (interest rates and inflation expectations) on cycles in velocity during the twentieth century. The importance of velocity for monetary policy is obvious, and Friedman's controversial views about the response of velocity to interest rates are well known.

We find that these views cannot be reconciled with the evidence for Australia (or the U.S. for that matter). Significantly, we also find that the evidence presented is in conflict with the studies of the demand for money which provide the current alternative to Friedman's explanation. An alternative hypothesis of short-run adjustments in the monetary sector is advanced in chapter 17, and its consistency with the evidence is examined.

Finally, in chapter 18 we look into the sources of cyclical changes in the money supply, with particular attention being paid to the role of the balance of payments. An attempt is made to reconcile the behaviour of the money supply during post-war business cycles with the way monetary policy in Australia has been formulated and implemented, thus linking the analysis contained in the latter part of the thesis with that of earlier sections.

Section I

The Formulation of Monetary Policy

Chapter 2

Monetary Policy and Time Lags

This section examines the speed with which the stance of monetary policy responds to changes in the economic environment - the so-called 'inside' lag of monetary policy. Usually the lag is estimated by comparing some indicator of the state of the economy with various measures of the behaviour of the financial system. But which financial variables are to be used, and with which indicators of economic activity are they to be compared? Why is such a comparison presumed to reveal *policy* behaviour rather than other responses in the financial system? In order to provide a framework for answering these questions, we examine here the theory of stabilization policies.

'Monetary policy' is defined as the process of manipulating certain *instruments* under policy control in order to influence (hopefully achieve) broad *goals* of macroeconomic policy, which are not controlled but to which utility is attached. Accordingly, a policy can be seen as a particular vector of the policy instruments, and the policy problem is to determine the optimal path for policy, given knowledge of what is achievable in terms of the structure of the economy. In the spirit of Theil's (1964) work on government decision-making, the optimal path for policy is that which maximizes utility (or minimizes disutility), given the constraints. Solution of the policy problem thus requires specification of (a) the authorities' objectives, (b) the economic system which imposes the constraints upon achievement of the goals, and (c) the conditions for optimality. By giving these elements an exact mathematical expression in the form of a goal function, constraint function and a conditional optimization procedure, it is possible to formulate the optimal strategy in a precise manner.

It is supposed that the monetary authorities have a preference function incorporating their conception of the public's welfare. Their preferences are assumed to be such that they attach welfare loss, W, not only to the deviations of the targets of stabilization policy, y_i ($i = 1.....n$), from their desired levels but also to the deviations of the instruments, x_j ($j = 1.....m$), from their desired levels. The authorities have in mind certain desired values of the principal goals, signified by y_i^*, such as an unemployment rate of 1.50 per cent and a rate of price inflation of 3 per cent per annum. A policy problem exists when y_i deviates from y_i^* and the job of policy in the short run is to stabilize these deviations. But, in attempting to do so, the authority is not indifferent to the values which the instruments take on. Interest rate variations resulting from monetary policy, for example, may compromise longer-run objectives of economic policy such as income distribution and resource allocation. The instruments can be thought of as 'minor' goals of policy themselves which must be balanced against the 'major' objectives. This is done by assuming, perhaps unrealistically, that the authorities have desired values of the instruments, denoted by x_j^*, and attach disutility to these deviations as well as to the deviations $(y_i - y_i^*)$. Reconciliation of the two sets of preferences comes from the loss function,

$$W = \sum_{i=1}^{n} k_i (y_i - y_i^*)^2 + \sum_{j=1}^{m} h_j (x_j - x_j^*)^2 \qquad (2\text{-}1)$$

where k_i and h_j are the weights given to the respective deviations. Alternatively, in matrix notation,

$$W = (y - y^*)'K(y - y^*) + (x - x^*)'H(x - x^*) \qquad (2\text{-}1a)$$

where y and x are vectors of the targets and instruments, and K and H are respectively n x n and m x m diagonal matrices of the weights accorded the respective deviations.

Certain features of the preference function should be recognized. As K and H are diagonal matrices, cross-product terms are absent from the arguments of the loss function. This implies that the government is indifferent both to how the goals are achieved and to the mix of instruments. The squaring of the deviations means that the deviations are assumed to be increasingly costly to society. While this seems a desirable feature, the quadratic form has the disadvantage of ascribing positive and negative divergences an equal importance in policy considerations. No allowance is made for there to be assymetric responses to the deviations of the goals or instruments from their desired values.

The authorities are constrained in their stabilization policies by the economic system, and are assumed to have firm notions of the links connecting the instruments to the goal variables. These are represented by a set of linear equations.

$$y = Ax + Bz \qquad (2\text{-}2)$$

where A is a n x m matrix of coefficients expressing the policymakers' view of the linkage between the targets and the instruments, z is a m x 1 vector of predetermined variables (non policy influences and lagged values of goal and policy variables) and B is a n x p matrix relating these to the targets.

The appropriate setting of the policy instruments is given by minimizing (2-1a) subject to (2-2). We commence the conditional optimization procedure by expanding the preference function (2-1a). As H and K are symmetric, this can be written as

$$W = -y'Ky + 2y'Ky^* - y^{*\prime}Ky^* - x'Hx + 2x'Hx^* - x^{*\prime}Hx^*$$

Substitution of the constraints (2-2) into the above form gives

$$W = -(Ax + Bz)'K(Ax + Bz) + 2(Ax + Bz)'Ky^* - y^{*\prime}Ky^* - x'Hx + 2x'Hx^* - x^{*\prime}Hx^*$$

$$= - x'A'KAx - x'A'KBz - z'B'KAx - z'B'KBz + 2x'A'Ky^* + 2z'B'Ky^* - y^{*\prime}Ky^*$$

$$- x'Hx + 2x'Hx^* - x^{*\prime}Hx^*$$

Minimizing W with respect to the instruments, x, we have

$$\frac{\partial W}{\partial x} = - 2A'KAx - A'KBz - z'B'KA + 2A'Ky^* - 2Hx + 2Hx^* = 0$$

Now the term A'KBz has the dimensions m x 1 and z'B'KA the dimensions 1 x m. Making the latter the 'correct' shape, we obtain

$$\frac{\partial W}{\partial x} = - 2A'KAx - 2A'KBz + 2A'Ky^* - 2Hx + 2Hx^* = 0 \qquad (2\text{-}3)$$

As $Ax + Bz = y$, this is equivalent to

$$x^o - x^* = H^{-1}A'Ky^* - H^{-1}A'Ky \qquad (2\text{-}4)$$

where x^o indicates the *required* behaviour of the instruments. Denoting the m x n matrix $H^{-1}A'K$ by Γ, we have for the *j*th instrument

$$x_j^o - x_j^* = \sum_{i=1}^{n} \gamma_{ij}\, y_i^* - \sum_{i=1}^{n} \gamma_{ij}\, y_i \qquad (2\text{-}5)$$

where γ_{ij} is the *ij*th element of Γ.

Equations (2-4) and (2-5) define the optimal strategy for the policy-maker to follow in response to the behaviour of the y_i: the so-called *policy reaction function*. These decision rules are optimal ones because account is taken of the preferences for the instruments and goal variables as well as for the impacts which the instruments can make upon the goals;

y^*, x^*, K and H coming from the preference function.

In order to relate the instruments directly to the objectives, it is necessary to make some assumptions about the unobservable variables x^* and y^*. The simplest is to treat them as constants. As we shall see later, this assumption has the effect of limiting the scope of the analysis and constraining the choice of data: accordingly we will experiment with some alternative assumptions about these variables. For the moment, by treating x^* and y^* as constants, and making the further assumption that the authorities make random errors in arriving at the values of x_j required for loss minimization, we obtain

$$x_j^o = \alpha_j - \sum_{i=1}^{n} \gamma_{ij} y_i + \varepsilon_j \tag{2-6}$$

where $\alpha_j = x_j^* + \sum_{i=1}^{n} \gamma_{ij} y_i^*$ and ε_j is a random error.

Recalling the questions posed at the beginning of this chapter, equation (2-6) provides the *basis* for supposing that a direct comparison of the objectives and instruments of policy evidences policy behaviour and not other responses in the financial system. As matters stand, however, the equation defines the necessary conditions for policy to be optimal; that is, it relates to how policy *ought to be* prosecuted. In using the model to quantify monetary policy objectives and responses, we are assuming that actual policies follow along more-or-less similar lines. More formally, the 'heuristic postulate' being tested, to use the terminology of Machlup (1955), is that the procedures adopted by the monetary authorities result in policies very similar to those which would have been produced if they had in fact followed the approach outlined above. Whether or not this is the case is to be judged by the results.

There remains the question of which variables are appropriate for defining the need for policy action to occur and for measuring the policy responses. We have also skipped over the nature of the lags between y_i and x_j and the definition of the 'inside' lag. These matters are now discussed.

Policy Objectives

The framework makes clear that no unique measure of the need for policy action is likely to exist. The central bank has a variety of objectives in mind when policy is formulated, and during a particular episode of policy some of these objectives may assume more important than others. Policy behaviour can only be correctly measured against goals that matter to a central bank. Knowledge is needed of the central bank's goals, the relative weights attached to them, and the desired path of the goals over time. But how are we to get inside the heads of policy-makers? Some studies seek to circumvent precise quantification of the policy goals by defining the over-riding objective of monetary policy as being one of smoothing the cycle and using general summary measures of business activity to indicate the need for policy. However, the theory of stabilization policies, combined with the theory of revealed preference, suggests an alternative method: by relating 'relevant' measures of the short-run stabilisation goals to indicators of monetary policy it may be possible to identify statistically *both* the objectives of policy *and* the lag in policy response. This is discussed further in chapter 6.

Policy Behaviour

So far we have taken it for granted that the controlled behaviour of the authorities can be readily identified. There are a variety of measures of monetary policy in common usage - banks' free liquidity, interest rates, and the growth rate of monetary aggregates are well known examples. Policy behaviour can only be measured meaningfully with variables that are relevant to the central bank. Knowledge of the central bank's operating strategies is a prerequisite for selection of an appropriate measure, and in chapter 3 we look at the *modus operandi* of monetary policy in Australia. Even if we manage to identify the set of instruments actually used in policy-making, there is an index number problem involved in weighting the various instruments and determining to what *extent* the policy stance is moving in a particular direction. Thus in chapter 4 we also consider this 'indicator problem' and the selection of a measure of monetary policy. Some of the points which are raised there can be usefully anticipated at this juncture.

The clear distinction which we have assumed to exist between the non-controlled policy goals and the policy instruments, subject to direct command, is not exemplified in practice. Such a clear division between controlled and non-controlled variables may be an appropriate description of fiscal policy, where economic theory directly links government spending and taxation changes to expenditure plans, but monetary policy is concerned as well with variables which are *intermediate* between these classifications. Economic theory usually relates the goals of policy to variables such as the money supply and interest rates, rather than directly to the policy instruments. Indeed, the implementation of monetary policy is recognized as being a *two-stage process*. These two stages often form separate bodies of analysis: one is the relationship between expenditure, income and production, and variables such as interest rates and the money supply; the other concerns the linkages connecting the latter (the intermediate variables) with the instruments of direct control, such as open market operations and reserve ratio changes.

Changes in the setting of the policy instruments may have little effect upon the ultimate objectives of policy, independent of that through the intermediate variables. Thus the intermediate variables are necessary links in the chain of causation from the central bank to the economy. While the intermediate variables are not subject to direct policy control, they are usually easier to control than the goal variables. In the absence of full information about the state of the economy and the transmission mechanism, they serve both as guides to the continual adjustment of monetary policy and as indicators of the effects of monetary policy, giving rise to the 'intermediate target problem' and the 'indicator problem'.

The *intermediate target problem* involves choosing a variable which is readily observable with little information lag, which responds quickly to the policy instruments and is thought to be related in a predictable way to all or some of the ultimate goals of policy. These are then treated, for purposes of short-run operating targets, as if they were the true ultimate goals of policy. Thus the policy-makers respond to their uncertainties about the condition of the economy and delays in the receipt of information about how the goals are behaving, by aiming at targets that reduce uncertainty and appear to increase the amount of information. As the intermediate variables are not under the policy authorities' direct control, there is a need to separate the effects of policy actions upon the targets and the goal variables. The *indicator problem* concerns the construction of a scale which summarizes the relative degree of monetary ease or restraint. An indicator thus gauges the thrust of monetary policy and enables us to isolate the effects of policy alone on the intermediate targets, and ultimately the goal variables. However, we will see that there are severe difficulties involved in devising such a measure.

Brainard (1967) argues that the policy-maker's uncertainties about the transmission mechanism of monetary policy influences not only the strategy but the nature of the policy itself. Because of the complicated processes of policy and uncertainties about the response of the goals to policy actions, there exists the risk that policy may accentuate rather than moderate economic fluctuations. Brainard's model indicates that a policy-maker with this possibility in mind is likely to lower his sights and accept a lower expected value of goal achievement, and not seek to fully restore the goal variables to their desired levels. Uncertainty also exists about the relative strength of the various instruments. Brainard shows that this risk is reduced by 'diversifying' policy amongst the range of instruments and using several of them in combination to attain the goals.[1] Actions involving small changes in a wide number of instruments are preferred to actions involving large changes in some. This provides one explanation of the 'package' nature of monetary policy. One incidental by-product of the package approach is to further complicate the selection of a comprehensive measure of monetary policy.

Uncertainty also surrounds the pre-determined variables. When deriving the model we assumed the policy-maker to possess perfect foresight about the exogenous elements and the impact of these and current and past policy actions upon the targets: in short, to have perfect knowledge of the behaviour of the targets and the necessity for policy action. This uncertainty can be readily taken into account, at least at a theoretical level. Definite knowledge about the y_i is replaced by the expectation, $E(y_i)$, and x^o is derived as before by minimizing expected rather than actual

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1 This result assumes that the correlation between the outcome of each policy instrument is zero, which may not be the case.

losses. Under the "certainty equivalence theorem", the authorities proceed as if their best guess of the behaviour of the goal variables is certain knowledge. This is not to say that the problem is trivial empirically. The accuracy of the forecasts will, in general, decline as the period over which it is necessary to forecast lengthens, which leads us to the question of the time lags of policy. Further, the nature of the forecasting methods adopted by the authorities needs to be taken into account when proxies of the goals of policy are selected.

Time Lags

The model (2-1)-(2-6) concealed the existence of lags by dealing with an all encompassing policy period in which policy is formulated and takes effect. If the instruments of policy do not attain their 'required' values in each planning period, the model needs to be extended beyond the one period. Theil and others[2] have done this, and formulated more complex decision rules than those here. However, as Jonson (1973) has pointed out, "it is not obvious that the more complicated policy rules they imply have in fact been used in the past. Indeed, the simple one-period model fits the data well, in this and other reaction function studies, which could be taken as providing empirical support for the proposition that governments are relatively myopic when making decisions about stabilization policy". This effectively begs the question of why lags might enter the theoretical framework and what criteria are needed to translate the planning period into calendar time.

The seminal classification of the lags in monetary policy is that of Friedman (1948), who recognized three lags: "(1) the lag between the need

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2 See Chow (1972) and B. Friedman (1971).

for action and the recognition of this need; (2) the lag between the recognition of the need for action and the taking of action; and (3) the lag between the action and its effects". The first two categories came to be called subsequently the 'inside' lag, and the third lag is known as the 'outside' lag.

Friedman's classification is sufficient for fiscal policy, but the attempt to apply it to monetary policy has produced semantic confusions. Treasury fiscal actions impinge, albeit through various fiscal agencies, directly upon ultimate spending units lying outside the control of the authorities. Monetary policy is implemented through a network of financial intermediaries; principally the banking system, but also short term money market dealers and operators in bond and mortgage markets. These institutions fall into a category intermediate between the goals and instruments of policy; they are more closely connected to the authorities than are other economic units and yet far enough removed to pose a control problem. Their existence in the monetary policy process is the basis of the two-stage conception of monetary policy, discussed earlier. The lags between the variation in the instruments and changes in the intermediate variables have been classified in a variety of ways. Mayer (1967) and Selby (1968) include this lag as part of the outside lag, whereas studies by Dewald and Johnson (1963) and Reuber (1964) implicitly incorporate it within the inside lag. Kareken and Solow manage to classify it differently in the same study, having it as part of the outside lag in the summary paper (Kareken 1961) and treating it as a separate, and unnamed, lag in the final study (Kareken and Solow, 1963).

More than semantic issues are involved in the appropriate classification of the various lags, for the economic processes underlying them differ markedly. Referring to Table 2, suppose that an economic event occurs which

Table 2

Lags in Monetary Policy

Time Sequence	Description	Lag	
t_0	Need for policy action		
		Recognition lag	Inside lag
t_1	Recognition of need for action		
		Action lag	
t_2	Taking of policy action		
			Intermediate lag
t_3	Response of internediate variables		
			Outside lag
t_4	Response of economy to policy		

necessitates a revision in the stance of policy. It will take the authorities some time to appreciate this need, formulate policy and act accordingly. The time elapsing between the occurrence of the event and the modification (of emphasis or direction) of policy is referred to here as the *inside lag* (equivalent to Mayer's 'policy inauguration' lag). Usually the time lapse is subdivided into a *recognition lag* between the need for policy response and recognition of this by the monetary authorities, and the *action lag* between the time when the need for action is recognized and the time when policy-makers alter the setting of the instruments. The length of the recognition lag (Rowan's 'diagnosis' lag) is governed by the nature and availability of economic data and by the administrative procedures the authorities use to analyse economic events. Although the change in economic circumstances begins at time t_o, it will be some time before data evidencing the change is sampled and assembled. More time will elapse while the data is analysed and cyclical patterns distinguished from irregular movements. Rarely will policy-makers be content to monitor one piece of information; they will 'look at everything' that might contain useful information. The action lag (referred to otherwise as the 'administrative' lag or 'decision' lag) is governed solely by the organizational structure of policy-making. Measures need to be designed and executed, and (assuming that it is the central bank which does the recognizing and the taking of action) consultation undertaken by the central bank with Treasury officials and the banking system.

Once action is taken by the monetary authorities, it may be a while before conditions in the network of intermediaries and credit markets change. This is termed the *intermediate lag*, and is equivalent to Rowan's 'financial' lag and Mayer's 'credit market' lag. Its length is conditioned by the operating strategy which the central bank adopts; that is, by the particular intermediate variable(s) (for example, interest rates, money stock or bank credit) chosen as a short run target, on the one hand, and the choice of instruments (reserve ratio, lending directives), on the other hand. Generally speaking, the intermediate lag reflects banks' response to monetary policy actions.

The intermediate variables are in turn related to the goals of policy, the deviation of which from their desired position began the process, and the time it takes the intermediate targets to have an impact upon the goal variables is the *outside lag*. This is called the 'economic' lag by Rowan and the 'output' lag by Mayer. In our definition, 'outside' means outside the banking system and the financial intermediaries through which monetary policy is instituted, and is the same as the 'lag in the effect of monetary policy' which Friedman measures between changes in the money supply and economic activity. Where interest rates and investment decisions are considered to be the principal transmitters of monetary policy, the outside lag is frequently subdivided into 'decision', 'production' and 'multiplier' lags evocative of the interest rate mechanism.

Several features of this classification need to be borne in mind when it is applied to the measurement of policy behaviour. First, the time scale t_0 - t_4 is given for illustrative purposes only, and for convenience of presentation the lags have been assumed to be of discrete time intervals. Where the lags are distributed over time rather than of a fixed time delay form, the classification is more complicated. The length of the lags will vary according to whether our euphemisms 'change' and response' are interpreted as meaning the initial effect, average length of the distribution, or as some specified percentage of the total effects. Whether or not the inside component of the total lag is of a distributed or discrete form is taken up later in this section.[3]

Secondly, the inside lag is conditioned by the publication period of the data. As the data available to policy-makers range from weekly to quarterly or even annual series, there is a strong possibility that the planning period of the authorities as envisaged in the theory may not coincide with the data sampling period. In such circumstances, the lag cannot be specified in advance, and needs to be determined on an ad hoc experimental basis.

Thirdly, the time response $t_0 - t_2$ given for the inside lag effectively begs the question of this section by implying the existence of positive time lags. It is conceivable, though unlikely, that by the use of forecasting techniques the authorities could predict at t_{-1} the occurrence of the event producing the need for action at t_0, making the recognition lag negative. More likely is the possibility that the intermediate lag could be zero if a fortuitous change in an intermediate variable resulting from non-policy forces occurs at t_2 simultaneously with the authorities' decision to instigate policy.

Fourthly, the classifications necessarily embody a 'view' of the transmission mechanism of monetary policy and the operating procedures of the central bank. In consequence, the existence and relative length of the lags reflect the central bank's choice of intermediate targets, for the intermediate variables do not respond at equal speeds to variations in the instruments of policy. For example, yields on government securities are likely to respond more quickly to open market operations than is bank lending. Also, where the intermediate target is determined by administrative fiat, as bank interest rates have been, the intermediate lag and the action

3 Insofar as the outside lag is concerned, these matters are discussed in chapter 12.

lag may be synonymous. This indicates again the importance of considering the authorities' views and strategies about the conduct of monetary policy before proceeding further with the analysis.

The remainder of this section proceeds as follows. In the next chapter we examine the *modus operandi* of monetary policy, and then investigate the indicator question in the context of the measures of Australian monetary policy which are conventionally employed. Next we outline an alternative view of the monetary policy process and develop our preferred indicator. Finally, we present estimates of the inside lag and of the objectives of monetary policy.

Chapter 3

The Modus Operandi of Monetary Policy*

The questions we seek to answer are:

1. Who are the monetary authorities in Australia? What goals do they pursue?
2. What instruments are at the disposal of the authorities? What mix of the instruments are used in the typical monetary policy 'package'.
3. What are the intermediate targets of monetary policy? What view of the transmission mechanism is implicit in the authorities' thinking?
4. What strategies do the authorities follow in reconciling conflicts between the various intermediate targets of monetary policy e.g. as between interest rates and the money supply?

We begin by examining the legal framework for central banking in Australia. This is followed by an analysis of the principal instruments of monetary policy and the changes in their usage occasioned by the switch in the policy targets.

The Legal Framework

The Commonwealth Bank of Australia was established in 1911 as a government-owned savings and trading (commercial) bank. Its accretion of central banking powers was a tortuous process and not until the legislation of 1945 was it adequately equipped as an effective central bank. Major revisions to the legislation in 1959 severed the unusual nexus between the central bank and the other government financial institutions, and provided for the Reserve Bank of Australia to assume the central banking powers.

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* This chapter draws upon some of the ideas in Lewis and Wallace (1973a and 1973b). It has also benefited from reading Arndt and Stammer (1972).

Changes were made also to the form of the cash reserve ratio applied to the trading banks. With these two exceptions, the Reserve Bank (hereafter referred to as 'the Bank', as is its predecessor) inherited virtually the same set of weapons forged in the 1945 legislation.

The banking legislation directs the Bank "within the limits of its powers, to ensure that the monetary and banking policy of the Bank is directed to the greatest advantage of the people of Australia" and in particular to use its power in such a way as "will best contribute" to "the stability of the currency," "the maintenance of full employment" and "the economic prosperity and welfare of the people of Australia."[1] Clearly the Reserve Bank has a mandate to undertake discretionary measures, and it is endowed with an impressive range of policy instruments. It has an uninhibited monopoly of the note issue, custody of the foreign reserves, and power to control all foreign transactions. Transactors must purchase and sell all foreign currency to the Bank, through the sole agency of the trading banks at the determined exchange rates. It is banker to the Commonwealth government and the Treasury's agent for loan raisings. The Bank is authorized to deal in any type of security but to date has restricted its trading to bonds, to the discounting of Treasury notes and bills, and to limited dealings in the securities issued by semi-governmental authorities and local governments and in bank accepted commercial bills.

Those who designed the banking legislation of 1945 considered control of the banks to be the essence of monetary policy. By 1959 this emphasis had been somewhat modified; nevertheless the 1959 legislation, like that of 1945, permits the Bank to regulate almost every aspect of trading banking. It possesses the power to take over the operation of any bank needing

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1 This broad directive is similar to that given to the Commonwealth Bank of Australia in the 1945 Commonwealth Bank Act.

assistance beyond the customary lender-of-last resort accommodation. With the approval of the Treasury, the Bank determines the interest rates offered to the banks' depositors and charged to their borrowers, and it makes extensive use of this power.[2] The Bank makes much use of its authority to prescribe lending policy for the banks; it regularly sets quantitative targets for advances, overdraft limits and the rate of new lending and, on occasions, the banks have been given qualitative guidance.

The 1959 legislation also empowers the Bank to require each trading bank to deposit in a Statutory Reserve Deposit (S.R.D.) Account with it, a sum equal to a specified percentage (the S.R.D. ratio) of the bank's deposit liabilities. The technique was originally proposed by a Royal Commission in 1936, but from 1940 to 1959 the alternative, Special Account, device was used. This variant of a cash reserve ratio was a highly flexible device (similar to that now used by the Bank of England) whereby the Commonwealth Bank could 'call' to 'frozen' accounts absolute increments to the banks' deposits. The Bank regards changes in the S.R.D. ratio as operating as a lever against the fulcrum of the liquidity convention to achieve changes in the bank's free reserves. Prior to 1956 the banks had not adhered to any specific liquidity convention but in that year Governor Coombs obtained their voluntary acceptance of the L.G.S. (liquid assets and government securities) convention. The initial minimum L.G.S. ratio was set at 14 per cent; it was raised by 2 per cent in 1959 and again in 1962, since when it has remained

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2 The Reserve Bank determines the maximum rates chargeable on overdrafts of limits less than $100,000. Since February 1972, the interest rate on larger overdrafts has been a matter for negotiation between banks and their customers. The Bank also determines the maximum rate which trading banks may offer on fixed deposits, but banks have discretion to negotiate rates within the maximum. Under special arrangements with the Reserve Bank, banks have discretion to issue Certificates of Deposit without any limitation as to the rate of interest (yield). Savings Bank interest rates are also subject to the determination of the Reserve Bank.

at 18 per cent until increased to 23 per cent between February 1976 and March 1977.

Savings banks, which rival the trading banks in size (see Table 3), are also subject to banking legislation. Since 1956 they have been required to maintain a ratio of liquid assets and government securities to deposits, originally of 70 and currently 45 per cent. Their other major investment is home mortgages and the savings banks are the major source of this finance. Savings banks' rate of new mortgage approvals is determined in consultation with the Bank, which appears to be satisfied with the responses to its guidelines.

The Reserve Bank now has the legal authority to control the activities of other financial intermediaries, in the form of the Financial Corporations Act, passed at the end of July 1974. This Act empowers the Reserve Bank to prescribe asset ratios, impose interest rate ceilings and determine the lending policies of non-bank financiers; however, the provisions have not been used. Rather, the Bank has preferred other measures. Life offices and Pension Funds must maintain 30 per cent of their assets in the form of government securities, or suffer severe tax penalties. Lender of last resort facilities were extended in 1959 to official dealers in the short-term money market in exchange for their adoption of portfolio constraints. Overseas borrowings by merchant banks have been subject to various administrative controls and restrictions permitted under the provisions of the Exchange Control requirements. With respect to other non-bank financial intermediaries, the Bank consults regularly with the most important of these - building societies and finance companies - and endeavours to use moral suasion, together with interest rate variations, to influence their activities.

The framers of the banking legislation of 1945 and 1959 were resolute in the view that the ultimate responsibility for monetary policy must rest with the government. The 1959 legislation charged the Reserve Bank Board,

Table 3

Assets of Australian Financial Institutions

(as at end of June)

	1953 $m.	1953 Per cent of total	1960 $m.	1960 Per cent of total	1970 $m.	1970 Per cent of total	1974 $m.	1974 Per cent of total
1. Reserve Bank	2009	23.4	2112	14.9	3119	8.8	6360	9.2
2. Trading banks	3079	35.9	3924	27.5	8007	22.6	15340	22.1
3. Savings banks	1999	23.3	3192	22.4	7504	21.1	11766	16.9
4. Other banking institutions	59	0.7	101	0.7	474	1.3	737	1.1
5. All banks (consolidated)	5987	69.8	8126	56.9	17258	48.6	33289	47.9
6. Money market dealers	-	-	160	1.1	666	1.9	488	0.7
7. Finance companies	171	2.0	1157	8.1	3400	9.6	9023	13.0
8. Pastoral finance houses	259	3.0	377	2.6	700	2.0	820	1.2
9. Building societies	241	2.8	481	3.4	1850	5.2	4521	6.5
10. Life offices and pension funds	1597	18.6	3159	22.1	8905	25.1	13264	19.1
11. General insurance	212	2.5	486	3.4	1233	3.5	3062	4.4
12. Merchant banks	3	-	23	0.2	635	1.8	2249	3.2
13. All other institutions	102	1.3	310	2.2	833	2.3	2791	4.0
Total (items 5 - 13)	8572	100.0	14279	100.0	35480	100.0	69507	100.0

Source: Reserve Bank of Australia, *Flow of Funds* (various supplements).

comprising three *ex-officio* members and seven appointees, to promote the Bank's objectives as set out in the legislation. The *ex-officio* members are the Governor, who is also Chairman of the Board, the Deputy-Governor, and the Secretary to the Department of the Treasury. The latter is permanent head of the government department responsible for budgetary policy and he has direct access to the Treasurer and the Cabinet. This background alone would ensure that the Bank heeds his views but he does not have to rely upon this for an attentive audience, for he comes armed with the power of veto. The legislation provides that, in the event of any dispute between the Treasury and the central bank, the Treasurer's opinion is to prevail. In addition, certain critical policy changes - in particular, those concerned with interest rates and debt management - can be made only with the explicit permission of the Treasurer. The Governor is permitted under the legislation to make public any difference of opinion by laying the relevant documents and statements before Parliament, but this provision has not been invoked.

In practice the Secretary to the Treasury does not flaunt his authority. Nor has the Reserve Bank sought to exploit what independence and potential for power it has, preferring an alliance with the Treasury. Officials of the Treasury and the Bank have regular informal discussions, and there are also more formal meetings of joint committees to examine specific policy issues. In the background discussions to the Budget, the Treasury considers the Bank's assessment of the economic situation, but the senior officers of the Bank are not privy to the Treasury's pre-budget planning and the Bank must accept the financial impact of budgetary decisions as an exogenous factor.

Dr. H.C. Coombs, Governor from 1947 to 1968 has spelled out his view of the proper relationship between the Bank and the Government (1971, pp. 57-63). As Coombs sees it, the Bank is the creation of the Parliament; its broad social and economic objectives are prescribed by the Parliament; it is required to keep the government informed of its current policies; and it must submit to the Parliament an Annual Report of its stewardship, together with its accounts. Coombs held that the Bank should endeavour to influence government policy by its arguments, and suggested that the Bank had some particular vantage points for its assessment. First, the Bank is closer to the market-place than the government or its administrators. Secondly, the Bank is conscious of its part in an international brotherhood of central banks, which have their own code of thought. Thirdly, unlike the government, the Bank is in some sense immortal, making for greater objectivity in outlook and continuity in policies. But Coombs recognized that, in the last resort, the Bank must accept government decisions and co-operate whole-heartedly to promote them.

Thus the answer to the first of the questions posed at the beginning is clear, and monetary policy shares the general objectives of the government of the day. This still leaves open to question the weighting which is attached to the specified objectives. The advice tendered by the Bank in policy deliberations, and the methods it uses to achieve the government's objectives, will be much influenced by its special position in the domestic and international financial system. Its views on economic affairs are likely to reflect the mores of the banking community, and it has frequently warned of the dangers of "speculative movements in asset prices" and argued that "from a policy viewpoint, action to limit speculative price rises must often be given priority".[3] Similarly, its thinking is influenced by other central banks; indeed, many of its ideas about the operation of monetary policy have been imported from Britain and U.S. We now examine these views in detail.

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3 *Reserve Bank of Australia*, Sydney 1966 pp. 9-10.

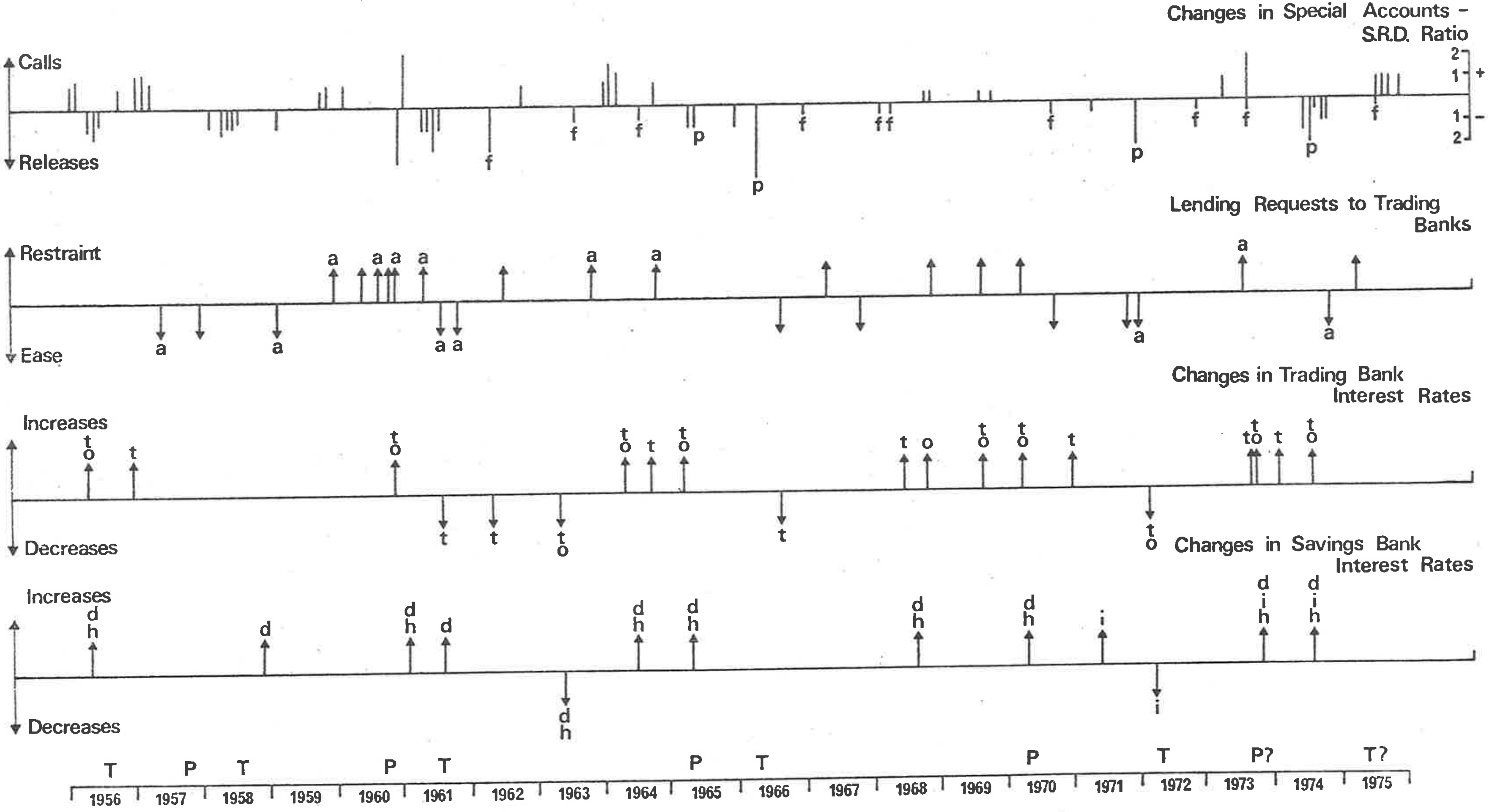
The Rationale and Mechanisms of Policy

Our discussion centres around documents which clearly enunciate the central bank's thinking in 1958, 1964 and 1971 respectively and illustrate the marked changes in the ideas underlying the operation of monetary policy. These documents are examined in detail, with attention given to the implied framework and to how the changes were translated into policy actions. The main findings can be summarized as follows:-

1. In 1958 the instruments of policy were designed for the semi-developed condition of the Australian capital market, in particular, the narrowness of the bond market and the dominance of bank lending in the financing process. This framework was to be substantially modified in the light of developments in the capital market and in monetary analysis.
2. In the early 1960's, the Reserve Bank concluded that the foundations of its policy were being eroded by the growth of non-bank intermediaries and concomitant instability of the velocity of money. Under the new strategy, interest rates were seen as the key to actions impinging upon "general liquidity", and some highly original policies were designed.
3. The change in the latter 1960's was more subtle. The Bank has adopted a sophisticated view of policy mechanisms, based on its large scale econometric model. While interest rates remain the keystone of policy, the money supply is also of importance, and the Bank's strategy is correspondingly more complex.

These alterations in the Bank's thinking have been accompanied by changes in the usage made of instruments of monetary policy. As a backdrop to our discussion of the policy documents, we illustrate in Figure 3 the frequency with which selected instruments have been varied. At the top of the figure is shown calls and releases to the frozen account devices of Special Accounts and Statutory Reserve Deposits, expressed as percentages of trading bank

FIGURE 3
SELECTED INSTRUMENTS OF MONETARY POLICY, 1956-1975



deposits. Those reductions in the ratio to establish and replenish the special Term and Farm Development loan funds are denoted by *f*, those partly designed for this purpose are marked by *p*. Next is shown moral suasion by means of requests to the trading banks to modify their lending policies. Requests announced publicly are indicated by *a*. Finally there are the policy determined changes in bank interest rates. Changes in time (fixed) deposit rates are denoted by *t*, and in overdraft (loan) rates by *o*. Changes in the maximum rates which savings banks are permitted to pay on ordinary deposits are given by *d* and on investment accounts by *i*, while *h* indicates changes in the maximum rate chargeable for ordinary housing loans. At the bottom of the figure are marked out the peaks (P) and troughs (T) of the Australian reference cycle. The derivation of these dates is described later (chapter 12).

1958 : Bank Lending

Governor Coombs was invited to submit a *Memoranda of Evidence* (cited below as *Evidence*) to the United Kingdom's Radcliffe Committee, and that submission together with his *Mills Memorial Lecture* of 1958 (Coombs, 1958) give a clear picture of the Bank's view at that time of the nature of the Australian financial system and the appropriate instruments for its regulation. Coombs in a summary section of his *Evidence* (para. 50) said:-

> "From the above analysis it will be apparent that the instruments of control over the monetary and credit system ... and the techniques employed in their administration in recent years have, in large part, been designed to meet the following special features of the Australian economy and its financial structure:-
> (a) the substaintial seaonal and cyclical fluctuation in the balance of payments to which the economy is subject;
> (b) the limited scope for ... open market operations ...
> (c) uncertainties in the response of the banking system to Central Bank action arising partly from the earlier absence of a stable liquidity convention amongst the trading banks, but also to some extent inherent in the operation of overdraft lending within a branch banking system."

Coombs' first point draws attention to the vulnerability of the economy to the vagaries of the weather and the international markets for primary products, and indicates the importance of the balance of payments objective. His second point highlights the difficulty in using 'classical' methods to cushion the banking system from external shocks, and in chapter 18 we show that the Special Account/Statutory Reserve Deposit technique has proved to be a simple and highly effective device for insulating the banks' reserves (but not the money supply) from changes in foreign reserves. The Governor argued that the frozen account technique was necessary because the scope for the more orthodox device of open market transactions was limited by the embryonic nature of the securities market. He informed the Committee that as there was no well-organized and officially-recognized body of dealers in short-term securities, the Bank and the National Debt Commission operated regularly in the market for government bonds "to ensure that a reasonable market is kept alive", and consequently had come to accept "undue responsibilities for the yields." Under Treasury instructions bond yields and bank overdraft and time deposit rates were altered infrequently, and the Governor pointed out that "there is no real equivalent of the United Kingdom Bank Rate." (*Evidence*, para. 20).

Monetary control was accordingly based on the S.R.D.-Special Account mechanism. Used in conjunction with directives and the liquidity convention, the central bank sought "to influence the liquidity of the banking system and, therefore, the total volume of bank lending." Bank lending was considered to have a clear link with aggregate expenditures. Coombs noted that the source of finance for an expenditure may be from current earnings, accumulated reserves of money, money borrowed other than from a bank, and money borrowed from a bank. Monetary policy affected expenditure by varying the amount of money, people's willingness to use money (velocity), and the capacity and willingness of banks to lend. The latter was of major importance for banking policy.

> "Loans and purchases of securities by banks directly enable the borrower or seller to spend more but also, as he spends the proceeds of the loan or sale, increase the money supply. They are, therefore, *doubly stimulating to expenditure* and accordingly a great deal of central bank policy is concerned with measures to ensure that the flow of bank loans and investments is appropriate to the needs of the economy." (our emphasis)

The Bank had worked resolutely throughout the 1950's towards control of bank advances and in 1958 Coombs was optimistic that the problems which bedevilled the Bank's earlier efforts had been resolved by his negotiation of the L.G.S. convention. Under the 1956 agreement, the banks agreed to maintain at least the conventional ratio of liquid assets and government securities (the *L.G.S. ratio*) to deposits - if necessary by borrowing from the Bank. For its part, the Bank agreed to administer required cash reserves (through changes in frozen accounts) in such a manner that, if they adhered to the guidelines set for advances, the banks would not normally have to borrow at penal rates. By including government securities in the convention, the central bank expected to see an end to banks' practice of switching out of bonds to accommodate an increase demand for advances during cyclical upswings in the economy and, in addition, there would be the advantage of a captive market for bonds.

It was not envisaged that the new policy would work in a mechanistic manner. The banks' acceptance of these portfolio constraints meant that the proportion of their assets held in frozen reserves (which earn a nominal rate of interest of less than one per cent)[4] could be reduced, and that this would promote a more conducive climate for moral suasion. Since 1945 the Bank has had the statutory authority to issue lending directives to the banks, and could prosecute any bank which infringes them. The Bank has never used

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[4] Since November 10th 1976, 2.5 per cent per annum.

the penal sanction, which now appears an anachronism from post-war direct controls. Nevertheless the Bank has long given the banks clear indications as to the policies it desires them to follow. Coombs envisaged in 1956 that when the Bank wished to restrain lending it would issue the appropriate quantitative directives (the Bank prefers the euphemism "requests") and support these by calls to the frozen reserves; but so long as the banks followed the guidelines for new lending, calls to the frozen accounts would be used as a signalling rather than a punitive device:

> "If, for example, the Reserve Bank thought a more restrictive policy were needed, it would, in addition to informing the trading banks of this view, consider the desirability of administering Statutory Reserve Deposits so as to bring the actual L.G.S. ratios of the banks closer to the conventional minimum." (*Reserve Bank of Australia*, 1966, page 20)

> "The margin of 'free' liquidity in the banks' hands as measured by the difference between the actual level of the L.G.S. ratio at any time and the conventional minimum level serves both as an *indicator* and a *support* for credit policy." [our emphasis] (*Annual Report*, 1962, page 22).

The first rigorous test of the L.G.S. convention and the associated arrangements came in the Reserve Bank's initial year, 1960, when the government became greatly concerned at the development of a boom and a rapid loss of foreign reserves. At the end of 1959 the banks were informed that only a "moderate expansion" of bank credit was "appropriate" in 1960, and additional reserves were impounded. As 1960 unfolded the tone of the Bank's requests to the banks became more strident and finally in November 1960 the Treasurer, when announcing the imposition of a package of deflationary measures, stated:-

> "The outpouring of bank credit ... can be stopped ... and serious consequences will follow if it is not stopped. So it must be stopped."

In fact the level of bank advances (seasonally adjusted) declined from January 1961 but the economy had already gone into a downturn and the measures of November 1960 exacerbated the ensuing recession.

During the post-mortems into the events of 1960 reference was frequently made to what Coombs in his *Evidence* had described as problems "to some extent inherent in the operation of overdraft lending with a branch banking system"; namely the drawing down of unused limits and the time lags involved in enforcing policy through branch networks. The Reserve Bank's own econometric evidence indicates a lag of twelve months between a request to "reduce advances" and the consequent impact upon advances. Certainly these lags are, in part, explained by Coombs' "inherent" factors, but it is doubted that the lags would be reduced if Australia had a system of unit banks extending term loans. Perhaps authorities in unit bank systems yearn for the Australian situation, where the Governor can gather the general managers of the banks around a small table and explain to them the precise requirements of policy. Similarly, some central bankers may envy their brothers who operate in systems with overdraft lending on the grounds that overdrafts - being repayable on demand - respond more quickly to measures of restraint.

However it is probably fair to say that the problems involved in the control of bank advances have proved to be even more formidable than Coombs' envisaged. In particular , there are difficulties in the strategy of controlling the level of bank advances by attempting to control a particular subset of bank assets. The S.R.D. technique together with the L.G.S. convention enables the Bank to lock a specified proportion of the banks' portfolios into S.R.D. and L.G.S. assets (with the composition of the latter at the banks' discretion). But it is the banks who determine the allocation of the residual assets between 'free' L.G.S. assets (i.e. the excess over the amount needed to satisfy the convention), advances, and the other income-earning assets (principally loans to official dealers in the money market). Coombs had envisaged that, following the adoption of the L.G.S. convention, the impounding of reserves would not merely reduce the aggregate of the residual assets, but would ensure that the reduction was primarily in advances. In fact the banks have frequently used their free L.G.S. assets as a buffer insulating advances from calls to the frozen reserves.

The banks' differing and variable margins of free L.G.S. assets make it difficult for the Bank to anticipate their responses to changes in their reserves. Strong and variable seasonal movements in bank reserves, deposits and advances may obscure fundamental changes in banks' behaviour for some months. Each bank is responsible for assessing its own seasonal requirements, and each desires to hold some additional excess reserves to meet other contingencies. Preferences for free liquidity may differ significantly over time and between banks, making it particularly difficult to determine what part of free liquidity is 'desired' and what part is actually in 'excess' of requirements. The Bank has on occasions (for example, 1960 and 1970) faced the situation where differences in free liquidity were such that some banks could conceivably continue to expand advances substantially and still have excess reserves whereas others were in the position of having to borrow from the Reserve Bank.[5]

The Banks' own conception of the mechanism has contributed to the difficulties, for a liquidity but not a cash constraint has been imposed upon banks' decision-making. The Reserve Bank has viewed L.G.S. assets as a total

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5 The 1970 Annual Report (p.17) states: "with differences in ratios between banks the agreed minimum convention ... was a constraint upon some banks and borrowings from the Reserve Bank became necessary." The 1960 case has been documented by Davis and Wallace (1963). They argue the importance of interbank differences in liquidity in hampering the Reserve Banks' attempts to check the increase in bank lending. Yet the information on individuals banks' new lending necessary to establish their case does not exist, and even Davis and Wallace concede that the most expansionary banks were not the most liquid ones. Institutional developments (short term money market, commercial bill market, certificate of deposit market) have lessened the potential significance of this problem by providing a mechanism for the transfer of 'excess' liquidity between banks and in the 1974 'credit squeeze' all banks borrowed from the Reserve Bank.

and has ignored transactions which affect the composition of bank liquidity.[6] The Bank pays little attention to the banks' cash position and has conducted security transactions to make good their cash deficiencies; on other occasions the Bank has sold securities from its portfolio to provide banks with earning assets. During periods of restraint the banks have been able to avoid a constraint of diminished cash and near-cash assets by making sales of bonds, often directly to the Bank. In 1960, for example, the Bank raised the rate at which it would discount government securities but not by enough to prevent the banks selling to it over $100 m. of securities. This has given the banks some discretion as to the speed of their response to directives and liquidity constraints.

After the 1960 experience, control of bank advances was downgraded in importance as an intermediate target of policy but remains an ingredient of any policy action. The Bank now considers that "the nature of the liquidity regulation mechanism precludes exclusive reliance on it" (Kirkwood, 1969) and places more faith in directives. Except for rare and brief periods the Bank strives continuously to influence the banks' lending. The Bank regularly informs them of its view of trends in the economy and the responses required. The desired rate of new lending is emphasized for this (relative to the usage and repayment of existing limits) has proven most readily subject to the banks' own administrative controls. These guidelines are occasionally announced publicly and considerable information is given in the Bank's Annual Reports; and on several occasions the Bank has recorded its satisfaction with the current approach to quantitative control of

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6 The banks hold large portions of their L.G.S. assets in the form of bonds. During 1969/70 the L.G.S. assets of the banks averaged 23.2 per cent of deposits, with 'free' cash of 2.4 per cent, Treasury notes of 1.8 per cent, and marketable government bonds equal to 19.0 per cent of deposits. The average period to maturity of the latter was just under six years. The importance of the composition of L.G.S. assets was emphasized by Dewald (1967a).

advances.[7]

1964 : Non-banks and Liquidity

In 1958 Coombs had informed the Radcliffe Committee in his *Evidence* of "one of the most significant features of Australian experience ... the development of new financial institutions", which was "probably a natural phenomenon in a growing economy", but which reduced "the effective scope of monetary policy to the extent that it relies upon action through the banking system." At the time Coombs was ambivalent as to whether the flows of funds through these burgeoning intermediaries either could or should be constrained, but by the early 1960's these flows had become a major target of monetary policy.

The Reserve Bank's own post-mortems of the 1960 experience, in the 1960 and 1961 annual reports, gave prominence to the rate of turnover of money due to non-bank financial innovation and the instability of public preferences for liquid assets. Such concern grew naturally from the availability-of-finance framework sketched out by Governor Coombs, as non-banks' financing was growing rapidly.[8] The Bank's thinking had also been strongly influenced by the Radcliffe Committee. In its Report the Committee stated unequivocally that the non-banking intermediaries could, by increased lending, offset the impact of constraints on bank advances, and by their asset-creating activities could also offset the effects of a reduced money supply upon the level of 'liquidity'. The Banks' own direct interest in the Committee's deliberations ensured that it would consider the Report assiduously, and it also had the

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7 See, for example, Annual Report 1971 pp. 33-34.

8 Their share of intermediary assets grew from 30 per cent in 1953 to 43 per cent in 1960 and 51 per cent in 1970. See Table 3.

benefit of sympathetic appraisals by influential Australian academics, D.C. Rowan (1961) and H.W. Arndt (1962). The extent of the Reserve Bank's acceptance of Radcliffe Theory is indicated by the following extract from Phillip's address in 1964:

> "The event of 1959-60 demonstrated even more clearly than experience in earlier cycles that the focus of monetary policy must extend beyond the quantity of money to the state of general liquidity. They also established that variations in both the demand for and the supply of liquid assets can have important implications for financial stability; previously, concern had been mainly with the supply side."

Accordingly after 1959-60 the Bank endeavoured to pursue policies impinging upon "the liquidity situation generally, rather than more narrowly on the banks." (Phillips, 1964)

Opinion in Australia, as in other countries, was divided between those who advocated the extension of specific regulations to the non-bank financial intermediaries (N.F.I.'s) and those who preferred the development of techniques operating through the market. The Radcliffe Report provided some ammunition for both views. Initially it appeared that the former view would prevail in Australia, and the authorities developed some novel regulatory devices directed at specific sectors.

Between 1953 and 1960 the annual compounded rate of growth of the assets of the finance companies was 31.4 per cent compared with 5.0 per cent for the trading banks. The central bank's attempts to curb their growth by directing the trading banks to discriminate qualitatively against them in their lending policies merely accelerated the switch from overdrafts to direct borrowing as their major source of funds. The finance companies were seen as having fed the booms of 1955 and 1959-60, and there was substantial support for their direct regulation. Action came in Novermber 1960 when, as part of the deflationary package of monetary and fiscal actions, the government announced its intention to alter the income tax laws in such a manner as would raise the companies' effective borrowing costs. This led to an immediate and sharp reduction in their activities, but in the event, because of the sharp downturn in activity, many of the November measures were reversed within a quarter, and the mooted taxation measure was never implemented. Following the British precedent, the Bank has regular consultations with representatives of the instalment credit industry and it uses this moral suasion together with general monetary measures to influence the finance companies' activities. The measures of November 1960 which were implemented included a change in the income taxation legislation giving life offices and pension funds an overwhelming incentive to voluntarily hold at least thirty per cent of their assets in the securities of government and semi-government authorities. This *de facto* imposition of a constraint akin to the L.G.S. device does not provide a flexible instrument to regulate the short run investment policies of these institutions and for this purpose the authorities rely upon moral suasion through regular consultations.

By 1964 enthusiasm for the extension of specific controls had dissipated, and the portfolio constraints imposed upon the life offices, like those upon the savings banks and official dealers in the money market, are primarily devices to ensure a captive market for government debt, and not flexible instruments of short-term control. Indeed, the Reserve Bank, as distinct from the Treasury, has never been enthusiastic for direct controls, and it has made no moves to use the powers granted to it in 1974 by the Labor Governments' Financial Corporations Act. Instead the authorities have sought to develop policies which impinge upon the entire financial system. The rationale for this "market-oriented" approach to policy was clearly enunciated by Phillips in 1964. He saw the need for the Bank to "deepen its knowledge of capital markets" and to place "greater emphasis on the liquidity situation generally." Other Bank officials, in particular Sanders (1969), have spoken of the necessity of "keeping the market on the side of policy" and designing measures which take account of the preferences of lenders and borrowers. The key to achieving these broader effects, according to Phillips, lay in a more positive approach towards interest rates: of allowing rates to move in line with market forces and, on appropriate occasions, to take the initiative in monetary management.

Phillips in 1974 referred to developments conducive to this new strategy, and these have continued. The trading banks' time deposits have been re-established as an attractive component of the portfolio of sophisticated investors. The banks have broadened the term structure of time deposits and the rates offered have been made relatively more attractive; since 1969 the banks have been permitted to issue negotiable certificates of deposit. Within the limits imposed by the constraints upon their portfolio's, savings banks can set their deposit rates and have used this flexibility to expand the attractiveness of the investment accounts which at January 1976 accounted for 34 per cent of depositors' balances. The Bank sees these developments as major factors slowing the decline of the banks' relative importance in the financial system and enlarging the impact of policy-determined changes in bank interest rates.

But the most important pre-condition for the use of "market-oriented policies" was the Treasury's acquiescence in more frequent and more substantial changes in the interest rates on bank deposits and on government debt. The constraints upon interest rates reflected a general predeliction for low interest rates, and Treasury concern for debt management. Terms of new issues are determined by the Loan Council (which comprises representatives of the six State and the Commonwealth Governments). The States resist increases in interest rates because of their direct budgetary impact and the Commonwealth Treasury, at least during the 1950's appears to have been sceptical of the necessity for, and effectiveness of, flexible interest rates as an instrument of demand management. These attitudes considerably hampered the Bank's attempts to use interest rates in policy. Phillips in 1964 reported that "greater flexibility of interest rates had come to be accepted," and subsequently Bank officials have frequently reiterated that its policy hinges upon this flexibility. The Bank certainly does not have the ability to unilaterally adjust interest rates, but today the likelihood of persuading the Treasury to accept its arguments is much stronger.[9]

Flexible interest rates were also to be used in a more positive fashion to enable the Bank to "take the initiative in monetary affairs." The typical 'policy package' in the 1960's has involved changes throughout the range of both bank deposit and overdraft rates accompanying changes in bond yields in the same direction. The relative emphasis given to bank and bond rates has varied considerably over the decade, and in the early 1960's the emphasis was upon bank rates with bond rates having the supporting role. The Bank shared the Radcliffean view that the demand for money is volatile, and that non-banking intermediaries exacerbate cyclical instability. The activities of non-bank financial intermediaries were to be influenced primarily through their borrowings, with the Bank taking the initiative in the capital market by using changes in bank interest rates (supported by bond rates) to influence the cost and availability of non-bank debenture raisings.

> "The Bank sought ... to limit the growth of lending by other financial institutions, over which it has no direct control, by ensuring that interest rates on financial assets under its influence (especially fixed deposits) were competitive with general market rates, thereby making funds less readily available and more costly to financial institutions borrowing in the market." (Annual Report, 1965)

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[9] Bank spokesmen have used public addresses to espouse the merits of interest rates and, more pointedly, to remind the Treasury that "there have been non-economic constraints" which have had "the unfortunate consequence of weakening ... the stance of monetary policy." (Phillips, 1971).

Interest rates were also seen as a way of influencing the demand for money. Considerable credence was attached to the view that the demand function for money is highly unstable and that shifts in liquidity preference are capable of giving rise to serious monetary disturbances. Interest rates were regarded as a means directly to vary the attractiveness of bank liabilities and government debt. It was also considered that shifts in liquidity preference could be countered indirectly by playing upon the announcement effects of these interest rate changes. In essence the Bank saw manipulation of the demand for money as a policy instrument alternative to, or supplementing, changes in the money supply: a policy which took "Radcliffism" further than in most other countries.

It is not appropriate for an assessment to be made at this stage of the efficacy of these novel policies; this is done in chapter 9 when we examine the activities of the non-banks. Nevertheless the rationale behind interest rate policies was amended in the late 1960's, and this followed in part from a recognition that the previous strategy was based on faulty, or at least exaggerated, assumptions. As we have shown, the Bank saw its problems as stemming from the allegedly perverse behaviour of non-bank financiers and the instability of the demand for money, and interest rates were seen as a way of impinging upon the non-banks and of engineering appropriate shifts in the demand for liquid assets. However, the rapid shifts in liquidity preference did not seem to eventuate and econometric evidence on the demand for money function for the 1960's gave indication that policies which operated upon the quantity of money might have predictable consequences for macroeconomic variables.[10] The Bank continues to pay

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10 Australian studies of the demand for money are examined in chapters 16 and 17. Our own evidence of the impact of non-banking intermediaries upon the demand for money is presented in chapter 8.

attention to the secular growth of the N.F.I.'s, and has occasionally been concerned with their potential to feed speculative demand for land during booms. But overall, the Bank appears to be less concerned that non-banks' borrowing and lending behaviour may frustrate its own counter-cyclical actions.

These changes are more than simply shifts in emphasis. They reflect a conversion to a more catholic view of the impact upon expenditures of monetary actions in general, and of interest rates in particular. The change in the Bank's thinking was revealed in Governor Phillips address in 1971.

1971 : Complex Transmission Mechansim

Governor Phillips in 1971 reviewed developments in monetary theory. He took an eclectic approach to theory, and argued that there is a consensus among the various factions that policy should not focus upon the banks but have a general impact throughout the financial system. Significantly, he also noted that "the pendulum seems to have swung back a little" towards the view that the money supply has some special significance. The Governor was undoubtedly referring primarily to the monetarist counter-revolution in economic thought, but he was also influenced by the results of the Bank's econometric model, in which real money balances exert a direct impact upon expenditures. At the time of the address, the Bank had "not opted for steady growth in the money supply as a wholly sufficient target of policy." (Sanders, 1969) Doubts about the controllability of the money supply may have been a contributing factor, for the Governor went on to infer that the Bank may be able to exercise only a loose control over the money supply.

> "... the supply of money cannot be controlled by simply controlling the level of the monetary base, because of the possibility of substantial switches between the bank and non-bank sectors in holdings of the monetary base. The link is also broken if there is a change in the banks' preferences for holding government securities (and cash) relative to making loans or other investments."

The Governor also reiterated the Bank's view about the substitutability of cash and government securities by arguing that "the monetary base is best regarded as the quantity of cash and government securities held by the private sector." These particular inferences will be examined in detail in chapter 10 below. For the present it is sufficient to note that the Bank did "acknowledge that large fluctuations in the rate of growth [of the money supply] can be unsettling" (Sanders, 1969), and this is a departure from past policy, which has gathered momentum in the years since 1971.

Current policy, with attention being paid to interest rates and the money supply, is more complex than in the past. The Governor took a 'neo-Keynesian' view of the transmission mechanism of monetary actions, and saw effects working through five main channels:-

(i) Interest Rates. The Governor argued that increases in the interest rates of banks and on government debt will push up the whole structure of rates, causing desired stocks of financial and real assets to diverge from actual holdings. The resulting attempts to restore portfolio balance generate changes in spending on goods and services.

(ii) Wealth. He argued that "monetary policy has an impact on wealth and spending is influenced by wealth." The illustration he chose was of interest rate changes affecting equity prices hence spending.

(iii) Availability of Credit. The Governor recognized that many lenders are subject to constraints upon maximum interest rates so that non-price rationing occurs. When "credit is made harder to get ... some individuals will have to reduce their expenditure."

(iv) Expectations. Shifts in policy are thought to cause changes in attitudes and expectations and these, in turn, influence expenditure. Expectations can also affect the willingness of lenders to make loans and of others to borrow.

(v) Volume of Money. The Governor argued that "in addition to interest rate effects there appears to be a direct link between the volume of money and spending." The illustration he used has overtones of Friedman's helicopter. "If money was showered from the roof of the Reserve Bank, it would, among other things, raise spending on goods."

Interest rates are still the keystone of the Bank's strategy: these are seen as affecting credit availability, wealth and expectations as well as having cost of funds effects on investment. Its econometric model attributes powerful, but slow acting, effects upon expenditures to changes in a selected interest rate package. The package comprises interest rates on government bonds, bank advances, time and savings deposits, and on house mortgages. The model predicts that a specified change in these rates acts upon expenditures in three principal ways. The first is through the supply price of capital to construction and equipment investment. The second is via private sector wealth to expenditures on durables and dwelling investment. These two ways conform broadly with Phillips' channels (i) and (ii) above. The third way works through the banking system, combining elements of (iii) and (v) above. Increases in government bond rates reduce bank deposits and the availability of mortgage finance, thereby impinging upon investment in dwellings.

The use of interest rates as instruments implies that in the markets for these assets, the authorities set prices and the public's decisions determine the quantities held. When the interest rate peg is not being altered, official transactions in securities are passive and the money supply adjusts to the public's demand for securities.[11] Accordingly, the Bank has developed a more complex strategy to reconcile its new concern about the money supply with the earlier policy of controlling interest rates. In broad terms it follows a 'moveable peg' policy. Yields on government securities are pegged to absorb purely financial shocks; for example, upward pressures resulting from an upsurge in liquidity preference would be resisted and the wanted money created. The peg is altered from time to time when spending deviates from that desired by policy.

> "Tendencies towards instability may originate either with some financial flurry or with changes in the desire to spend. If goods markets are in balance, the pressures put on interest rates by an upsurge in liquidity preference should be resisted and the wanted liquidity should be created. But the pressures put on interest rates by an excessive desire to spend should not be resisted."[12]

In terms of the framework developed by Poole (1970), this policy would seem to be ideal for reducing the variability of income. Poole shows that if instability comes from the monetary side, an elastic money supply and control of interest rates is required. On the other hand, if disturbances are from the commodity sector, then control of the money supply rather than interest rates is called for. The Reserve Bank's practice of identifying the source of disturbance before setting its policy is consistent with Poole's argument and is superior to a policy which aims to control either the money supply or interest rates separately. The doubts surrounding this strategy come from the difficulties inherent in identifying shifts in liquidity preferences and

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11 Actually the Banks' view is stronger than this statement, for Phillips advances the proposition "... when interest rates are held steady ... the quantity of money held is really determined by demand." This is true only if interest rates are defined broadly, otherwise shifts in preferences between non-monetary assets may induce a supply response unmatched by an increase in the demand for money. The importance of this point will be made clear later in chapter 17.

12 Holmes (1972). The author was at the time Manager, Research Department, Reserve Bank of Australia, Sydney.

from the fact of life that the Reserve Bank is not the sole arbiter of interest rate variations.

The Bank also has an eclectic view about the instruments of policy, and the 'monetary policy package' draws upon most of the available instruments. The composite nature of current strategy was first revealed by the restrictive measures of 1969/70: the S.R.D. ratio was raised by one per cent, lending requests were issued to banks and non-bank intermediaries, ceilings on trading and savings bank interest rates were raised, the Bank became a willing seller and reluctant buyer of securities, yields on bonds rose sharply, and the growth rate of the money supply was curbed. However, the usage made of the various instruments has changed. (See Figure 3) Whereas changes in the frozen account device and lending requests formed the first line of defence in the 1950's and early 1960's, the position is reversed in the 1971 strategy.

> "As a rough rule, and depending on the circumstances, we would nowadays tend to look first at the more pervasive instruments of open market operations and interest rates, and then at direct influence on lending, and direct liquidity controls." (Phillips, 1969)

Two factors underlie this change in strategy. First, Governor Phillips spoke of a progressive shift of "the emphasis of monetary policy away from direct controls and towards measures that operate through the market." He branded use of direct controls as hindering "the process of having the community's financing done by the most efficient means," and Statutory Reserve Deposits were criticized as discriminatory against the banks. Secondly, the downgrading of the S.R.D. technique implicit in the strategy rests also on the Bank's appraisal of the weapon's potency. The Governor argued that "... open market transactions have an impact on the balance sheets of most groups in the economy," and hailed them as "an essential ingredient of any monetary policy package." By contrast a change in S.R.D.'s was said to have its sole certain direct effect upon the margin of the Bank's free L.G.S. reserves. As we argue in chapter 10, this unfavourable comparison stems from a failure to distinguish the S.R.D.'s potential role from its actual role.

The Governor's statement that open market operations are the "key instrument of monetary policy" appears to be more of a goal, consistent with its market philosophy and towards which substantial progress has been made, rather than the actual situation. There has been a revival of the S.R.D. device in the years following the Governor's address. In the four years 1972-1975, the S.R.D. ratio was altered on 19 occasions, only 4 of which were designed to replenish the Term Loan or Farm Development loan funds. This compares with 23 changes in the ten years 1962-1971 when 11 were to replenish the funds. Significantly, 8 of the 15 'non-fund' changes in the recent period were increases, in contrast to the progressive reduction in the S.R.D. ratio during the second half of the 1960's. Much of the impetus for these developments undoubtly came from Labor Treasurer Frank Crean who stated in 1973: "My preferences would be for more direct controls and less resort to interest rates." Some sections within Treasury still favour direct controls and there have been disputes between them and the Bank's 'open-marketeers'. Similarly, despite the Banks' own predilictions it has continued to use its authority to issue lending directives, and the banks are almost continually subject to lending guidelines. Evidence of the Bank's satisfaction with both the trading banks' and the savings banks' response to these 'requests' can be discerned from time to time in its Annual Reports. The enthusiasm with which the banks co-operate is, no doubt, enhanced by the knowledge that the S.R.D. device, which is more damaging to their profitability, is available to the Bank.

Conclusion

This survey has traced the evolution of the Reserve Banks' monetary policies since institution of the L.G.S. ratio in 1956 to the mid 1970's. In the early years of the period, bank advances were the principal target of policy. Interest rates were varied infrequently, and control of the quantity of money was subsidiary to the pursuit of other targets. Monetary control centred around the S.R.D.-L.G.S. liquidity mechanism and directives about bank lending. The switch to a different strategy in the early 1960's is seen by the Bank as marking "a watershed in the approach to Australian monetary policy" (Sanders, 1969), and throughout the 1960's the Bank sought to broaden the scope of monetary policy. Considerable emphasis was initially given to non-banking intermediaries and possible instability of the demand for money, and under the new strategy more frequent changes in bank and market interest rates and their associated impact upon expectations were seen to hold the solution to these problems. In the latter part of the decade the Bank adopted a more 'conventional' view of the impact of monetary actions upon expenditures, in which elements of the monetarist as well as neo-Keynesian arguments are discernable. The intermediate targets of policy are correspondingly now more complex. Although the money supply is accorded greater significance in policy, interest rates remain the centre-piece of the Bank's strategy.

While we have sought to identify and emphasize changes in the authorities' strategy there have also been significant elements of continuity. The changes in operating strategies have been, as it were, grafted onto the arrangements existing previously. Consequently, key elements of the 1958 and 1964 strategies remain within the current framework. Although open market operations are considered by the Bank to be a necessary condition for effective policies, the use of lending directives continues, S.R.D.'s are used to restrict bank lending, and the margin of banks' free liquidity continues to be featured as an indicator of monetary policy. Monetary policy is seen to work through playing upon the expectations of borrowers and lenders, and the Bank's interest rate strategy is designed, as in the early 1960's, to allow for variability in the demand for money. This mixture of old and new ideas gives current policy an eclectic flavour, and can be seen as the Bank's response to what it sees as the competing 'theologies' in monetary analysis. This eclecticism makes for difficulties in selecting an 'indicator' or monetary policy.

We now turn to consider the measurement of monetary policy and following that, the lags in the formulation of policy. At a later stage (in section II) we take up some of the points raised here insofar as they relate to the effectiveness of monetary policy and the definition of money. First, Governor Phillips expressed doubts about the controllability of the money supply, and we will examine the relationship between the money supply and the quantitative instruments of monetary policy. Secondly, we have stated that the Banks' policies which treat the components of L.G.S. assets (i.e. cash and government securities) as equivalents have led it to underrate the potential efficacy of the S.R.D. weapon. These issues are taken up in chapter 10. Finally, the activities of non-bank financiers and the associated instability of monetary velocity featured in the Bank's strategy in the mid 1960's and is implicit in its current interest rate policy, which allows for instability in the demand for money. The role of non-bank financiers is considered in chapters 8 and 9.

Chapter 4

The Indicator Problem

The indicator question is one of the more elusive issues of recent monetary economics. Much of the controversy comes about from a failure to make clear what the indicator is required for and how it differs from other policy variables. Four main terms are used in the literature and it is important that their meaning be made clear. First, there are the *goal variables*, the ultimate objectives of monetary policy as defined in the Reserve Bank Act. These lie outside the authorities' control but they are the variables which the Reserve Bank ultimately seeks to influence in the course of monetary policy operations. At the opposing end of the scale there are the *instruments* of policy, which are under the full control of the authorities and change only when the authorities act to do so. Following chapter 3 these can now be identified as the S.R.D. ratio, the minimum L.G.S. ratio, supplies of notes and coinage, the exchange rate, discounting operations, transactions in government bonds, the issuing of lending directives, and perhaps certain bank interest rates.

The other two terms are the *indicators* and the *intermediate targets* of policy. Most monetary variables that are neither goals in themselves, nor instruments as defined above can fit into the two categories of indicators or intermediate targets. Otherwise they are intermediate variables of some sort and probably irrelevant to the operation of policy - Tinbergen's irrelevant variables.

As we explained earlier, an intermediate target is a variable which the Reserve Bank aims for in the conduct of policy. Although not a definite goal of policy, it is a medium by which the Bank hopes to influence broader objectives and which is used in the absence of better information about the behaviour of the targets. In Governor Phillips' (1971) words:

> "The usual procedure is to set the policy dials in a way which we hope will produce reasonable balance between aggregate demand and supply. As part of the decision to set the dials in a particular way a forecast is made of the likely changes in financial variables. These are then used as *target variables* since normally information is available sooner on them than on measures of real activity in the economy." (our emphasis)

The Governor recognized that difficulties arise "in trying to assess the effects of policy action in the monetary sphere." As he saw the problem:

> "... the variables through which policy is implemented are influenced not only by policy changes but by developments within the economy itself. What is observed is the total movement of these series whereas an *indicator of policy* needs to separate the effects of policy from the effects of other variables." (our emphasis)

After discussing the difficulties of selecting an indicator, and in particular choosing between monetary aggregates and measures of money market conditions, the Governor concluded that in practice the Bank did not see the need for an indicator:

> "At a practical operational level we usually short circuit the need to separate policy and non-policy effects on a variable."

Presumably the Governor is saying simply that the Bank knows what it is doing. He does not inform us how the Bank solves the index number problem when there is more than one instrument of policy: that is, how a change in the S.R.D. ratio is to be compared with a discounting of Treasury notes or a request for a variation in the rate of new lending. There is also a need to scale the extent, as well as the direction, of policy change. Some sort of summary measure is necessary to calibrate the effects of policy, even if it is implicit. Furthermore, even if the Reserve Bank knows what it is doing or trying to do, we as outsiders do not.

Given that an indicator is needed, only if for intellectual curiosity, what criteria are to be followed in its selection? Brunner and Meltzer (1969) define the indicator problem as "... the problem of constructing a scale that is invariant up to a monotone transformation and that provides a logical foundation for statements comparing the thrust of monetary policy."

Elsewhere (Brunner and Meltzer, 1964) they say that the monetary policy indicator "... summarizes in an index the relative degree of monetary ease or restraint." Suppose that the central bank seeks to influence one goal variable and has several instruments at its disposal, and that the two sets of variables are related by reduced form equations, such as in chapter 2 above, containing as well exogenous and lagged endogenous variables. The Brunner-Meltzer monetary policy indicator is then a weighted index of all the instrument variables, with each variable's weight proportional to its coefficient in the reduced form equation.

Following from Brunner and Meltzer's definition, the indicator must be comprehensive, quick in its response to the instruments of policy, and related in a reliable way to either or both the intermediate targets and the goals of policy. Ideally the indicator would be free of non-policy influences. But in a complex monetary policy framework, the 'thrust' of a monetary policy instrument proceeds towards the goal variables by a transmission process which successively incorporates a number of other influences as the effects span out from the Reserve Bank to the banking system and other financial intermediaries. The choice of an indicator is very largely the choice of *at what particular point in the monetary policy process the thrust is to be measured.*

If we choose an indicator which is 'close' to the goal variables it is necessary to sort out whether the change in the intermediate variable stems from the Reserve Bank's actions or from other sources. The Bank may be passively allowing the non-policy induced changes to exert the desired effect; alternatively , non-policy influences may be responsible for the actual thrust differing from that required. This might suggest the desirability of choosing an indicator closer to the instruments of policy. But another problem then emerges: the meaning of monetary policy. We must be mindful of the distinction, first made by Roosa (1956), between 'dynamic' operations (in his example, actions designed to change the reserve base of the banks in line with the direction of policy) and 'defensive' operations (designed to protect reserves from exogenous factors). The basic idea underlying this distinction is that it is useful to talk about monetary policy in a way which abstracts from certain non-policy influences. It would not be considered useful to record monetary policy as expansionary if the Reserve Bank (as it has done on several occasions) takes actions to expand bank reserves in order to offset an unseasonably large demand for currency. At the other extreme there is the question of the relationship of monetary policy to other economic measures. During much of the period under review the Reserve Bank has seen its role as "essentially supplementary" to fiscal policy and has frequently characterized its actions as "supporting" other economic measures. Monetary policy may seem to be weak or even inappropriate if assessed separately from the fiscal actions. Yet, for some purposes, it might be useful to characterize monetary policy as expansionary if it is designed to prevent fiscal policy from having too severe an effect on the goal variables.[1] These two examples illustrate the two extremes, and there are a large number of events in financial markets which lie between them. Selection of an indicator involves making a judgment about those actions which should be abstracted from and those actions which should not.

These points can be illustrated by considering the various indicators of Australian monetary policy, namely:

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[1] Recently the situation may have been reversed with monetary policy seeking to neutralise expansionary fiscal budgets. In 1974 and 1975 the Bank warned that monetary policy could not be "tightened to the point where the prospect of a reduction in inflation was brought about by that means alone." (Annual Report 1974, p. 42)

(i) Ratio of free L.G.S. assets to deposits

(ii) S.R.D. ratio

(iii) Bank advances/overdraft limits/new lending

(iv) Money supply

(v) Base money/net domestic assets

(vi) Potential money indicators

(vii) Fiat money indicator

(viii) Interest rates

The first three are the traditional measures of monetary policy. Of these, the ratio to deposits of L.G.S. assets in excess of the required minimum convention (the *free L.G.S. ratio*) has been the one most frequently emphasized by both the central bank and Australian economists. In establishing the L.G.S. convention, the Bank envisaged the margin of free liquidity serving as an indicator of its credit policy, and it is invariably featured in the Bank's annual report - in the 1970/71 report it was highlighted as a "monetary indicator". There is much to commend the free L.G.S. ratio as an indicator. It is situated, as it were, midway in the transmission mechanism between the instruments and the intermediate targets, and it readily reflects central bank security transactions with the banks and the public, as well as changes in the required L.G.S. and S.R.D. ratios and accompanying directives. Indeed it shows too much: Dewald (1967b) has illustrated how it absorbs and reflects virtually *everything* occurring in the financial system and not just policy actions. Changes in the balance of payments, the demand for bank loans, and banks' and the public's liquidity preferences will all show up as movements in banks' L.G.S. assets. Perhaps more seriously the indication provided may be incorrect. In the previous chapter we argued that the banks have used their free L.G.S. assets as a buffer to absorb changes in the demand for advances, and to insulate their lending from calls to the frozen accounts. A reduction in the free L.G.S. ratio occasioned by banks moving from L.G.S. assets into advances to accommodate a larger demand for loans is an example of such a false signal.

Bank advances are a long standing intermediate target of the Bank, but a poor indicator of policy intentions. Studies by Norton, Cohen and Sweeny (1970) and Valentine (1973) indicate that bank advances in Australia are primarily induced by economic activity and respond only sluggishly to quantitative and qualitative policy. The Bank has emphasized that the rate of new lending, and not the behaviour of advances outstanding, is the focus of its attention. New lending seems to have responded quite quickly on occasions to the Bank's lending directives, but data is available only from September 1961 and it is difficult to interpret; it takes about six months to distinguish a change in direction of the series from an irregular movement.[2]

The *S.R.D. ratio* is a direct policy instrument of the Reserve Bank and the question of control does not arise. It is used by Jonson (1974) in his quantitative study of policy objectives in Australia as one of his two indicators of the stance of monetary policy. Variations in the ratio have announcement effects and these are seen by another commentator (Purvis, 1975) as "an indication of monetary policy." He explains that "an increase in required S.R.D. ratios would likely be taken as a 'signal' that tight monetary policy is planned." Both Jonson and Purvis over-rate the usefulness of the S.R.D. ratio as an indicator. A one per cent increase in the S.R.D. ratio in itself tells almost nothing about policy intentions, for it may be designed to maintain an unchanged stance, tighten policy, or prevent it from being too easy. As we shall see in chapter 18 below, many of the

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2 As judged by the months for cyclical dominance (M.C.D.) of the seasonally adjusted series. A description of this measure is given in Appendix A to chapter 12.

adjustments appear to be defensive ones designed to smooth out short run influences on bank liquidity, and the ratio has also been used extensively to offset longer run liquidity disturbances from outside the domestic banking system.

There is considerable support for the use of monetary aggregates as indicators of monetary policy, as Governor Phillips acknowledged in his Mills lecture (1971). He noted that discussion had focused around the various definitions of the money supply (the Governor opted for a narrow definition) and the volume of bank credit. But for much of the period surveyed in the previous chapter, the *money supply* appeared to be almost an irrelevant variable in policy considerations. Policy has also been much concerned with the demand for, as well as the supply of, money making the behaviour of the supply alone difficult to interpret from a policy viewpoint. (The Bank discounted the expansionary impact of the large increase in the money supply in 1963/64 by arguing that "memories of financial failures and a recent downswing had created a considerable demand for liquid and secure assets.") Nor, in recent years, can the money supply necessarily be presumed to indicate policy. Movements in the money supply may reflect the actions of the public and the banking system as well as those of the authorities. This is the clear implication of the Governor's comments:

> "... in the Australian situation the supply of money depends not only on the level of cash and government securities but also on the willingness of the banks and the public to hold them."

In practice, despite the inference in the Governor's statement, the money supply appears to be dominated by movements in the *monetary base*, as will be shown in chapter 10 when we examine the Governor's statement and the evidence in greater detail. This latter magnitude - the private sector's holdings of notes, coin and central bank deposits - is more directly under the Bank's control than is the money supply. In particular, it responds directly to Reserve Bank transactions involving bank reserves and/or deposits: it expands whenever the Bank purchases government securities, discounts notes and bills, and makes loans, whether to the public, the banks or the government. In the Annual Report for 1969-70, the Bank described the base as "one useful guide to the Bank's influence on financial conditions". It is also Brunner and Meltzer's preferred indicator: as they see it, base money responds quickly and unambiguously to the principal instruments of open market operations and discounting, and is a link in the chain running from the Federal Reserve via bank reserves to the money supply and the goal variables.

However not all components of the monetary base are under the Bank's control. In Australia the injections of high-powered money from the government budget are largely exogenous to the Bank, as are fluctuations in the balance of payments, which show up in the Bank's holdings of gold and foreign exchange, when the exchange rate is fixed. The dominance of the latter source of base money led Porter (1974) to use the domestic component of the base, adjusted for changes in the S.R.D. ratio and termed *net domestic assets* as an indicator of monetary policy. The idea of his study was to demonstrate that 'policy intentions', as revealed by net domestic assets, may be offset to some extent by capital inflows. Since net domestic assets may be used as a defensive measure of offset inflows of capital, his indicator is open to the same objections as were raised against the S.R.D. ratio.

In chapter 18 below we examine the role of both the domestic sources of base money and the S.R.D./Special Accounts system in offsetting swings in base money arising from gold and foreign exchange movements. We find that policy-induced variations in the frozen accounts have moved so as to mitigate the effects of these fluctuations upon banks' liquidity position. As the monetary base itself does not respond directly to changes in required cash reserves,[3] some combination of these items may provide a useful index of monetary policy. This appears to be the idea underlying Dewald's (1967b) measures of potential money.

Dewald defined *potential money* as the maximum amount of money that the banking system could generate given the reserve base and the setting of the relevant reserve ratio, and saw it measuring the shift in the money supply function produced solely by policy actions. He provided two definitions. The narrow definition is the monetary base (cash base) divided by the required S.R.D. ratio viz.

$$M^* = \frac{\text{Cash base}}{\text{S.R.D. ratio}}$$

Australian economists (and the Governor indicated that he agreed with them) have typically argued that the banks are constrained by the quantity of L.G.S. assets in the system and not by the quantity of cash. Dewald's second definition of potential money widens the cash base to include government securities in the hands of the banks and the public and includes the required minimum L.G.S. ratio in the denominator. Thus the 'liquidity indicator' is

$$M^{**} = \frac{\text{Cash plus Government Securities}}{\text{S.R.D. plus L.G.S. ratio}}$$

Some years later Dewald indicated a preference for a *fiat money indicator* and this was used by himself and Kennedy (1969) in a comparative study of the relative effectiveness of fiscal and monetary policies. The indicator is

$$F^* = \frac{\text{Fiat money}}{\text{S.R.D. ratio}}$$

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3 The word 'directly' is needed because some feedback may occur from changes in required reserves to gold and foreign exchange holdings.

where fiat money is that part of base money comprising the Reserve Bank's securities portfolio and the Treasury's deposit. In the present writer's opinion, Dewald's adoption of the fiat money indicator is a retrograde step, for the narrow focus of fiat money opens it to the same objections as were made against the use of the S.R.D. ratio and Porter's net domestic assets; namely, that fiat money may be used to offset other items of base money.

Returning to the potential money measures, several criticisms can be made of them. First, Dewald visualised the shift being a parallel one at the existing interest rate structure. Smyth and Holmes [1970] argue that the curve may rotate in response to certain policy combinations making the stance of the policy change ambiguous. Their criticism does not really appear to be relevant in this context unless the authorities are also aware of the possibility, which seems unlikely.[4] Second, there are difficulties in the treatment of the S.R.D. ratio. A reduction in the ratio expands potential money both by liberating reserves for lending and by modifying the leakages in successive rounds of the ensuing multiplier process. While the theoretical multiplier (for M*) has averaged about 8, the actual multiplier is going to be considerably less than this due to banks' holdings of excess reserves and other leakages in the credit rounds. Excessive weight may be accorded to variations in the S.R.D. ratio in the overall measure relative to variations in the numerator. Another difficulty with the S.R.D. ratio is how releases in the ratio to establish and replenish the special Term loan funds should properly be treated. Third, Dewald suggested that the measures be deflated by the Consumer Price Index, and a

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4 In a later comment, Stammer (1971) argues that part of the cash base is endogenous with respect to the behaviour of the economic system. He ignores the possibility that the denominator, the S.R.D. ratio, may be used to offset these responses. This was discussed earlier, and is examined in chapter 18.

measure of potential real G.D.P. to subtract liquidity increases which accommodate economic growth. This latter scaling assumes the income elasticity of demand for real money balances with respect to real income is unity, whereas the correct measure would be the income elasticity as perceived by the Reserve Bank.

More seriously, the concept itself can be questioned. The formulation of potential money implicitly presupposes that the monetary base can be controlled or, if not, any unwanted impact upon banks' reserve base can always be sterilized by appropriate changes in the reserve ratio. In an economy open to foreign trade and capital flows, this presumption is at least questionable. There is also the general question of whether the authorities have been concerned with monetary aggregates or with measures of money market conditions.

Interest rates are used as indicators by those who consider that the authorities have set the 'price' of money rather than the quantity. The yield on long term government securities is generally seen as the key rate in the structure of interest rates, and this rate is used by Jonson (1974) as his other indicator of monetary policy. Except in more recent years, interest rates are a restricted measure of monetary policy. If interest rates are defined by their cost attributes in common with other aspects which make it costly or difficult to obtain control over capital, interest rates and credit availability are different dimensions of the one concept. When banks undertake loans of higher quality or make less loans at existing interest rates, this is equivalent to a rise in interest rates. Even in a market not marked by rationing, interest rates are difficult to interpret. The restrictiveness of a particular interest rate structure depends on the demand for credit and the anticipated decline in the real value of securities. Nominal interest rates have undoubtedly been influenced by rising expectations of inflation and, without suitable correction, this indicator seems likely to overstate the authorities' preference for avoiding inflation if used in a study of monetary policy objectives. Nor can we ignore the possibility that much of the movement of interest rates around their rising trend reflects the authorities' accommodation of other economic forces at work in the bond market. Interest rates may behave *as if* they are market determined even if the authorities appear to have formal control. As we have seen, the interest rate strategy pursued by the authorities for much of the 1960's did not seek to control either interest rates or the money supply to the exclusion of the other in a rigid, unchanging fashion.

None of the indicators we have examined cover the full gamut of policy instruments utilized by the Reserve Bank. By and large they focus upon quantitative policy actions. But in addition the Bank has striven continuously to alter the banks' lending policies by means of directives and it has frequently used the announcement effects of these directives and of changes in S.R.D.'s and interest rates to influence the behaviour of the banks and the community. Increasingly it has discussed policy objectives with representatives of the life offices, finance companies and building societies, and has attempted to exert moral suasion over their lending. These actions may not be adequately captured by the indicators.

The various indicators can be faulted from another point of view. When we examine the various indicators during 1959-60, a period examined in detail by Australian commentators, we find that bank advances and monetary aggregates rose, interest rates remained unchanged and the movements in potential money suggest that expansionary policy in 1959 and restraint in 1960 were mild by comparison with other periods. This may be a reflection of what monetary policy actually achieved, but it does seem at variance with what all commentators say the policy-makers had in mind. *Ex post* observations of financial variables may not be suitable proxies of the controlled behaviour of the authorities.

This particular point has been neglected in the literature on the indicator question, which by and large has been concerned with measuring the thrust that monetary policy is actually exerting, or about to exert, upon the real sector. No allowance is made for the possibility that this accomplished stance may diverge from that which the authorities sought to establish. Such a divergence is, to be fair, irrelevant in the context in which the indicator question has arisen, but cannot be ignored when the objective is one of identifying the decision rules inherent in policy deliberations.

With these criticisms in mind, an alternative way of calibrating monetary policy is investigated in the next chapter.

Chapter 5

An Alternative View of the Monetary Policy Process

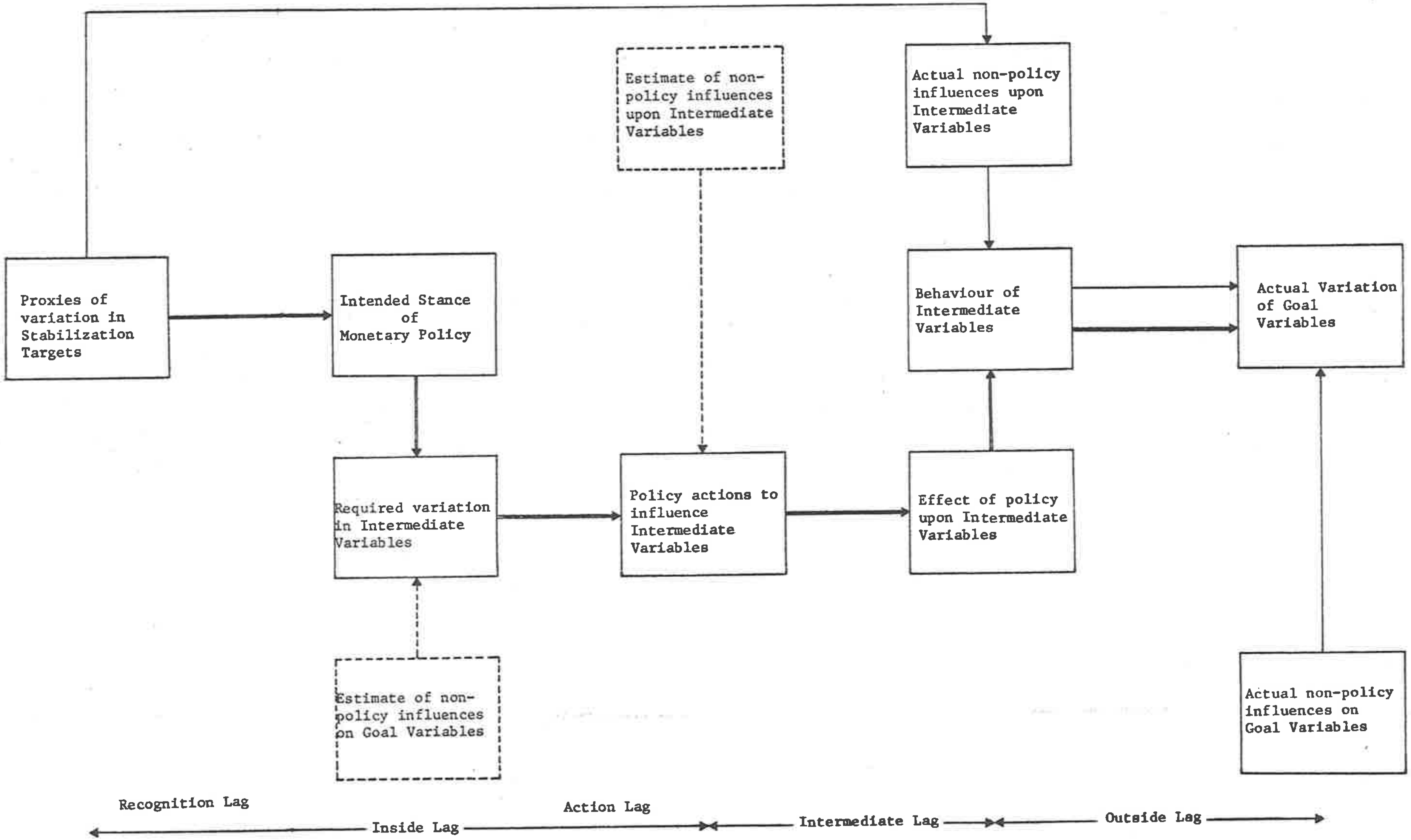
In the theory of optimal stabilization policies, monetary policy is viewed as a *one-stage process*, running directly from the instruments of policy to the goal variables. This conception is borrowed from fiscal policy, where a strict division between controlled and non-controlled elements is appropriate, and for which the time lags in policy can usefully be divided into the categories of 'inside' and 'outside'. A one-stage process of policy is also embodied in the popular IS-LM system. Poole (1970) has shown that in this framework the policy problem is one of controlling either interest rates or the money supply, with both treated as instruments of the central bank.

In contrast with these theoretical models, the more empirically based literature on monetary policy has generally adopted a *two-stage* conception of the process. Poole's analysis is seen to be relevant for the selection of an intermediate target, leaving as the instrument problem the choice of the variables over which the central bank will exert direct control - see Pierce and Thomson (1972). Corresponding with this two stage process there is a three-fold classification of the time lags into the categories of inside, intermediate and outside lags.

However, a more realistic depiction of the workings of monetary policy can be obtained by thinking of a *three-stage process*. As in the immediately preceding schema there is the link between the intermediate targets and the goal variables, and between the intermediate variables and the policy instruments. The additional step suggested here is 'policy intentions' and the actions taken to translate these intentions into practice. Policy is visualized as proceeding in four steps. This has the advantage of according with the four lags distinguished in chapter 2, namely the recognition, action, intermediate and outside lags. The process is illustrated in Figure 5a. First, there is the formulation of policy. In the light of various proxies of the condition of the economy, the Reserve Bank determines the intended stance of policy. Following standard macroeconomic analysis, this policy stance is transmitted to the goals through intermediate variables such as the money supply, interest rates or bank lending, which we denote as x. Determination of the variation in the intermediate variables, x°, required for policy to be optimal proceeds along the lines already indicated in the formal theory of economic policy. Secondly, there is the implementation of policy. The central bank acts upon the instruments of policy (perhaps after a lag) to alter the intermediate variables in line with policy requirements. These actions take into account the expected changes in the intermediate variables arising from non-policy forces. In some cases the action will be offensive, indicative of policy intentions, in other cases no action may be required or the action may be defensive. Thirdly, the banking system and financial markets respond to the Bank's actions and other economic forces. Finally, the changed financial conditions impinge upon the goal variables.

Measures of monetary policy have usually been drawn from what we term the second and third stages of the process. When the measures are required for ascertaining the policy goals or for measuring the lags in formulating policy, additional difficulties exist in interpreting the meaning of the results. At a formal level, the interpretation of the policy reaction functions, as indicated by equations (2-4) and (2-5), needs revision. Earlier studies have elucidated that the coefficients embody (i) the authorities' preferences towards the goals and the intermediate targets,

Figure 5a: Schematic Representation of the Monetary Policy Process



and (ii) their views about the structure of the economy. Our schema indicates that, in addition, there are the mechanisms by which the intended stance is to be accomplished. If instrument variables directly under the authorities' control are used, there is the problem of sorting out defensive operations, to offset or iron out anticipated non-policy influences upon the intermediate variables, from offensive operations, aimed at the ultimate goals. For example, Jonson (1973) uses the S.R.D. ratio to measure policy in his reaction functions. He finds there is a positive association between the S.R.D. ratio and international reserve holdings, which may indicate defensive policies. On the other hand, when intermediate variables are used, the studies may reveal the independent adjustments of the financial system and feedback from the goal variables as well as the authorities' intentions. Also, the intermediate lag is measured along with the inside lag of policy.

These problems would be avoided if policy were to be measured at what we term the first stage of the policy process, and what is required is a numerical index of *intended* monetary policy. The point can be stated in an alternative way. The theory of optimal economic policy outlined in chapter 2 relates to the *formulation* stage of policy. By measuring monetary policy at its formulation rather than at a later point in the process, this theoretical framework is directly applicable.

Such an index of policy intentions has decided advantages over the usual indicators of monetary policy in an exploration of the goals of policy and the lags in formulating policy responses. First, it seeks to assess intentions directly rather than endeavour to infer these from policy actions involving, for example, the S.R.D. ratio. Secondly, by providing an overall summary of the stance of policy it specifically faces up to any conflicts between the indicators arising from their lack of comprehensiveness. Thirdly, use of policy intentions rather than one of the intermediate variables enables us to identify the policy response rather than some mixture of this and the impact of the economy upon the monetary system. Finally, as an index of intentions relates to the formulation stage of policy, the intermediate lag is excluded and an arbitrary combination of two or more lags is avoided.

We have attempted to develop such an index by assessing the 'tone' of the Reserve Bank's statements about monetary policy. The idea has its origins in several studies of the inside lag for the U.S., where examination was made over a limited time period of the Minutes of the Federal Open Market Committee to date changes in the emphasis of monetary policy. These are the studies by Brunner and Meltzer (1964), Willes (1967) and Selby (1968), which are surveyed in more detail in the next chapter. Their acceptance in the U.S. (for an assessment see Fels and Hinshaw, 1968) led us to believe that the technique could be usefully employed here.

For our Australian analysis the time period is longer than the U.S. studies and the source material comes from public press releases (P.R.) issued frequently by the Reserve Bank, and the details of lending requests to the trading banks and the discussion of monetary policy contained in the Bank's annual reports (A.R.). Because of the dominance of the Treasury in framing monetary policy we have also examined the discussion of general policy intentions, involving both monetary and fiscal actions, in the Treasury's various annual economic surveys (E.S.) and the Treasury Information Bulletin (T.I.B.). All policy statements or directives which might conceivably indicate the authorities' intentions were extracted from all these sources. They are set out in Table 5.1. Each statement was scored as having a strength of from 0 to 5 in intervals of 1, indicating a subjective evaluation of the incremental tightening (-) or loosening (+)

Table 5.1

Construction of the Index of Monetary Policy

Date	No. and source of statement		Statement	Score 1	Score 2	Scoring	Cumulated Score	Policy Stance
September 1955	1	P.R. 13/9	"...Restraint in lending is necessary...The Central Bank has asked the banking system to co-operate by applying restraint in undertaking new lending commitments...In addition the banks have been asked to undertake a comprehensive review of large overdraft accounts with the object of achieving reductions in both limits and indebtedness."	-	-	-	15	
March 1956	2	P.R. 14/3	Announcement of increase in trading banks' fixed deposits and lending rates.	-3	-3	-3	12	
	3	P.R. 26/3	"Banks have agreed that, in determining rates to be applied to individual overdraft accounts, they would be guided by the need to restrain inflation..."					
	4	A.R. 1956	"Central Bank policy...reduced to more normal proportions support given to the Commonwealth bond market and (included) some increases in bank interest rates." (p.5)					
	5	E.S. 1956	"With the two objects of applying a brake to internal demand and of avoiding a cash deficiency and the use of bank credit, the Government brought down taxation measures designed to yield some £115 m. in a full year. Concurrently, bank interest rates on both advances and deposits were increased." (p.35)					
April 1956	6	P.R. 10/4	Announcement of increase in savings banks deposit and lending rates.	-1	0	-½	11½	
(1956/57)	7	A.R. 1957	"Credit policy in 1956/7 was mainly characterised by the continued application, with some modifications, of the action already taken by the bank as part of the general pattern of measures introduced early in 1956 to halt the rising inflationary pressure of expenditure." (p.18)					
	8	E.S. 1958	"For the time being (1956/7), the mood was cautious ...and the banking system was still holding back on new lending." (p.5)					
May 1957	9	P.R. 7/5	"The Commonwealth Bank...has informed the banks that in its view the Australian economy appears to have moved towards a condition of reasonable balance but there were factors developing, arising particularly from the balance of payments, which could lead to a renewal of inflationary pressures. In these circumstances, while it would not be appropriate at the present time to make any overall relaxation in credit policy, it was no longer necessary for total advances to fall further apart from normal seasonal variations. It was emphasized ...that there would no no general increase in trading bank lending.	+1	+1	+1	12½	Ease
	10	A.R. 1957	"Modification of the restraints on imports and on credit did not become possible until the year was well advanced." (p.18) "This represented a significant though modest easing of credit conditions."					
	11	E.S. 1958	"It was evident that the restraints imposed on expenditure early in 1956 and carried on since then did not need to be increased." (p.6)					
December 1957	12	A.R. 1958	"In December 1957, the Central Bank stated that... it considered it appropriate for the banking system to continue a rate of lending which would result in some *increase* in advances during the financial year." (p.3) "Credit policy changed from one of general restriction...to relative ease in 1957/8." (p.19)	+2	+3	+2½	15	

Date	No. and source of statement		Statement	Score 1	Score 2	Scoring	Cumulated Score	Policy Stance
March 1958	13	P.R. 1/3	"The Commonwealth Bank announced today that a total of £15 m. had been released from Special Accounts of the trading banks.	+1	+1	+1	16	
	14	E.S. 1959	"During 1957/8 a comparatively easy credit policy had been operating." "The Central Bank was encouraging the trading banks to lend more." (p.8)					
February 1959	15	P.R. 6/2	"Release of £15 m. from the Special Accounts of the trading banks. It was stated that it was central bank policy that there should be some expansion of bank lending during 1958/59. The release had been made as a cushion for the normal run-down (in liquidity) to be expected later in the year and to assure the trading banks of adequate liquid resources for the desired increase in advances."	+2	+2	+2	18	
	16	A.R. 1959	"Liberal credit policy...encourage banks to maintain a high lending rate." (p.3)					
	17	E.S. 1959	"Monetary policy was directed towards a further increase in bank lending during the year." (p.9)					
November 1959	18	P.R. 31/10	"Call of £15 m. to the Special Accounts of the trading banks. The call is made at a time when bank liquidity is unusually high and with the prospect of a significant net increase in liquidity over the financial year. Further calls would probably be needed to absorb excess liquidity as the year progressed. This action did not indicate a general tightening of credit and indeed was consistent with some moderate increase in bank advances over 1959/60."	-1	-1	-1	17	Restraint
	19	A.R. 1960	"The economic outlook at the beginning of 1959/60 continued to be somewhat uncertain...it seemed appropriate, in the light of economic prospects generally, for the central bank to *continue* to provide in its monetary policy for some *moderate* expansion of advances. (p.19)					
	20	A.R. 1961	"Reserve Bank credit policy...had commenced to be restraining from October 1959." (p.20)					
	21	E.S. 1960	"The Central Bank was taking action to restrain the growth of bank liquidity." (p.8)					
December 1959	22	P.R. 1/12	"Call of £20 m. lodged yesterday to Special Accounts was part of the general programme described at time of the October call, to absorb excess bank liquidity. The banks had been asked to see that their lending policies were consistent with not more than a moderate expansion of bank credit over the financial year."	-1	-1	-1	16	
February 1960	23	P.R. 29/1	"S.R.D. ratio raised by 1% effective from 10th February. This action was a further stage in the programme of absorbing excess bank liquidity which was commended with the October and November calls."	-1	0	-½	15½	
	24	Treasurer 15/11	"We were given to understand last February that there would be at the most, only a moderate increase in bank advances during the months ahead." (p.4)					
May 1960	25	A.R. 1960	"Towards the end of the financial year...banks were asked to review their lending policies and achieve an early and significant reduction in the aggregate rate of new lending." (p.20)	-3	-3	-3	12½	

Date	No. and source of statement		Statement	Score 1	Score 2	Scoring	Cumulated Score	Policy Stance
		E.S. 1961	"In May the Reserve Bank requested the trading banks to make a prompt and significant cut in their rates of new lending." (p. 9)					
August 1960	26	P.R. 7/8	"Despite the Reserve Bank's policy which called for increased restraint in bank lending, the very strong pressure for bank loans over a wide field had produced a sharp expansion of bank credit. It was important that this expansion should be checked and, following earlier requests for moderation in lending, the Reserve Bank had asked banks to achieve an immediate and significant reduction in the rate of new lending. Meanwhile, the Reserve Bank would maintain strong pressure on banking liquidity."	-2	-2	-2	10½	
	27	A.R. 1961	"The Reserve Bank...gave the banks more specific directions concerning the rate of lending." (p.9)					
October 1960	28	A.R. 1961	"Banks were again requested to apply severe restraint in their current lending." (p.20) "to direct their lending policies with the object of achieving a considerable reduction in their advances outstanding before the end of March 1961. At the same time they were asked to warn customers ...of the tight credit and liquidity situation and of the further tightening expected later in 1960/61."	-2	-2	-2	8½	
November 1960	29	Treasurer 15/11	"The Reserve Bank has followed its earlier requests for a reduction in the rate of new lending approvals with a request to the trading banks for a substantial reduction in the total of outstanding advances between now and the end of next March.... The outpouring of bank credit...can be stopped...and serious consequences will follow if it is not stopped. So it must be stopped."	-4	-3	-3½	5	
November 1960	29a	A.R. 1961	"As part of the special economic measures announced by the Government in November, 1960, the Reserve Bank issued instructions to the trading banks reiterating and amplifying in certain respects requests already made to them regarding lending policies, and bank interest rates on both advances and deposits were increased. The request to the trading banks to limit the rate of new lending and reduce advances outstanding considerably by the end of March was reaffirmed and the banks were given further guidance as to its application." (p.20)					
	30	P.R. 16/11	Confirmation of increases in fixed deposits and lending rates.					
	31	P.R. 26/11	Confirmation of bank credit restraint outlined by Treasurer.					
April 1961	32	P.R. 19/4	"The trading banks had been asked to continue the policy of restraint in lending.... Releases of funds from S.R.D. would be regulated to support the current restrictive credit policy and would not imply any change in that policy."	0	0	0	5	
	33	E.S. 1961	"On the view they took of the situation late in April, both the Government and the Reserve Bank left no doubt that they were not at that stage ready to dismantle the main structure of restraint." (p.20)					
	34	E.S. 1961	"The Reserve Bank asked the trading banks to continue the policy of restraint in lending and to keep the expansion of their advances in the next few months to the minimum necessary to meet essential requirements within the selective policy that had been announced in November." (p.18)					
	35	A.R. 1961	"It was considered desirable to maintain the general credit policy of fairly firm restraint earlier imposed." (p.21)					

Date	No. and source of statement		Statement	Score 1	Score 2	Scoring	Cumulated Score	Policy Stance
	36	E.S. 1962	"Credit restraint was eased after March 1961." (p.7)					
May 1961	37	P.R. 9/5	"S.R.D. ratio reduced by 1%. It was emphasized that these reductions in the ratio did not imply any relaxation in the current credit policy."	0	0	0	5	
June 1961	38	P.R. 20/6	"S.R.D. ratio reduced by 1%. The object of the reduction was to keep bank liquidity at satisfactory levels in present circumstances."	+1	+1	+1	6	Ease
July 1961	39	P.R. 29/6	"S.R.D. ratio reduced by a further 1%... Within the limits of a moderate increase in their new lending, the banks may grant additional accommodation on the basis of normal banking criteria." "The reduction of inflationary pressures in the economy has now enabled the Reserve Bank to restore to trading banks greater discretion in the allocation of loans."	+5	+5	+5	11	
	40	P.R. 12/7	"S.R.D. ratio reduced by 1%." (No comment)					
October 1961	41	P.R. 27/10	"Restore to the trading banks general discretion as to the classes of lending they could undertake. The conditions...which had led the Reserve Bank to impose restraints on various types of bank lending had now passed." "They were being asked when considering applications for loans to give special weight to the need to increase employment and productivity in Australia."	+4	+4	+4	15	
	42	A.R. 1962	"Now moderately expansive credit policy." (p.19)					
June 1962	43	A.R. 1962	"Towards the end of the year...a steadying of the rate of new lending commitments seemed appropriate." (p.19)	-1	-1	-1	14	Restraint
	44	A.R. 1963	"The emphasis of monetary policy in relation to bank lending was shifted slightly from providing an active and positive stimulus to the economy to a somewhat more passive policy of moderate expansion." (p.17) "Credit policy had been modified slightly towards the end of 1961/62 to seek a steadying of the rate of new lending commitments." (p.16)					
October 1962	45	A.R. 1963	"Since bank liquidity was already fairly high at the beginning of the year, it was considered unwise to allow any further substantial increase over the year as a whole. This decision did not imply any change in credit policy, for the banking system was still left with ample liquidity to finance a relatively high rate of lending. It was, of course, recognised that an increase in the S.R.D. ratio could be misinterpreted as a tightening of lending policy and care was taken to make it clear to banks and to the community that this was not the case." (p.16)	0	0	0	14	
		P.R. 24/10	"S.R.D. ratio increased by 1%. Emphasized that this action did not indicate a change in the R.B.A.'s general credit policy which for some months had been moderately expansive."					
	46	A.R. 1963	1962/3 - "It was not felt that...any further change in bank lending policy was necessary." (p.17)					
	47	E.S. 1963	1962/3 - "Official monetary policy has sought...to encourage bank lending." (p.13)					

Date	No. and source of statement		Statement	Score 1	Score 2	Scoring	Cumulated Score	Policy Stance
April 1963	48	P.R. 29/3	Announcement of general reduction in bank interest rates. "Opportunity be taken to move to a lower level of interest rates while there was still room for some further recovery and expansion in economic activity. These reductions would help in using interest rates more flexibly."	+2	+2	+2	16	Ease
	48a	A.R. 1963	"As the year progressed it became increasingly evident that trends in the security and capital markets were favourable to lowering interest rates and it was arguable that, although the pace of recovery was reasonably satisfactory, a reduction in rates accepting these market trends would provide a useful but moderate stimulus to expenditure generally, and in particular would make borrowing for capital expenditure more attractive." (p.16)					
October 1963	49	P.R. 31/10	"Important that bank lending should continue to provide support necessary for economic expansion... Desirable that banking system should not add unnecessarily to public liquidity... Some months ago banks had been informed that the Reserve Bank did not think it appropriate at that stage of economic recovery for the trend of new lending commitments to continue to rise. At the end of September the banks had been asked to ensure that their new lending commitments remain well within the level suggested earlier by the Reserve Bank when there had been greater need for more positive stimulus to the economy."	-1	-1	-1	15	Restraint
	50	A.R. 1964	"Bank lending and interest rate policies continued to operate in support of a rising level of economic activity." (p.15)					
	51	E.S. 1965	"By end of 1963, it was clear that a change in the bent of policy was *due*." (p.13)					
January 1964	52	P.R. 7/1	S.R.D. increase. "The transfer...did not mean any change in the banking policies puclicly stated by the Reserve Bank last October. Banks will still hold liquid funds, adequate to enable new lending to continue at a rate sufficient to support expanding economic activity and high employment." "Australia's very favourable balance of payments... high export receipts and strong inflow of capital have been adding to liquidity.... In these circumstances, some precautionary restraint of the growth of trading bank liquidity is considered appropriate... Foreshadowed the probability of further adjustments to S.R.D. ratio...over the next 2 or 3 months."	-1	0	-½	14½	
February 1964	53	P.R. 3/2	S.R.D. increase by 2%. ("Foreshadowed early last month.")	0	0	0	14½	
March 1964	54	P.R. 28/2	S.R.D. increase. "Continuation of the policy announced by the Reserve Bank in January of modifying the rise in banking liquidity."	(-½)	0	0	14½	
	55	A.R. 1964	"Early in 1964...monetary policy began to press more firmly and on a wider front against the possibility of increases in the supply of money exceeding demand."					
April 1964	56	P.R. 7/4	Increase in bank interest rates. "Conditions had changed considerably since bank interest rates were reduced 12 months ago. The higher rates on fixed deposit would...assist in counteracting any tendency for surplus funds...to give rise to excessive pressures on resources or asset values generally."	-1	-2	-1½	13	
(1964/65)	57	A.R. 1965	"At June 1964 bank liquidity was comfortable... Banks were exercising restraint in their new lending... In discussions with the banks, the need to keep down new lending was stressed." (p.18)					

Date	No. and source of statement		Statement	Score 1	Score 2	Scoring	Cumulated Score	Policy Stance
October 1964	58	P.R. 6/10	Increase in S.R.D. "The banking system should exercise further restraint in its lending. The Reserve Bank had asked the trading banks to effect some reduction in new lending below recent levels."	-1½	-2	-2	11	
	59	A.R. 1965	"Trading banks to effect some reduction in new lending below recent levels, to keep the increase in advances outstanding within reasonable bounds, and to avoid, as far as practicable, further increases in overdraft limits outstanding." (p.21) "In October, with liquidity rising strongly, the S.R.D. ratio was raised one per cent to 15.8 per cent to support the Bank's policy of monetary restraint."					
March 1965	60	P.R. 9/3	Increases in fixed deposits and lending rates. "Rates are being increased...to support the Reserve Bank's policy of monetary restraint."	-1	-1	-1	10	
	61	P.R. 19/3	Increases in savings bank rates.					
April 1965	62	P.R. 31/3	Reduction in S.R.D. ratio "...Unusually severe impact on the liquidity of both the banks and the public during the next few months... Reduction...would provide only partial liquidity relief for the banks, and emphasized that it did not represent an easing of current Reserve Bank policy of monetary restraint."	0	0	0	10	
May 1965	63	P.R. 4/5	Reduction in S.R.D. ratio. "...This release... would still leave the major part of the drain to be met from resources in the banks' own hands and would therefore not permit any easing of the current monetary restraint."	0	0	0	10	
(1965/66)	64	A.R. 1966	"Throughout 1964/5 bank lending policy had been directed towards limiting the growth in expenditure. In 1965/6 it was considered that...a policy of restraint on bank lending would be appropriate... Banks were requested to continue to exercise restraint in granting new overdraft approvals and, in general, to aim to ensure that cancellations and reductions in existing limits continued at a high level." (p.19)					
	65	E.S. 1966	"With the expected further fall in overseas reserves, monetary liquidity would probably diminish, especially in the second half of the year, but there seemed no need for the time being to ease off the general restraints on bank lending." (p.14)					
December 1965	66	P.R. 3/12	Reduction in S.R.D. of 1%. "There would be fairly substantial reductions in banking liquidity in 1965/66...a programme of reductions of required S.R.D. was therefore envisaged... The Reserve Bank would continue to adjust S.R.D. ratio as necessary to permit the banks to maintain lending at an appropriate rate for the needs of a sound economy."	+1½	+2	+1½	11½	Ease
	66a	A.R. 1966	"From about the December quarter of the year, a declining trend in imports became evident and, with private capital inflow rising to very high levels, the fall in reserves was checked. Domestically, however, with the impact of drought spreading and signs of developing hesitancy in some sections of the economy, policy changes over the year consisted mainly of fairly gentle action designed to relieve sectional weaknesses and provide assurance against an undue slowing of the economic tempo."					

Date	No. and source of statement		Statement	Score 1	Score 2	Scoring	Cumulated Score	Policy Stance
April 1966	67	P.R. 1/4	Reduction of 1.5% in S.R.D. "Present reduction was part of the programme...related to the decline in banking liquidity expected to occur over 1965/66... Further adjustments...would be made as appropriate to permit banks to maintain their lending..."	0	0	0	11½	
	68	P.R. 21/4	S.R.D. reduced by 1%. "...This was a further step in the programme of reductions related to the decline in bank liquidity in 1965/66..."					
August 1966	69	P.R. 16/8	Announcement of reduction in fixed deposit rates.	+1½	+2	+1½	13	
	70	A.R. 1967	"Monetary policy supported (fiscal policy) with a number of measures which provided some modest stimulus early in the year. During the first half of the year stimulus was given by removing existing restraints on bank lending... A number of other changes which were partly technical in character but which would have tended...to provide some further modest stimulus were made... These included a reduction in the rate of interest on fixed deposits." (Also, reduction in government security yields, replenishment of term loan fund, and introduction of personal loans.) (p.4) "In 1965/66 monetary policy had required trading banks to exercise restraint on new lending... These restraints were largely removed during the first half of 1966/67... It was hoped to provide a modest stimulus to expenditure..." (p.7)					
April 1967	71	A.R. 1967	"Early in the final quarter of the year...trading banks were requested to moderate their new lending." (p.8) (Date confirmed in 1968 A.R.) "In the closing months of the year, after new lending had risen considerably and the rate of growth in activity had accelerated, policy became a little restrictive and banks were asked to moderate their new lending." (p.4)	-1	-1	-1	12	Restraint
October 1967	72	A.R. 1968	"...In October 1967 the Reserve Bank eased the modest restraints which it had imposed on bank lending some 6 months earlier." "...The need to slow down bank lending had diminished 8 and in October 1967 the Bank informed the trading banks that new lending could continue at around the levels prevailing over preceding months...banks were asked to maintain a high level of cancellations and reductions of overdraft limits to avoid an excessive increase in unused limits."	+1	+1	+1	13	Ease
July 1968	73	P.R. 26/6	Announced increases in fixed deposit rates. "...These changes were being made in the light of rising tendencies in other market rates over recent months and were designed to maintain the relative attractiveness of bank deposits."	0	0	0	13	
	74	P.R. 10/7	Increase in savings banks deposit rates and lending rates being reviewed.					
	75	A.R. 1968	"Economic developments during the year did not suggest a need for changes in the general level of interest rates... Changes in interest rates were not needed either to stimulate or restrain activity..." (p.28)					
	75a	A.R. 1969	"These measures exerted a milk tightening influence in financial markets, though they were *designed* largely to maintain the attractiveness of banks' liabilities." (p.28)					

Date	No. and source of statement		Statement	Score 1	Score 2	Scoring	Cumulated Score	Policy Stance
October 1968	76	P.R. 11/10	Announced increase in overdraft rates and increase in S.R.D. ratio of 1%. "The action...was designed to bring a cautionary influence to the developing situation, without impeding the underlying growth of the economy."	-3	-3	-3	10	Restraint
	77	E.S. 1969	"To steady down the rate of bank lending and, more generally, to strike a note of caution an additional 1% of deposits was called into S.R.D. in October and November 1968." (p.15)					
	78	A.R. 1969	"In November, trading banks were told that some tapering down in the rate of new lending would be appropriate." (p.5) "Banks were informed also that S.R.D.'s would be administered to maintain restraint on bank liquidity over the year." (p.28)					
August 1969	79	P.R. 31/7	Increase in S.R.D. ratio of 1% and increase in fixed deposits and overdraft rates. "In these circumstances some tightening of monetary policy was desirable. These measures were intended as a further precautionary move against the growth of inflationary trends, whilst not inhibiting the underlying strength of the economy."	-1½	-2	-2	8	
	80	A.R. 1970	"In August...both trading and savings banks were asked to moderate their lending." (p.25)					
March 1970	81	P.R. 6/3	Announcement of ½% p.a. increases in trading bank deposit and lending rates of interest. "Trading banks were experiencing very heavy demand for loans and the increases in lending rates were designed to moderate this demand. The increases in deposit interest rates were considered necessary to maintain competitiveness of fixed deposits."	-2	-2	-2	6	
	82	P.R. 26/3	Increase in savings bank rates.					
	83	A.R. 1970	"By March 1970, with evidence of rising pressures on resources, further measures of restraint were considered necessary." "...the Bank moved to effect some further tightening of financial conditions. Trading bank maximum deposit and lending interest rates were increased in March 1970 by 0.5 per cent and savings bank interest rates were raised in April. Trading banks, whose advances were expanding rapidly, were asked to cut back new lending approvals and to maintain a high rate of cancellation and reduction of overdraft limits. The trading banks were also informed that they could not assume that policy action would be taken by the Bank to relieve their liquidity positions which were becoming very tight." (p.27)					
S eptember 1970	84	A.R. 1971	"By the beginning of 1970¦71 there had already been a considerable cut-back in new lending approvals by the banks following the Reserve Bank's request in March 1970 for restraint and any further reduction did not seem called for. Accordingly, in September the Reserve Bank indicated to the trading banks that while the maintenance of generally tight financial conditions continued to be appropriate and no significant general easing in policy was envisaged, it did not wish the banks to reduce further their rate of new lending and accepted that some moderate rise in new lending from the low levels reached in June/July would be appropriate." (p.33/34)	+1½	+1	+1	7	Ease

Date	No. and source of statement	Statement	Score 1	Score 2	Scoring	Cumulated Score	Policy Stance
April 1971	85 P.R. 14/3	Announcement of reduction in S.R.D. ratio of 0.5 per cent "...the 0.5% reduction in the Statutory Reserve Deposit ratio would provide only partial liquidity relief for banks and that their position would continue to be kept under close review during the remainder of the seasonal run down. He emphasized that, consistent with the Government's anti-inflationary policy, the move did not represent an easing of the current policy of monetary restraint but was rather a technical step designed to avoid unwarranted further tightness developing in banking liquidity and in bank lending."	0	0	0	7	
	86 A.R. 1971	Commentary on Government measures in December 1970 following National Wage Case. "In view of the Government's actions, no further tightening of monetary policy was considered necessary. Nor did further curtailment of trading bank lending seem appropriate; for some time, lending by banks had been restrained and prospects were that their liquidity would continue to be tight. Subsequent disturbances in financial markets and their sobering influence on investor behaviour strengthened the case against additional monetary measures. With the further passage of time it became increasingly apparent that pressures on the banks' liquidity could be such as to cause severe restrictions in their lending and possibly force them to seek central bank loans to satisfy the L.G.S. convention unless action were taken to relieve them. Banks were adhering closely to Reserve Bank lending policy and, accordingly, it was decided in April to reduce the Statutory Reserve Deposit ratio from 9.4 per cent to 8.9 per cent." (p.35)					
October 1971	87 T.I.B. Jan. 1972 p.23	"There was a further significant easing in monetary conditions during the recent December quarter. Private sector liquidity continued to grow very strongly and a number of monetary policy measures were taken to ease financial conditions. In October the major trading banks were advised that there would be no objection to some increase in the level of their lending."	+1½	+2	+1½	8½	
December 1971	88 P.R. 13/12	Announcement of reduction in S.R.D. ratio from 8.9 to 7.1 per cent of deposits (0.8% for Funds and 1.0% general). "The Government has agreed with the Reserve Bank that the present situation no longer required bank lending to remain under official restraint. Banks should feel free to meet the requirements of their customers, subject of course to their normal commercial judgements and to their individual liquidity positions." "Until recently bank lending had been under a policy of firm restraint and as mentioned above, this restraint was now removed. However, ability of banks to lift their lending was also determined by how they saw their liquidity position. To give general support to banks in their lending and to provide a higher level of liquidity ahead than would otherwise have occurred, it was decided to make a significant release of Statutory Reserve Deposits in addition to the amount required to replenish the Term and Farm Development Loan Funds."	+5	+5	+5	13½	
	89 T.I.B. Jan. 1972 p.23	"Following downward pressure on market yields of short-to-medium term securities after the September loan closed, the Government took action to confirm this lower yield structure and to take the movement somewhat further at some points of the rate spectrum in the November Commonwealth loan."					

of policy compared with the prior stance. One scoring was made by the present writer. Mr. R.H. Wallace (Reader in Economics, Flinders University of S.A.) kindly consented to undertake a second and independent scoring. In a majority of cases the scores were identical. Where they differed we argued each case at some length and in some cases arrived at a consensus; where we could not agree the separate scorings were averaged. The results are shown in the Table. The index of policy was then constructed by cumulating the composite scores from an arbitrary starting value of 15 in January 1956.

When constructing the index we were mindful of there being a possibility that, at a later stage and with posterity in mind, the authorities may 'windowdress' their original intentions. Some check upon this is afforded by comparing press releases at the time of the episode and the immediately following annual report with later accounts. Two instances of such window-dressing can be discerned.

As part of the November 1960 measures, trading banks were 'requested' to make a "substantial reduction in the total of outstanding advances between [November 15, 1960] and the end of next March [1961]". After this directive expired, a further press release was issued on April 19 informing the public that "the trading banks had been asked to continue the policy of restraint in lending" and that "releases of funds from S.R.D. would be regulated to support the current restrictive credit policy and would not imply any change in that policy." We suspect that the Bank was not as enthusiastic as the Treasury for either the intensity or the duration of this particular credit squeeze. Certainly the Treasury's stand as at mid 1961 was more blunt:

> "On the view of the situation late in April, both the government and the Reserve Bank left no doubt that they were not at that stage ready to dismantle the main structure of restraint." (Statement 34)

Yet 12 months later, after widespread condemnation of policy's contribution to the severity of the recession, the Treasury stated boldly:

"Credit restraint was eased after March 1961." (Statement 36)

A less blatant example came during the recovery phase of the same cycle. In June 1962 the emphasis of monetary policy had been modified from "active and positive stimulus" to "seek a steadying of the rate of new lending commitments." This stance was confirmed in October 1962. Recovery of the economy was slow and recognition of the tardiness of official policies led to the appointment of the Vernon Committee. Perhaps with these criticisms in mind, the Treasury's economic survey described monetary policy early in 1962/63 as seeking to "encourage bank lending."

In both cases the scoring is based on the earlier statements, and the later assessments ignored. Significantly, it was the Treasury and not the Bank which was responsible for both of the examples.

Many illustrations are provided in the policy statements of the unreliability of the S.R.D. ratio as an indicator of policy intentions. On most occasions, great pains are taken to explain the intention behind the change. For example, in the October 1962 case discussed above, the Bank "recognised that an increase in the S.R.D. ratio could be misinterpreted as a tightening of lending policy and care was taken to make it clear to banks and to the community that this was not the case." When no such explanation is provided, this is taken as evidence that the announcement effect is intended to be a positive change in the policy stance. Indications are also occasionally given in the policy documents that the stance of policy which actually eventuated differed from that which was intended. Increases in bank interest rates in July 1968 appear to be primarily defensive: they "were designed to maintain the relative attractiveness of bank deposits" and "were not needed either to stimulate or restrain activity", and accordingly no change in the stance of policy is recorded. Later the Bank conceded that while not designed as such, they in fact "exerted a mild tightening influence in financial markets."

These examples are suggestive of the index's value in studying the formulation of policy. Before proceeding further with the analysis, two further and more extensive checks were conducted: one comes from savings bank lending, the other from comparing the index with some of the quantitative indicators. In constructing the index, attention was focused upon the general stance of monetary policy and directives to the trading banks and the broad group of intermediaries over which moral suasion is exerted. The savings banks are the largest providers of finance for housing and a close relationship can be observed between their approvals of housing loans and new dwelling commencements. Their lending has a powerful selective effect upon the building industry as well as a general impact through the importance of this industry for the economy. Ceilings imposed upon mortgage interest rates have ensured an excess demand for these loans and the various rationing devices employed by the banks creates a receptive environment for directives.

Details of the lending requests are predominantly given in the annual reports, rather than in public announcements. (Nevertheless, on the basis of the examples cited above, we place much confidence in the veracity of this source.) But even in the annual reports there is less information about the nature of these directives, as compared with those to the trading banks. One reason for this difference is the institutional structure of the savings bank industry. With so much of the business handled by government-owned banks, the Reserve Bank has not found it necessary to use public statements to exert pressure upon them, as has been the case with the predominantly privately-owned trading banks. Further, as the savings banks are dealing with a politically sensitive matter in housing loans, the authorities have probably been reluctant to state publicly that they are squeezing housing. In the absence of explicit policy statements, long comments about the state of the housing industry and the appropriateness or otherwise of the flow of finance probably give some clues as to how the Bank felt about the stance of policy.

Details of the Reserve Bank's requests to the savings banks and their comments about housing finance are set out in the Appendix to this chapter. As assessment of these is given below.

1959/60 The Reserve Bank was concerned at the high level of house construction. We can only guess that the savings banks were asked to curb lending, and such requests would be in line with the index of policy intentions.

1960/61 From "early 1961", "counter-action" was taken to boost housing finance. This occurred some months before the Bank modified the general squeeze, but the response was erratic and generally fell short of the Bank's hopes. Changes in interest differentials which favoured savings banks relative to trading banks support this interpretation.

1961/62 The policy stance was to continue to encourage lending, but the response was disappointing.

1962/63 The level of lending was regarded as being too low throughout calendar 1962, and in February 1963 the government eased savings bank lending terms and also used its direct influence via the Loan Council to boost housing.

1963/64 In August 1963, portfolio regulations on saving bank lending were altered, and this was a clear signal that a high rate of lending was desired. It appears the Bank made an error of judgement because by December 1963 it was referring to pressures in the building industry and using persuasion to dampen lending. The interest change of April 1964 on bank time deposits and the subsequent lesser adjustment of savings bank rates of June 1964 could be regarded as a positive curb.

1964/65 The Bank's position is difficult to interpret. By about the end of calendar 1964 it seems anxious to stimulate house lending even though its overall policy stance was one of tightness. However the statement is worded vaguely.

1965/66 From mid calendar 1965 the savings banks were asked to lift their lending. There was a "discussion" (circa July 1965?) and banks were hopeful of getting lending up. The Bank then "requested" an increase (circa September-October 1965?), and expressed its approval of a "quick" and "effective" response.

1966/67 The Bank continued to urge the savings banks to sustain their housing loans.

1967/68 Again the Bank urges savings banks to at least sustain lending.

1968/69 The hint given in the *previous* year's report of "the prospect of some tightening in the availability of finance ... in 1968/69" is the only suggestion of any reservations about the rate of lending.

1969/70 Throughout most of 1969/70, almost certainly beginnning in August 1969, savings banks were required to reduce their lending, which they did. But building societies tended to fill the gap. When building societies' lending fell markedly around March 1970, the restraints upon savings banks were eased - lifted in May 1970, and then in July 1970 they were clearly and strongly urged to lift their lending.

1970/71 The Bank was pleased with the response to its requests for more loans, but would have welcomed an even bigger response.

1971/72 The Bank again commends the savings banks for their response to requests.

In summary, seven changes in the emphasis of policy towards the savings banks can be identified, and there is a hint of another change at the end of 1964. These dates are set out in Table 5.2, along with the comparable dates of change of the policy index. Some of the differences in dates have been noted in the year by year commentary. In only two of the cases is the divergence wide enough to call the dating provided by the index into question. One is the tentative dating of December 1964, where the Bank's intentions as to savings banks were unclear. The other is the period of restraint of 1968/69. During this fiscal year the Bank appeared to regard housing as about "right" and it did not need to cajole the banks to lend more. This could be seen as a policy change from one of active encouragement to a more passive one of acceptance of existing levels. Given the political difficulties inherent in squeezing housing, it might be interpreted as a period of mild restraint corresponding to the general policy tightening of October 1968.

If we ignore the 1964 episode and rate the August 1969 tightening as part of the general tightening in the same month, there is a close correspondence between the two sets of dates: on average, the difference is less than one half of a month. This is useful collaborative evidence

Table 5.2

A Comparison of the Index of Monetary Policy with Policy Directives to the Savings Banks

Date of announcement	Policy Stance of Directives to the Savings Banks	Comparable date of Index of Policy
Feb. 1961	Positive stimulus	June 1961
Feb. 1963	Positive stimulus	April 1963
Dec. 1963	Mild restraint	Oct. 1963
April/June 1964	Positive restraint	April 1964
Dec. 1964	Mild stimulus?	-
July 1965	Positive stimulus	Dec. 1965
Aug. 1969	Positive restraint	Oct. 1968/Aug. 1969
July 1970	Positive stimulus	Sept. 1970

on the construction of the index of the intended stance of policy, particularly as policy intentions are revealed in some cases by actions taken through the Loan Council under the Commonwealth-State Housing Agreement.

Next we compare the indicator with various quantitative measures of the actual thrust of monetary policy. The purpose here is two-fold: to guard against the possibility that the authorities say one thing and do another; the other to see whether the index can contribute to our knowledge of policy intentions. Table 5.3 gives the simple correlation coefficients between the index and quarterly first differences of measures of monetary aggregates (money stock, base money and potential money) and interest rates (bank advances and yields on long term government bonds). The correlations are with the variables in synchronous terms, and are *not* improved when the indicators are lagged relative to the index. Only potential money and interest rates are significantly correlated with the index, and while these

Table 5.3

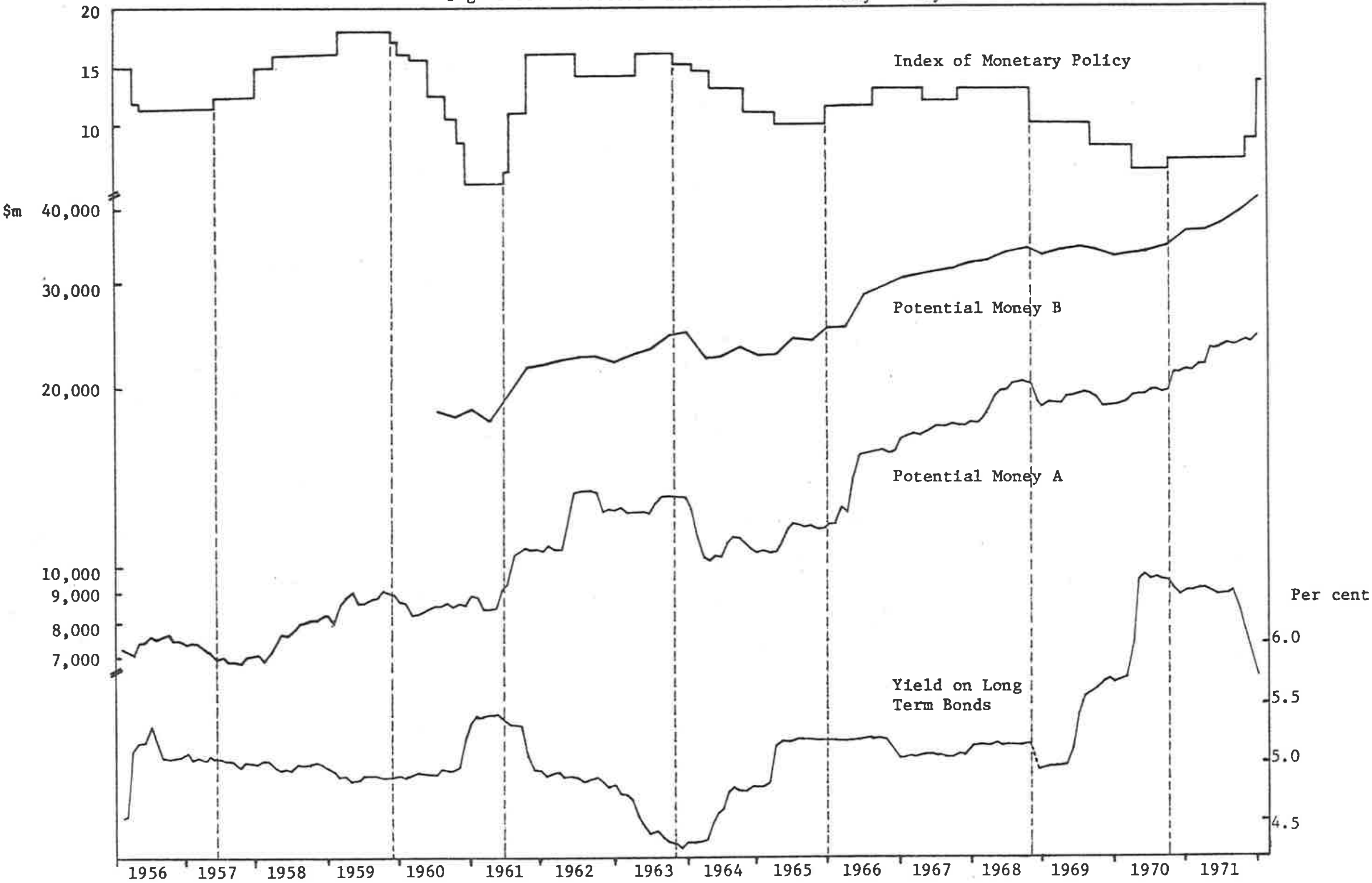
Simple Correlation Coefficients between Index of Policy and First Differences of Various Indicators of Monetary Policy, 1956-1970

Index	M1	M2	M3	Adv.	Base	Interest Rate	Pot. Money	
1.00	.16	-.05	-.03	-.20	.05	-.45	.31	Index
	1.00	.76	.75	.37	.58	-.14	-.07	M1
		1.00	.95	.37	.50	.10	-.08	M2
			1.00	.47	.50	.07	-.08	M3
				1.00	.26	.24	.10	Advances
					1.00	.17	-.55	Base
						1.00	.03	Interest Rate
							1.00	Pot. Money

correlations are not particularly high, they are in the direction which would be expected. That these two indicators are the ones most closely related to the index is hardly surprising in view of our earlier evaluation of the worth of the quantitative indicators.

The reliability of the index is examined further by comparing it visually with the two measures of potential money and long-term bond yields (see Figure 5b). Seven *major* alterations in the stance of policy are identified by the index, and on each occasion the policy changes have been translated fairly rapidly into appropriate variations in potential money and interest rates. This would appear to establish the index's credibility, but there is the further question of whether it provides any 'better' indication than either or both of the other indicators. The three indicators of potential money, interest rates and the policy index provide conflicting signals in 1958, 1959-60, 1966, 1968, and 1970. On the first two occasions the index and potential money are in agreement, both recording first stimulus and then restraint, while interest rates remained unchanged. Indeed, interest rates changed hardly at all during the four years 1957 to 1960, suggesting that in these years they were more of a goal variable than a component of the Bank's stabilisation armoury, and the stance of policy they indicate is unreliable. In 1966, potential money and the index record a switch to an expansion phase, and interest rates were again unchanged. There are hints in the 1967 Annual Report that the Bank wished to allow interest rates to fall to stimulate domestic spending but feared that any reduction, particularly in long rates, might jeopardise the capital account of the balance of payments. The next disparity occurs at the end of 1968. Potential money and the index indicate a switch to restraint, but long term bond yields fell. Interest rates would again appear to provide the faulty signal, for controlled bank interest rates increased

Figure 5b: Selected Indicators of Monetary Policy



and issue yields on Treasury notes rose, the likely explanation for this pattern being the cessation of the issue of tax-rebateable bonds late in 1968. Perhaps the most marked disparity occurred in 1970. On this occasion, the index records a policy tightening and bank and market interest rates rose sharply, yet potential money gives no inkling of such a policy change. Here potential money may provide the incorrect signal. The rise in interest rates stimulated a large inflow of capital funds from overseas and probably prevented the authorities from achieving the control they sought over the monetary base.

It would appear that on each of these occasions the index of policy provides what seems to be the 'correct' indication of the policy stance, insofar as this can be judged from seeing which of the stories corresponds with '*a priori*' information. Our expectation that an index of policy intentions would provide a more reliable and comprehensive representation of policy attitudes would seem to be borne out by this preliminary evidence.

Two other aspects of Figure 5b are noteworthy. The two alternative measures of potential money do nothing to resolve the issue of whether a cash based or liquid asset based indicator is the relevant one for Australia. Conventional wisdom, as exemplified by the Bank and the majority of Australian economists, have assumed that cash, Treasury notes and other Commonwealth government securities are perfectly substitutable so that the relevant constraint is total L.G.S. assets. Dewald and the present writer (with R.H. Wallace) have argued that the composition of L.G.S. assets is important, and that the margin of cash imposes a further constraint.[1] As both measures appear to give identical signals, the choice between them may not be as

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1 The issues are discussed by Dewald (1968), Stanford (1968) and Lewis and Wallace (1973a and 1973b).

important as the participants suggest. Secondly, there is considerable agreement between interest rates and the potential money measures. The central bank is frequently characterized in 'monetarist' or 'Keynesian' terms as rigidly setting *either* the rate of monetary growth *or* the structure of interest rates (as is assumed in studies of the demand for money). We argued in chapter 3 that the Reserve Bank had sought to adopt a composite strategy, and the data in the figure provide some evidence of this.

Appendix to Chapter 5

Statements on Directives to Savings Banks, 1956-1972

1956-1959		Commonwealth Bank Reports give no information about savings bank lending.
1960	p. 4.	"The demand for new dwellings is particularly buoyant."
	p.15.	"The additional finance available from banks and other lending institutions was a major factor in the high rate of dwelling construction."
1961	p. 4.	... home-building ... on the basis of an exceptionally favourable combination of supplies had been operating at a level considerably higher than was warranted by long term demand considerations. (It) ... reacted sharply *early in 1961* to lower levels than these considerations would warrant. *Official action was taken progressively to counter the reduction in the supply of home-building finance* and so increase the level of housing construction.
	p. 5.	... following the official moves towards the end of 1960 (calendar) ... a degree of slackness appeared *early in 1961* ... (and) "*counter action was taken ... the banks gave special consideration to the maintenance of the flow of housing finance* ... As the second half of the year (1960/61) proceeded an increased flow of housing finance both from traditional lenders and from official sources, went some way towards cushioning the fall in home-building..."
1962	p.12.	... private expenditure on new dwellings after falling steadily (in the first nine months, January - September, 1961) increased slowly (in the first six months of 1962) ... Special measures were taken ... the Commonwealth Government gave substantial assistance under the Commonwealth-State Housing Agreement ... and *the banks endeavoured to maintain the flow of housing finance*. Expenditure was slow to respond to these measures and in February (1962) the Loan Council approved an increase in the borrowing programme to housing finance. *At the same time several important* lenders increased their maximum loans ... signs of recovery (in housing actively in the first six months, January - June, 1962).
1963	pp.19-20	"Savings bank deposits increased by a record amount ... (so) had more funds available for investment ... New lending approvals ... almost double the 1961/62 figure ... *Savings banks continued to consult regularly with the Reserve Bank about their investment and lending policies*." (Note: first reference in reports of 'consulting').
	p. 4.	"In February (1963), (increased public authority spending) including allocations for housing finance. *From about this time more institutional finance was also made available for housing.*

p.12. "Largely as a result of greatly increased lending by savings banks, ... finance ... for new housing increased in 1962/63. Individual loan limits of savings banks were increased as well as the total amount of funds provided."

1964 p.15. By the middle of 1963/4 (that is, at the end of calendar 1963) "Increased lending by savings banks, the predominant suppliers of finance for new housing, had contributed greatly to the increased demand ... but in the short and long term interests of the building industry it was important that sharp fluctuations in the rate of lending for housing be avoided. Earlier in the year the Government had modified savings bank regulations (August 1963) to *provide for the continuation of a steady rate of increase* in housing finance. *From around the end of 1963, the Bank in its consultations with savings banks emphasized the desirability of gearing lending to long run expectations of growth in depositors' balances and to the capacity of the industry.*"

p.15. "By the middle of 1963/64 (that is, December 1963) ... most components of expenditure were accelerating and ... in particular the building industry was already operating close to capacity."

p.19. "New lending approvals (of savings banks) increased sharply in 1963/64. As the year progressed the Bank ... emphasized (to the savings banks) the importance of a steady rate of growth ..."

p.19. "At the time of the increase in trading bank rates early in April 1964 the Bank consulted the savings banks ... (who) increased their deposit rates by ¼% on June 1st, 1964 ..." (Note: the trading deposit rate went up by ½%, whereas savings bank rate went up by ¼%).
Note also the space given to savings banks, together with large diagrams showing the spectacular increase in housing approvals during 1963/4.

1965 p.11. "The increase in savings bank loans was about the same as in 1963/64 but the rise in their deposits was smaller."

p.13. "After increasing strongly (in 1963/64) the flow of housing funds from the main institutions showed a much smaller rise in 1964/65. Loans approved for new housing by these institutions were approximately the same ... as in 1963/64. Building society lending increased again ... but the rate of loan approvals by savings banks to individuals for new housing declined particularly towards the end of the year .... Loan approvals to existing houses ... particular (by) the savings banks ... appear to have risen further in 1964/65.

p.18. "The primary task ... in 1964/65 ... was to support other aspects of ... policy in restraining the growth of expenditure ... A wide range of measures was used to this end, including actions on trading bank liquidity, *directions to the trading banks on lending policy, consultations with the savings banks* and discussions with other groups."

p.23. "In the aggregate, the level of lending ... by savings banks appeared adequate ... in relation to the capacity of the industry and the pressure on its resources. In its consultations with the savings banks the ... Bank sought to ensure that their lending ... remained consistent with the longer term growth of their deposits."
(Note: again large section of graphs showing new loans approved in 1964/65 are about the same as in 1963/64. It really is very difficult to sort out what the Report means.)

1966 p. 8. "In 1964/65 ... (there was) a continued fall in house commencements, ... and during the first half of 1965/66 ... there was a *substantial decline* in total dwelling commencements. Following policy action to increase the availability of funds for housing this downward trend was checked ..."

p.14. "Housing loan approvals by savings banks which normally account for something approaching half of total institutional lending ... rose by $26 m .. Most of this increase occured in the *second half of the year* in *response* to the ... Bank's request for a higher level of housing lending ... Aggregate finance approvals for new housing by major lenders rose by about 1 per cent ... Savings bank lending for new housing showed a significant rise but some other groups showed decreases."

p.15. "*Early in 1965/66*, when evidence of slowing down in housing activity was accumulating, *the Bank had discussions* with the savings banks ... (who) expressed *confidence* that despite a lower rate of growth in deposits, they would be able to maintain a high level of ... approvals. However, housing commencements continued to decline ... the Bank later *requested* the savings banks to lift their rates of ... lending and the Commonwealth Government made a supplementary allocation under the ... Housing Agreements."

p.21. ... "*the savings banks responded quickly and effectively to this request* ..."

p.22. ... "It is appropriate that the savings banks ... should from time to time help to offset temporary shortfalls in the overall availability of housing finance..."

1967 p. 4. ... "The general tone of policy for 1966/7 was ... an expansionary fiscal policy ... Monetary policy supported this ... During the first half of the year (that is, July - December, 1966) ... existing restraints on (trading) bank lending (were removed) ... and savings banks (were requested) to at least maintain their earlier high level of lending for housing."

p. 8. "To ensure that a level of finance was available for housing, the Bank ... requested the savings banks to continue their aggregate housing loan approvals at a rate not less than in the six months to June 1966."
(Note: 1968 Annual Report, p.21, shows that the savings banks just achieved this target).

pp.12-13 The tone of a lengthy statement on p.12 is that in the period July - December 1965 housing loans were lifted to levels desired by the Bank, and that throughout calendar 1966 and the first half of calendar 1967 the level of lending was certainly not regarded as being too high, and that the Reserve Bank would prefer it to be higher.

p.28. "The Reserve Bank *suggested* to savings banks in September 1966 that it was desirable for ... approvals to continue at a rate not less than the average rate ... in the six months to June 1966 ... In the event loan approvals exceeded this rate in every quarter of the year (1966/67).

p.23. "Two developments during the year (1966/67) tended to to increase the competitiveness of savings bank deposits." (These were change in trading bank/savings bank interest rates and raising the interest bearing limits.)

1968 p.10. "Expenditure on dwellings had been the only component of private fixed investment to show strength in 1966/67 and it continued to grow strongly during 1967/68 ... with the prospect of some tightening in the availability of finance ... the rate of growth of expenditure on dwellings could moderate a little in 1968/69. The steady advance ... in 1967/68 was *supported* by the ready availability of housing finance ... Savings banks were mainly responsible for the increase (of housing finance in 1967/68 over 1966/67).

p.21. "With the continuing strong demand for finance and *no signs of pressure on resources in home-building*, the Reserve Bank *informed* savings banks in October 1967 that it was appropriate ... to continue at least at the levels of the previous six months.."
(Graph shows the rate of approvals in 1967/68 was up on 1966/67, and the tone of the report is of satisfaction.)

p.27. "To meet the strong demand for housing finance and to employ available resources in the building industry the Reserve Bank in October 1967 suggested ... that it would be appropriate ... to continue ... approvals at least at the level of the preceding six months."

1969 p. 5. "... despite a high rate of new lending the rate of growth in outstanding loans over the year was slightly less than in 1967/68."

p.13. "Private dwelling commencements totalled about 123,300 in 1968/69 compared with 108,600 in 1967/68 ... with a further increase in lending ... by major financial institutions, finance was available to allow the expansion."

p.23. "The high level of expenditure on housing ... was reflected in a strong growth in the rate of new approvals by savings banks ... Other loans by savings banks grew more slowly."

1970 p. 2. ... "Spending on dwellings ... increased particularly strongly; housing commencements however slackened considerably towards the end of the year.."

p. 4. "Up to early 1970, financial conditions had been generally easy ... Savings bank lending approvals had been maintained at a rate about the same as in the second half 1968/69 ... New loans .. by .. building societies increased rapidly and, in the second quarter of 1969/70, approached the level of savings bank lending for housing.." "In the latter part of (1969/70) ... loan approvals by the ... societies ... fell markedly."

p.19. "... from April 1970, savings banks could increase the rates charged on their loans (for housing)."
"Demand for housing finance was strong during the year and savings banks continued to be a major source of finance. With pressures increasing on resources in the building industry, banks *responded* to *official requests* - which were in effect until May 1970 - to limit their rate of new lending for housing to about the same rate as in the second half of 1969/70. There was ... some fall in ... their approvals by the second half of 1969/70; this reflected the changed trend in their depositors' balances, and *for some banks, concern about their narrowing margin above the required 65 per cent rates* ..." .. Around the end of 1969/70 (July 1970), savings banks were informed that there was scope for increasing their rate of new lending ... They were asked to consider adding significantly to their allocations for housing lending over the following few months..."

p.25. "In August (1969) ... both trading banks and savings banks were asked to moderate their lending."

p.48. Under public statements (July 23, 1970) the directive of savings banks to "substantially increase" their lending over the next few months is set out.

1971 pp.12-13 "Expenditure on dwellings was fairly subdued throughout 1970/71 ... commencements of private dwellings ... fell by about 6 per cent. In the (three quarters September 1970 - June 1971) the rate of commencements was somewhat higher reflecting increased availability of funds from savings banks and ... building societies, but did not regain the levels achieved towards the end of 1969.

p.28. "Around the end of 1969/70 savings banks had been asked to consider adding significantly to their lending for housing ... their response is indicated by the increase of 25 per cent in their approvals ... in the September quarter; this rate ... was maintained in the December quarter. A change announced in October 1970 ... removed a potential constraint on lending for housing ...

p.30. "Some savings banks were beginning to feel constrained by the 65 per cent requirement."
N.B. The 1970 report speaks of savings banks having regard to the 65 per cent regulation.

1972 p.16. "During 1970/71 only the dwellings component of private investment had failed to grow strongly; in the past year (1971/72) this item recovered quite strongly..."

p.17. "... dwellings grew in 1971/72 by ... about 4 per cent in real terms as against a fall of 2 per cent in 1970/71. The growth ... was aided by ready availability of finance from the major lenders..."

p.34. "Facilitated by the strong growth in deposits and by the change announced in October 1970 ... savings bank lending for housing grew particularly strongly ... New approvals were 18 per cent higher than in 1970/71 and more than 40 per cent higher than in 1969/70."

Chapter 6

Empirical Estimates of the Inside Lag

Introduction

In chapter 2, the inside lag of monetary policy was defined as the time which elapses between the need for action and the subsequent alteration of policy stance, and subdivided into a recognition lag and an action lag. This division accounts for *why* a lag should exist but has little empirical content, for the information which would be required to distinguish one from the other is not available. On the one hand, we do not have any inside knowledge pertaining to the date when the need for action was first recognized. Our index of intended policy relates to variations in the publicly announced (or subsequently indicated) policy stance, many of which accompany policy actions. On the other hand, we have been unable to select a reliable overall indicator of policy actions. Hence to the best of our knowledge the estimates provided here relate to the sum of the recognition and action lags.

Some of the overseas studies, for example Kareken and Solow (1963), Brunner and Meltzer (1964) and Selby (1968), make the assumption that the action lag is negligible, so that the inside lag measured by them is essentially a recognition lag alone. They argue that the central bank has the power to act when the need to do so is recognized, but in Australia the Reserve Bank does not possess such unilateral authority. The Treasury has the final say about monetary policy, and certain policy actions, for example those involving changes in bank interest rates, cannot be implemented without the Treasurer's permission. Policy action may be delayed to avoid hampering the Treasury's debt operations, while increases in the S.R.D. ratio have rarely been affected during the months of seasonal run down in the economy when banks' liquidity is low. The action lag could be of substantial length. Equally, it could be short, for the Governor of the Bank and the Secretary to the Treasury meet informally at least once a week, and the formal consultative arrangements could be bypassed if necessary. Indeed, one of the chief appeals of monetary policy is the ability to take quick action if required. Thus it is difficult to reach any conclusion in advance about the length of the action lag.

As the first step towards rendering the concept of the inside lag operational, we constructed our preferred indicator of the stance of monetary policy. What is needed now is to develop measures of the need for policy action and to determine the method of measuring the lags.

Table 6.1 summarizes relevant features of the existing studies of the inside lag of monetary policy. They are divided into two groups. Of the 15 studies, eleven use what we term the 'multivariate regression method', by which various indicators of monetary policy are regressed against a set of possible goal variables, incorporating an appropriate lag schema. No attempt is made to determine in advance the relative importance, if any, of the policy objectives. Rather the authorities true preferences are 'revealed' by the behaviour of the policy variables (indicators) in the light of the movements of the goal variables. Under this method, all of the goal variables which feature in the central bank's preference function jointly define the need for action and the lag structure provides an estimate of the average inside lag over the period studied.

The alternative method, referred to as the 'direct observation method', seeks to short cut the problems involved in selecting and weighting the various objectives of policy. In the absence of detailed knowledge of the minds of the policy-makers, comprehensive measures such as the upswings and downswings of the general business cycle, the industrial production index, or the unemployment rate are used as proxies for the need for action on the

Table 6.1

Summary of Studies Measuring the Inside Lag of Monetary Policy

Study	Data	Measures of need for action	Measures of monetary policy	Estimates of lags	Special Comments
		(a) Direct Observation Method			
Kareken and Solow (1963)	U.S., 1951-1960 monthly	(i) N.B.E.R. turning points (ii) Turning points in F.R.B. Index of Industrial Production (iii) Turning points in unemployment rate	Maximum earning assets of commercial banks	Visual dating (i) 8.5 mo peaks; 3.0 mo troughs (ii) 8.0 mo peaks; 3.0 mo troughs (iii) 10.0 mo peaks; 0.5 mo troughs	Assumes 'action' lag is zero. Lags of similar length were found for the period 1947-50
Brunner and Meltzer (1964)	U.S., 1947-1960	N.B.E.R. turning points	Changes in policy stance based on policy statements in annual reports	Turning points 0 mo at peaks, 4 mo at troughs	Assumes action lag is zero
Willes (1967)	U.S., 1952-1960	N.B.E.R. turning points	Policy stance based on F.O.M.C. minutes	Turning points 3.7 mo at peaks, 3 mo at troughs	Examines action lag as well
Selby (1968)	U.S., 1953-1958	N.B.E.R. turning points	Policy stance based on F.O.M.C. minutes	Turning points 2.5 mo at peaks, 2.8 mo at troughs	Assumes action lag is zero
Uchihashi, Machinaga and Kodera (1968)	Japan, 1955-1966 quarterly	(i) Private fixed capital formation (ii) Total supply of industrial funds (iii) Imports (iv) Gold and foreign exchange holdings	Changes in policy direction based on rediscount rate of commercial bills, and required reserve ratio	Visual dating of monetary tightenings (i) 6 months (ii) no dating revealed (iii) 8.3 months (iv) no dating revealed	Total supply of industrial funds is irregular, and not a good indicator. No relationship between gold and foreign exchange and the timing of monetary policy is revealed.
		(b) Multi-variate regression method			
Reuber (1962)	Canada, 1949-1961 quarterly	Unemployment rate C.P.I., implicit G.N.E. index (levels) Manufacturing production Index of output per man-hour	Money supply Net Cash Reserves of commercial banks Treasury bill rate	For the money supply, the Koyck lag indicated 11 per cent of effect in 1st quarter and 90 per cent completed in 20 quarters. The Pascal distribution showed 22 per cent in 1st quarter, and 3 quarters for 90 per cent of effect. For reserves, 18 per cent in 1st quarter and 12 quarters for 90 per cent of effect.	No relationship between the Treasury bill rate and policy objectives was revealed. Indicators of the balance of payments objective were omitted due to existence of flexible exchange rate.

Table 6.1 *continued*

Study	Data	Measures of need for action	Measures of monetary policy	Estimates of lag	Special comments
		(b) Multi-variate regression method (continued)			
Dewald and Johnson (1963)	U.S., 1952-1961 quarterly	Unemployment rate C.P.I. (levels) real G.N.P. U.S. gold sales, plus increase in short-term liabilities	Money supply, M1 and M2 Free reserves Treasury bill rate, and long-term bond rate	The shortest lags are with the interest rate series, where about 50 per cent of the effect occurs by the end of the 1st quarter, and by the end of 3 quarters for 90 per cent of the effect. The longest lags are with the money supply, where 8 quarters elapse for 90 per cent of the effect to occur.	
Havrilesky (1967)	U.S., 1952-1965 quarterly	Unemployment rate WPI, squared deviation from goal (level) Current A/C deficit Overseas bond rates G.N.P. in nominal terms	Total reserves, adjusted for legal reserve requirements	No inside lag is allowed for, other than the one quarter time period.	G.N.P. in nominal terms allows for transactions demand for money. Overseas bond rates proxies for foreign activity. The WPI 'goal' level was 92 for 1952-57, and 100 for 1958-65.
Wood (1967)	U.S., 1952-1963 quarterly	Unemployment rate G.N.P. Balance of trade in goods and services Industrial materials index (levels)	Federal Reserve Bank's portfolio of Government Securities	No inside lag is provided for beyond the one quarter time period.	Allowance is made for 'defensive' policies as well as 'offensive' actions. Target values of unemployment, G.N.P. and the balance of payments are included in the regressions.
Fisher (1968)	U.K., 1951-1964 quarterly	Employment: vacancies, nos. employed, per cent unemployed. C.P.I. (levels) Gold and foreign exchange holdings Consumption, deflated	Bank rate, bill rate, one year govt. rate, consol rate. M1, M2, Bank deposits (current and total) Liquid assets, liquid assets ratio. Bill supply outstanding.	The lags with the bank rate and the liquid assets ratio are the shortest, with 52 and 45 per cent of effect in 1st quarter. The longest lags are with the consol rate and the money supply, with 14 and 10 per cent of effect in the initial quarter.	Use of consumption data to measure.

Table 6.1 *continued*

Study	Data	Measures of need for action	Measures of monetary policy	Estimates of lag	Special comments
(b) Multi-variate regression method (continued)					
Fisher (1970)	U.K., 1955-1968 quarterly	Unemployment rate C.P.I. (levels) Gold and foreign exchange Growth rate of G.D.P.	Bank rate, bill rate, consol rate Special deposits Liquid assets ratio Hire purchase controls	The shortest lags are with the Bank rate, where 55 per cent of the effect occurs in the initial quarter, and 2 quarters for 90 per cent. The longest lags are with Special deposits, and 9 per cent occurs in the initial quarter.	
Pissarides (1972)	U.K., 1955-1969 quarterly	Unemployment rate Price index (consumption deflator) - levels Foreign reserves	Bank rate Per cent down payment on cars (H.P.) Income and expenditure taxes (discretionary changes as per cent of G.D.P.)	On average, about 40 per cent of the adjustment occurs in the initial quarter.	Lagged dependent term is related to the desired value of the instrument. Fiscal policy instruments included in study.
Villanueva (1972)	Belgium, 1957-1968 quarterly	Unemployment rate Gold and foreign currencies Domestic prices (rate of change) Wage index (rate of change) Industrial production (rate of change)	Discount rate	17 per cent of the adjustment occurs after 1 quarter, and after 5 quarters the adjustment is 90 per cent complete.	
Friedlaender (1973)	U.S., 1954-1964 quarterly	Of the form y=Y-Y* where Y_1 = unemployment rate Y_1* = 4.0 per cent Y_2 = GNP Y_2* = potential GNP Y_3 = GNP deflator Y_3* = 2 per cent growth rate Y_4 = Treasuring bill rate Y_4* = Y_4-1 Y_5 = Balance of trade Y_5* = Y_{5-1} Y_6 = Govt surplus or deficit Y_6* = Projected surplus or deficit	Of the form x=X-X* where X_1 = net free reserves X_1* = target values of FOMC X_2 = Govt expenditure X_2* = X_{2-1} X_3 = personal tax rate X_3* = projected rate X_4 = corporate tax rate X_4* = projected rate	Adjustment is assumed to occur within the period of observation	Data in deviation form. Inclusion of dummy variables for change of govt. administration. Many of the individual variables have insignificant coefficients
Jonson (1973)	Aust, 1959-1971 quarterly	Vacancies/Unemployed. Gold and foreign exchange holdings. C.P.I. (levels)	Govt. bond rate (10 years). S.R.D. ratio Govt. expenditure (Commonwealth govt) Weighted sum of 5 tax rates	For the bond rate, 32 per cent occurs in the initial quarter, and after 6 quarters, the adjustment is 90 per cent completed. For the SRD ratio, 73 per cent occurs by the end of the initial quarter.	Joint stability of the 'package' of fiscal and monetary measures is examined.

Table 6.1 *continued*

Study	Data	Measures of need for action	Measure of monetary policy	Estimates of lag	Special comments
			(b) Multi-variate regression method (continued)		
Hosek (1975)	U.S., 1952-1971 quarterly	Unemployment rate W.P.I. (levels)	Total reserves, free reserves. Money supply. Bank credit.	The fastest adjustment is for free reserves, with only 25 per cent in the initial quarter. The initial effect for bank credit and total reserves is 15 and 5 per cent respectively.	Allowance is made for 'defensive' policies in the regressions. The coefficient on the lagged term exceeds unity in the case of the money supply.

grounds that they *must* figure in policy deliberations. These are then compared visually with measures of monetary policy to estimate the inside lag.

Of the two approaches, the regression method accords more closely with the theoretical framework outlined in chapter 2. However, no distinction is made in the regressions between major and minor movements in policy. The episode by episode approach of the direct observation method focuses attention on the major swings in policy, and also permits a ready assessment of whether the lag differs as between periods of tight or expansionary policy. Both methods thus have their merits, and are used in this study. We begin with the direct observation approach.

Direct Observation Method

Two steps are necessary to define the need for policy action under this approach. First, we must select a proxy which will adequately represent the policy-makers' concern about the state of the economy. Secondly, a 'decision rule' concerning the policy response to this proxy needs to be formulated.

The proxy employed here is the phase chronology of general business activity, as used in the four U.S. studies of the inside lag. Five studies have replicated for Australia the reference cycle approach as developed by the National Bureau of Economic Research in the U.S.; these are Mallyon (1966), Waterman (1967 and 1972), Bush and Cohen (1968), Beck, Bush and Hayes (1973) and Haywood (1973). There is disagreement about some of the dates selected, ambiguity about the appropriate treatment of particular cyclical episodes, and only two of the studies cover the 1970-72 period. In order to provide additional evidence on these matters and thus establish some basis for making a selection among these dates, we have examined 10 selected series in detail. The series selected and the reference dates they indicate are discussed in detail in chapter 12. At this juncture we use the final reference dates selected, with little further comment.

Despite the widespread employment of reference phases in other studies of the inside lag, some justification for their use is warranted, for the concern of policy would seem to be the alleviation of unemployment and inflation and not the moderation of business cycles. Even if unemployment is the sole concern of the authorities, their lack of knowledge about future employment trends may lead them to peruse a wide range of economic time series for evidence collaborating the behaviour of the employment series. They will "look at everything", particularly indicators which provide a reliable representation of the business cycle, for in Australia movements in employment and vacancies closely trace out the course of the cycle (with the notable exception of the 1957/58 episode). It is instructive that three of the five studies of the Australian reference cycle emanate from the Reserve Bank's research department.

The simplest decision rule relates to the peaks and troughs of the reference cycle, with a need for a reversal in the emphasis of policy occurring whenever there is a cyclical turning point in the economy. A rationale for this rule is as follows. Let cyclical fluctuations in the absence of policy be represented by y which follows the path of a pure sine wave of the form

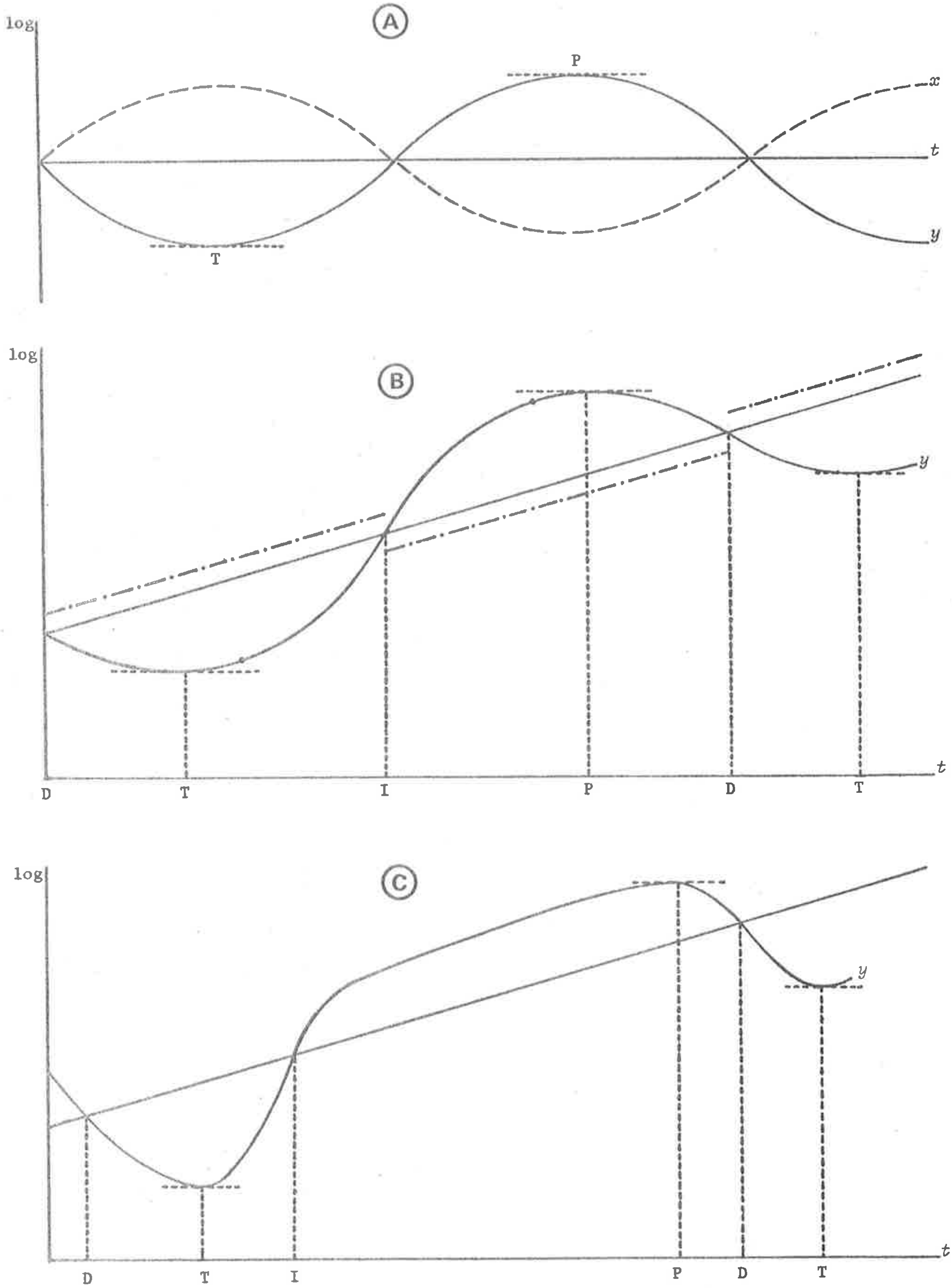
$$y = a \sin wt \qquad (6\text{-}1)$$

where $a > 0$, $w > 0$, illustrated in panel A of figure 6a. The course of monetary policy is denoted by x. If monetary policy seeks to ameliorate the fluctuations in the economy, the appropriate response for x is of the form

$$x = -b \sin wt \qquad (6\text{-}2)$$

Figure 6a

Diagramatic Representation of Policy and Non-Policy Behaviour



as illustrated in the figure. A peak in business activity signals the need for a switch of policy from tightness to ease, and vice versa for a business trough.

One difficulty with this decision rule is immediately apparent. In the example above, the need for policy is defined in terms of the unobservable magnitude of business activity in the absence of policy. The general reference cycle measures we employ include the policy injections. The difficulty can be illustrated by letting x denote the impact of monetary policy upon business activity (income). Where policy is perfectly successful in stabilizing income, i.e. $b = a$, the business cycle is eliminated completely, and comparing the stance of policy with the cycle in business activity will be incorrect. The comparison will also be incorrect where policy moderates the fluctuation by generating an opposite cycle with an amplitude less than the original one ($a < b < 2a$). Our criterion remains valid if it is assumed that policy injections, when they are in the right direction, are not overdone ($b < a$). Alternatively, the policy injection may be perverse and increase the amplitude of the fluctuation. In these cases, income including the policy injection moves in the same direction as income in the absence of the policy influence.

The decision rule also assumes the intermediate and outside lags to be of zero length. Allowing for their existence brings forward the true date of the need to change the stance of policy. In the case of a fixed time lag of Z units of time, the reversal of policy should precede the cyclical turning points by Z time units, i.e.

$$x = -b \sin w(t-Z) \qquad b < a \qquad (6\text{-}2a)$$

No such simplicity exists when the intermediate or the outside lag are distributed over time.

Estimates of the inside lag as marked out by turning points in the reference cycle are given in Table 6.2. The decision rule calls for matching reversals in the stance of monetary policy; these phases were shown in Figure 5b. Ambiguity surrounds three of the policy datings. In the last phase of expansionary policy there is a minor policy change in September 1970 followed by a more significant expansion beginning October 1971. We have used the earlier date. Prior to the periods of restrictive policy which we have dated from October 1963 and October 1968 there were restrictive moves announced in June 1962 and April 1967, but subsequently reversed. These have been ignored, but had they been used the inside lag for restrictive policy inception would have averaged 12 months, the same as for expansionary policy changes. Some ambiguity surrounds the 1956-1958 period. Although we identify a trough in 1956 and a subsequent peak in October 1957 for general business activity in addition to the peak in 1955 and trough in 1958, no such additional cycle is evident for the phases of monetary policy. In constructing the Table, the policy easing commencing in May 1957 was matched with the business peak of August 1955. Had it been matched up with the minor peak of 1957, the inside lag would have been -5 months for this episode, and the mean lag for expansionary policy reduced to 4½ months.

Notwithstanding these possible amendments to the calculations, it would seem that on the criterion used, the inside lag is considerably longer in Australia than in the U.S., and greater for the switch to restrictive than to expansionary policy. The latter is not surprising. Consider the state of the economy immediately following the trough of 1961. According to the turning point rule, a period of restrictive monetary policy should have been instituted from August 1961, when the unemployment rate was 2.8 per cent. Twelve months later the unemployment rate was 2.1 per cent, still well above normal. Monetary policy is concerned with the levels as well as the cyclical

Table 6.2

Lag of Monetary Policy Changes behind Reference Cycle Turning Points, 1955-1970

(No. of months)

Date of Turning points	Lag behind cyclical turning points: Expansionary policy	Lag behind cyclical turning points: Restrictive policy
Aug. 1955	21	
July 1956		n.a.
Oct. 1957	n.a.	
Sept. 1958		14
Sept. 1960	9	
Aug. 1961		27
April 1965	8	
April 1966		30
March 1970	6	
Mean	11	23

changes in the goal variables.

There would be general agreement that conditions of ease should continue, or at least restrictive policy be deferred, as long as the economy remains depressed. Conversely, it might be argued that policy tightness should be continued after a peak as long as conditions remain inflationary. Accordingly, an alternative 'rule' would be to have monetary policy restrictive when economic conditions are above normal and expansionary when conditions are below normal.

Suppose that income in the absence of policy, i.e. y, continues to take on the form of a sine wave but that this occurs around a trend, viz.

$$y = ct + a \sin wt \qquad (6\text{-}3)$$

where $c > 0$ gives the slope of the linear trend, illustrated in panel B. Use of a curve such as in B rather than the trendless variant as in A, to date business cycles results in short downswing phases relative to the upswing phases - a characteristic of post war reference cycles. Now suppose further that the trend line traces out the normal growth path sought by policy. The points where y crosses the trend are called, following Waterman, the points of inflation (I) and deflation (D). Periods of above normal activity are indicated by the phase I-D and the phase D-I indicates periods of depressed activity.

One measure of above and below normal activity draws upon a convenient feature of the curve in B. It can be shown that the points where y crosses the trend are mid way between the cyclical turning points, P and T. The mid points of the expansionary and contractionary phases serve as our first measure. Where the cycles fail to exhibit the smooth regularity of those in B, this method is inappropriate. Evans (1969) argues that the typical shape of business cycles since the mid-nineteenth century is as in panel C, where the cycle is marked by a substantial period where it grows at the same rate as the trend and has little curvature. Theoretical models involving ratchets and upper ceilings have been advanced to explain a cycle of this shape. Obviously mid-expansion and mid-contraction points no longer coincide with the points of inflation and deflation.

An alternative, and more laborious, method of dating the inflation-deflation points follows the studies by Waterman, Haywood and the O.E.C.D. As part of a study of Australian business cycles, Waterman fitted linear and quadratic trends by regression methods to all of the 36 series he examined, using these to obtain average I, D points for the whole economy. Haywood fitted moving averages to his series to identify what he terms periods of expansion and contraction, which correspond to the I-D and D-I phases of our terminology. The O.E.C.D. study (1973) identifies periods of above and below average resource utilization in Australia from series of actual and potential G.N.P. Unfortunately Waterman's series terminate in 1964, and there are large discrepancies between the dates for the 1960's. In order to clarify the dating, we replicate Waterman's study using the 10 series selected for reference cycle dating. Log-linear and second-order log quadratic trends were fitted by regression to each of the 10 series and the choice between these alternative specifications was made by visual inspection. The curves selected and the dates so obtained are set out in Table 6.3, along with the dates from the other studies.

Of the four sets of datings, those of the 10 selected series are preferred. These match closely with Waterman's for the first four cyclical episodes, and lie between the dates given by Haywood and the O.E.C.D. studies for the fifth episode. Inspection of the series for the I_6 point reveals that only the import series records a point of inflation after July 1968, that is, well before O.E.C.D. and Haywood indicate the period of above-average

Table 6.3

Specific Cycle Reference Points for Australia

Indicators of Business activity	Type of trend curves fitted	I_1	D_1	I_2	D_2	I_3	D_3	I_4	D_4	I_5	D_5	I_6
Waterman series	log-linear and quadratic	Nov 49	Mar 52	Apr 54	Mar 56	Feb 57	Nov 57	Aug 59	Mar 61	(Nov 62)	n.a.	n.a.
Haywood series	moving averages	n.a.	Mar 52	Mar 54	Jul 56	-	-	Apr 59	Feb 61	Jan 64	Nov 65	Jan 69
O.E.C.D. series	log-linear	n.a.	n.a.	n.a.	Jun 56	Dec 56	Sep 57	Jun 59	Dec 60	Jun 63	Mar 66	(Sep 68)
Selected series												
Real G.D.P.	log-linear	-	Jan 52	Aug 53	Apr 56	Nov 56	Aug 57	Aug 59	Feb 61	Nov 63	Nov 65	May 68
A.N.Z. Index	log-linear	Sep 49	Feb 52	Mar 54	Feb 56	Oct 56	Jun 57	Dec 58	Feb 61	Jan 64	Jan 66	Jul 68
Male Vacancies	log-quadratic	Apr 48	Jun 52	Mar 54	Aug 56	-	-	Jan 60	Jan 61	Oct 63	(May 67)	-
Male Applicants	log-quadratic	Sep 49	May 52	Feb 54	Aug 56	-	-	Mar 60	Jan 61	Dec 63	Sep 66	Mar 68
Brick Production	log-linear	May 48	May 52	Aug 53	Jan 56	-	-	Jun 59	Mar 61	Sep 63	(Dec 66)	Dec 67
Imports	log-linear	Jun 50	Jul 52	Mar 54	Jun 56	-	-	Dec 59	Apr 61	Feb 64	Apr 66	Jul 69
G.F.E.	log-linear	Nov 49	Jan 52	Mar 53	Jan 55	Apr 57	Apr 58	-	-	Jan 63	(Jan 67)	-
Share Prices	log-linear	Nov 49	Feb 52	-	-	-	-	Apr 59	-	Oct 62	Mar 65	Jul 67
Bank Debits	log-quadratic	Jan 50	Sep 52	Mar 54	Apr 56	Oct 56	Aug 57	Jul 59	Mar 61	Sep 63	Aug 65	Dec 67
Bank Clearings	log-linear	Nov 49	Sep 52	Sep 53	Feb 56	-	-	Feb 60	Feb 61	Jan 63	Oct 65	Jan 63
Average of selected series		Aug 49	May 52	Jan 54	Mar 56	Dec 56	Oct 57	Aug 59	Mar 61	Sep 63	Feb 66	Apr 68

activity. The earlier date of April 1968 is thus preferred.

A decision rule corresponding to the periods of above and below average activity needs to be derived. We have suggested that periods of tightness and ease follow the I and D dates, but this is not based on optimising behaviour. Removal of the trend from the y curve in panel B makes it equivalent to the y curve in panel A, and the correct policy response continues to be x. That is, the upswings and downswings in x do not commence at the I, D points. Rather policy ought to respond to points of maximum deviation from the trend. These dates lead the actual peak, and lag the actual trough, by a constant time period where the reference cycle has a more or less regular period. Using the deviation cycle dates to measure the inside lag will do little to alter the length of the overall *average* inside lag from that measured in Table 6.2.

The problem is one of the strength of policy response. For policy to be perfect, in the sense of ironing out cyclical fluctuations, the x series has to take into account the extent of the deviation of y from its trend and vary inversely with this. Our criterion of the need for action relates only to the existence of periods of over and under activity. Commensurate with this criterion, we need to assume that policy varies in an on-off fashion between tightness and ease, and responds only to the existence and not to the extent of the deviation from trend. The required path of policy is illustrated in panel B by the dashed line, and the rule is: policy be tight when economic conditions are above normal, and easy when conditions are depressed.

Estimates made of the inside lag by applying this rule to both mid-cycle and inflation-deflation points are set out in Table 6.4. These estimates are much shorter than was indicated by the turning point rule; on average, the inside lag appears to have been about 4 months in length. It was noted earlier that ambiguity surrounds the strength of the 1956/57 cycle, and the

Table 6.4

Lag of Monetary Policy Changes behind Reference Cycle Phases

(No. of months)

Reference Phase dates	Lag behind reference cycle phase dates: Expansionary policy	Restrictive policy
	Mid-Phase Intervals	
(a) Jan. 1956	(a) 16	
(b) Jan. 1957	(b) 4	
Sept. 1959		2
Feb. 1961	4	
July 1963		3
Oct. 1965	2	
April 1968		6
April 1971	6	
Mean	(a) 7 (b) 4	4
	Inflation-Deflation Intervals	
March 1956	14	
Dec. 1956		n.a.
Oct. 1957	n.a.	
Aug. 1959		3
March 1961	3	
Sept. 1963		1
Feb. 1966	-2	
Aug. 1968		6
Mean	5	3

second mid-contraction date used, i.e. (b), comes from assuming that the whole period August 1955 - September 1958 was a contraction. Similarly, while we have followed Waterman in marking out points of inflation-deflation during this cycle (I_3 and D_3), only 4 of the 10 series provide clear evidence of such intervals. In constructing the lower part of the table, the period of expansionary policy instituted in May 1957 was considered to be in response to the period of deflation beginning from March 1956. Had it been related instead to the point of deflation of October 1957, the inside lag for the inception of expansionary policy would have been (-1) month. Finally, Haywood tentatively dates a period of below average activity as beginning in October 1971, and the O.E.C.D. study indicates that actual G.D.P. fell below the average utilization trend early in 1971. Using a date of June 1971 as an average of these, the inside lag in this instance was 4 months, in line with the average from earlier episodes.

Our discussion has revealed there to be difficulties inherent in the direct observation method. Its principal advantages are that it concentrates attention upon the major swings in monetary policy over business cycles and enables an examination of whether there are assymetries in the policy response. The first is reduced by ambiguities in defining the need for action and in determining cyclical episodes, so that any observed differences between the timing of expansionary and restrictive action may arise from these ambiguities, not the preferences of policy-makers.

Examination of policy behaviour during business cycle phases is also inefficient, as much information about the workings of policy is excluded from consideration. Monetary policy is more than an on-off matter and has potential as a continuing influence upon the economy, with its strength depending upon the extent of the deviation of the goal variables from the desired path. The constructed index of monetary policy shows marked variations in the intensity of the policy stance, as well as periods of relatively 'neutral' policy as in 1962/63 and 1967/68 which are ignored by the cyclical criteria.

Finally, our measures assume implicitly that the various goals of policy bear a constant relationship to the general swings in income and production. The analysis which follows directly examines the relationship of monetary policy to the separate policy goals.

Multivariate Regression Method

This method assumes that the multiple objectives of monetary policy jointly determine the stance of monetary policy. The hypothesized association follows from the theory of stabilization policies outlined in chapter 2, whereby the central bank varies the instruments of monetary policy, x, from their desired levels, x*, in response to weighted deviations of the policy goals, y, from their socially desired levels, y*. Specifically, we derived the policy reaction function (2-4),

$$x^{\circ} - x^{*} = H^{-1} A' K y^{*} - H^{-1} A' K y$$

where x° indicates the policy required to optimize the implicit utility function.

By making assumptions about the unobservable variables x* and y*, selecting proxies for x and y, and by allowing for a lagged response in the policy variables, it is sought to reveal simultaneously the policy objectives and the inside lag. Providing that the authorities behaviour is correctly identified, the inside lag is thereby measured against variables which the policy-makers themselves consider (by their actions) to be important. At the same time, the regressions indicate the authorities' order of priorities amongst the objectives. This is not to assume that the monetary authorities consciously pursue marginal analysis and maximizing behaviour. Rather it is supposed that the Reserve Bank's approach results in policies very similar to those which would have been produced by the maximization of a well defined utility function subject to the constraint of a logically consistent model of the economy.

While following the general approach developed first by Reuber and used by other researchers, as summarized in Table 6.1, we modify the way it has been applied in several respects. First, there are difficulties in obtaining an indicator of monetary policy. The common practice amongst the studies is to run the whole gamut of conflicting indicators in the equations, making a selection on the basis of the results. For example, Fisher (1968) uses four interest rate series, four money supply measures, three measures of the liquid assets ratio, and in a subsequent study examined also special deposit variations and hire purchase controls. There is something to be said for this practice if there is reason to believe that the instruments of policy are specialized to different targets. But if it is merely to postpone the day of decision as to which of the indicators is the more 'sensible', the procedure can be criticized on the grounds that the purported reaction functions are then selected on preconceived notions as to the length of the lag and the response to the goal variables rather than on what is revealed by the data - the latter being the point of the exercise. The notion of instrument speciality also conflicts with the 'package deal' approach to policy, whereby the instruments of policy are used all at once as part of a general attack upon the economic situation. Examination of any one of the component parts is likely to give a misleading representation of the whole, and this is one reason why we have sought a general measure of monetary policy.

Secondly, in the process of developing a general measure of policy we found deficiencies in the standard conception of the monetary policy process. In the underlying theory of stabilization policies there is a one stage process involving only the instruments and goals, but this framework is usually extended to incorporate the intermediate targets of policy, and correspondingly a two stage process of policy. As can be seen from column 4 of Table 6.1, measures of monetary policy have been drawn from both of the two stages, but the variables most frequently used have been intermediate variables such as interest rates, bank reserves and the money supply. We have found it more instructive to think of monetary policy as a three stage process, consisting of the formulation of policy, implementation of actions, and the effects upon financial markets. The theory of policy relates directly to the formulation of policy, specifying the *ex ante* response of policy to the goal variables. *Ex post* observations drawn from financial markets may not be suitable proxies of the controlled behaviour of the authorities. Thus we have sought to measure policy at the formulation stage by constructing a numerical index of policy intentions.

Thirdly, the proxies of the goal variables are typically selected 'scientifically', according to which is most closely linked with the behaviour of the policy variables. The data is supposed to determine simultaneously the appropriate lag structure, the variables which measure monetary policy, and the goals of policy. This is not only asking a great deal of the data, but when it is found that the authorities pursue the objective of absolute price stability and seek a fixed dollar amount of foreign reserves irrespective of the level of imports, the results of the exercise seem questionable. Further, finding that interest rates increase with the level of employment and prices, or that the money supply increases as the balance of payments improves is to be expected, but may not indicate the form of policy response. Considerable attention is consequently directed here to selecting relevant proxies of the goal variables.

Fourthly, assumptions have to be made about the authorities' preference function and these necessarily shape the analysis. As the utility function cannot change in form during the study, both the weight which the authorities attach to the respective goal variables and the values of these variables at which they aim are held constant. Much care must be given to the selection of the time period of the study, for this validates the assumption of the constancy of preferences and influences the choice of the proxies of the goal variables. The preference function itself incorporates the assumption that deviations on either side of their respective desired values have equal significance, implying that 'low' unemployment is as bad as 'high' unemployment. We shall examine an alternative set of equations which do not make this assumption.

Finally, there is the question of the specification of the lags in policy response, on which matter a clear division exists in the literature. Eight of the eleven studies which have estimated empirical reaction functions employ distributed lags, and all but one of these uses the conventional Koyck geometric lag formulation. The three remaining studies not only assume a fixed lag but specify it to be shorter than the quarterly time period used in their analyses. These differences are sufficient to introduce caution about the specification of the lags, but there are additional problems associated with distributed lags which deserve consideration.

Before proceeding to the empirical analysis, an extended discussion of three of the items just mentioned is made: these are the specification of the lags in policy response, the time period of the study, and the proxies of the goal variables.

Specification of the lags

The issues involved are why there should be a lag and what form it takes. Considerations such as those discussed earlier suggest that the authorities will take time to collect and digest information, to order priorities and to design appropriate measures. But what form does this take? These lags may be adequately accounted for by allowing for a fixed time delay of one or two quarters. Little argument opposing this view comes from the studies which specify distributed lags: with only one exception (Jonson), these are introduced arbitrarily.

One justification for distributed lags is the presence of adjustment costs. The theoretical framework provides for disutility from operating the policy instruments at different levels, for these compromise other, longer run objectives of policy. No allowance is made, however, for any costs being associated with changes per se, arising from the 'setting up' of policy, the political controversy or from the revision of private plans. It can be shown, following Jonson, that their inclusion in the loss function provides one possible rationale for a distributed lag model. The preference function is amended to include squared changes in the instrument setting during the period, $x - x_{-1}$, viz.

$$W = (y-y^*)'K(y-y^*) + (x-x^*)'H(x-x^*) + (x-x_{-1})'V(x-x_{-1}) \tag{6-4}$$

where V is a diagonal matrix of weights attached to changing monetary policy. Minimizing this function subject to the constraint (2-2) we obtain

$$x^\circ = (H+V)^{-1}Hx^* + (H+V)^{-1}A'K(y^*-y) + (H+V)^{-1}Vx_{-1} \tag{6-5}$$

which defines the required response recognizing adjustment costs.[1] A similar functional form can be obtained by retaining the original preference function (2-1a) and by letting adjustment costs delay the adjustment of the vector of instruments, x, to their required level , x°, as is done in the other studies.

Whether adjustment costs actually do enter into policy deliberations is another matter. Policies which succeed in stabilizing the economy may have a favourable impact upon private planning, as Okun (1972) has pointed out. There are also few costs in setting monetary policy in motion, for the legislative and administrative costs are negligible and, as compared with fiscal policy, a great many small steps can be taken, minimizing the political impact. The relevance of adjustment costs for monetary policy must be questioned.

An alternative rationale for the imposition of a distributed lag is suggested by our earlier discussion of policy making when there is imperfect knowledge of the behaviour of the goal variables. Whereas the model has the authorities responding to discrepancies between the desired and actual values of a target variable, in fact policy has to be formulated on the basis of

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1 Expanding W and substituting $Ax + Bz = y$ we obtain

$$W = x'A'KAx + x'A'KBz + z'B'KAx + z'B'KBz - 2x'A'Ky^* - 2z'B'Ky^*$$
$$+ y^*Ky^* + x'Hx - 2x'Hx^* + x^{*\prime}Hx^* + x'Vx - 2x'Vx_{-1} + x_{-1}'Vx_{-1}.$$

Differentiating with respect to x and setting equal to zero we have

$$\frac{\partial W}{\partial x} = 2A'KAx + 2A'KBz - 2A'Ky^* + 2Hx - 2Hx^* + 2Vx - 2Vx_{-1} = 0.$$

As $y = Ax + Bz$ we can write this as

$$A'Ky - A'Ky^* + Hx - Hx^* + Vx - Vx_{-1} = 0.$$

Rearranging

$$x = (H + V)^{-1}A'K(y^* - y) + (H + V)^{-1}Hx^* + (H + V)^{-1}Vx_{-1}.$$

a forecast of that target. If only past values serve as the basis for the prediction, then for some series the 'best' forecast is a weighted average of its own past history.[2] Now from (2-6), suppose that the authorities adjust the stance of policy in the light of forecasts of the values of two target variables y_{1t+1}^E and y_{2t+1}^E,

$$x_t = \beta_1 y_{1t+1}^E + \beta_2 y_{2t+1}^E + u_t. \tag{6-6}$$

Let the forecasted (or expected) value be formed by the weighting system

$$y_{1t+1}^E = \lambda \sum_{k=0}^{t} (1-\lambda)^k y_{1t-k} \tag{6-7}$$

or

$$y_{1t+1}^E = \lambda y_{1t} + \lambda(1-\lambda)y_{1t-1} + \lambda(1-\lambda)^2 y_{1t-2} + \ldots.$$

for both y_1 and y_2. By substituting the expressions for y_{1t+1}^E and y_{2t+1}^E into (6-6) and applying the Koyck transformation, we obtain the equation

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2 Suppose that a time series v_t can only be observed with an error e_t through a proxy variable w_t, and that the 'true' value v_t is a linear function of its own past values subject to disturbances, e_t, viz.

$$w_t = v_t + e_t$$

$$v_t = g\, v_{t-1} + \varepsilon$$

when there is first order autoregressivity in v_t. Such a series, for example employment, is subject to disturbances from strikes but tends to exhibit a degree of persistency from period to period, introduced by variables such as the foreign trade cycle which have effects lasting over several periods. In these circumstances the optimal forecast w_{t+1}^E is

$$w_{t+1}^E = \alpha_0 \sum_{j=0}^{t} \alpha_1{}^j\, w_{t-j}$$

for some α_0 and α_1. This result is based on Bailey (1971, chapter 11).

$$x_t = \beta_1\lambda y_{1t} + \beta_2\lambda y_{2t} + (1 - \lambda)x_{t-1} + \varepsilon_t \qquad (6\text{-}8)$$

where $\varepsilon_t = u_t - (1 - \lambda)u_{t-1}$, which is empirically indistinguishable from the partial adjustment model which would be derived from (6-5), although the interpretation given to the coefficients differs.

While the expectations model provides a plausible explanation of distributed lags, its formulation is more restrictive than the partial adjustment model, and not only because the disturbance term ε_t in (6-8) is serially correlated. In both models the lag distribution is identical for all of the goal variables entering the reaction function. This restriction has some meaning for the partial adjustment system, as the costs of making policy changes ought not to be conditioned by the objectives which are sought. But in the expectations model, the restriction is severe. There is little reason to suppose that the forecasting methods appropriate for the employment position would be the same as those which might be used for the rate of price inflation or the balance of payments.[3] For some series, the cyclical pattern may be so clear that policy actions can be instituted on the basis of their current behaviour, and no distributed lag formulation may be warranted.

Other more practical considerations reinforce the view that a distributed lag formulation should be approached with care. We have considered the partial adjustment and adaptive expectations models separately, but both may conceivably be present. When the true system contains elements of both lags, use of either model is incorrect and

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3 When the weighting pattern for y_1 and y_2 differ, the functional form (6-8) is no longer the correct one. Terms for y_{1t-1}, y_{2t-1}, and for x_{t-2} have to be added, and the standard estimating equation is mis-specified.

estimates of the lags are biased upwards - see Waud (1966). Biased estimates of the lags in policy will also arise if the planning period of the authorities fails to coincide with that for which the data is sampled. Use of quarterly data when the true response is weekly or monthly will tend to result in long lags being estimated.[4] There is also no guarantee that the proxies of the goal variables we choose are those actually used by the authorities, and further errors are introduced in this way.

These considerations may not be of paramount importance if one is concerned solely with identifying the objectives of policy, as many of the other studies have been. But the length of the policy lags is a vital question for the success of monetary policy and one that we are specifically investigating. Lags generated by the need to acquire and process information may be adequately represented by fixed time lags, as some of the studies have shown. This specification avoids some of the difficulties inherent in the use of distributed lags as well as enabling us to examine whether the assumption of a common lag for all of the targets seems appropriate. The study is limited initially to fixed time delays in the response of policy, while allowing for 'expected' values of some of the variables formed as weighted averages of their own past values. Later we introduce distributed lags and compare these with the fixed time lags.

Time Period

A key factor determining the choice of the time period is the assumption that the utility attached to the goal variables and their desired levels be constant. As a consequence the period must be defined functionally to validate this assumption.

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[4] This would seem to be the implication of studies by Mundlak (1961) and Bryan (1967).

For a study of the policy objectives of unemployment and price stability, the period covered by the Liberal and Country Party coalition governments from 1949-1972 seems appropriate. The period also marks the end of the regime of fixed exchange rates. Yet from the viewpoint of the balance of payments objective a shorter period seems required. The international commodity booms of the early 1950's and early 1970's undoubtedly altered the Australian authorities' views about the desirable (and achievable) balance of payments position and the desired holding of international reserves, and these periods should be omitted from the study. Finally, the requirement that there be a relatively consistent view taken about the instruments of policy suggests commencing the study somewhat earlier. Two watersheds have occurred in policy attitudes about monetary policy. One was in 1956 with the institution of the L.G.S. ratio and clarification of the rules about banks' liquidity and lending responses to policy. The other was in the early 1960's following the post mortems of the 1960-61 experience, when interest rates assumed greater significance in policy deliberations. Thus our basic time period is 1956-1970, and we also examine the shorter periods 1956-1961 and 1962-1970, the data being quarterly.

The Policy Targets

The measures most commonly employed in the other studies are the unemployment rate, the *level* of consumer or wholesale prices, and the *level* of gold and international reserves. We follow them in using the unemployment rate, but also experiment with vacancies and registered unemployed as alternative measures.[5] However the other proxies seem to be an obvious,

5 The Australian study by Jonson uses the ratio of Vacancies to Registered Unemployed, but follows the other studies in using the *level* of foreign reserves and the *level* of consumer prices. In order to remove seasonal influences, Jonson smooths the data by applying a four quarter average.

indeed absurd, misrepresentation of policy objectives. Use of the level of consumer prices supposes absolute stability of prices to be the objective. Most governments concern themselves with the *rate of change* of prices, and this is our preferred proxy. (The price *level* is included only for comparison with other studies.) Similarly, few governments seek to hold international reserves at a particular value in terms of domestic currency, except for brief intervals. The desired value of reserves presumably varies with movements in the price and volume of international trade and incomes, and for this reason our proxy of the balance of payments objective is the *ratio* of international reserves to imports, G.D.P., or its own trend.

The standard approach can also be criticized for ignoring policy-makers' uncertainty about the state of the economy. Policy-makers rarely examine a narrow set of statistics relating to employment, prices and the balance of payments. Rather they will seek to gain information and avert uncertainty by 'looking at everything', particularly indicators which provide a reliable representation of the course of the business cycle. In the words of a Reserve Bank study by Bush and Cohen (1968),

> "Trying to assess the current stage of the cycle may require some kind of a forecast. Statistics relating to the current period are generally unavailable due to publication delays. However, looking at the whole range of indicators, it is possible to deduce the stage at which the economy is. Those series which are most promptly available are, of course, more helpful in making these forecasts."

The Reserve Bank has expended considerable effort to develop forecasting techniques and to select trustworthy indicators. On their scoring, the most reliable *leading* indicator (which has the advantage of no publication delay) is the Sydney Stock Exchange index of ordinary share prices, with a score of 87 out of a maximum of 100 points. This series is included in the regression analysis so as to replicate the information available to policy-makers at the time of decision-making. In addition, economic policy in general, and monetary policy in particular, has also been much concerned with activity in the building industry and the rate of home construction for home ownership is part of the Australian ethos. To test for any impact of this concern upon the stance of policy we include the number of housing approvals as an additional explanatory variable. This variable is also one of the leading indicators[6] identified by the Reserve Bank study, with a score of 75 out of 100. On the assumption that the policy-makers use cyclical swings in the series as indicators, both this variable and also share prices enter the regressions as ratios to their fitted trends.

The Results

The first model we examine is derived from the earlier framework by assuming that there is a simple scaling factor, k, involved in converting the formulated policy stance into the required variation in the intermediate variables, x^0, these variables being related in turn to the policy goals. Following from our discussion above, we allow initially for the lags in recognizing the need for action and in formulating the optimal response to produce discrete time lags when quarterly data is employed. Thus

$$P_t = \frac{1}{k}(\alpha - \sum_{i=1}^{n} \gamma_i \, y_{it-\tau} + \varepsilon_t) \qquad (6\text{-}9)$$

where P_t is the index of monetary policy intentions and $y_i (i=1 \ldots n)$ are the policy goals, represented by various proxies. Determination of τ, the length of the policy lag in quarters, proceeds as a first step by lagging the whole block of explanatory variables from 0 through to 4 quarters relative to the index. Then on the basis of the results obtained, we test

6 Both Share Prices and Housing (Dwelling) Approvals were explicitly cited as being reliable leading indicators of the business cycle in two recent studies in A.N.Z. Bank Quarterly Survey, April 1976 and The Australian Economic Review, 4th Quarter 1975.

for the individual lag which gives the 'best' representation of each individual policy goal.

Initially the index is regressed against two measures of the employment objective, three measures of prices, and three measures of the balance of payments objective. The employment measures are:

U = Unemployment, expressed as a per cent of the work force

V - U = Registered vacancies less unemployed, as a per cent of the work force

As measures of the balance of payments we use:

G.F.E. = Gold and foreign exchange holdings of the Reserve Bank

$G.F.E./_{Im}$ = Ratio of G.F.E. to Value of Imports

$G.F.E./_{G.N.P.}$ = Ratio of G.F.E. to Gross Domestic Product

The proxies of the prices objective are:

P = Consumer Price Level in index numbers

$\dot{P}$ = Rate of change of Consumer Prices

$\dot{P}^E$ = 'Forecasted' rate of change of Consumer Prices

All data (with the exception of the index) are adjusted for seasonality and where in monthly form are averaged over the quarter.

The results are set out in Table 6.5. In assessing the equations A1-A25, it needs to be reiterated that the dependent variable is by its nature completely free of non-policy influences and was derived independently of any variables used to explain its behaviour. Of the three policy goals, unemployment and the balance of payments are the ones most consistently related to the policy index. These 'explain' 67 per cent of the variation of the index in 1956-1961 and 74 per cent of the variation of the index in the period 1962-1970 (equations A12 and A19). That the stance of monetary policy responds to unemployment is not surprising for the unemployment rate stirs the electorate and it is also a reliable coincident indicator of

Table 6.5

Regressions between the Index of Monetary Policy and Measures of Policy Goals for various time periods.

Equation no.	Regression Coefficients on Explanatory Variables. ('t' statistics in parentheses)	R^2	D.W.	Comments
	1956-1970			
A1.	$2.978\ U_{-2} + 1.023\ (GFE/_{Im})_{-2}$ (4.49) (5.46)	.61	.40	Correlation also high when lag is 1 quarter.
A2.	$3.535\ U_{-2} + 22.208\ (GFE/_{GDP})_{-2}$ (5.48) (3.68)	.59	.36	"
A3.	$-2.842\ (V-U)_{-1} + 1.125\ (GFE/_{Im})_{-2}$ (6.28) (5.25)	.58	.30	
A4.	$3.867\ U_{-2} - .116\ P_{-2}$ (5.94) (4.61)	.56	.30	
A5.	$3.984\ U_{-2} - .160\ \dot{P}_{-2}$ (4.31) (0.89)	.40	.24	Addition of GFE adds nothing to correlation.
A6.	$3.632\ U_{-2} - .301\ \dot{P}^{E}_{-2}$ (3.48) (1.14)	.41	.23	"
A7.	$3.119\ U_{-2} - .044\ P_{-2} + .768\ (GFE/_{Im})_{-2}$ (4.66) (1.27) (3.55)	.62	.38	
A8.	$3.821\ U_{-2} - .139\ P_{-2} + .003\ GFE_{-2}$ (6.01) (5.12) (1.97)	.59	.30	
A9.	$2.960\ U_{-2} - .007\ \dot{P}_{-2} + 1.021\ (GFE/_{Im})_{-2}$ (3.79) (0.04) (5.30)	.61	.40	
A10.	$3.360\ U_{-2} - .061\ \dot{P}_{-2} + 21.976\ (GFE/_{GDP})_{-2}$ (4.29) (0.40) (4.97)	.59	.36	
A11.	$3.395\ U_{-2} - .054\ \dot{P}^{E}_{-2} + 21.971\ (GFE/_{GDP})_{-2}$ (3.86) (0.24) (4.88)	.59	.36	
	1956-1961			
A12.	$4.245\ U_{-2} + 1.510\ (GFE/_{Im})_{-2}$ (2.65) (4.23)	.67	.47	
A13.	$4.902\ U_{-2} + 33.646\ (GFE/_{GDP})_{-2}$ (2.99) (3.19)	.59	.38	
A14.	$-3.950\ (V-U)_{-2} + 1.183\ (GFE/_{Im})_{-2}$ (3.52) (2.23)	.59	.34	

Table 6.5 *continued*

Equation No.	Regression Coefficient on Explanatory Variables. ('t' statistics in parentheses)	R^2	D.W.	Comments
	1956-1961 *continued*			
A15.	$5.402\ U_{-2} - .245\ \dot{P}_{-2}$ (2.43) (0.90)	.39	.22	
A16.	$4.932\ U_{-2} - .177\ \dot{P}_{-2} + .004\ GFE$ (2.04) (0.59) (0.56)	.40	.22	Coefficient on $\dot{P}$ assumes incorrect sign when other GFE variables used.
A17.	$4.213\ U_{-1} - .451\ P_{-1} + .996\ (GFE/_{Im})_{-1}$ (2.28) (2.40) (2.00)	.68	.25	
A18.	$10.656\ U_{-2} - .747\ P_{-2} + .100\ (GFE/_{Im})_{-2}$ (10.35) (8.39) (0.42)	.93	1.22	
	1962-1970			
A19.	$4.325\ U_{-1} + .762\ (GFE/_{Im})_{-1}$ (6.37) (4.07)	.74	.34	
A20.	$4.596\ U_{-1} + 16.476\ (GFE/_{GDP})_{-1}$ (7.20) (4.34)	.74	.38	
A21.	$-2.932\ (V-U)_{-1} + .886\ (GFE/_{Im})_{-1}$ (7.41) (4.56)	.73	.37	
A22.	$5.386\ U - .302\ \dot{P} + .006\ GFE$ (5.64) (1.72) (3.57)	.70	.50	
A23.	$5.205\ U - .337\ \dot{P}^E + .006\ GFE$ (3.62) (0.97) (3.20)	.68	.37	
A24.	$3.349\ U - .190\ \dot{P} + .849\ (GFE/_{Im})$ (3.82) (1.16) (4.40)	.74	.46	Use of $\dot{P}^*$ instead of $\dot{P}$ does not improve the goodness of fit.
A25.	$3.269\ U_{-1} - .166\ P_{-1} - .129\ (GFE/_{Im})_{-1}$ (4.25) (2.42) (0.31)	.78	.48	GFE variable has wrong sign when P used instead of $\dot{P}$.

general business conditions. The correlations are slightly higher when the unemployment rate rather than the alternative measure of employment feature in the regressions, as illustrated by comparing equations A1, A12 and A19 with equations A3, A14 and A21 respectively. This result parallels the finding of overseas studies, and the unemployment rate is our preferred proxy in the remaining work.

Other studies prefer to use the *level* of international reserves to proxy the balance of payments, but we find that the proxies constructed by deflating reserves by either imports or G.D.P. provide a clearer representation of this objective, confirming our *a priori* expectations. There is little to choose between the two deflated versions of the balance of payments proxy, but the number of months of imports purchaseable with reserve holdings is of obvious relevance to the authorities and the ready availability of import data over the period makes it likely that G.F.E.$/_{Im}$ was used in policy deliberations.

When the three objectives are considered together it is difficult to disentangle the separate influence of the prices and balance of payments measures. Some interaction between these objectives is to be expected if periods of domestic inflation rates higher than those in countries competing on world markets coincide with balance of payments deficits. In particular, a close inter-correlation exists between the measures of the balance of payments and the index of prices, and the relative contribution of the price stability and balance of payments objective depends upon whether we use the price level or its rate of change as the proxy. Generally speaking, the prices variable is better determined and the balance of payments less well determined when the price index is used, as is evident by comparing equation A25 with A24, and also A7 with A9. If we retain our *a priori* specification that policy-makers are concerned about the rate of inflation and not the level of prices, and ignore the higher correlations obtained with the latter specification, then we must accord the objective of price stabilisation a minor role in policy formulation over the period examined - at least on the evidence presented in Table 6.5. The rate of change of prices is a highly variable series, and it seemed possible that the authorities might frame policies on the basis of a forecast of this rate. Following the idea of Muth (1960) as explained earlier, we approximated this forecast by applying the weighting scheme .4, .3, .2, .1 to current and prior rates of changes of prices, where .4 is the weight given the current quarter and .1 is the weight given to the most distant quarter of the yearly horizon. However this variable does not provide any clearer picture of the role of the prices objective.

It was suspected that the emphasis given to the objectives may have altered considerably over the years, and evidence of such a change can be found. Unemployment is now more significant and, although not shown in the table, it alone explains 61 per cent of the variability of the index in the years 1962 to 1970; and correspondingly less importance is attached to the balance of payments. Comparing equation A12 with A19, there is a striking consistency in the response of the index to the unemployment rate, but the response of policy to the balance of payments measures declined in magnitude in the second sub-period. The lessened significance attached to the balance of payments is illustrated from 1968 and 1969. In these years international reserves expressed in terms of either imports or G.D.P. fell to a level lower than in 1960 but, whereas in 1960 the losses were an important factor prompting a severe credit squeeze, official concern was much less in the later years.

A comparison of the equations for 1956-1961 with those for the 1962-1970 period indicates a marked difference in the length of the inside lag. It would seem that the stance of policy responded not only with lesser severity but also more quickly to changes in the balance of payments and, to a lesser degree, the unemployment rate. In the earlier sub-period the policy lag is generally 6 months, but for the later period the time lag is 3 months or less. A shortening over time of the inside lag was also noted in the estimates obtained by what we termed the 'direct observation method'.

For the next set for experiments we retain the three preferred proxies, namely the unemployment rate (y_1), the rate of change of prices (y_3) and the rates of G.F.E. to imports (y_4), as well as the level of prices (y_2) for comparison with other studies, and add the proxies for building activity and share prices. Thus the goal variables are

y_1 = U

y_2 = P

y_3 = $\dot{P}$

y_4 = $^{GFE}/_{Im}$

y_5 = Ratio of Housing Approvals (number of new houses and flats approved for construction) to trend.

y_6 = Ratio of Share Prices to trend.

The last two variables may have significance for monetary policy in their own right but are also reliable leading indicators of the business cycle.

The results of regressing the index against the variables $y_1 \ldots y_6$ are set out in Table 6.6, and the explanatory variables now explain between 76 and 94 per cent of the variation of the index. The regressions again show clearly the significance of the unemployment rate in monetary policy deliberations. In addition, monetary policy appears to respond to forecasts of the stage of the business cycle provided by movements in share prices

Table 6.6

Regressions between the Index of Monetary Policy and Measures of Monetary Policy Targets for various periods.

Equation no.	Regression Coefficients on Explanatory Variables. ('t' statistics in parentheses)	R^2	D.W.	Wrong signs
	1956-1970			
B1.	$3.709\ y1_{-3} - .072\ y2_{-3} + .206\ y4_{-3} - .034\ y5_{-3} - 11.658\ y6_{-3}$	.79	.73	none
	(4.67) (2.57) (0.90) (0.01) (5.11)			
B2.	$2.800\ y1_{-3} - .114\ y3_{-3} + .610\ y4_{-3} - 2.358\ y5_{-3} - 10.952\ y6_{-3}$	.76	.67	none
	(3.10) (0.93) (3.60) (0.64) (4.56)			
B3.	$4.204\ y1_{-2} - .135\ y3_{-3} + .601\ y4_{-3} + 4.229\ y5_{-3} - 12.840\ y6_{-3}$	.81	.86	y5
	(5.41) (1.16) (4.07) (1.16) (6.02)			
	1956-1961			
B4.	$10.232\ y1_{-2} - .529\ y2_{-2} + .279\ y4_{-2} + 6.569\ y5_{-3} - 8.943\ y6_{-3}$	.94	1.07	y5
	(7.20) (2.95) (1.11) (1.63) (1.64)			
B5.	$6.194\ y1_{-2} - .026\ y3_{-3} + 1.172\ y4_{-2} + 1.260\ y5_{-3} - 10.684\ y6_{-3}$	.84	.82	y5
	(4.33) (0.13) (3.03) (0.23) (2.41)			
B6.	$9.384\ y1_{-3} + .105\ y3_{-3} + .419\ y4_{-2} - 7.550\ y5_{-3} - 13.896\ y6_{-2}$	.92	1.85	y3
	(7.43) (0.73) (1.42) (2.14) (4.38)			
	1962-1970			
B7.	$2.542\ y1_{-1} - .079\ y2_{-3} + .255\ y4_{0} - 3.216\ y5_{-3} - 5.857\ y6_{-3}$	.88	1.10	none
	(2.04) (1.51) (0.78) (0.51) (2.69)			
B8.	$2.984\ y1_{-1} - .086\ y3_{-1} + .699\ y4_{0} - .524\ y5_{-3} - 7.498\ y6_{-3}$	.87	1.27	none
	(2.39) (0.59) (4.24) (0.08) (3.48)			
B9.	$2.637\ y1_{-2} - .034\ y3_{-2} + .592\ y4_{0} - 2.075\ y5_{-3} - 7.865\ y6_{-3}$	.88	1.25	none
	(2.57) (0.24) (3.81) (0.36) (3.64)			

and perhaps by housing approvals. The inter-correlation between the index of consumer prices and the ratio of international reserves to imports is evidenced in equation B7 where the coefficient of neither variable is statistically significant. However, when the 'correct' specification of the *rate of change* of prices is used, the balance of payments variable becomes highly significant and while the coefficient on the prices variable generally bears the correct sign, it is insignificant. Again we must accord the objective to prices stabilization a minor role in the formulation of policy over the time period studied.

The meaning of the regression coefficients may be appreciated most clearly by considering how the stance of policy would change in response to a movement of the target variables from their mean to the maximum values they take on over the period 1956-1970. Basing the calculation on equation B2, a movement of the unemployment rate from 1.4 to 2.9 per cent eases the index by 4.2 units. An increase in the rate of inflation from 2.5 to 10.5 per cent per annum results in a tightening of 1 unit. An increase in the ratio of foreign reserves to imports from 6.00 to 9.00 results in a policy easing of nearly 2 units. If housing approvals and share prices were to rise to a ratio of 1.3 of their trend value this would cause the index to tighten by .7 and 3.3 units respectively.

Commentators such as Perkins (1967 and 1971) have argued that monetary policy has been prosecuted more successfully in the 1960's than in earlier years. Direct confirmation of this point cannot be obtained from our regressions, for these relate to the formulation and not to the effects of monetary policy. Nevertheless some objective basis for Perkin's view may come from comparing the regressions for 1962-1970 with those for 1956-1961. They reveal more clearly than the earlier regressions reported in Table 6.5 that the stance of policy responded with lesser severity to changed circumstances. At the same time, policy reacted more promptly to economic events.

Asymmetric Responses?

The models examined in Tables 6.5 and 6.6 make the assumption (standard in the theory of optimum policy) that positive and negative divergences of the targets from their desired values are considered equally serious. That the authorities are equally concerned by the unemployment rate being 1.0 per cent when the desired value is 1.5 per cent as they would be if it were 2.0 per cent seems doubtful. Most policy-makers would prefer an unemployment rate that is smaller than the desired value to one that is greater, and similarly, an inflation rate smaller than the desired rate would be preferred. Such asymmetric responses may account for the relatively 'low' measured reaction of policy to increases in the rate of change of prices, for these may be 'accounted for' statistically by decreases in the unemployment rate. As a way of providing a simple alternative to the standard approach, we make the assumption that deviations of the unemployment rate and the inflation rate below their desired levels are accorded zero weight in policy decisions. Thus we define

$$
\begin{aligned}
y_7 &= y_1 - y_1^* \quad \text{for } y_1 > y_1^* \\
&= 0 \qquad\qquad \text{when } y_1 \leqslant y_1^* \\
y_8 &= y_3 - y_3^* \quad \text{for } y_3 > y_3^* \\
&= 0 \qquad\qquad \text{when } y_3 \leqslant y_3^* \\
y_9 &= y_3^E - y_3^* \quad \text{for } y_3^E > y_3^* \\
&= 0 \qquad\qquad \text{when } y_3^E \leqslant y_3^*
\end{aligned}
$$

where y_1^* and y_3^* are the respective desired values of the unemployment rate and the inflation rate. From his study of fiscal policy over the years 1953-69, Nevile [1970] argues that the preferred trade-off of the

Liberal-C.P. government was for a 1.5 per cent unemployment rate with a 2.5 per cent inflation rate. We adopt Nevile's rate of 2.5 per cent for the desired inflation rate. This rate is presumably influenced by the 'world' rate of inflation, and during the period 1955-1969 consumer prices in the O.E.C.D. countries (excluding Australia) increased at an average rate of 2.65 per cent per annum.[7]

Our reading of the documents of monetary policy suggests that the figure of 1.5 per cent is a little high for an unemployment goal; the Department of Labour and National Service [1970] defines full employment as between 1.0 and 1.5 per cent of the work force, and we use the mid-point of this band, 1.25 per cent, as the desired unemployment rate.[8]

There is a case for arguing that the policy-makers' responses to the balance of payments may also be asymmetric. Two considerations lead us to continue to assume symmetrical responses to this variable. First, we have already excluded the periods of *large* surpluses in the balance of payments from our sample. Second, the argument for ignoring the other periods of surplus implies that the authorities do not see such periods as being opportune ones to pursue a more expansionary policy stance, which we doubt. However, in order to make the balance of payments measure more nearly comparable with the others, we introduce the new variable,

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7 The source of the calculation is data provided in Duck, Parkin, Rose and Zis (1974). They weight consumer price series of the 10 countries by relative size of 1963 G.D.P. in terms of U.S. dollars.

8 Evidence in support of our choice comes from two studies by the OECD secretariat. Their statistical study (1973) of cyclical fluctuations in Australia found that 1.25 per cent unemployed corresponded to the 'average' resource utilization of the economy. In their earlier study (1972), they argued that "any post-war Government was thought likely to face political defeat if it allowed the unemployment rate to rise for any length of time above 1.5 per cent." If so, it seems unlikely that this would be the level which the authorities 'desired'.

y_{10} = ratio of GFE to its own trend value,

where the trend line is assumed to measure the 'desired' value.[9] The variables y_5 and y_6 are unchanged, as these are already in the form of deviations from trend. In view of the nature of the dependent variable, no allowance is made for it to have a desired value.

Table 6.7 shows the result of fitting this alternative model to the data. As expected, clearer delineation is provided of the prices objective. The coefficients on the proxy variables y_8 and y_9 bear the correct sign in all equations, and in three instances are statistically significant, which was not true of any of the rates of change of price transformations in the earlier tables. Our comparison with the results in Table 6.6 is based on equation C5 for 1956-1970. A movement of the unemployed rate from its mean to maximum value now causes the index to ease by 8.6 units, and an increase of 7.5 per cent in the rate of inflation tightens the index by 1.6 units. Having the balance of payments variable increase to a ratio of 1.4 of its trend value causes an easing of the index 1.4 units. We again find that the stance of monetary policy responds more quickly to changes in employment, prices and the balance of payments during the period 1962-1970 than in the earlier sub-period.

Distributed Lags?

As a final step in the analysis, we further investigate the lags in policy response. Table 6.5-6.7 assumed that the lags in acquiring and

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[9] This method of identifying the 'desired' level of international reserves has similarity with the methods employed by Mosley (1976). Although his study post-dates ours, he also uses least squares regression trends to define what he terms the 'satisfactory' level of the policy goals. A further similarity with our study is his assumption that the authorities react in an asymmetric way to divergences between the goals and their 'satisfactory' levels. Yet, paradoxically, he seeks to deny the relevance of the standard theory of economic policy, and argues for a 'satisficing' theory of policy.

Table 6.7

Regressions between the Index of Monetary Policy and Alternative Measures of Monetary Policy Targets for various periods.

Equation no.	Regression Coefficients on Explanatory Variables. ('t' statistics in parentheses)	R^2	D.W.	Wrong signs
	1956-1970			
C1.	$4.519\ y7_{-2} - .257\ y8_{-2}$	.34	.24	none
	(4.60) (1.14)			
C2.	$4.252\ y7_{-2} - .524\ y9_{-2}$	.36	.24	none
	(4.32) (1.76)			
C3.	$4.609\ y7_{-2} - .169\ y8_{-2} + 3.076\ y10_{-2}$	.37	.24	none
	(4.73) (.73) (1.46)			
C4.	$4.399\ y7_{-2} - .379\ y9_{-2} + 2.454\ y10_{-2}$	.37	.24	none
	(4.44) (1.17) (1.12)			
C5.	$6.132\ y7_{-2} - .210\ y8_{-3} + 3.436\ y10_{0} + 8.916\ y5_{-3} - 16.181\ y6_{-3}$	.70	.58	y5
	(5.08) (1.24) (1.92) (1.77) (6.09)			
C6.	$4.243\ y7_{-1} - .238\ y8_{-2} + 3.852\ y10_{-1} + 1.634\ y5_{-3} - 13.146\ y6_{-3}$	.63	.35	y5
	(3.89) (1.30) (2.04) (0.36) (4.81)			
	1956-1961			
C7.	$2.484\ y7_{-2} - .145\ y8_{-2} + 9.927\ y10_{-2}$	.38	.37	none
	(1.56) (.41) (1.83)			
C8.	$2.306\ y7_{-2} - .411\ y9_{-2} + 7.865\ y10_{-2}$	.39	.36	none
	(1.43) (.69) (1.20)			
C9.	$11.524\ y7_{-3} - .274\ y8_{-3} + 3.188\ y10_{-3} - 5.463\ y5_{-3} - 15.110\ y6_{-3}$	.95	2.00	none
	(7.59) (2.33) (1.54) (1.49) (5.60)			
	1962-1970			
C10.	$6.096\ y7_{0} - .525\ y8_{0} + 5.748\ y10_{0}$	.58	.50	none
	(4.66) (2.13) (3.12)			
C11.	$5.847\ y7_{0} - .738\ y9_{0} + 5.443\ y10_{0}$	.62	.67	none
	(4.69) (2.86) (3.12)			
C12.	$4.257\ y7_{-2} - .316\ y8_{-2} + 3.234\ y10_{-2} - 6.587\ y5_{-2} - 5.388\ y6_{-2}$	.74	.45	none
	(2.64) (1.05) (2.00) (0.90) (1.68)			
C13.	$2.163\ y7_{-1} - .277\ y8_{0} + 4.251\ y10_{0} - 10.849\ y5_{-3} - 5.552\ y6_{-3}$	.86	1.15	none
	(1.65) (1.77) (3.56) (1.97) (2.52)			

processing the information necessary for decision making could be adequately represented by a discrete time lag, but allowed also for the lag to vary as between the targets, as policy-makers may be able to recognize the need for action more quickly in some cases than in others. As was noted earlier this approach contrasts with other reaction function studies. Three of these studies have adopted a one quarter discrete time lag (applied to all variables), but more usually there has been allowance for policy to approach the optimal setting gradually, and it seems desirable to test for this possibility.

Inclusion of a lagged dependent variable in the equations (shown in Table 6.8) does little to alter the relative contribution of the employment, rate of change of prices and balance of payments variables. The principal contrast lies in the implied lag before the stance of policy is brought to the optimum level: less than 20 per cent of the adjustment is completed in the first quarter and this means that it takes 10 quarters for the adjustment to be 90 per cent completed. While lags of this length are not uncommon in the other studies, the possibility that a distributed lag formulation is inappropriate should not be overlooked. If distributed lags are thought to derive from 'expectations', the imposition of a common expectations forming mechanism is unduly restrictive, and more sophisticated specifications may be needed to capture the tendency, noted earlier, for policy to respond more quickly to employment and the balance of payments. Alternatively, distributed lags may be thought to reflect 'adjustment costs', but these may condition the way monetary policy is conducted and not its formulation. That is, costs may arise in changing particular instruments rather than monetary policy per se, influencing the *mix* of instruments used to implement the intended stance.

Table 6.8

Regressions between the Index of Monetary Policy, its Lagged Value and Various Measures of Monetary Policy Targets, 1956-1970.

Equation No.	Regression Coefficients on Explanatory Variables ('t' statistics in parentheses)	R^2	D.W.	Wrong signs
D1.	$.840\ P_{-1} + 1.358\ y_1 + .042\ y_2 + .586\ y_4$	.89	1.46	y_2
	(16.09) (3.93) (2.34) (4.16)			
D2.	$.842\ P_{-1} + 1.695\ y_1 + .045\ y_2 + .519\ y_4 - 3.014\ y_6$	.91	1.78	y_2
	(12.93) (3.25) (2.42) (3.58) (-2.00)			
D3.	$.800\ P_{-1} + 1.295\ y_1 - .072\ y_3 + .342\ y_4$	.89	1.31	none
	(15.62) (3.25) (-.90) (3.04)			
D4.	$.815\ P_{-1} + 1.401\ y_1 - .070\ y_3 + .283\ y_4 - 1.980\ y_6$	.90	1.52	none
	(16.08) (3.56) (-.90) (2.48) (-1.90)			
D5.	$.873\ P_{-1} + 2.156\ y_7 - .063\ y_8 + 1.905\ y_{10}$	.87	1.25	none
	(17.40) (4.95) (-.66) (2.01)			
D6.	$.879\ P_{-1} + 2.121\ y_7 - .093\ y_8 + 1.594\ y_{10} - 2.542\ y_6$	.88	1.51	none
	(18.23) (5.07) (-1.00) (1.73) (-2.37)			

With only one or two exceptions, most of the equations indicate the presence of serially correlated disturbances, evidenced by the low values of the Durbin Watson (DW) statistics. In the absence of a lagged dependent variable (as in tables 6.5-6.7), the sampling variances of the estimators are larger than they would otherwise be, but the estimates of the coefficients are unbiased. However, the serial correlation may indicate that a major explanatory variable has been omitted, and further investigation is warranted.

The influence of political events is an obvious candidate given that monetary policy in Australia is firmly under the control of the (central) government. Recent attempts to model the nature of politically determined social choices also draws attention to this consideration. By political events we refer not to the influence of changes in government ministries for we have chosen a time period which excludes the changeover to Labor party rule in 1972-1975, and it appears unlikely that the changes of Prime Minister in 1966 and 1968 within the ruling Liberal-Country Party coalition would markedly alter economic management. It is more likely that the reaction functions may be 'disturbed' by the reactions of the political authorities to the approach of an election. One possible hypothesis would see the politicians as trying to manoeuvre the economy according to some amalgam of the conventional 'welfare' considerations that we have emphasized and partisan political strategy. This is the essence of the notion of a *political business cycle*, associated with the names of Kalecki (1943), Downs (1957), and recently Lindbeck (1973 and 1976) and Nordhaus (1975). In view of the potential importance of this theory for the prosecution of monetary policy, we now examine it in detail.

Political Business Cycle?

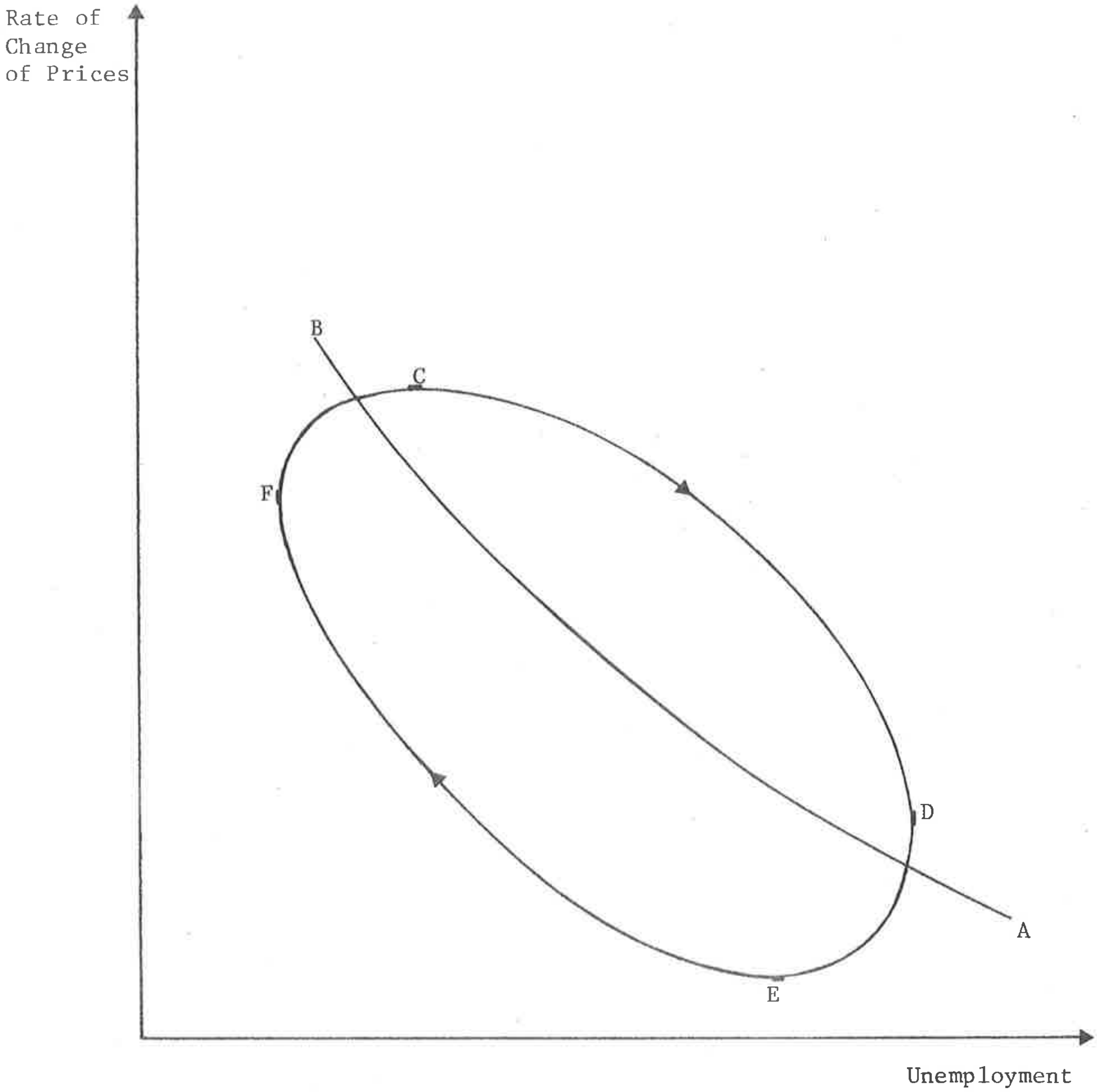
Suppose that the economy is experiencing economic cycles which take the form of 'clockwise' loops around a short-run Phillips curve trade-off between unemployment and the rate of change of prices given by the line AB in Figure 6b. Such loops are one of Laidler and Parkin's (1975) 'stylized facts' about the wage (price) inflation-unemployment relationship in most advanced economies in post-war years. Consistent with the expectations-augmented Phillips curve approach, we assume the loops to be generated by a combination of current domestic economic pressures (excess demand), expectations of inflation based on past economic policies and imported inflation (the expectations variables) as the government pursues domestic economic management.

The theory of economic policy envisages the policy-makers maximizing social welfare represented by a set of indifference curves concave to the origin (not shown), choosing some combinations of inflation and unemployment, presumably lying along AB. Accordingly they attempt to manipulate economic events according to these welfare considerations. In the region of DE, unemployment is higher than the socially desired level and the low rate of inflation, reduction in inflationary expectations and possibly improved balance of payments provides a favourable climate for an expansionary stance of policy. Conversely, in the region of FC, inflation is higher than the community would wish it to be, the balance of payments is deteriorating and a restrictive policy stance is in order.

The literature on the political business cycle adds the idea that the timing and the strength of domestic economic management will be affected additionally by party politics. Governments seek to retain power and will accordingly endeavour to manipulate the course of the economy to win the election. The preference function relevant for politicians incorporates the probability of winning the next election as well as social attitudes to unemployment and price inflation. In turn the probability of winning the next election might be perceived to be governed by the level of unemployment

Figure 6b

A Political Business Cycle



and price inflation and also the direction or rate of change of these variables. Given such preferences, the politicians will not wish to face the electorate at point C where the inflation rate is at its maximum. Nor will they want an election at D when unemployment is at a maximum. It would be better for the government if the election were to take place somewhere along DEF where unemployment is decreasing even if still 'high', and the inflation rate and inflationary expectations low enough to permit pursuit of expansionary policy. As a corollary, restrictive economic policy and movement along FCD would be undertaken immediately after an election in order to prepare the ground for a run up to the next election. Thus "optimal partisan policy will lead to a political business cycle, with unemployment and deflation in early years followed by an inflationary boom as elections approach." (Nordhaus)

In terms of our earlier analysis, any such political influences can be interpreted econometrically as disturbances to what would otherwise be a systematic continuous association between the policy goals and the stance of policy. During the period preceding an election, monetary policy is likely to be more expansionary than the normal relationship between the index and the unemployment rate (and other influences) might lead us to expect, and *vice versa* for the period following an election. That is,

$$P_t = \frac{1}{k}\left(\alpha - \sum_{i=1}^{n} \gamma_i \, y_{it-\tau} + \varepsilon_t\right) + \beta E_t \qquad (6\text{-}10)$$

where E_t defines the run up to an election. Omission of the variable E_t from the analysis is likely to produce serially correlated disturbances as elections are non-random occurrences.

Nordhaus tested the hypothesis of a political business cycle with data for Australia and eight other countries over the period 1947-1972, and found evidence to support it from Germany, New Zealand and the U.S. but for Australia he found a political business cycle to be 'implausible'. His test was:

> "During an electoral period of length Θ, the unemployment rate should rise in the first $\Theta/2$ years and fall in the second $\Theta/2$ years."

An immediate criticism of the test is the assumption, by using the unemployment rate, that the government not only attempts but succeeds in influencing the 'business' cycle. Another is the neglect of price stability, balance of payments or any other objective which might either influence the electorate in their voting or, alternatively, over-ride the political strategy. Both defects are corrected here.

Figure 6c shows the index of policy and the values of the index calculated from equations B2, B5, and B8, and at the foot of the figure are the dates of elections for the House of Representatives (R) and the Senate (S).[10] One question concerns whether the hypothesis applies to elections to both houses or only to the dominant House of Representatives, for the elections coincide on only two occasions and their frequency makes the task of manipulating economic events more difficult. A further difficulty in applying the hypothesis to Australia comes from the ability of the government to call an election before the three year electoral period has run its course, as in 1963. In this way the government might attempt to take advantage of developing economic trends without the need to institute expansionary policy. In the particular case of 1963, an expansionary stance was instituted anyway 6 months before the election was called.

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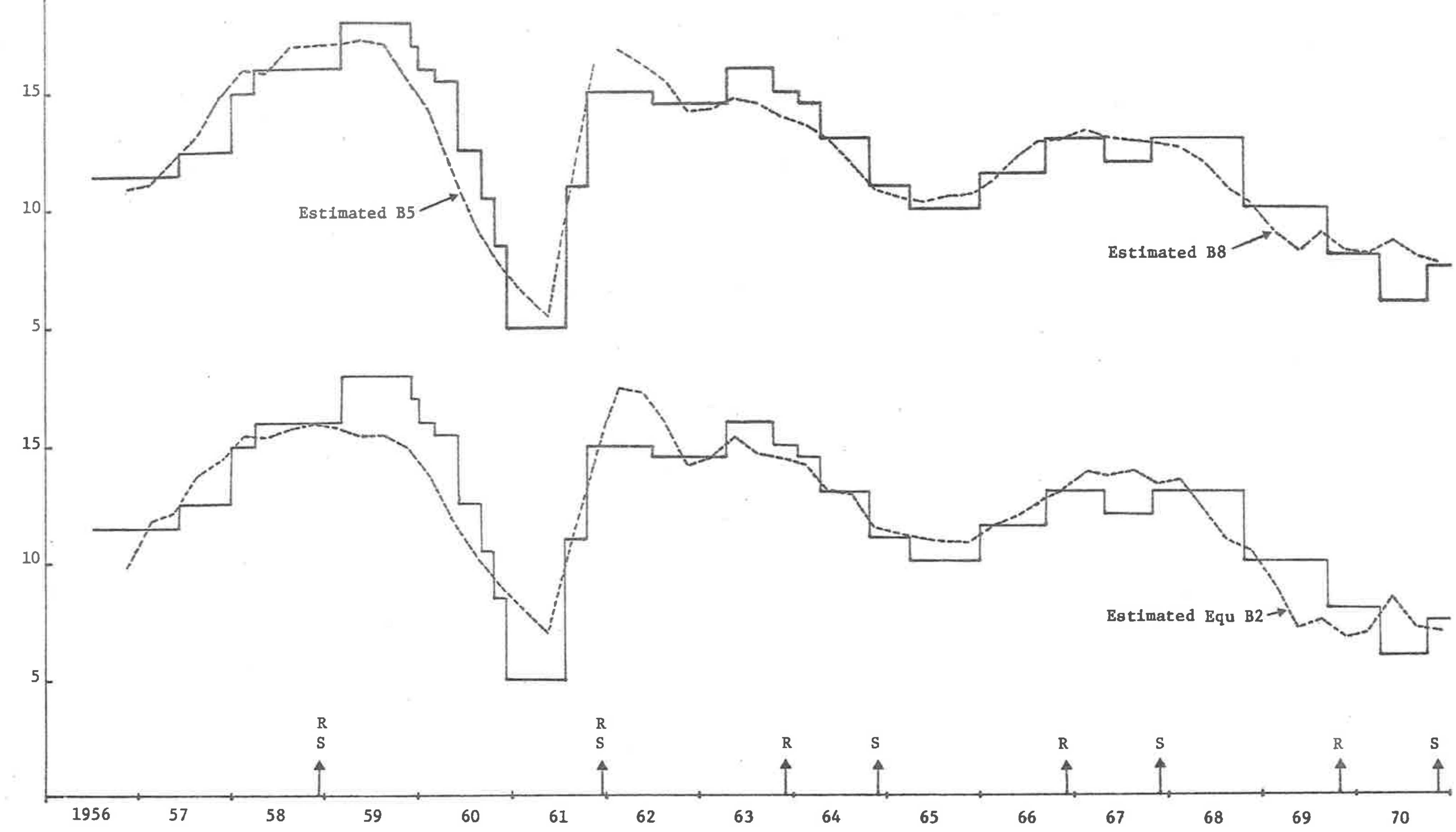
10 The source of the dates of the elections are the Australian Year Book.

Figure 6c

Actual and Estimated Values of the Policy Index, and Timing of Federal Elections, 1956-1970.



Examining the eight elections which occurred during the period 1956-1970, an easier policy stance was introduced in advance of 6 of them, the exceptions being the Senate election of 1964 and the House of Representatives election of 1969. While this would seem to provide *prima facie* support for the hypothesis, the position is altered when account is taken of the 'normal' influences upon policy. In only one of the 6 cases (1963) was the policy instituted more expansionary than would be anticipated on the basis of the usual relationship between the index and the policy goals, and this may be one instance of the government's political strategy. Monetary policy was also more expansionary than 'normal' prior to the House of Representatives election of 1969, but the general policy stance at this time remained restrictive. Alternatively, there is little evidence that monetary policy was consistently less expansionary than normal immediately after elections. It must be conceded that the frequency of elections in Australia may possibly make the distinction between the 'usual' and 'unusual' influences on policy a fine one, and what we have interpreted as welfare-type reactions may be inextricably inter-twined with political motives.

Whatever is concluded about the relevance of the political business cycle for Australia, it would appear to be a minor factor generating the pattern of the disturbances. Much of the serial correlation appears to arise because the index of policy has a pronounced step-like pattern whereas the variables which determine the policy stance presumably vary more continuously, producing runs of negative and positive residuals. Rather than evidencing that a major explanatory variable has been omitted, this pattern may indicate that the relevant decision period is longer than one quarter or that policy decisions are revised infrequently. Perhaps the Reserve Bank should be seen as a body which, instead of responding in a continuous fashion to economic circumstances, reacts discontinuously when the economic situation deteriorates 'significantly' from the prior position. Nor should we overlook the observation in Theil (1965):

> "The standard practice of Western countries is to attack this problem [of policy formation] very informally. When there are difficulties (as to employment, balance of payments, etc.), one takes measures which, hopefully, will lead to a more satisfactory state of affairs. Intuition and feeling are frequently the most important ingredients of the procedure."

While we have been able to trace systematic policy responses to the behaviour of the stabilization targets, we cannot confidently reject the notion that policy has at times been haphazard and has pursued alternative goals.

Section II

The Demand and Supply of Liquid Assets

Introduction to Section II

Reliance on monetary policy for economic stabilization involves assumptions about both the timeliness and the effectiveness of monetary changes in influencing the course of the economy. Many issues are involved in the *effectiveness* of monetary policy, but certain conditions are of critical importance (see Laidler, 1969). First, the monetary authorities must be able to control the supply of those items which correspond to the textbook concept of the 'money stock'. Secondly, the demand function for this stock must be stable enough for manipulation of the volume of money to have predictable consequences. Thus, thirdly, money is presumed to be 'important', in the sense that the interaction of the supply of money with the relatively stable demand for money function influences macroeconomic variables which have significance for policy.

Each of these elements has been disputed by the Australian monetary authorities. The Reserve Bank questioned the importance of the money supply when, in its mood of disenchantment with conventional policy after 1960/61, it enthusiastically embraced the Radcliffian view that "the supply of money is only part of the wider structure of liquidity in the economy." Governor Phillips argued in 1964 that "it was no longer feasible to rely only on the traditional approach of endeavouring to maintain financial stability and to influence expenditures by controlling the capacity of banks to increase the supply of money."

In line with the diminished significance attached to the supply of money, greater attention was given to the demand for money and its possible instability. Non-bank financiers were seen by the Bank to be the main cause of financial instability in the 1959-60 boom: while "reasonably prompt action was taken to limit the capacity of the banks to lend and thus produce further additions to the money supply", the operations of the non-banks "were adding new dimensions to the state of liquidity." Monetary policy in subsequent years was predicated on the assumption that non-bank intermediaries actually *do* generate financial disequilibrium, and the Bank made provision for alleged variations in the demand for liquid assets (money) when providing additions to bank reserves. Also, the Bank's current interest rate strategy makes allowance for 'financial flurries' and instabilities in liquidity preferences.

Along with other central banks, the Reserve Bank has now been persuaded towards the view that after all 'money matters' (although in Governor Phillip's words "so do other factors" - see Phillips, 1971). Yet, at the same time as recognizing that the money supply may have "some special significance", the Bank argues that "readings of trends in the money supply should take account of significant changes in other liquid assets" (Sanders 1972), and more controversially, questions the controllability of the conventionally defined money stock (currency plus bank deposits). The elasticity of the money multiplier is seen as contradicting policy actions through the monetary base, whereas the contribution of the S.R.D. ratio to monetary control is considered to be a limited.

No exhaustive examination of all of these three issues is attempted here. Rather, the whole of this study should be seen as being concerned in one way or another with the importance of money and the potential for operating monetary policy. Similarly, the issues of the demand for money function and the control of the money supply are matters discussed at considerable length in later chapters. For the present, we concentrate on examining certain facets of the issues involved. These are:

1. the definition of money, for the importance of money is traditionally associated with its transactions and asset functions.
2. the substitutability between bank and non-bank intermediary claims.
3. the behaviour of non-bank intermediary claims and monetary controls.
4. the monetary authorities' control over the supply of bank deposits.

Chapter 7

The Nature and Importance of Money

"When a student is asked 'what is money' he has still no choice but to give the conventional answer. Money is defined by its functions: anything is money which is used as money: 'money is what money does'. And the functions of money are threefold: to act as a unit of account (or 'measure of value' as Wicksell puts it), as a means of payment, and as a store of value." This pragmatic statement by Sir John Hicks (1967, chapter 1) gives no inkling of the debates about which of these functions is paramount and should provide the basis for a proper definition. Specifically, major schools have grouped around the issue of whether money's importance derives from its function as a medium for effecting payments or as a store of value. An intermediate position is taken by those who emphasize the role of money as a temporary abode of purchasing power.

Medium of Exchange

The former is clearly in the tradition of the classical quantity theory wherein money derives its importance from serving as a medium of exchange. The amount of exchange media demanded was presumed to depend primarily upon the value of current transactions and in explaining this demand the technological factors and insitutional arrangements which determine the length of pay periods, the extent of intermediate relative to final payments, the use of cheque accounts and such matters were examined. Although other determinants of the demand for money were not ignored (see Pesek, 1976), they were generally regarded as being of secondary importance and a reasonably mechanical link was thought to exist between the amount of money and the value of transactions. This relationship made for regulation of the price level by variations in the quantity of 'money'. Only those monetary items which actually change in ownership as a consequence of transactions were treated as money: originally coinage and paper money and eventually bank deposits transferable by cheque.

Recently the importance of the transactions role of money has been championed by Robert Clower (1969 and 1971). Using the criterion of "whether the tender of any given financial instrument permits a buyer to take delivery of a commodity from a seller", (1971, p. 18), he broadens the definition of money beyond hand-to-hand currency and demand deposits to include those credit facilities, such as unused overdrafts, department store credit and trade credit which permit buyers to acquire goods and services. At the same time he explicitly rejects the qualifications of time deposits and similar stores of value as money. The policy implications are obvious: the problems involved in controlling the use of trade credit and other substitutes for cheque deposits make it difficult to use monetary policy to stabilize prices along quantity theory lines.

The productive role of money in both of these formulations lies in avoiding the inconveniences and inefficiencies of barter. In a world of barter, goods are traded for goods and such direct exchanges are costly to arrange. A long chain of complex, costly and uncertain transactions are needed to be undertaken by transactors to convert an initial endowment of commodities (or labour) to the most preferred bundle. But in an economy which uses money, goods do not buy goods - goods buy money and money buys goods. Money exchanges are less costly than goods exchanges, so that the cost of searching out and effecting transactions to reach a preferred bundle is greatly reduced.

While this seems an elementary point, the rigorous analysis of a money using economy is still in its infancy. The Walrasian general equilibrium system of Arrow and Debreu assumes certainty equivalence and the existence of markets in which transactions are costless. It cannot accommodate money in any essential way, for money is an asset whose existence depends on transactions costs and uncertainty. Allowance for the existence of transactions costs or incomplete information (and thus uncertainty) gives rise to the study of what is termed a 'sequence economy', in which money serves as "an efficiency augmenting device economizing on transactions costs" (Madden, 1977).

Instead of a direct exchange of, say, goods for labour, there is now a sequence of markets in which labour services are first exchanged for money and then money for goods and services. It is no longer necessary for transactors to merge decisions about what to buy with decisions about what to sell. Transactions are less complex and less costly than under barter: money enables individuals to delay transactions by selling goods and services for generalised purchasing power which can be exercised later. But this means that money must be serving temporarily as a store of purchasing power "in which the seller holds the proceeds in the interim between sale and subsequent purchase or from which the buyer can extract the general purchasing power with which he pays for what he buys." (Friedman and Schwartz, 1970, p. 106) The means of payment function and the store of value function necessarily overlap.

Money clearly "matters" in its role as a medium of exchange, but it does so only in a particular sense. The elimination of barter exchanges clearly transforms economic life and permits specialization to occur, but once the social institution of money is established, variations in the form and quantity of the exchange media itself may not have great significance. Keynes (1937) stated this implication of exchange analysis clearly: "it (money) facilitates exchanges without its being necessary that it should ever itself come into the picture as a substantive object. In this respect it is a convenience which is devoid of significance or real influence." Instead, Keynes saw the importance of money stemming from its related function as a store of wealth.

Store of Value

The Keynesian tradition emphasizes money's function as an asset by which wealth is held. Attention is focused upon the psychological reasons for holding wealth in monetary form, specifically for 'precautionary' or 'speculative' reasons (Keynes) or as 'diversification' balances (Tobin), and any mechanical link between money demanded and the flow of transactions is eschewed. Indeed, it is precisely because the amount of money (however small) held in excess of transactions needs is seen as a voluntary and changeable component that money assumes importance. Because it is subject to direct economic incentives through changes in asset yields, this component of money is the vehicle for monetary policy and monetary disturbances (Hicks, 1967).

Money has the characteristics of an asset whose capital value does not fluctuate with the rate of interest, averting uncertainties which arise in market transactions and providing a reserve for emergences. For this purpose time and savings deposits are just as good as cheque deposits, and would be included in the definition of money, as Keynes did.[1] Indeed, time and savings deposits may 'dominate' the monetary aggregate, for as well as possessing stable nominal value they earn the holder a pecuniary income.

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1 Keynes (1936, p. 167). He also suggested the possible inclusion of treasury bills in the definition of money. Earlier in the Treatise, Keynes argued that balances required for the "purpose of making current payments" are held as demand deposits; time deposits roughly correspond to "savings deposits", held for reasons such as the anticipation that "other investments are likely to depreciate in money value." (Keynes, 1930 Vol. I, chapter 3).

But why should one stop here, for claims against non-bank intermediaries presumably satisfy the criteria? A theory about money dissolves into a broader theory about assets with constant (nominal) purchasing power.

Friedman generally follows in the Keynesian tradition of focusing upon the asset function of money, but doubts the value of examining the 'motives' for holding money as a basis for its demand and thus its definition. Instead he argues that the demand to hold money is *formally* identical to ("on a par with") the demand for other assets, commodities and services. This is not to say that money is exactly identical, for Friedman stresses the *temporary* nature of money holdings ("temporary abode of purchasing power"). But as he readily admits, a wide variety of assets could be used for the purpose of bridging the gap between the receiving and the making of payments. The definition of 'money' would commence as before with currency and current deposits, but would then possibly embrace time and savings deposits, claims against non-bank intermediaries such as building societies, finance companies and credit unions, holdings of short-term prime debentures and securities. What is, or is not money is arbitrary: "so far as I can see, no important substantive issues are involved ... only a question of the empirical usefulness of one or another admittedly imperfect approximation to a theoretical construct." (Friedman, 1964)

The Radcliffe Committee saw no value in even attempting to draw a line between money and other assets in terms of moneyness, expressing the view that in "a highly developed financial system" there are "many highly liquid assets which are close substitutes for money", money being defined as "immediately transferable purchasing power." The range of liquidity is such that only the state of general liquidity influences expenditures.

> "The decision to spend thus depends upon liquidity in the broad sense, not upon immediate access to the money ... The spending is not limited to the amount of money: but it is related to the amount of money people think they can get hold of, whether by receipts of income (for instance from sales), by disposal of capital assets or by borrowing." (para. 390)

Without going to this extreme, there would seem to be grounds for doubting the importance of money in either the Keynesian or Friedman analysis. Once the medium of exchange function is downgraded, and the money stock treated as an asset yielding services much like other assets, then many other stores of value seem to stand on equal ground. Why should one or more of these asset stocks be singled out as having special significance for economic activity? Friedman is particularly schizophrenic on this point. As we have seen, he says that "no issue of principle is involved in the choice of definition." More explicitly, he states that "there is *a priori* no reason why a fairly narrowly defined subtotal of liquid assets should have any special importance." (Friedman and Schwartz, 1970, p. 127) In endeavouring to set out why a quantity theorist considers the demand for money to be more important than the demand for a commodity like pins, Friedman had to confess that "it is not easy to state this point precisely." (Friedman, 1956). Yet he is the principal proponent of the view that "money matters", and in a recent comment (1976, p. 316) on Tobin and Buiter (1976) wrote that "for the monetarist/non-monetarist dichotomy ... the key difference is whether the stress is on money viewed as an asset with *special characteristics*, or on credit and credit markets." (our emphasis) If, however, these special characteristics cannot be elucidated, many will continue to doubt his monetary analysis.

The Importance of Money

Keynes had no doubt about the importance of money for his analysis. In a little known paper written in 1933, he outlined the task which lay before him "to work out in some detail a monetary theory of production to supplement the real exchange theories", for "booms and depressions are phenomena peculiar to an economy in which money is not neutral." This discussion is largely contained in chapter 17 of the General Theory, a chapter ignored by many, if not most, interpreters of Keynes.[2] Forty years after publication of the book general equilibrium theorists are beginning to discuss the matters which form the subject matter of this chapter; namely the differences between real exchange economics and monetary economics, and the important characteristics of money - see Ostroy (1973), Ostroy and Starr (1974), Ulph and Ulph (1975), Hahn (1976) and Madden (1977). Although Professor Hahn has described the chapter as "largely incomprehensible", we shall endeavour to unravel some of its mysteries.[3]

Keynes commenced by posing the question "wherein the peculiarity of money lies as distinct from other assets." His answer turned on three characteristics of money: (a) its high liquidity premium and low carrying costs; (b) its negligible or zero elasticity of production; and (c) its negligible elasticity of substitution.

In comparing money with other assets, allowance must be made for the presence of non-pecuniary services. The total net return from an asset can be sub-divided into three elements: the pecuniary return, r_p; the non-pecuniary service flow, r_{np}; and the convenience costs (the cost of holding the asset and acquiring the pecuniary and non-pecuniary yields), r_a. The pecuniary return is the interest or dividend income received in the case of bonds, debentures and shares, while for capital assets and consumer durables the return is in the form of services supplied in lieu of rentals, or services which assist in production. Most assets suffer wastage over time and there are transactions costs involved in acquiring or disposing of them. Keynes called these the "carrying costs". Finally, there are the non-pecuniary services, summarized by the word "liquidity", and covering attributes such as ease and speed of disposal (marketability), certainty

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2 The most recent instance is the book of Patinkin (1976).

3 The discussion which follows has benefited considerably by reading Hansen (1953), Dillard (1953), Cagan (1958) and Yeager (1968).

of value at future dates (predictability), divisibility, and protection from theft. The return implicit in these services can be measured by the explicit return which must be sacrificed to acquire the asset.[4] The net return can be written as

$$r_n = r_p + r_{np} - r_a$$

These own rates, as Keynes called them, may be expressed in terms of the asset itself or in terms of any other asset such as wheat or land. Normally the own rates are expressed in terms of money, so that the net return is in terms of holding a dollar of the asset per year.

Characteristically, the pecuniary yield on capital assets exceeds the convenience costs, and the non-pecuniary service flow is negligible. Stocks of finished goods usually have high holding costs relative to the expected yield and liquidity services. Money is peculiar in having a non-pecuniary service flow that exceeds its convenience costs, while its pecuniary return is either zero or established by government regulation.

> "It is an essential difference between money and all (or most) other assets that in the case of money its liquidity premium much exceeds its carrying cost, whereas in the case of other assets their carrying cost much exceeds their liquidity premium." (Keynes, 1936, p. 227)

Money is the asset whose own rate is the most reluctant to fall. Unlike other goods, money has no single definite price of its own which responds rapidly to economic forces in order that its market may be cleared by variations in its yield. The adjustment occurs in the prices of *other* commodities or assets, as an excess demand or an excess supply of money

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4 If the interest rate on a bank time or savings deposit is 3 per cent per annum, and the interest rate on a competing asset which provides no non-pecuniary services is 15 per cent, then the non-pecuniary service flow from the deposit is implicity worth at least 12 per cent per annum, ignoring differences in transactions costs.

spills over into other markets. The price of money is either the inverse of the general price level (to monetarists) or the interest rates, yields and thus the prices of other assets (to Keynesians).

Reinforcing this attribute is money's *negligible elasticity of production*. An increase in the demand for an ordinary product is met in part by an increase in price (a lowering of the own rate) and in part by higher production, which reduces the impact upon other markets. This is not so in the case of money, because it is not produced like ordinary commodities. Under a gold standard, additions to the demand for gold will not add significantly to employment, except in the case of gold-producing countries. With fiat currency, it is normal for the government to monopolize the issue.[5] Nowadays, the government shares its monopoly of the creation of money with banking institutions, and the presumption exists that the *features* of fiduciary currency are shared as well. This point is taken up later.

These two features of money provide the essence of Keynes' explanation of depressions and his invalidation of a Say's Law-type proposition that the supply of labour is the demand for goods produced by labour, so that real supply and real demand are necessarily equal. Without money, an individual could save only by accumulating real goods and dissave only by disgorging accumulated goods, in both cases with little or no effect on aggregate production. But in a monetary economy, an increase in the hoarding of money means a reduction in labour effort required, and real supply exceeds real demand, generating unemployment.

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5 Government monopoly of note issue is needed because of the gap between costs of production and exchange value. (Friedman, 1960, chapter 1) If currency were produced under conditions of open competition, its value in exchange for goods would fall to its marginal cost and we would have commodity money - a literal paper standard.

Similarly, an increase in the *supply* of money assumes special significance. Imagine that the government conducted an open market purchase of a commodity by selling some other commodity that it was storing. The price of the commodity being purchased would rise and that of the commodity being sold would fall. More production would be demanded of the commodity purchased and less of the commodity sold and, depending on the relative supply elasticities, the changes in the two outputs will tend to cancel each other out. When money is used in the open market purchase the offsetting responses do not arise and the effects run in one direction.

A further feature was seen by Keynes to reinforce the importance of shifts in the demand for money and make it the source of persistent unemployment; namely that "it (money) has an elasticity of substitution equal, or nearly equal, to zero." By contrast, most capital assets have a non-zero elasticity of substitution. If their price rises under the influence of expanding demand, substitutes flow in and check the rise in the value of the asset in question. In the case of money, such substitution is thought to be less likely.

> "Thus, not only is it impossible to turn more labour on to producing money when its labour-price rises, but money is a bottomless sink for purchasing power, when the demand for it increases, since there is no value for it at which demand is diverted, as in the case of other rent factors, to substitute some other factor for it." (Keynes, 1936, p. 231)

To Keynes, these three characteristics make money central to the problem of unemployment. Its liquidity premium is a "measure of our disquietude", while the low carrying costs make it relatively costless (except for foregone earnings) to hold wealth in monetary form. A preference for the hoarding of money is not easily satisfied by other assets, and its low elasticity of production means that an increase in supply does not rise to meet an increased demand. There is a flaw in the price mechanism because money is unlike other goods.

"Unemployment develops, that is to say, because people want the moon; - men cannot be employed when the object of desire (i.e. money) is something which cannot be produced and the demand for which cannot be readily choked off." (Keynes 1936, p. 235)

This interpretation of Keynes, and the importance of money, is disputed by Frank Hahn (1976).[6] He repeats Keynes' observation that the existence of money is not necessary to repudiate Say's Law. "Any non-reproducible asset will do", ... "land would have the same consequence and so would old masters." According to Hahn, "Keynes was fully aware of this and this is why he devoted so much space to the theory of choice amongst alternative stores of value." Money is "one of a number of non-reproducible assets. All such assets must compete with each other as well as with reproducible ones ... The equilibrium outcome in the labour market is of course not independent of the number of different assets there are and so the existence of money contributes to the outcome. But that ... is all." He concludes: "there is nothing to suggest that in a world of costless mediation without money with say a fixed land wage, the story would be different ... The special properties he [Keynes] claimed to find in the demand for money turn out to make no difference in kind to any theoretical proposition."

Keynes answered this criticism in part by his third characteristic of money - its low elasticity of substitution - which he introduced to "distinguish money from other rent elements." Land shares with money the attribute of having a zero or negligible elasticity of production, but when prices rise other factors can be substituted for it. With money, there are some substitutes which involve real resources, such as the hiring

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6 In an earlier but related analysis, Hahn (1965) argued that the existence of money is not necessary to establish unemployment.

of accountants and the development of cash flow systems, but these substitutions are generally thought to be minor for small variations in the exchange value of money or over short periods of time.

Yet substitutability is a matter of degree, and the question of whether money has close substitutes or whether it is different from other assets, particularly as a store of value, is empirical. Money may have a lower elasticity of substitution than land, but more than the other non-reproducible item cited by Hahn of old masters (that is, unless new paintings or undetected counterfeits are a close substitute for old works). A sophisticated financial system may be capable of throwing up substitutes for money in many forms.

The extent of substitutability in demand is only part of the answer, for Hahn's theory is far removed from the world of monetary *policy*. Consider Hahn's old masters, and suppose that the Reserve Bank were to conduct an open market purchase of securities (bonds) by selling off some of its extensive works of art. At a formal level the effects which ensue can be described in terms much like those which would ensue from the 'sale' of money. In order to effect the transaction the price of bonds will be bid up, while the bargain prices going on artworks would attract dealers in the bond market to temporarily become holders of art. But they will not wish paintings (previously money) to become a permanent component of their portfolio, and the secondary effects will commence as they sell the paintings (previously money) and re-acquire securities of various types, with effects fanning out through the various credit markets. Many of the securities acquired by dealers will presumably be newly issued by investors encouraged by the lower interest rates to produce durable assets.

There are important qualitative differences between the two cases. The undesirably large holdings of money are more easily disposed of than are the stocks of old masters, so that the secondary and subsequent effects of the open market operation get under way fairly quickly, and with little transaction costs. Because there are many more takers for money than there are for paintings, the effects are wide-ranging and not confined to any narrow segment of the capital market. In short, the 'market' for money is much better than the market for other assets. With old masters only the first round effect and the disposal of the paintings by the bond dealers is likely to be of use to policy. With money the first round effects are minor relative to the (so-called) 'secondary' effects which reverberate through the capital market. In Australia, the income velocity of narrow money, M1, is six or seven times a year, while transactions velocity (calculated as the ratio of bank debits to current deposits) is ten times that figure. The first round effects last less than a month!

Much of the importance attached to money thus comes because decisions about money have effects which are both wide ranging and speedy in operation. It is a component of most, if not all, balance sheets. In contrast with other assets and physical commodities which are much less widely distributed, changes in the quantity of money have broad effects on other markets. The breadth of the market for money makes it easy to spend or buy in large amounts quickly and without loss: in the terminology of Moore (1968), it has perfect 'marketability' and 'capital certainty'. An individual's excess holdings of money (but not those of the community at large) can be speedily reduced by acquiring securities or goods, whereas stocks of other goods are likely to remain at a higher or lower level than is desired for a considerably longer time. Changes in the supply of money are likely to have more immediate effects upon economic activity than will changes in other assets. These advantages of money cannot be exploited unless the authorities have the capability of generating an excess demand or supply of money in a significant and predictable way. That is, they must be able to shift the supply curve of money quickly, and the demand function for money must be significantly independent[7] of these actions.

We have now moved away from the characteristics, emphasized by Keynes, which render money " a bottomless sink for purchasing power" in depressions, towards characteristics (more relevant for inflationary times) which make variations in its *supply* have pervasive consequences for the economy - which is a feature of monetarist thinking. Much of the importance of money as a destabilizing element is business fluctuations comes about from features already mentioned, namely the absence of offsetting effects on production and employment, and because the adjustment of the system to monetary changes must necessarily fall upon other commodities. But why should monetary disturbances occur or, to be more precise, why don't disturbances in all of the n - 1 other markets in aggregate greatly outweigh the disturbances emanating from the money market? Part of the answer to this question may lie in characteristics of banks' intermediation processes. Perhaps bank credit creation is more expansionary than that of other intermediaries (see Culbertson, 1958 and Guttentag and Lindsay, 1968). Or perhaps banks are creators of credit, while non-banks are merely middlemen (see Aschheim, 1961). Perhaps banks are capable of generating substantial amounts of

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7 In a recursive sense. The arguments of the demand function (interest rates, incomes and price expectations) are not independent of the supply of money, but their reaction is not immediate. Such a recursive system is ignored by Laidler and Parkin (1975, p. 749). According to their criticism of the quantity theory, a cobweb (hog) cycle would be an invalid use of demand and supply analysis. What is required is that *shifts* in demand do not extinguish supply shifts.

money is excess of demand which cannot be extinguished (the 'hot potato' analogy), whereas non-banks' liabilities are predominantly demand-determined. Such differences would justify the existence of controls over banks and would ensure that government-induced variations in banks' balance sheets have large secondary repercussions.

If they are correct, such features would go a long way towards explaining why monetary policy is seen by monetarists to be so pervasive. They cannot be the complete answer. Decisions by the government to alter money are no different in principle from decisions of the public to alter their money balances (one affecting the supply of money, the other its velocity). Yet a feature of monetarist literature is its emphasis upon government actions as a source of instability while the private demand for money is seen as highly stable. Certainly the government does have the ability to "act on a scale that is extremely large relative to the actions of other independent economic groups." (Friedman, 1961) By virtue of its monopoly of note issue and controls over banks, the government has virtually unlimited power to inflate the currency. Restriction of the money supply is limited only by the amount of bonds it is prepared to sell and by the amount of taxes it is willing to levy. Political constraints do not operate in the short run, enabling a government to continue with an action, even if inappropriate, for a longer time than would private groups. These appear to be the sort of considerations which underlie the monetarists' dislike of government intervention.

Definition of Money

The foregoing discussion has identified several characteristics of money. First, the money asset must be universally acceptable in exchange. Any commodity can pay for at least one other commodity, but only the monetary commodity pays for *all* other commodities. Second, the holding of money enables individuals to delay transactions and store wealth in liquid form. Money serves as a "temporary abode of purchasing power ... which enables the act of purchase to be separated from the act of sale." (Friedman) Third, the money asset must be widely held. As Clower puts it, its 'market' must be "the least thin of all markets" so that it can be acquired and disposed of quickly and without loss: thus money is "liquidity par excellence" (Keynes). Fourth, the supply of money is desirably independent of demand. Much of the importance of money stems from it having a low supply elasticity with respect to elements of the demand for money. Further, to be useful for monetary policy, the supply of money should be readily responsive to variations in policy instruments, though by itself this cannot be an over-riding consideration.

Much of the dispute about the 'proper' definition of money arises because these characteristics are separable. In particular, the first two functions may be served by separate assets; in Friedman and Schwartz's (1970, p. 106/7) words, "the 'something' that is generally accepted in payment need not coincide with the 'something' that serves as a temporary abode of purchasing power". For many people credit facilities may serve as the instruments enabling them to take delivery of goods, while savings deposits serve as their major temporary abode of purchasing power. Any definition of money hinges upon what weight is given to the function of a temporary store relative to the means of payment function. Two approaches are commonly followed. One is to treat as money only those items which satisfy both criteria. Since the mere capacity of being a store of value does not confer moneyness, the attribute of being an exchange medium must do so. In the Australian context, this criterion is met by the M1 definition, of hand-to-hand currency and bank deposits at trading banks transferable by cheque. The alternative approach is to use a somewhat broader conception of money, based implicitly upon either the extent of substitutability in demand or substitutability in supply. For Australia, the most popular definition is the official Reserve Bank definition of M3, which adds time deposits and savings deposits to M1. This definition has been criticized by Arndt and Stammer (1972) and by Wallace (1964) for the inclusion of time and savings deposits, and by the former for the exclusion of unused overdraft facilities. Much of its justification, however, may come from the viewpoint of monetary control.

When the means of payment criterion is given prominence, the M1 definition provides a convenient starting point. Some savings bank deposits are transferable by cheque and some of the pastoral finance houses provide for their customers to write cheques, but these are both small in magnitude.[8] Similarly, some credit cards, and travellers' cheques are issued by private companies (such as American Express) but these are at present of minor significance. Nor are privately issued commercial bills used much as a means of settling debts.

There are, however, three questions which can be raised about the role of bank deposits as a means of payment (see Goodhart, 1975). First, as cheques are not universally acceptable in payment, do they qualify on the same grounds as currency? Secondly, does the availability of balances in time deposits and savings bank deposits enable payments to be effected by cheques? Thirdly, should unused overdraft and similar credit facilities be included as means of payment?

The first question worried monetary economists earlier this century.

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8 Client's credit balances with the Pastoral Finance Companies have declined from $80 m in 1953 to around $40 m in 1975. Cheque accounts at savings banks constitute about 3 per cent of total deposits.

In answering it, a distinction needs to be drawn between the deposit itself, and the instruments used to effect its transfer. A cheque is not money, any more than is a credit card. A cheque is simply a written order to transfer money, which in this context takes the form of a bank deposit. Refusal of a cheque does not mean that the deposits are unacceptable in payment, what is in doubt is the drawer's ability to transfer them to the account of the drawee. The limitation comes from the transfer mechanism, not from bank money.

The second question is prompted by the flexible arrangements which characterize the relation between bank and customer in the British and Australian systems of banking. As Shackle (1971) has noted, "I cannot write a cheque on my deposit account, but I can write one on my current account which, even if that account is empty, will be honoured if covered by my deposit balance (time deposit)." Time deposits in Australia are for longer terms than deposit accounts in Britain, but there can be premature encashment. His argument is certainly applicable to savings bank deposits, the majority of which are withdrawable on demand,[9] for easy transfer between current, time and savings deposits is encouraged by 'banking under one roof'. Some case would seem to exist for including *all* liabilities issued by a particular class of institution in the definition of money, rather than attempting to make a division solely on the basis of book-keeping categories. (See Friedman, 1960, p. 91)

But, thirdly, if time deposits and savings bank deposits are to be given consideration because they *may* permit the drawing of a cheque, should not unused overdraft facilities be considered, for these *do* enable a cheque

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[9] As at June 1976, ordinary accounts at Savings Banks accounted for 65 per cent of the total.

to be written? Payment by cheque can be made just as easily by over-drawing an account, once an overdraft limit has been negotiated, as by reducing a credit balance. For small accounts, unused credit on Bankcard serves a similar role. And if unused credit at a bank is to be included, what of a credit account at a department store or trade credit, which also enables a buyer to take delivery of goods? This is Clower's (1971) position: "for most practical purposes, 'money' should be considered to include trade credit as well as currency and demand deposits." A difference is frequently made between credit at a bank and other types of credit from the viewpoint of the supply of money, as bank credit has the potential to expand bank deposits whereas use of other credit rearranges the ownership of deposits. But this distinction boils down to the nature of bank preferences for excess reserves; in the absence of free cash or the willingness to draw down free cash, reductions in other earning assets need to offset the increases in credit extended, so that bank credit is on the same footing as other credit. More fundamentally, an important difference exists between use of *any* credit facilities and use of bank deposits. In the former case, the acquisition of purchasing power involves simultaneously assuming a matching specific liability. "Use of my overdraft facility of trade credit entails the accumulation of a debt that I must eventually repay, whereas I am under no obligation to rebuild my pocket cash or deposit balance. Money can alternatively be defined as assets I exchange for goods without incurring a debt and a repayment obligation." (Johnson, 1971).

Turning to the other characteristics of money, the case for including time deposits and savings deposits is strengthened. A large proportion of trading banks' interest-bearing deposits presumably serve as a temporary store of purchasing power: certificates of deposits are negotiable;

one third of term deposits are lodged for terms of three months or less and premature conversion of longer term deposits is permitted in most circumstances.

The case for adding savings bank deposits is stronger. They are widely held in the community, and their 'market' is good; they are capable of being withdrawn easily and quickly through a ubiquitous branch and agency network; their value at future dates is fully predictable in terms of cash; they are fully 'reversible' in that a simultaneous deposit of a sum and withdrawal of an equal sum are possible at no pecuniary cost and leave the depositor's capital intact; and balances are divisible into the smallest possible units. There is a close correspondence between deposits lodged and deposits withdrawn, and both move harmoniously with business activity, reflecting savings banks' general involvement in the flow of money payments in the community, and the public's use of savings bank facilities as a medium for temporarily storing purchasing power. (See Lewis and Wallace, 1974).

Nevertheless, the whole of savings deposits cannot be regarded as nearly identical with trading bank current deposits. Their turnover is on average 1.65 times per year compared with 21 times for trading bank accounts (in 1971). A large amount of savings deposits serve as permanent as well as temporary abodes of purchasing power, often held for fixed terms as a reserve for emergencies or to finance some future (and often vaguely conceived) expenditure.

There may be grounds for including time and savings deposits from the viewpoint of the criterion of monetary control and/or inelasticity of supply. Their existence may render the M1 definition of money demand-determined, for holders may be able to satisfy their 'transactions' requirement by drawing down these balances, or adding to them. Certainly, the M3 definition has been adopted by the Reserve Bank: it may be that the monetary authorities are more concerned about the total of the items in M3 than they are about individual component parts.

But if time deposits and savings bank deposits are to be given consideration for inclusion in the definition of money, why not deposits and claims with finance companies, especially bank-affiliated ones where the 'under the same roof' argument has appeal? What of credit unions? And what grounds can possibly exist for excluding deposits (shares) at building societies? These deposits appear to be close substitutes for savings bank deposits and time deposits (see Lewis and Wallace, 1974). It does not necessarily follow from this that building society deposits are substitutes for currency and demand deposits. If savings bank balances are a different order of 'moneyness' compared with trading bank deposits, the lower turnover of building society deposits is even more marked: they turnover 0.57 times per year. Indeed, we have not established that either time deposits or savings deposits are *in practice* substitutes for narrow money M1.

There may be grounds for distinguishing between these claims on the basis of their respective supply characteristics. Perhaps banks are inherently more expansionary (in terms of their credit creation) than are other intermediaries, which makes them potentially more destabilizing and more responsive to monetary policy operations. But to the extent that bank deposits possess more of the characteristics of money (in terms of supply behaviour) because they *are* controlled, but non-banks are not, this is hardly a useful distinction.[10] Under the Financial Corporations Act, non-bank financiers could be controlled, and then the uniqueness of banks would disappear.

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10 This point was made by Tobin (1969).

The critical issue as far as monetary control is concerned is empirical, concerning the extent of substitutability in practice. Control of the quantity of bank deposits is of little value if a supply of near-money assets is available to perform the same functions. When the quantity of bank deposits is reduced, does the market expand the substitute assets to satisfy the excess demand for balances? Or do the various 'liquid' assets bear a stable relationship to narrow money, M1? These are points taken up in following chapters.

Conclusion

To summarize the argument so far, there *are* important issues of principle involved in the definition of money, for money has characteristics which set it apart from other assets, and which give it importance for economic fluctuations. Only the M1 definition of money meets all the criteria we have indentified, but one or more of the characteristics are shared by other assets. In particular, time and savings deposits, whch form part of the official M3 definition of money, are temporary abodes of purchasing power and, at least in the case of savings deposits, are highly liquid and widely held. But so are building society deposits, and perhaps claims of finance companies and credit unions. From the viewpoint of monetary control, issues of government securities are an additional instrument of policy. Are these substitutes for money (Tobin), or for private bonds (Friedman)? While we know that M1 is money, we must resort to empirical evidence to determine the boundaries of moneyness.

As with the question of defining an 'industry' in industrial organization,[11] so in delineating money one is led to examine actual behaviour.

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11 See Needham (1969).

This involves consideration of the demand characteristics, that is the extent to which the public regards liquid assets as being more or less equivalent to currency and demand deposits, and the supply characteristics, that is the processes which govern the extent to which, and terms on which, the various assets can be substituted for each other. In the following chapters we provide some evidence of the demand and supply of liquid assets.

Chapter 8

The Demand for Liquid Assets

Questions of the Analysis

This chapter examines wealth-holders' choices between the components of the narrow definition of money, M1, and various groupings of liquid assets, thought to be possible substitutes. In the first half of the chapter, the extent of substitutability with time deposits and savings bank deposits since 1910 is considered. Attention is then focused in the second section on the nature of the demand relationships in post-war years alone, and the range of assets is there broadened to include claims issued by non-bank financiers such as building societies, credit unions and finance companies, as well as interest bearing debt of the government.

On the basis of the discussion in the previous chapter we concluded that only hand-to-hand currency and demand deposits at the trading banks unambiguously satisfied the criteria we developed for defining money. One reason for considering wealth-holders' demand for the various liquid assets is from the viewpoint of the appropriate definition of money. Are other liquid assets 'strong' or 'weak' substitutes for the narrowly defined monetary aggregate?

The nature of the substitution relationships between the liquid assets also has relevance for the efficacy of monetary policy. Do the non-bank intermediaries issue liabilities which substitute for bank claims in wealth-holders' portfolios? How interest-sensitive is the demand for narrow money and has the interest rate elasticity increased with the growth of non-bank intermediaries? These questions are obviously relevant for assessing what potential exists for interest rate induced variations in the velocity of money to counteract policies affecting the supply of money. The Radcliffe Committee seemed to suggest that the interest rate elasticity of velocity might be nearly infinite, because of the ready supply of money substitutes. While this view has been generally discredited,[1] an elastic velocity can cause problems for monetary policy if the induced changes in the demand for liquid assets are difficult to predict either in timing or extent.

A possibly more vital question, then, is the stability and predictability of the substitution processes. But stability is not absolute; it is relative to the variety of economic circumstances and the number of explanatory variables, for a stable function is less meaningful if the number of variables included is allowed to be large. In the analyses which follow, only a limited number of explanatory variables are used to explain the demand for liquid assets.

From the viewpoint of monetary control, the extent to which government securities substitute for money is also of considerable interest. The assumption usually made is that government securities are closer substitutes for physical capital assets than they are for money, although it is recognized that government support programmes which remove uncertainties about bond price fluctuations may render bonds a money substitute. James Tobin disputes this:

> "What about ... the interest-bearing government debt held by the public? Are its size and composition of no monetary consequence? ... There is uncertainty about government security prices in normal times, but it does not prevent them being good substitutes for bank deposits." (Tobin, 1965b)
>
> "... If government securities must be assimilated to capital or money, one or the other, the better bet is money." (Tobin, 1961)

His views have found reflection amongst many Australian economists, who treat government securities and cash as equivalents in the portfolios of banks,

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[1] In the United States, the Radcliffean position is associated, though enunciated in less extreme form, with the names of Gurley and Shaw (1955, 1956 and 1960). The theoretical implications are discussed in Artis (1961), and empirical evidence on the extent of interest elasticity of velocity is surveyed in Laidler (1969).

and thus implicitly in the balance sheet of the public. Indeed, as we demonstrated in chapter 3, this can be said to be the official view of the monetary authorities.

The Model and Specifying Assumptions

Liquid assets offer potential holders a range of characteristics: in the previous chapter we divided the total return into the pecuniary return, the convenience costs and the flow of non-pecuniary services. Currency and demand deposits at trading banks (termed money) is held to effect transactions, in the case of demand deposits providing access to a sophisticated payments mechanism, and because of the implicit yield in the form of liquidity and similar non-pecuniary services. Interest-bearing assets are held partly for their pecuniary return in the form of interest rates and in part because their relative certainty of nominal value and their safety, convenience and ease of convertibility into currency or demand deposits enables them to be used as a temporary (or permanent) store of purchasing power. The service flows attached to the various assets cannot be directly observed, and only the stock of assets producing the services is measurable. If we assume a fixed relationship between the flow of services and the stock, then the stock may be used as a proxy for the service flow in a demand relationship utilizing the framework of traditional demand analysis to analyze the determinants of wealth-holders' demand for liquid assets.

Wealth-holders are visualized as having a capital account incorporating the type of asset they wish to hold, together with the sort of indebtedness they wish to incur. Liquid assets have a place in this account as payments media, as a temporary repository between the receipt of income and its disbursement, or between the sale of assets and re-investment of the proceeds, as a reserve for emergencies, or as an avenue for 'safe' investments. In addition to preferences for the various characteristics and services provided, the important determinants of demand for a particular asset is likely to be its pecuniary yield relative to the yields of alternative assets, and the 'budget constraint'. The obvious analogue of the budget constraint of conventional demand analysis is total assets, or net worth, as these constrain the holdings of assets in the same way that income restricts expenditure on income account. But liquid assets are likely to be closely related to income, both because income is itself a proxy for wealth and also because their 'moneyness' links them to the current flow of incomes and expenditures. Wealth or income affects the total stock of assets required as well as the desired asset 'mix' in the portfolio.

When measuring the demand for liquid assets the usual practice is to regress values of the asset holdings, expressed in nominal or real terms, against measures of interest rates and income (or wealth), and the observations of assets balances so explained are viewed as movements within a given demand function induced by changes in the nominated variables. As in any demand analysis, this interpretation is justifiable only if the possibilities that (a) the demand function itself may have shifted and (b) actual balances may differ from the public's desired holdings, can be excluded. In practice the appropriateness of ignoring the former possibility is judged on the basis of the results obtained - that is, upon the goodness of fit and stability over time of the empirical models - but these criteria do not rule out the possibility of supply disequilibria, so that the postulated demand function may in fact be a composite of demand and supply responses. This possibility follows from the public's use of liquid assets as temporary abodes of purchasing power. Unanticipated injections of liquidity (as, for example, arising from monetary policy actions) may be held temporarily as liquid assets pending expenditure or the purchase of other securities, and the balances lodged cannot be held to constitute a 'permanent' increase in the demand for each of the various liquid assets. Depending upon the length of the lags in the adjustment to monetary changes, even the use of annual data may not overcome the problem.

One way around it is suggested by the traditional analysis of the determinants of the money, and involves analyzing the behaviour of currency and demand deposits *relative* to other liquid assets.[2] Underlying this specification is the presumption that the *volume* of liquid assets is much influenced by supply disturbances and the behaviour of the monetary authorities; whereas the *division* of this total volume into the various categories is determined primarily by demand considerations. In the example given in the preceding paragraph, the injection of liquidity will presumably flow into current bank deposits initially and will then be transferred into time deposits and savings bank deposits and other liquid assets which serve as temporary stores of value on the basis of the usual preferences. All liquid asset holdings may be in excess of requirements but the relationship that they bear to each other may not, and the asset ratios may reveal demand influences more reliably than would the various asset stocks.

Use of the ratio approach has appeal from another point of view. The decision-making processes involved in the demand for liquid assets can be visualized as proceeding in two stages. First, there is a decision about the amount of 'safe' assets to be held in the portfolio relative to 'risky' assets, such as real capital assets, shares and perhaps long term bonds, perhaps along lines outlined by Tobin (1958, 1965). Then, secondly, there is a decision made about the *division* of the total liquid assets

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2 This method was originally employed for currency by Cagan (1958), and for demand deposits by Christ (1963).

into 'money' and interest bearing forms. In using the asset ratios to examine the demand for liquid assets, we are thus assuming that other media for wealth-holding (real goods, shares and bonds) do not affect the internal portfolio relations between money and other liquid assets.[3]

Thus the model has the form

$$^{D}/_{D + X} = \beta_0 + \beta_1 r_X + \beta_2 y + e$$

where D is currency and trading bank deposits; X is various aggregates of time deposits, savings bank deposits, and other liquid assets; r_X is an index of the pecuniary rates of return on the various aggregates of liquid assets, and y is a measure of income or wealth. As specified, the model assumes that the non-pecuniary service attached to each dollar of assets remains unchanged. This is obviously unrealistic, and we will modify this assumption when studying relationships in the post-war years.

Substitution among Bank Claims, 1910-1970

This section examines the substitutability of trading bank demand deposits (D), trading bank time deposits (T), and savings bank deposits (S) over the time period 1910-1970. This length of time period provides us with three major, and several minor, cyclical movements in interest rates; whereas in the post-war years, interest rates have moved predominantly, and with only minor interruptions, in one direction (upwards). It also provides some opportunity to assess whether the substitution relationships

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3 The method has advantages from a statistical as well as a theoretical point of view by enabling us to deal with the problem of trend, which plagues most long-run studies of the demand for liquid assets. One is always unsure whether the behaviour revealed from data which are dominated by secular trends carries over for shorter run movements. Expressing the variables as ratios to each other is an alternative to using first differences or some similar statistical transformation.

Table 8.1

Simple correlation coefficients between various liquid assets ratios and relevant interest rates, by decades 1911-1970.

Liquid asset ratio	Interest rate	1911-1920	1921-1930	1931-1940	1941-1950	1951-1960	1961-1970
$D/D + T$	r_T	+.74*	-.30	-.58	-.95†	-.88†	-.70*
$D/D + S$	r_S	+.13	-.94†	-.71*	-.19	-.93†	-.60
$D/D + T + S$	$r_{T.S}$	+.64*	-.70*	-.67*	-.79†	-.96†	-.66*

* Significant at .05 level
† Significant at .01 level

have altered over time, and specifically in response to the more rapid growth in savings bank deposits as compared with trading bank deposits.[4] Currency holdings are excluded partly because of the difficulties in obtaining reliable estimates of coinage holdings, and partly because complex demographic factors may condition its demand.

Particular interest attaches to the significance of interest rates on the relative demands for the liquid assets, and preliminary evidence of this association is provided in Table 8.1 in the form of simple correlation coefficients between the asset ratios and the appropriate interest rates for the 6 decades. The majority of correlations are significant and, with the

4 At the beginning of the period savings bank deposits were 40 per cent of the size of trading bank deposits. At the end of the period, they were approximately of equal size.

exception of those for the first decade, bear the correct sign. Generally speaking, the correlations are larger in latter periods, though this is not the case for the last decade. This may be due to the establishment of the second group of private savings banks and the associated competition to expand branch networks, with the result that the substitution between the liquid assets may have been in response to variations in the flow of non-pecuniary services per dollar of deposits as well as the pecuniary income: this possibility is investigated later. A similar reasoning may apply to the positive correlation in the first decade when the Commonwealth Savings Bank (now by far the largest bank) was formed. Further investigation of this period lies beyond the scope of this study and in the regressions which follow we concentrate attention upon the full period and the post-war years.

Regressions involving the substitution between time deposits and demand deposits are presented in Table 8.2. Demand deposits yield a flow of non-pecuniary services which are assumed to be roughly proportional to the stock of deposits held. Banks charge holders of demand deposits for some of the services provided by levying a service charge, and this should be seen as a negative pecuniary rate of return. However for most of the period banks levied charges mainly by means of interstate exchange charges, making the cost depend more upon the nature of the transactions rather than ownership, and insufficient information is provided to calculate the average service charge since the present method was instituted. Thus the interest rate on demand deposits is treated as zero. The interest rate received on time deposits differ according to the nominated term of deposit, and the interest differentials between the terms have varied considerably. In order to take these factors into account, the time deposit rate employed, r_T, is an average of the quoted term rates (weighted according to the average term classification over the period - see Appendix).

Table 8.2

Regressions with the dependent variable $^{D}/D + T$,

i.e. the percentage of demand deposits to the sum of demand

and time deposits, for various periods.

Time period	Regression coefficients				$\bar{R}^2$	D.W.
	1	r_T	y	y_P		
1910-1970	74.16	-6.09 (4.33)			.24	.05
	36.00	-3.43 (3.08)	.0456 (6.84)		.58	.10
	33.70	-3.63 (3.49)		.0515 (7.60)	.62	.08
1910-1970, excluding war years 1940-1945	79.23	-7.38 (4.54)			.29	.10
	38.54	-4.64 (3.80)	.0474 (6.83)		.65	.22
1948-1970	89.04	-6.66 (6.33)			.67	.81
	90.68	-3.74 (3.04)	-.0471 (3.27)		.80	1.04
	117.05	-4.27 (2.52)		-.0396 (1.74)	.71	.65

The income variable used, y, is real G.D.P. per head. Changes in the price level, and anticipations of the rate of inflation, are assumed to leave the division between the assets unchanged. Analysis of the demand for liquid assets in terms of balance sheet preferences suggests the use of wealth as a constraint, but no data for this is available in Australia. A series of permanent income is used as a proxy for wealth.[5]

The time period 1910-1970 encompasses a wide variety of economic circumstances - two world wars, one major depression, dramatic changes in the structure of the economy - yet income and the interest rate are able to account for about 60 per cent of the variability in $^{D}/_{D+T}$. In the post-war sample, 80 per cent of the variable is 'explained' by these variables, and it is noteworthy that the response of the ratio to interest rates is little altered, which is some evidence of stability over time. Only a minor improvement comes from the substitution of permanent for current income, and it may be that the means of payment function of demand deposits makes current income the appropriate scalar. The sign on the income variable is of interest. For the period 1910-1970 the coefficient indicates that the income elasticity of demand deposits exceeds that of time deposits; in post-war years this is reversed. With the greater economic stability of post-war years, more of 'precautionary' type balances (which are supposed to vary with income) may have come to be held in time deposits. Also, the income elasticity of demand deposits may decline as income rises. Teigen (1964) found with U.S. data that the income elasticity of demand of currency plus demand deposits in the post-war period was half that of the pre-war years.

A marked contrast is evident when the substitution of demand deposits and savings bank deposits is examined in Table 8.3. The ratio $^{D}/_{D+S}$

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5 Calculated by applying the exponentially declining weights of .35, .23, .15, .14, .13 to current and prior values of income. These weights are based on unpublished regressions of consumption spending upon income.

Table 8.3

Regressions with the dependent variable $^D/D + S$,

i.e. the percentage of demand deposits to the sum of demand

deposits and savings deposits, for various periods.

Time period	Regression coefficients				$\bar{R}^2$	D.W.
	1	r_S	y	y_P		
1910-1970	52.51	-3.42 (2.89)			.11	.13
	49.00	-3.02 (2.39)	.0038 (.96)		.11	.13
	48.32	-3.01 (2.43)		.0050 (1.11)	.12	.13
1910-1970, excluding war years 1940-1945	55.44	-4.68 (3.47)			.19	.15
	49.92	-4.04 (2.84)	.0058 (1.30)		.20	.15
1948-1970	74.15	-11.79 (7.40)			.74	.64
	85.75	-9.37 (4.50)	-.0189 (1.70)		.76	.98
	80.06	-10.53 (4.14)		-.0101 (.65)	.73	.65

exhibits little response to the explanatory variables over the full period 1910-1970. It may be that the substitution relationships discerned in Table 8.1 are unstable over time, or that the responses to the variables are swamped by variations in the flow of non-pecuniary services. Also, demand deposits and savings deposits may not have been close substitutes in the early years, for the relationship is much closer when the period 1948-1970 is considered. The interest rate alone 'explains' 74 per cent of the variability in $^{D}/_{D + S}$.

These results are generally confirmed in Table 8.4, which focuses attention on the behaviour of the ratio $^{D}/_{D + T + S}$. A close inter-correlation exists between the interest rates on time and savings deposits, which is to be expected if they are competing assets and if the rates are both subject to monetary policy influences. Accordingly, an index of the two rates, denoted by $r_{T.S}$, is constructed giving 40 per cent weight to r_T and 60 per cent to r_S, which reflects the respective size of the deposits on average during the full period. As with the ratio $^{D}/_{D + S}$, the regression analysis indicates the greater predictability of substitution relationships in post-war years. Movements in income and the two interest rates jointly explain 76 per cent of the variations in the dependent variable, compared with about 40 per cent over the whole period. The correlations are generally lower than when the substitution of demand deposits for time deposits alone was studied. From the viewpoint of the definition of money, there would seem to be little value in going beyond the M2 definition (currency, demand and time deposits) in the years before World War II. However, an important deficiency of the data must be noted, for while deposits at trading banks are held by both business enterprises and persons, savings deposits are only available to persons. Not all of demand deposits can be transferred to savings banks in response to interest rate changes.

Table 8.4

Regressions with the dependent variable $^{D}/D + T + S$, i.e. the percentage of demand deposits to the sum of demand and time deposits plus savings deposits, for various periods.

Time period	Regression coefficients				$\bar{R}^2$	D.W.
	1	$r_{T.S}$	y	y_P		
1910-1970	44.70	-4.42 (4.04)			.21	.09
	28.70	-2.93 (2.81)	.0182 (3.98)		.38	.11
	27.38	-3.03 (3.07)		.0213 (4.56)	.42	.11
1910-1970, excluding war years 1940-1945	48.41	-5.64 (4.51)			.29	.10
	30.68	-4.00 (3.47)	.0194 (4.07)		.47	.13
1948-1970	61.02	-8.49 (7.13)			.72	.65
	77.91	-6.24 (3.98)	-.0248 (2.02)		.76	1.17
	69.50	-7.34 (3.67)		-.0129 (.72)	.72	.66

Despite these limitations of the data, the interest rate elasticities calculated (from the means of the variables) and set out in Table 8.5, give confirmation that savings bank deposits as well as time deposits are a money substitute. If savings deposits do substitute for demand deposits, we would expect a more interest elastic relationship with $^{D}/_{D + T + S}$ as dependent variable than in the case of $^{D}/_{D + T}$, because shifts into savings deposits are taken into account as well as shifts into time deposits. This is so in both the periods shown in the Table. It is evident that the interest rate elasticity of demand deposits with respect to savings bank deposits has increased markedly in post war years. If this increased substitutability produced by the growth of savings banks since 1910 is mirrored by the growth of non-bank intermediaries in post war years, the fears expressed about the efficacy of monetary policy may be justified. By the same token, there has been a reduction in the interest rate elasticity of demand deposits to the time deposit rate. Savings bank deposits may now be performing the role in the banking sector which was previously carried out by time deposits.

One limitation comes from the presence of serial correlation in most of the regressions (though it seems to be a less serious problem in the post war years). It calls into question the assumption that variations in non-pecuniary services and convenience costs are of minor significance in the analysis, and also the assumption that substitutions with assets outside of the groupings can be ignored without affecting the results. These assumptions are now relaxed.

Money and Liquid Assets, 1953-1970

The analysis differs in several respects from that of the previous section. First, the range of assets studied is widened beyond the claims

Table 8.5

Regression coefficients and elasticities between various liquid assets ratios and relevant interest rates, for various periods.

Liquid assets ratio	Interest rate	Slope coefficients		Elasticity at sample mean	
		1910-70	1948-70	1910-70	1948-70
$^{D}/D + T$	r_T	-3.43	-3.74	-.21	-.16
$^{D}/D + S$	r_S	-3.02	-9.37	-.18	-.49
$^{D}/D + T + S$	$r_{T.S}$	-3.03	-6.24	-.28	-.42

of trading banks and savings banks to encompass the interest bearing liabilities issued by building societies, credit unions, unit trusts, finance companies, merchant banks, and governments. Secondly, the assets are placed on a similar footing. Deposits at trading banks are held by corporate enterprises and financial institutions as well as by persons, as are the claims issued by finance companies, merchant banks and government bonds. Savings bank deposits, shares and deposits with building societies and credit unions are ostensibly held only by individuals and non-profit organizations, but in practice they are used extensively by self-employed persons and farmers. To make the various assets comparable with each other, the data chosen for use are the holdings of both persons and unincorporated enterprises. The series are based on information contained in the Reserve Bank of Australia's Flow of Funds accounts, which provide annual observations over the period 1953-1970.[6]

The third difference makes allowance for returns on *non*-liquid assets to affect the portfolio composition as between the various liquid assets. Consider the ratio $^{D'}/D' + X$, where D' is personal and unincorporated enterprises' holdings of currency and demand deposits and X is the interest bearing liquid assets which make up the particular aggregation. Extending the earlier theoretical analysis, we hypothesize

$$^{D'}/D + X = \beta_0 + \beta_1 y + \beta_2 r_X + \beta_3 r_Z + \varepsilon$$

where r_Z is the rate of return obtainable from non-liquid assets, *Z*. The

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6 The data are, in the main, end-of-June holdings. Data of time deposits are not provided in the Flow of Funds and these are derived from the classification of deposits by industry published in various issues of the Reserve Bank of Australia's *Statistical Bulletin*. After 1960 these data are end-of-July holdings.

sign of β_3 is uncertain. Non-liquid assets may be substitutes for either D' or X. If substitutes for D', increases in the interest rate on non-liquid assets will, *ceteris paribus*, lower the ratio $^{D'}/_{D' + X}$ or leave it unchanged (when the transfers merely rearrange the ownership of demand deposits). If the non-liquid assets are substitutes for X, then increases in their rates will raise the ratio $^{D'}/_{D' + X}$ as shifts of funds out of X into market instruments reduce X and possibly raise D'. The precise nature of the substitution relationships needs to be determined.

Finally, the assumption of constancy in the non-pecuniary and convenience return per dollar of liquid assets is relaxed. The available data enables us to do this only with respect to trading and savings banks; nevertheless important changes have occurred in the characteristics of savings deposits. One was the establishment of the private savings banks in the late 1950's and early 1960's. With the availability of 'banking under one roof' switches between demand deposits, time deposits and savings deposits became easier and less costly to arrange. The bulk of deposits originally gained by the new savings banks came from the reallocation of funds by their clients as they took advantage of the opportunity to acquire savings accounts at what were previously solely trading bank branches, thereby earning interest on balances which are substitutes for current accounts. Our first proxy to capture this qualitative improvement in savings bank deposits is the ratio of the number of savings banks relative to the number of trading banks (TB/SB). Associated with the establishment of the new savings banks was aggressive competition between the new banks and the old banks to obtain a more intensive geographical coverage of the community with savings bank outlets. Over the decade to June 1967, the number of savings bank branches increased from 2389 to 5292, 1300 of which were newly opened branches. The second proxy is the number of savings bank branches expressed as a ratio to trading bank branches (BR).

Substitution amongst Bank claims

We examine first the factors governing the substitutability amongst the components making up the official definition of the volume of money. The regressions are reported in Table 8.6. Those equations prefixed by numbers 1 and 2 examine the role of incomes and interest rates in influencing the share of currency and demand deposit holdings (which correspond to narrow money, M1) in the broader monetary aggregates of M2 and M3 respectively. Regressions 1a and 2a replicate those in Table 8.2 and 8.4. Income is now personal income per head, and the index $r_{T.S}$ gives a weight of 82 per cent to savings deposits reflecting the different sizes of the respective balances in personal holdings. Both equations are well determined, 'explaining' respectively 88 and 92 per cent of the variations, and the interest rate elasticities are -.11 for r_T and -.43 for $r_{T.S}$. The income elasticity for currency and demand deposits appears to be much lower than for the other assets.

Movements within the monetary aggregate may indicate not only substitution between the various assets included but also shifts between one or two of them and other forms of wealth holding. Evidence of such substitution is provided in equations 1b and 2b, where the interest rates on long-term government bonds is used as an indicator of general market rates. The positive sign on the coefficient of r_G indicates that these 'non-liquid' assets are closer substitutes for time deposits and savings deposits than they are for demand deposits or currency - which seems reasonable. In equation 1c, 'permanent' real disposable income per head is substituted for current income, with some minor improvement in the coefficient of determination.

Table 8.6

Regressions relating the Division of the Public's Holdings of Currency, Trading Bank and Savings Bank Deposits to Various Explanatory Variables 1953-1970 ('t' values in parentheses)

Regression No.	Dependent Variable	Constant term	Variable and coefficient		Variable and coefficient		Variable and coefficient		R^2	D.W.
1a	$^{D'}/D' + T$	120.49	-.040 (3.460)	y_d	-2.523 (2.337)	r_T			.88	.66
1b	$^{D'}/D' + T$	103.25	-.043 (4.251)	y_d	-3.584 (3.505)	r_T	+4.648 (2.494)	r_G	.92	1.20
1c	$^{D'}/D' + T$	111.64	-.062 (5.636)	y_d^P	-3.316 (3.919)	r_T	+5.589 (3.532)	r_G	.94	1.33
2a	$^{D'}/D' + T + S$	83.59	-.032 (-3.513)	y_d	-5.976 (-4.024)	$r_{T.S.}$			.92	.67
2b	$^{D'}/D' + T + S$	69.22	-.034 (-4.906)	y_d	-7.820 (-6.352)	$r_{T.S.}$	+4.461 (3.464)	r_G	.96	1.60
3a	$^{D'}/D' + S$	88.24	-.030 (3.679)	y_d	-6.591 (4.023)	r_s			.92	.73
3b	$^{D'}/D' + S$	79.44	-.023 (3.540)	y_d	-1.258 (0.660)	r_s	-12.930 (3.63)	$^{S.B.}/T.B.$	.96	1.09
3c	$^{D'}/D' + S$	74.83	-.023 (3.820)	y_d	-0.364 (0.193)	r_s	-11.720 (4.140)	B.R.	.96	1.14
4a	$^{T}/T + S$	5.71	+.013 (2.318)	y_d	+1.378 (1.400)	$(r_T - r_s)$			.74	.88
4b	$^{T}/T + S$	5.67	+.013 (2.181)	y_d	+1.558 (1.051)	$(r_T - r_s)$	-0.430 (-.167)	B.R.	.74	.85

Definition of Variables

D' = Currency and Current Deposits of Trading Banks

T = Time Deposits of Trading Banks

S = Savings Bank Deposits

r_G = Yield on long-term government bonds.

$^{SB}/_{TB}$ = Ratio of Number of Savings Banks relative to Trading Banks.

B.R. = Ratio of Number of Savings Bank Branches relative to Trading Bank Branches.

In the equations prefixed by numbers 3 and 4 the direct comparison of savings deposits with both time deposits and demand deposits plus currency permits us to incorporate the bank and branch variables. The relative contribution of variations in non-pecuniary as opposed to pecuniary returns is difficult to determine - one reason is that the two have tended to move together over the period. Interest rate differentials appear to have exerted a larger impact on substitution of savings banks vis-a-vis time deposits as compared with demand deposits, and vice versa for the bank and branch variables. It would thus seem that changes in the convenience of savings deposits have exerted more of an impact upon currency and demand deposits. This conclusion is consistent with our earlier suggestion that savings deposits substitute for narrow money as a temporary abode of purchasing power.

We turn to examine the role of other possible substitutes for money.

Substitution amongst Bank and Non-bank Claims

Our method of analysis is to extend the ratio $D'/D' + T + S$ to include personal holdings of deposits and shares issued by building societies, credit unions, unit trusts and pastoral finance houses (B); debentures and deposits issued by finance companies, merchant banks and business enterprises (F); and securities issued by the public authorities (G). Indices of the rates of return on the various aggregates are again used, and are calculated as weighted averages of rates paid by the dominant assets in each grouping - building societies, finance companies and Commonwealth government bonds respectively. Variables to represent changes in the non-pecuniary service flows attached to the various assets are omitted because of the difficulty of finding suitable proxies.

The results of the regressions are summarized in Table 8.7. Those regressions summarized in the top panel allow for substitutions to occur

Table 8.7

Regressions relating the Division of the Public's Holdings of Currency, Demand Deposits and Other Liquid Assets to Various Explanatory Variables 1953-1970.

Type of Asset X included in the dependent variable $D'/D' + X$	Regression Coefficients (and 't' values) r_x	y_d	r_G	Elasticity at sample mean r_x	R^2	D.W.
T + S	-5.976 (4.05)	-.032 (3.52)		-.429	.92	.67
T + S + B	-6.022 (4.69)	-.034 (4.29)		-.485	.94	.73
T + S + F	-8.589 (4.75)	-.029 (2.55)		-.767	.91	.60
T + S + G	-2.471 (2.14)	-.014 (2.34)		-.265	.81	.70
T + S + B + F	-8.631 (5.31)	-.030 (3.00)		-.849	.93	.65
T + S + B + F + G	-4.487 (3.74)	-.018 (2.69)		-.590	.89	.59
T + S	-7.820 (6.35)	-.035 (4.91)	+4.461 (3.46)	-.557	.96	1.60
T + S + B	-7.295 (7.02)	-.038 (6.19)	+3.893 (3.48)	-.588	.97	1.63
T + S + F	-11.714 (9.46)	-.031 (4.59)	+7.005 (5.25)	-1.046	.97	1.83
T + S + B + F	-11.313 (10.25)	-.033 (5.47)	+6.283 (5.25)	-1.113	.98	1.93

Definition of Variables

D' = Currency and Current Deposits of Trading Banks.

T = Time Deposits of Trading Banks.

S = Savings Bank Deposits.

B = Deposits and/or Shares issued by Building Societies, Credit Unions, Unit trusts, Pastoral Finance Companies.

F = Debentures and Deposits issued by Finance companies, Merchant banks, Business Corporations and others.

G = Securities issued by Commonwealth, Local and Semi-government authorities.

r_x = Weighted average of Interest Rates on the Various Liquid Assets included in X.

only within the asset groupings. The coefficients of determination range from 0.94 to 0.81, the highest correlation being obtained when data for building societies and credit unions are included with time and savings deposits, the lowest being when holdings of government securities are included. Time deposits and building society shares appear to have the highest income elasticities as discerned from the size of the coefficient on the income variable as the assets groupings change, while currency, demand deposits and government securities have the lowest response to income. The relevant interest rate elasticities shown in the table are calculated at the respective sample means. These elasticities increase as non-bank claims and debentures (B + F) are included with time and savings deposits in the ratio $^{D'}/D' + X$. This is to be expected if the assets are substitutes for D', as shifts into a wider range of assets is allowed for.

Contrary to the position taken by Tobin and echoed in Australian discussion, government securities do not appear to be money substitutes. The multiple R^2 and the interest rate elasticities tail off markedly when government securities are included. Shifts between currency plus demand deposits and government securities in response to changes in bond rates may be swamped by movements between the other interest bearing assets and bonds. Such substitution is taken into account in the lower panel of the table, and confirmation of the hypothesized portfolio shifts is provided. Failure to provide for these shifts in the prior specification may account for the presence of serially correlated disturbances in the upper panel. In the results summarized in the lower panel the highest correlation can be seen to occur when the ratio $^{D'}/D' + T + S + B + F$ is the dependent variable.

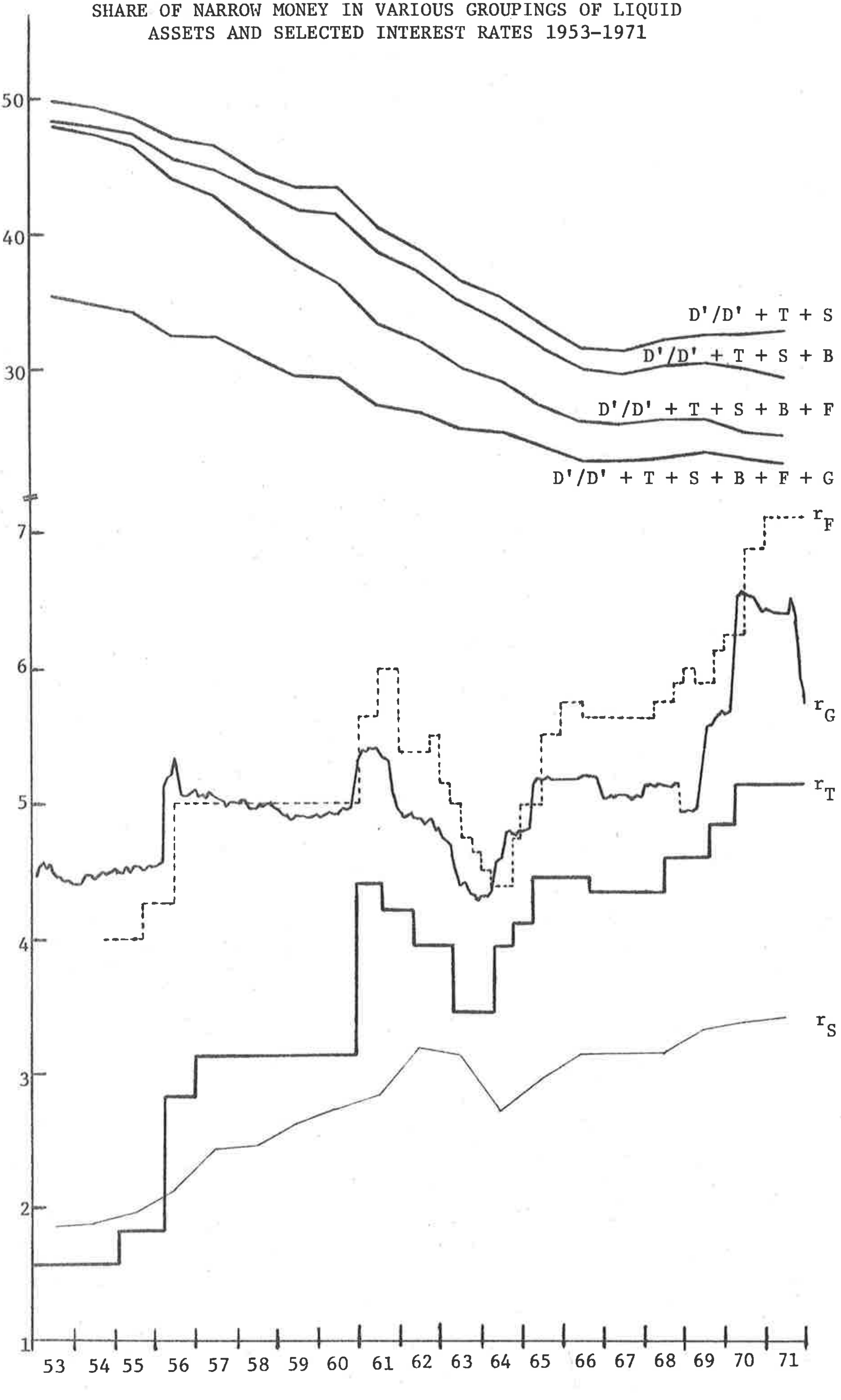
Two broad conclusions are suggested by this analysis. First, the results support the view, associated with the Radcliffe Committee and Gurley and Shaw, that non-bank intermediaries such as building societies and finance companies provide money substitutes. However, contrary to that general viewpoint, the evidence presented here does not seem to suggest that the substitution processes involved between 'money' and non-bank claims are highly unstable and unpredictable. Second, the non-banks provide households not only with substitutes for money but also with an alternative to the holding of time deposits and savings bank deposits. While these latter assets would seem to be the most important of the near money assets, no special relationship with currency and demand deposits is discernible from 8.7. Indeed, the multiple R^2 is highest (.98) when liabilities of building societies and finance companies are included in the asset grouping. If a line has to be drawn between the assets in terms of their substitutability with currency plus demand deposits, it would have to include these assets and, by the same token, exclude government securities. Substitutability in demand is not the only consideration relevant in defining the boundaries of money; there are practical considerations of the availability of adequate time series and the characteristics of supply. But whatever is decided, these non-bank assets cannot be ignored, and in the next chapter their behaviour is examined.

Concluding Remarks

By way of summarizing the analysis of this section, Figure 8 graphs some of the asset ratios and the interest rates which featured in the empirical investigations. The declining share of currency and demand deposits in *all* of the various aggregates of liquid assets is obvious. Equally clearly, in explaining this behaviour the influence of the factors we have identified in the regression analysis is discernible: the lower income elasticity of currency and demand deposits, the general rise in all of the interest rates over the period, and the rapid decline in the ratio $D'/D' + T + S$

Figure 8

SHARE OF NARROW MONEY IN VARIOUS GROUPINGS OF LIQUID ASSETS AND SELECTED INTEREST RATES 1953-1971



during the early 1960's as savings banks improved their services. Yet this decline slowed down or even reversed itself from 1967-1971; and in the face of (then) historically high interest rates.[7] This behaviour appears to be somewhat of a puzzle in Australian monetary analysis; the unexpected growth of currency as an asset demanded after 1966 (when decimal currency was introduced) has been noted in other studies (for example, Norton, Cohen and Sweeny, 1970) and no satisfactory explanation for this behaviour has been provided - usually a dummy variable is inserted to get around the problem.

Our analysis does provide us with two possible explanations not previously canvassed. Currency and demand deposits may not be directly involved. Instead, their increased share may have been produced by switches between substitute liquid assets, such as savings deposits, and other media for wealth holding; for the end result of such switches may be an increased holding of demand deposits or currency. Savings bank deposit rates and, to a lesser extent, time deposit rates failed in general to keep pace with market rates in the latter 1960's and early 1970's, and in particular the differential of the finance company debenture rate over these rates widened. The other explanation looks to the influence of variations in the non-pecuniary service flow, and argues that the special factors which produced shifts of demand deposits into savings banks in the early 1960's - the new banks and the branch expansion - may have run their course by the end of the decade. Certainly by 1970 most savings bankers were persuaded that the scope for gaining additional profitable business by branch expansion had been fully

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7 The modified decline in $^{D'}/D' + T + S$ has continued since 1971. Using total volume of money series, *not* Flow-of-Funds data, the ratio was .33 as at June 1971 and as at June 1976 was .29. Yet over the same period, the maximum time deposit rate increased by 3 full percentage points.

exploited, and thereafter the opening of new branches was halted.

This second explanation raises an important question about other research on the demand for money function in Australia. Much of what is seen as being the response of money balances to interest rates may in fact be a confounding of interest rate effects and the response to variations in the flow of non-pecuniary services per dollar on competing liquid assets. This interesting possibility is generally ignored in other studies; yet there are obvious implications which follow from it about the predictability of the actions of non-bank intermediaries and their potential for generating instability.

Chapter 9

The Supply of Liquid Assets, Non-Bank Intermediaries and Monetary Controls

Questions of the Analysis

Throughout the post war period in Australia and most other advanced countries there has been a rapid growth of non (trading) bank financial intermediaries (N.F.I.) and an associated decline in banks' share of total financial assets. The relative decline of banks in the financial sector has been under way for some time. Australian trading banks accounted for just over 50 per cent of total financial assets in the years immediately prior to World War I. Their share had fallen to 40 per cent in 1939 and 22 per cent in 1974. While banks are still the single most important class of institution in terms of size, some other institutions, notably finance companies and building societies, are growing at a much faster rate.

These developments have given rise to questioning about the sufficiency of financial policies effected primarily through the banking system in general and trading banks in particular. Australian literature in the subject (principally Runcie, 1969 and Hogan, 1960 but also F. Argy, 1960 and V. Argy, 1966) provides ample evidence of such concern. Runcie examines the growth of the instalment credit (finance) companies, their borrowing and lending behaviour and the rôle of instalment credit financing. There are several reasons why the finance companies are singled out for attention: first, finance companies are one of the fastest growing of the non-bank intermediaries; secondly, they are the largest unregulated N.F.I., holding 10 per cent of total intermediary assets; thirdly, finance companies are the largest provider of short-term bridging finance for housing; fourthly, they provide most finance for real estate; fifthly, they are widely believed to lend and borrow in competition with banks.

Knowledge of their behaviour is thought to be of particular importance for questions of monetary policy.

After considering some of these matters, Runcie goes on to summarize Australian discussion about the impact of non-bank intermediaries in general upon monetary controls. The flavour of this discussion can be gained from the following statements, which feature in the book:

i) N.F.I. create credit in a similar way to banks (pp. 119-121);

ii) N.F.I. attract idle balances from banks and so increase the velocity of circulation of money (pp. 118-119); and

iii) Instalment credit (or more generally, non-bank credit) increases most rapidly when bank lending is being restrained or reduced (pp. 70-71).

Hogan's main focus was upon N.F.I.'s credit creation and the impact of this upon the banking system through the cash leakages in the payments mechanism. In an introductory section entitled "Intermediaries and the Velocity of Circulation" he argued that the rise of the non-banking intermediaries gives "cause for alarm" as "it seems to *have hampered* monetary policy at the very points where its usefulness is most strongly upheld", for "the non-banking intermediaries *provide* an alternative source of funds at a time when credit restraint limits the capacity of the banking system to meet the requirements of business." (our emphasis). These statements relate to the actual, not the potential behaviour of the non-banks, yet the only evidence provided is a table showing the rise over time of the income velocity of circulation of money.

These attitudes find reflection in policy discussion. In chapter 3, we documented the development of the Reserve Bank's attitudes towards the growth of non-bank intermediaries. In particular, concern about the activities of non-banks was prominent in the Bank's strategy in the mid 1960's, and actual policies were framed to offset their presumed cyclical impact upon the velocity of money. At that time the monetary authorities decided against legislating controls over non-banks. This was done in 1974 with the passing of the Financial Corporations Act. In an address given on February 6, 1974 to the Economic Society of Australia and N.Z. explaining the legislation, the Treasurer described it as "an essential requirement for a government charged with the responsibility for economic management." He made reference to both the actual and the potential that non-banks have for economic mischief.

> "While the actual extent of the destabilizing activities of non-bank groups over the economic cycle has, of course, varied according to the types of institutions and the circumstances of particular periods, there is no disagreement that such intermediaries have significant potential to undertake activities which are inimical to an effective monetary policy."

The rationale for the government's basic policy attitude (as exemplified in the legislation) derived, according to the Treasurer, from the "major theoretical works" and the "empirical studies" which were "produced in the 1950's and 1960's.[1]

Such studies do not exist for Australia,[2] and in an attempt to fill

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1 The Treasurer was presumably referring to the theoretical works of Gurley and Shaw, and Tobin (1963) Tobin and Brainard (1963). As examples of empirical studies we cite Entine (1964), Friend (1964), Freund (1962), Gibson (1967), Hendershott and Murphy (1964), Smith (1959), and work on the demand for money function surveyed in Laidler (1969).

2 One exception is the article by F. Argy (1960) which presented three tables, two relating to the relative growth trends of N.F.I. and bank funds and the other showing selected N.F.I. holdings of government securities. Another is V. Argy (1966), who compared the turnover of liquid assets and correlation coefficients of various liquid assets with interest rates.

this gap, some data pertinent to the issues outlined above are assembled. In the next section we compare the credit creation of non-banks with that of the banks, and examine the different institutions' potential of generating economic instability. Then we examine the actual behaviour of non-banks. They may increase economic instability and impair restrictive monetary policy by reducing their reserve ratios, so that idle funds which they were holding are now lent out. Another way is by supplying substitutes for bank deposits, inducing depositors to shift balances from banks during periods of tight money. Both are considered.

Credit Creation of Banks and Non-banks

N.F.I. can (without creating new securities) extend loans to the private sector by lowering their 'cash' reserve ratios or by running down their holdings of government securities, where these are treated as a cash equivalent. The ultimate credit expansion may exceed the run down of cash reserves if a return flow of deposits to N.F.I. results from *their* initial loans. In such a case there is a multiple expansion of N.F.I. credit which, it is often argued, is similar to the multiple expansion of credit which banks can generate.

For example, in Hogan's framework, which follows that of Thorn (1958) and Smith (1959), similar formulae are developed for the credit creation 'rounds' of banks and N.F.I. For banks, the increase in loans which follows from an initial increase in reserves of a is:

$$\Delta L_b = a(1-r) + a(1-r)^2(1-g) + a(1-r)^3(1-g)^2 + \ldots\ldots\ldots\ldots$$

$$= \frac{a(1-r)}{r+g-rg}$$

For non-banks the formula is:

$$\Delta L_f = \Delta D_f(1-p) + \Delta_f(1-p)^2(1-z)^2 + \ldots\ldots\ldots\ldots$$

$$= \frac{\Delta D_f(1-p)}{p+z-pz} ,$$

where ΔD_f is the initial injection of deposits and reserves of the non-banks. In both cases the initial expansion of loans is less than the injection of reserves by the size of the reserve ratio - r for banks and p for non-banks - and the return flow (assumed in both cases to be positive) is less than unity by virtue of the 'leakages', to cash in the case of banks (g) and to cash and banks in the case of non-banks (z). The similarity is clear and the point of issue is the size of r relative to p and of g relative to z.

One question which arises from this schema concerns the nature of the mechanism whereby N.F.I. obtain a return flow of deposits. Hogan envisages it arising through what we termed the 'income account' in the previous chapter: the credit activities of the non-bank intermediaries create additional incomes and the recipients of the incomes allocate some of their savings back to non-bank claims. One difference between bank and non-bank credit creation thus emerges, for with banks the return flow arises automatically - indeed, the deposits never leave the domestic system - whereas for other intermediaries a conscious portfolio choice is required. Further questions arise. What if the recipients of the non-bank loans acquire 'old' stocks of goods and existing securities rather than newly-produced goods which generate income? Won't the reshuffling of asset portfolios alter the demand for non-bank claims?

Also, the increase in incomes will probably raise the demand for bank claims as well as non-bank claims, and the relationship that the two types of assets bear to each other may be unaltered - at least in the short run. These comments suggest that it might be more fruitful when considering non-bank credit creation to use an *asset approach*, which focuses on the *stocks* of the various assets and the *ratios* that they bear to each other, rather than emphasizing income and credit flows.

Another question is the nature of the links between the N.F.I. and the banks. Hogan's model has non-bank credit creation impinging adversely upon the banks, their loans adding directly or indirectly to the cash leakages from the banking system which take the form either of an inland drain or an increase in imports. Two queries arise about this specification. First, it might be thought that an increase in cash holdings (whether this be literally in the form of domestic currency or in terms of foreign goods or foreign assets) would be at the expense of *all* domestic non-cash assets (including N.F.I. claims) not just bank deposits. Nor, secondly, is any allowance made for the credit expansion of the banks to affect the lending by the N.F.I. Inflows of funds to the N.F.I. arise only from "once-for-all" portfolio changes or alternatively from their own activities. These deficiencies can also be corrected by following a portfolio approach.

In developing a model of bank and non-bank credit creation a choice needs to be made between linear and non-linear systems. In the former, used by Wood (1970), the asset *level* is regarded as being a linear function of say, relative interest rates, income and other relevant variables; in the latter, favoured by Coghlan (1977), asset *ratios* are related to these variables, appropriately modified for the changed specification. We have already indicated reasons why the asset proportions approach may be more suitable, and it also has the advantage of conforming with the analysis in the previous chapter. While for convenience we follow Guttentag and Lindsay (1968) in writing the ratios as fixed constants, they should be thought of as being behaviourally determined, although the actual behaviour assumed is not made explicit.

The model embraces the behaviour of the public and a three-tiered financial system of central bank, banks, and non-bank financial intermediaries (N.F.I.), as set out in Table 9.1. The public's portfolio preferences amongst the various assets issued by these institutions are:

$d = {}^{C}/_{D_p}$	public's currency preferences
$t = {}^{T}/_{D_p}$	public's time to current deposit preferences
$f = {}^{F}/_{D_p}$	preferences for non-bank claims

Preferences for reserves are:

$r = {}^{R}/_{D}$	banks' reserve ratio
$g = {}^{D_a}/_{F}$	non-banks' reserve ratio

It is assumed that banks maintain their reserves in the form of base money; non-banks in the form of bank current deposits. Our schema ignores the special position of savings banks: these can be seen as being a component of bank time deposits.

From the balance sheet of the Reserve Bank, we define base money (B) as

$$B = C + R \tag{9-1}$$

Table 9.1

Simplified Balance Sheet of Financial System.

Public

Loans from Banks	E_b	Currency	C
Loans from non-banks	E_a	Bank Current Deposits	D_p
Total loans	E_t	Time Deposits	T
Net worth		Non-bank claims	F
		Liquid Assets	L

Reserve Bank

Currency held by Public	C	Foreign Exchange and other Assets	B
Currency held by Banks Statutory Reserve Deposits Other Deposits of Banks	R		

Banks

Current deposits of Public	D_p	Reserves	R
Current deposits of N.F.I.	D_a	Earning assets	E_b
Time deposits	T		
Total deposits	D		

N.F.I.

Claims issued	F	Reserves	D_a
		Earning assets	E_a

substituting into (9-1) the formulae for public, bank and N.F.I. preferences,

$$B = dD_p + r(D_p + D_a + T)$$

$$= dD_p + rD_p + rgf\ D_p + rt\ D_p$$

$$= [d + r + rgf + rt]\ D_p \qquad (9\text{-}2)$$

Alternatively,

$$D_p = \frac{B}{d + r + rgf + rt} \qquad (9\text{-}3)$$

Using (9-3), we can obtain expressions for the intermediaries' liabilities and earning assets. In the case of banks:

$$D = D_p + D_a + T$$

$$= D_p + gfD_p + t\ D_p$$

$$= \frac{(1 + gf + t)}{d + r + rgf + rt} . B \qquad (9\text{-}4)$$

$$C_b = D - R$$

$$= D_p + gf\ D_p + t\ D_p - (B - d\ D_p)$$

$$= \frac{(1 + gf + d + t)\ B}{d + r + rgf + rt} - B$$

$$= \frac{1 + (1-r)\ gf + (1-r)\ t - r}{d + r + rgf + rt} \ .B \qquad (9\text{-}5)$$

For non-banks,

$$F = f\ D_p$$

$$= \frac{f}{d + r + rgf + rt} \ .B \qquad (9\text{-}6)$$

and

$$C_a = (1-g)\ f\ D_p$$

$$= \frac{(1-g)\ f}{d + r + rgf + rt} \ .B \qquad (9\text{-}7)$$

Our objective is to examine the determinants of bank and non-bank credit creation with the view of comparing their credit generating capacity. Under the assumed conditions, N.F.I. are able to engage in a multiple expansion of lending, as summarized in (9-7). An initial run down in N.F.I. reserves and increase in lending will transfer bank deposits from N.F.I. accounts (D_a) to the public (D_p). Providing that the public's willingness to add to F in response to an increase in D_p exceeds zero (i.e. marginal f is greater than zero), the public will wish to acquire more securities issued by N.F.I. and this will permit an additional credit expansion by N.F.I. This mechanism is conditioned by the reserve ratio of the N.F.I. (g), and the public's preference as between the securities issued by N.F.I. and bank deposits (f).

These are not the only determinants of N.F.I. credit creation, and equation (9-7) shows the two factors neglected in Hogan's approach. The presence of d illustrates that the public's cash requirements, and variations in them, alter the credit expansion of both banks *and* N.F.I. By transferring the ownership of deposits from themselves to the public, the public demands more cash in order to retain their usual division of M1 between D_p and C. As Hogan saw, this action causes a reduction in banks' reserve base and in their credit creation. But D_p now increases by less than it otherwise would have, and multiple credit creation by N.F.I. is attenuated.

This example illustrates that N.F.I. lending will respond to the credit creation of the banks. Any increase or decrease in bank credit will flow through to the N.F.I. By contrast, increased lending activities of the N.F.I. do not expand lending by banks. Bank deposits held by the public are the 'base' for N.F.I. credit creation in the same way that high-powered money provides the base for bank credit creation.

This difference would seem to make banks inherently more expansionary dollar-for-dollar than the N.F.I. But N.F.I. may still possess a greater potential to expand total credit and total liquid assets by virtue of their size. Thus we pose for Australia the question asked originally by Guttentag and Lindsay for the U.S: "How large do N.F.I. need to grow relative to banks in order to equalize the change in total credit resulting from equal changes in bank and N.F.I. reserve ratios?" In order to answer this question, we now develop formulae for the money supply, liquid assets and bank credit. Defining the money supply M1 as the public's holding of currency and current deposits, we have

$$M1 = C + D_p$$

$$= \frac{1 + d}{d + r + rgf + rt} \cdot B \qquad (9\text{-}8)$$

The money multiplier in (9-8) is lower than the standard formulation $^{1+d}/_{d+r}$ by virtue of the exclusion of time deposits from money, for time deposits absorb reserves which therefore are not available to expand current deposits, and also because flows through intermediaries rearrange the ownership of bank deposits. These other liquid assets can be embraced in the analysis to derive multipliers for the M2 definition of money and the total supply of liquid assets, L.

$$M2 = C + D_p + T$$

$$= \frac{1 + d + t}{d + r + rgf + rt} \cdot B \qquad (9\text{-}9)$$

$$L = C + D_p + T + F$$

$$= \frac{1 + d + t + f}{d + r + rgf + rt} \cdot B \qquad (9\text{-}10)$$

Banks and non-banking intermediaries can be compared in terms of their potential to expand the total liquid assets (inclusive of high powered money) or their potential to expand total credit creation, which is the supply of liquid assets exclusive of high powered money. Clearly the two parallel each other, but the literature is generally couched in terms of credit creation. It is convenient to express total credit in the following way, utilizing the balance sheet identities of Table 9.1:

$$E_t = L - B$$

$$= \frac{1 + d + t + f}{d + r + rgf + rt} \cdot B - B \qquad (9\text{-}11)$$

From (9-11) the effect on total credit of a change in the bank reserve ratio can be seen. Denoting this change as $(\Delta E_t)_r$, we have when B = *1*

$$(\Delta E_t)_r = \frac{1 + d + t + f}{d + (r+\Delta r) + (r+\Delta r)gf + (r+\Delta r)t} - \frac{1 + d + t + f}{d + r + rgf + rt} \qquad (9\text{-}12)$$

Similarly, we can derive the change in E_t associated with a change in the non-bank reserve ratio,

$$(\Delta E_t)_g = \frac{1 + d + t + f}{d + r + (g+\Delta g)rf + rt} - \frac{1 + d + t + f}{d + r + rgf + rt} \qquad (9\text{-}13)$$

We wish to ascertain what relative size of non-banks to banks will equalize the change in total credit resulting from equal absolute changes in the reserve ratios of banks and N.F.I. respectively. Setting $(\Delta E_t)_r$ = $(\Delta E_t)_g$, we have

$$d + (r+\Delta r)\ (1+gf+t) = d + r + rt + (g+\Delta g)rf$$

which reduces to

$$\frac{\Delta r}{\Delta g} = \frac{rf}{1 + gf + t} \qquad (9\text{-}14)$$

It may be noted that the term d has dropped out, and thus the credit expansion potential of banks versus N.F.I. is independent of the public's cash requirements. Also, the relative credit potential is unaffected by the direction of change of the reserve ratios. For $\Delta r = \Delta g$, we have

$$f = \frac{1 + t}{r - g} \tag{9-15}$$

As (9-15) stands it gives the ratio of N.F.I. claims to bank current deposits required to equalize the change in total credit. Multiplying both sides $(1+t)^{-1}$ to obtain the required ratio of N.F.I. to bank deposits held by the public, we obtain

$$f* = {}^{F}/{D_p} + T = \frac{1}{r - g} \tag{9-16}$$

In Table 9.2 estimates of $f*$ are compared with the actual size of non-banks relative to banks. Two different assumptions are made about the composition of bank reserves. In case 1, the credit expansion of banks is constrained by a cash ratio, equal to the sum of S.R.D. assets plus desired 'free' cash to deposits. In the second case, banks work to a liquid assets ratio where liquid assets are cash and government securities, assumed to be perfect substitutes. Here the reserve ratio is the sum of the S.R.D. and L.G.S. assets to deposits. These two cases straddle the two extreme positions which are taken about bank reserve behaviour in Australia. In one case government securities are treated as being part of earning assets and the role of the L.G.S. convention is to determine the minimum division of earning assets as between government securities and advances. In the other, government securities are as good as high-powered money and form part of the base for banks' credit creation.

Table 9.2

Comparison of actual size of N.F.I. relative to banks with that required to equalize the individual credit expansion potential, 1965-1967.

Comparison of trading banks and	Case 1		Case 2	
	f^*	f	f^*	f
Finance Cos.	8.7	.3	3.3	.3
N.F.I.[1] (excl. savings banks)	8.6	1.9	3.3	1.9
All other N.F.I.[2]	12.2	2.9	3.7	2.9

1 The total assets of all non-trading and non-savings bank institutions listed in the Reserve Bank of Australia, *Flow-of-Funds* Supplement, 1969, were used to calculate f. For calculating f^*, g is a weighted average of the cash ratios of Finance Companies, Life Offices, Non-Life Insurance, Building Societies, Public and Private Pension Funds.

2 f and f^* are calculated as above, including savings banks in F and cash ratio of savings banks in g.

Source of data used: Reserve Bank of Australia, *Flow-of-Funds Supplement*, 1969.

In both cases we retain the assumption that N.F.I. hold reserves in the form of bank deposits. This is crucial, for the superior credit generating potential of banks would disappear if N.F.I. held reserves in the form of currency rather than bank deposits. This would also be so if in case 2 N.F.I. hold government securities as secondary reserves, obtaining their supplies from the banking system rather than the public. Under these conditions, the credit generating capacity of banks and N.F.I. would be the same if the intermediaries are of the same size and possess the same initial reserves ratios. What limited evidence there is suggests that the assumption that N.F.I. reserves are held in the form of bank deposits is appropriate.[3]

Given the assumptions of the model, it is clear from Table 9.2 that, compared with finance companies and other non-bank financial intermediaries, banks have a much greater potential to expand total credit. Under a cash-based reserve system, non-bank intermediaries need to be 9 times larger than trading banks to have the same credit generating capacity. In the comparison least favourable to banks, case 2, non-banks need to be 3.3 times larger than the trading banks, whereas even on the latest data they are only about twice as large. Hence f would need to increase by about 1.3 in order that the credit generating capacity of the two groups of institutions be equalized. By contrast, the largest yearly increase in the ratio of non-banks to banks over the period 1953-1967 was 0.19 (and the average yearly increase was 0.08). Which of the two assumptions about bank reserves is appropriate? This is discussed in the next chapter, and the evidence presented there suggests that, of the two, case 1 is the more accurate, and that accordingly banks have a markedly larger potential for economic instability.

The model may also exaggerate the capacity of N.F.I. to expand credit by assuming that the public distributes increments to its financial assets in the same proportion as its initial holdings, i.e. that marginal f equals average f. Unlike the holding of bank deposits, acquisition of non-bank claims requires a conscious portfolio decision. In the short run, the 'return flow' to N.F.I. may be small - marginal f less than average f.

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3 Inspection of some pastoral finance companies' balance sheets indicates that currency holdings are minute relative to bank deposits. I am indebted to Mr. R.J. Edgar for making this data available. The assumption we make about the composition of N.F.I. reserves is the one most commonly employed in the literature.

The process of non-bank credit rounds may be more sloppy, whereas the 'return flow' to banks arise automatically through the payments mechanism. Banks are distinguished also by the speed and regularity of their credit creation.

Finally, it is interesting to compare the figures in Table 9.2 with calculations for certain pre World War II years of f^* and f for trading banks and all other financial intermediaries.[4]

	f^*	f
1911 - 1913	5.6	.9
1926 - 1928	5.2	1.3

These calculations suggest that it was a sensible practical policy for financial regulation in Australia to concentrate upon control of the banks. The credit-creating capacity of the banks far exceeded that of non-banks and the trading banks were by far the largest financial intermediary. Nowadays the potential of N.F.I. to generate credit is considerable. Yet despite the rapid growth of N.F.I. in the post-war years, banks' potential to expand total credit still exceeds that of non-banks.

Behaviour of Non-bank Intermediaries

Potential to create instability is one thing, actual behaviour may be

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[4] In order to make these calculations, figures of trading bank and N.F.I. assets as at June for the various years were extracted from Commonwealth of Australia *Year Book* (various issues), *Finance Bulletin* (various issues), and the *Report* of the Royal Commission into the Monetary and Banking System, 1936. Bank cash for 1911-13 comprises coin, bullion, and Australian notes; for 1926-28 it includes deposits with the Commonwealth Bank and London funds as well as the above items. The N.F.I. cash ratio for 1911-13 is a weighted average of the cash ratios of savings banks and life offices; for 1926-28, non-life offices and building societies are included in the calculation.

another. Now that banks are controlled, and their greater potential for expanding or contracting credit is curtailed, might not the principal instability over the business cycle be produced by the N.F.I.? Non-bank intermediaries are twice the size of the trading banks, and their activities may provide a substantial offset to monetary policy. Traditional policies which operate upon the money supply and make no allowance for the influence of non-bank lending upon the velocity or turnover of money may be inadequate.

Non-banking intermediaries may also matter from the viewpoint of the *time lags* in monetary policy, as well as for the *effectiveness* of policy, for loans provided by the non-banks presumably serve as a substitute for bank loans. At the inception of a period of restrictive monetary policy, unsatisfied demand for bank loans may spill over to the N.F.I., delaying the impact of monetary policy on the economy. As the ability and willingness of the N.F.I. to satisfy this demand may vary from cycle to cycle, or between the upswing and downswing phase, they may contribute to the variability of the lag as well as its length.

This type of thinking underlay the Reserve Bank's policies in the mid 1960's. The Bank concluded that the foundations of its policies were being eroded by the unchecked growth of non-bank intermediaries and concomitant instability of the velocity of money, and more positive use of interest rates was seen to hold the key to impinging upon the activities of N.F.I. and thus 'general liquidity'. The modus operandi of this policy is enunciated in this extract from the Bank's 1965 Annual Report:

> "... to slow down the transfer of funds to financial intermediaries and final users; to maintain the strong preference throughout the community for liquid and secure assets ...."

The first part of the quotation indicates the aim of influencing the activities of N.F.I. through their public borrowings. The other aim of the policy was more novel and controversial. As instability of velocity was seen to be the source of cyclical instability, the Bank sought to influence the demand for money. For example, in 1964 controlled interest rates were increased to "discourage increases in the rate of turnover of money." A reading of the relevant documents suggests that the Bank had in mind a model along the lines

$$Y = V(r_F, r_{T.S}, \dot{P}/P, u) \,.\, M3$$

where $\frac{\partial V}{\partial r_F} > 0$, $\frac{\partial V}{\partial r_{T.S}} < 0$, $\frac{\partial V}{\partial \dot{P}/P} > 0$; and

Y = nominal income

$M3$ = the public's holdings of currency, trading and savings bank deposits

r_F = a representative interest rate on non-bank intermediary claims

$r_{T.S}$ = an index of interest rates on bank time and savings deposits

$\dot{P}/P$ = the public's expectations of inflation

u = the public's taste for the liquidity services of M3.

The instruments of policy were bank time and savings deposit rates ($r_{T.S}$) and to a lesser extent government bond rates. Increases in $r_{T.S}$ would *directly* increase the attractiveness of bank debt, lowering the turnover of money and serving as a counter to increases in velocity brought about by increases in r_F. In addition, by playing upon the announcement effects of interest rate changes, increases in velocity arising through $\dot{P}/P$ and u could be countered *indirectly*. The changes in 1964, for example, were designed to "dampen the climate of expectations about the future course of asset prices." The Bank has also spoken of the influence of bank interest rates upon "customers' attitudes to liquidity" and "business expectations generally."

The policy takes a strong stand on the appropriateness of a broad (M3) definition of money. To see this we can rewrite the model as follows:

$$Y = M_1 V_1 + (M_3 - M_1) V_2$$

where $V_1 = f_1 (r_{T.S}, r_F, \dot{P}/P, u_1)$

and $V_2 = f_2 ([r_F - r_{T.S}], \dot{P}/P, u_2)$

and M_1 is currency and demand deposits. Increases in $r_{T.S}$ which lower the differential (or ratio) between r_F and $r_{T.S}$ will *lower* V_2, the velocity of bank interest bearing deposits. However the deliberately manipulated increases in $r_{T.S}$, and the increases they induce in r_F, are likely to *increase* the velocity of narrow money M1. Our study of the demand for liquid assets (in chapter 8) shows that the share of M1 in broader groupings of liquid assets contracts in response to increases in both $r_{T.S}$ and r_F. Intermediation by the non-banks and savings banks on the base of a *given* M1 may be stimulated as the public attempt to shift out of demand deposits. The net impact of the policy on the economy may depend on whether the interest rate changes are supported by *reductions* in M1 and M3.

In practice, the interest rate changes *were* in part an alternative to actions upon the supply of money, and manipulation of the demand for money was in essence seen as a policy instrument alternative to, or supplementing, changes in the money supply.[5] This policy clearly involves risks. The

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5 In 1962/63, when unemployment was higher than normal, the Bank refrained from expanding the monetary base and the money supply, warning that "the highly liquid condition" of the economy was likely to cause a "a return to financially inflationary conditions." Conversely in 1963/64 there was an improvement in the balance of payments which, despite some offsetting responses by the Reserve Bank, increased the money supply by over 10 per cent. Yet the Bank discounted the possibility of expansionary effects, arguing that "memories of financial failures and of a recent downswing had created a considerable demand for liquid and secure assets." It raised

Bank's diagnosis about the behaviour of N.F.I. may be misplaced, and the anticipated variations in the velocity of money may not eventuate. With these considerations in mind, we now turn to consider how non-bank intermediaries have acted.

Examining the expression (9-10), N.F.I. may increase short run economic instability and impair (say) restrictive monetary policy in two ways. One way is by reducing their reserve ratio, g, so that idle funds which they were holding are now lent out, expanding the supply of liquid assets and stimulating spending for a given money supply. Another is that N.F.I. may encourage portfolio changes which alter f and activate idle money balances held by others, resulting in an increase in the income velocity of money. Both mechanisms are examined.

Reserve Ratio Changes

Our earlier analysis demonstrated that banks have a greater potential to expand credit than N.F.I. when equal absolute changes in the reserve ratios are made. It may well be that the reserve ratios of banks are highly stable while those of N.F.I. display considerable variation. Naturally the extent of variability of N.F.I.'s reserve ratios would need to be large to make up for their lesser credit creation. How much larger? The change in the non-bank reserve ratio, relative to the bank reserve ratio which equalizes the change in total credit is given by

$$\frac{\Delta g}{\Delta r} = \frac{1 + gf + t}{rf}$$

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5 *continued*

interest rates as a precautionary move: as a precaution against a sudden switch in public preferences it "... seemed wise to increase the attractiveness of the more conventional liquid assets." In effect, the Bank endeavoured to adjust the demand for money to the supply.

Feeding in values of *g*, *f* and *t* for Australia, it transpires that absolute variations in non-banks' reserve ratios would need to be at least four times larger than the variations in banks' ratio to have equal significance. This does not appear to be the case.

Figure 9a sets out the ratio of cash and government securities to total liabilities of selected financial intermediaries as at June for the years 1953 to 1971.[6] All the cash reserve ratios shown, including those of banks, decline over the period examined, but none of them appear to exhibit a consistent cyclical behaviour. The cash ratio of finance companies declined in 1960 and rose in 1961 but this apparently destabilizing behaviour was not repeated during other cycles. Although the cash ratio of finance companies fluctuates more than that of all N.F.I. (excluding savings banks) combined, the changes in the ratio are quite small. The government security ratio of all N.F.I. (excluding savings banks) declined markedly during the 1950's and it is this movement that F. Argy drew attention to in 1960. The decline was reversed in the 1960's following the institution of the government's 30/20 ruling over the portfolios of the life offices and pension funds. Neither N.F.I.'s ratio nor that of savings banks varies cyclically to any great extent. In contrast, banks' government security holdings display a strong

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6 Each of the ratios shown, with the exception of the Government Securities ratio of Savings Banks and other N.F.I., are drawn to the same scale. However, the scales have been overlapped, or separated, so as to clearly illustrate the movements of each ratio. To give some guidance as to the levels of the ratios, their arithmetic means are:

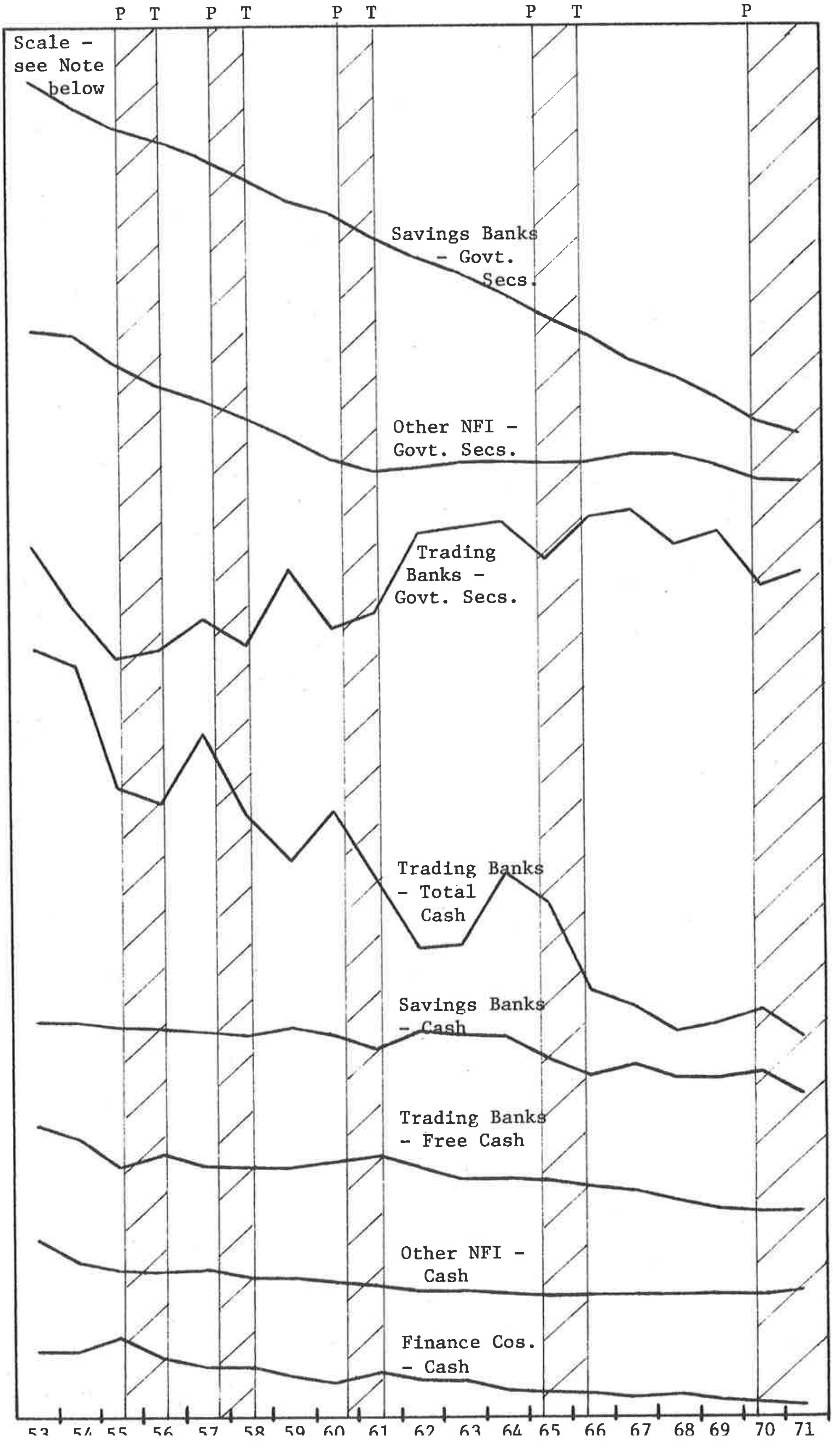
Govt. Secs. ratio (per cent): Savings Banks, 49.24; Other N.F.I., 16.02; Trading Banks, 16.21.

Cash ratios (per cent): Trading Banks, Total cash (S.R.D. plus Free Cash, 4.30; Savings Banks, 11.79; Other N.F.I., 1.98; Finance Company, 2.05.

Source of data is Reserve Bank of Australia, *Flow-of-Funds Supplement*, January, 1969.

Figure 9a

RATIOS OF CASH AND COMMONWEALTH GOVERNMENT SECURITIES TO TOTAL LIABILITIES OF SELECTED FINANCIAL INTERMEDIARIES, 1953 - 1971.



cyclical variation and the movement in the ratio was clearly destabilizing during the 1954/55 and 1959/60 upswings. Finance companies' government security ratio was very small over most of the period and is not shown on the graph. Overall, it seems that non-bank intermediaries do not draw down their reserve ratios during upswings any more than they do during downswings.

Portfolio Shifts

A second and perhaps more important way by which N.F.I. may increase economic instability is by inducing depositors to shift funds from bank deposits to intermediary claims (inducing increases in *f*).

The argument commonly adduced assumes that N.F.I. issue liabilities which are substitutes for bank deposits and that they lend in competition with banks. During an upswing in the economy when bank credit is restrained by central bank action, N.F.I. bid deposits away from banks (for example, by raising their borrowing rates relative to banks which are subject to interest rate ceilings) enabling them to increase lending and satisfy borrowers turned away from banks. In this way, it is argued, N.F.I. hamper a restrictive monetary policy. Conversely for an expansionary monetary policy.

Something of this nature presumably does take place, and in the previous chapter clear evidence of the (long run) substitutability of non-bank claims for narrow money, M1, was presented. What is at issue is the extent of substitutability in the short run, during business cycles. Two types of evidence are presented.

The first considers the demand functions for liquid assets just mentioned. The regressions had as dependent variables the ratios $^{M_1}/_{M_1+T}$ and $^{M_1}/_{M_1+T+F}$. In interpreting the regressions in the present context, we can rearrange equations (9-8), (9-9) and (9-10) to obtain

$$\frac{M_1}{M_1 + T} = \frac{1 + d}{1 + d + t}$$

$$\frac{M_1}{M_1 + T + F} = \frac{1 + d}{1 + d + t + f}$$

Comparison of one regression with the other provides direct evidence of the determinants of f, namely

$$f = {}^{F}/D_p = f_1\ (r_F,\ y),$$

where r_F is an index of the interest rates on non-bank claims.[7] Substitution as between non-bank claims, time (and savings deposits), and currency plus demand deposits appears to be relatively predictable. Given the explanatory power of the relationships, *portfolio shifts of any significance must arise within the function:* that is, they must arise from movements of the variables explaining the substitutions, these being income and relative interest rates.

The relevant interest rates are shown in figure 9b which covers the period 1954-1971. Bank interest rate ceilings are determined by the Reserve Bank in consultation with the Treasury (and the banks), and the typical 'policy package' has involved changes throughout the range of both bank deposit and overdraft rates. Of the available measures of the borrowing costs of N.F.I.'s, the issue rates of the finance companies are the best, and we show the range of rates on 12 month bank affiliated first ranking debentures. Changes in the bank interest rates have been followed on most occasions by changes in finance company debenture rates. There is no suggestion that the 'uncontrolled' intermediary rates lead the bank rates;

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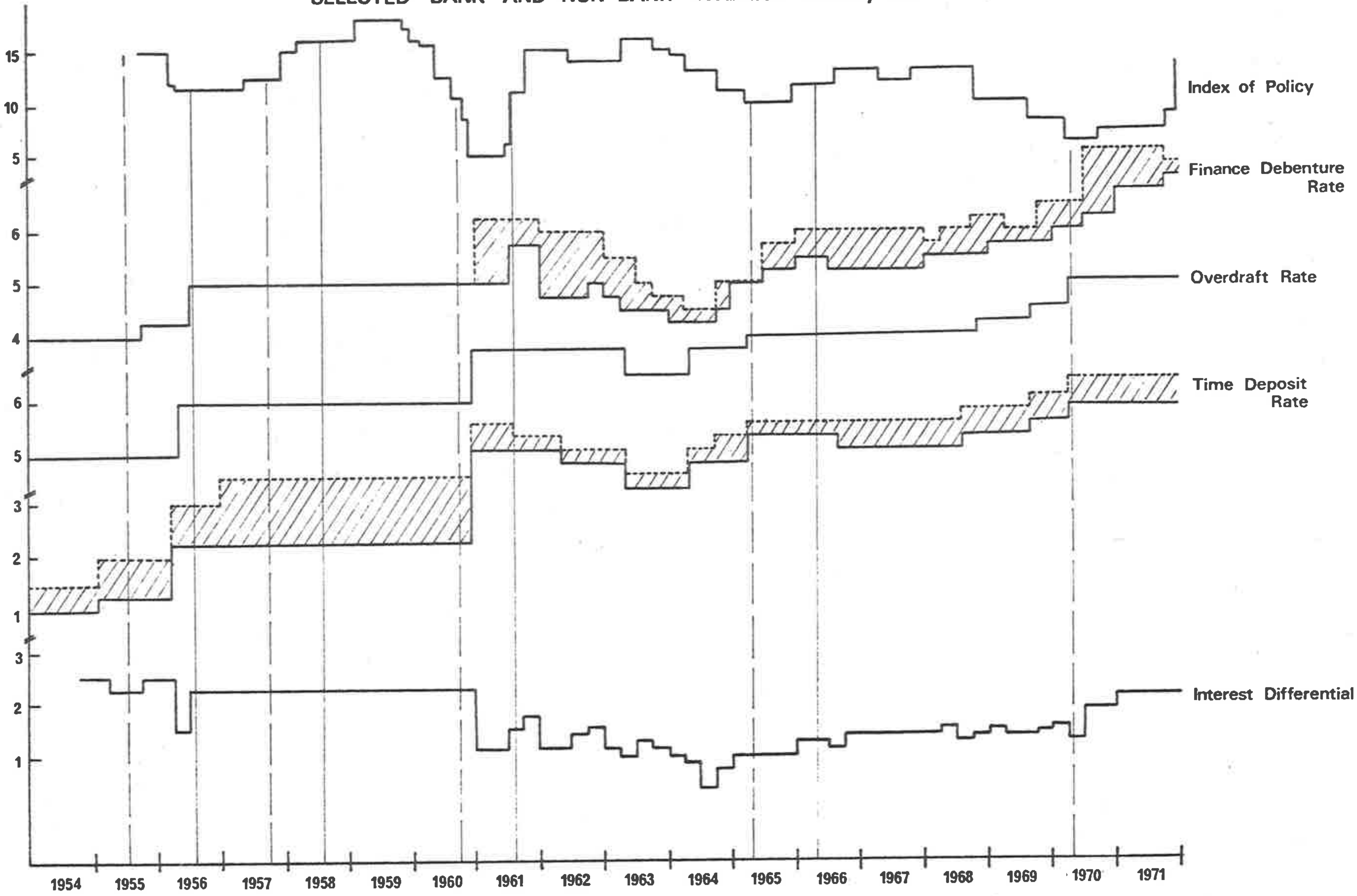
[7] In chapter 8 we used the finance company debenture rate and the building society deposit rates. What we have termed here F corresponds to the categories B + F in that chapter. Also S is implicitly grouped with T in the present discussion.

FIGURE 9b

SELECTED BANK AND NON-BANK INTEREST RATES, 1954-1971.



rather the reverse appears to be the case. The differential of the finance companies' rate over the bank time deposit rate is calculated using the averages of the bank 12 month time deposit rate. The differential rate does not appear to rise during upswings of the economy relative to downswings.[8] At the top of the picture is shown the index of monetary policy intentions, constructed in chapter 5. This index is not necessarily a suitable measure of the actual thrust of monetary policy, yet the story is the same as with the cyclical phases - the differential shows no evidence of having widened during periods of tight money and narrowed during periods of policy ease.

While the demand functions for the liquid assets, combined with the behaviour of the interest rates, provides powerful evidence about the unimportance of N.F.I. - induced portfolio shifts as a source of instability, two qualifications must be made. First, the demand relationships cover only the holdings of the persons and unincorporated enterprises sector in the Flow of Funds. Secondly, as in any demand analysis, we cannot rule out the possibility of shifts of the demand function (variations in the taste for non-bank relative to bank liabilities) as well as movements within it produced by the explanatory variables. Thus we now look to some evidence of the general cyclical behaviour of N.F.I.

If non-bank intermediaries are a source of cyclical instability, borrowings of N.F.I. might be expected to expand more rapidly during upswings of the Australian business cycle than during downswing phases. Figure 9c sets out the annual growth rates of various indicators of bank, finance companies and N.F.I. activity using annual data over the period 1953-67. Inspection of the figure reveals that there *is* some quickening of N.F.I. activity

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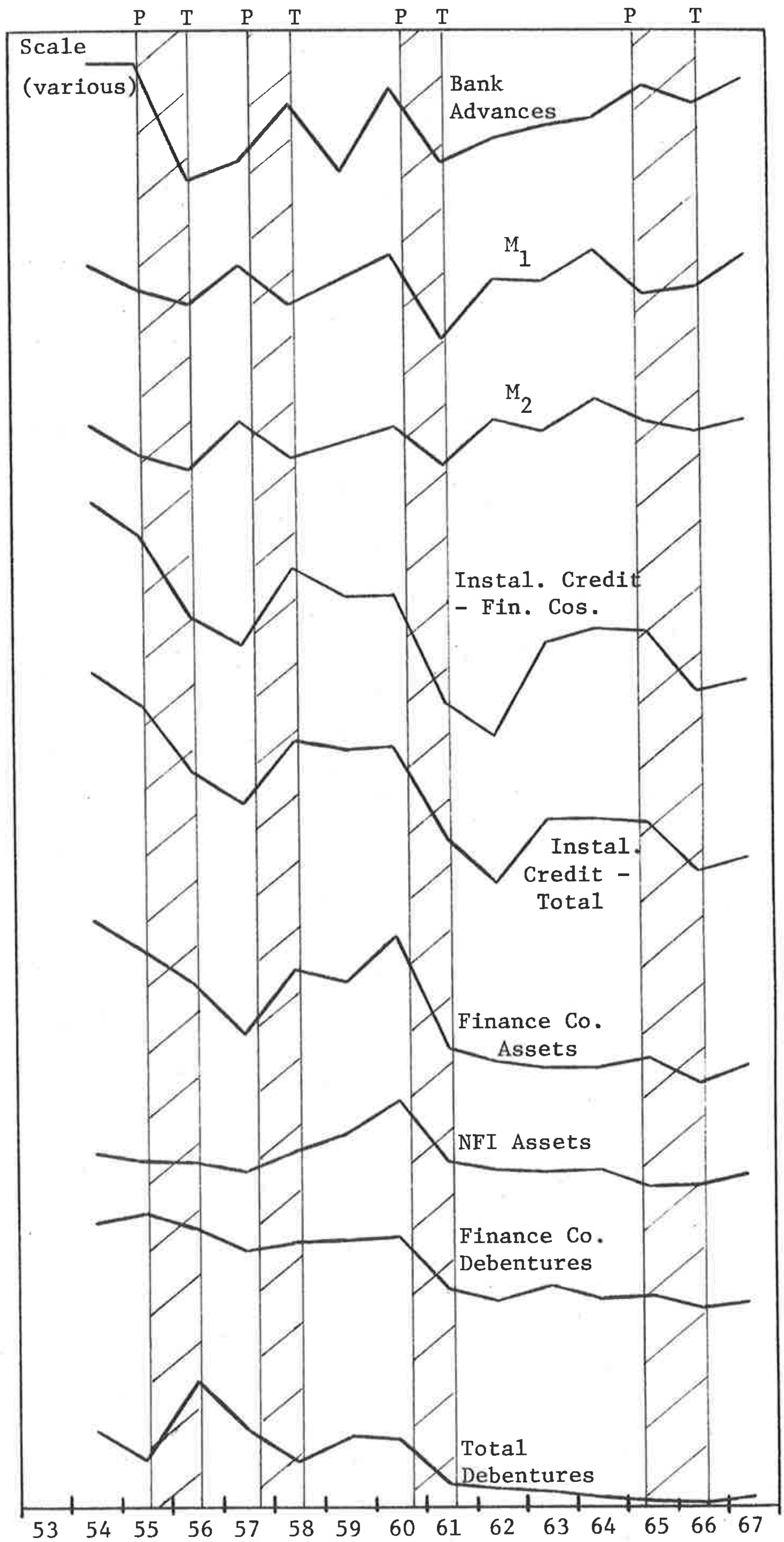
8 Peaks in economic activity are indicated by the broken vertical lines, troughs by the unbroken lines.

Figure 9c

ANNUAL RATES OF GROWTH OF VARIOUS INDICATORS OF N.F.I. AND BANK ACTIVITY, 1953-4 TO 1966-7.



Note: Details of the series and data sources are in Table 9.3.

during upswings of the economy and some easing of their growth during downswing phases. What is also revealed is that the bank series, particularly M_1 and M_2, vary in a pro-cyclical fashion and that the cyclical variation as between upswing and downswing appears to be both more consistent and more pronounced than in the case of the N.F.I.. This visual impression is confirmed in Table 9.3. In this table the annual growth rates of various series are divided as between periods of upswing and downswing. On average the money stock and bank advance series expand much more rapidly during upswing than during downswings. As far as N.F.I. are concerned, the evidence is more ambiguous and there is very little difference in the growth rates as between periods of upswing and downswing: they have grown strongly during both phases of the cycle.

Thus in interpreting the behaviour of non-bank intermediaries the distinction between trend and cycle is important. What other writers have seen as destabilizing cyclical behaviour may arise from a confusion of trend and cycle. Some of the growth of non-bank intermediaries may not be at the expense of banks at all. It may reflect a growing preference by the public for the services of intermediaries' claims relative to the services obtainable from the direct holding of bonds, equities and real assets. The economic function of financial intermediaries is to interpose themselves between the borrower and lender of funds. This substitution appears to have occurred in the case of the primary security about which most information exists - government bonds. Direct holdings by the public have been replaced by indirect holdings through intermediaries.

Our final piece of evidence about the behaviour of N.F.I. is presented in Table 9.4. This table sets out the correlation coefficients between first differences of various measures of lending by instalment credit (finance)

Table 9.3

Average Annual Rates of Growth During Business Cycle Upswings and Downswings of Various Indicators of N.F.I. and Bank Activity.

Series No.	Description	Period Covered and form of Data	Average Growth During Upswings (per cent)	Average Growth During Downswings (per cent)
1	Advance of all Cheque-paying banks	July - Dec. 1955 1968 Monthly s.a.	6.36	3.60
2	M_1 (notes and Current Deposits)	"	5.40	-3.48
3	M_2 (M_1 + Fixed Deposits)	"	6.84	- .02
4	Instalment Credit Balances Outstanding - Finance Cos.	"	9.09	9.96
5a	Instalment Credit Balances Outstanding - Total	1953 - 1967 Annual	11.82	9.91
5b	Instalment Credit Balances Outstanding - Total	1958_3-1968_4 Quarterly s.a.	7.60	4.84
6	Total Assets of Finance Cos.	1953 - 1967 Annual	16.07	15.51
7	Total Assets of N.F.I. (excluding savings banks)	"	10.65	10.37
8	Debentures, Notes and Deposits of Finance Cos.	"	21.40	21.73
9	Debentures, Notes and Deposits held by Private, Non-Finance Groups	"	21.34	25.61

Source of data:

Series 1 and 5a from Runcie, *Economics of Instalment Credit*, Table 1A and 17.

Series 2 and 3 from C.B.C.S. *Finance Bulletin* (various issues) Deseasonalization undertaken by present writer using U.S. Bureau of Census program, X-11 variant. M_1 is the sum of notes held by the public and current deposits of all banks.

$M_2 = M_1$ + fixed deposits.

Series 4 and 5b from C.B.C.S. *Seasonally Adjusted Indicators 1969*. Other series from Reserve Bank of Australia, *Flow-of-Funds*, (various issues).

TABLE 9.4

Correlations coefficients between first differences of various measures of Instalment Credit Debt and first difference of various monetary aggregates.

Measures of Instalment Credit Debt	Period	Bank Advances	M_1	M_2	M_3
Instalment Credit Debt for Retail Sales - Finance Companies	1950/1 - 1966/7 Annual	.26	.10	.06	.11
"	1955_3 - 1967_4 Quarterly Seas. adj.	.45**	.20	.00	.10
Instalment Credit Debt for Retail Sales -Total	1950/1 - 1966/7 Annual	.04	.01	-.12	-.14
"	1958_3 - 1967_4 Quarterly seas. adj.	.27	.34*	-.04	.03
Finance Companies - Total Assets	1953/4 - 1966/7 Annual	.25	.27	.17	.19

* Coefficient is significantly different from zero at the 95 per cent level.

** Coefficient is significantly different from zero at the 99 per cent level.

Source of data: as for Table 2.

companies, which are the non-bank grouping about which most concern has been expressed, and first differences of bank lending and the stock of money, which are used as measures of the actual tightness and ease of monetary controls over bank credit creation. A negative association would be expected if the N.F.I. provide a powerful offset to monetary controls. In fact the correlations are positive in most instances; though they are generally low.

It is interesting to reflect upon why a positive signed correlation should exist between these series. An explanation, consistent with the N.F.I. exacerbating cyclical instability and providing a weakening of monetary policy, is that they encourage switches from currency holdings to their own claims. Intermediation by N.F.I. increases but so does that of the banks as the currency finds its way into their reserve base. If this were the explanation, we should find that variations in the public's currency to deposit ratio (d in (9-8) above) are an important, indeed dominant, source of variability in money creation. We can anticipate the results of the next chapter to the extent of denying this to be the case.

An alternative explanation is available. In looking to the potential of N.F.I. to generate credit disturbances and weaken monetary controls, we have emphasized only half of the story. Non-banking intermediaries may *magnify* the impact of monetary policy. A one dollar increase in base money increases total 'liquidity' by $\frac{1 + d + t + f}{d + r + rgf + rt}$ when N.F.I. are present, compared with an increase of $\frac{1 + d + t}{d + r + rt}$ in a world without non-banks. Bank and non-bank credit will move together if the financial disturbances arise in the banking sector or with the monetary authorities. Injections of base money flow into bank reserves and enable them to expand their lending and create deposit liabilities; as the public 'dispose of' bank liabilities and acquire N.F.I. claims, these institutions in turn can expand their lending. There is now a three tiered system rather than a two-tiered system.

Hence the behaviour of non-banking intermediaries can cut both ways: they may transmit and widen the impact of monetary policy; alternatively, they may offset and delay the impact of policy. Evidence we have presented here on N.F.I. borrowings and lendings, their reserves ratios and on the extent of the portfolio shifts that they induce, does not suggest that they have exerted an independent destabilizing role or that they have significantly frustrated monetary policy. On the other hand, the correlation between changes in bank and non-bank claims give the suggestion that they may have amplified monetary policy. This particular interpretation presumes that variations in the Australian money supply are dominated by the actions of the monetary authorities. We now consider the determination and control of the money supply.

Chapter 10

Control of the Money Supply

Introduction

Governor Phillips' lecture in 1971 marked the Bank's movement away from its earlier view that the activities of non-bank intermediaries and control of 'general liquidity' through manipulation of the structure of interest rates were the paramount concern of central banking policy. A much more eclectic view of the transmission mechanism of policy was substituted in which monetary actions were seen to operate through interest rates, credit availability, wealth, expectations and the volume of money. This strategy was documented in detail in chapter 3.

While the whole tone of the lecture and the topics discussed in it leaves one with the impression that the Reserve Bank is now paying more attention to the money supply than it did in the 1960's (or in the 1950's), the Governor's wording was cautious and he fell far short of endorsing the money supply as the operational target of policy. One possible reason for this caution is to be found in the discussion of the determination of the money supply contained in the lecture. Reference is made to the "usual analysis of the supply of money" which runs "in terms of fairly fixed money multipliers translating changes in the monetary base mechanically into changes in the quantity of money." The usefulness of such analysis is firmly rejected:

> "... the supply of money *cannot* be controlled by simply controlling the level of the monetary base, because of the *possibility* of substantial switches between the bank and non-bank sectors in holdings of the monetary base. The link *is* also broken if there is a change in the banks' preferences for holding government securities (and cash) relative to making loans or other investments." [The emphasis upon "cannot", "possibility" and "is", is mine, not the Governor's.]

This statement has important implications for the prosecution of monetary policy. It means that the Reserve Bank considers that indicators derived from the monetary base, such as the potential money series devised by William Dewald, are poor guides to what is happening to the quantity of money and, furthermore, that the Reserve Bank considers that it may be able to exercise only a loose control over the money supply.

The aim of this chapter is to examine the argument of the Governor in some detail and to provide evidence regarding the determination of the money supply in Australia. Specifically, four aspects of the topic are singled out for investigation.

First, the controllability of the money supply is examined. The issues raised by Governor Phillips are essentially empirical. It certainly is *possible* that the link between the monetary base and the money supply is highly elastic, but until the evidence has been assessed it is premature to argue that the money supply *cannot* be controlled by control of the base. This leads to the question of which of the official M1, M2 or M3 definitions of money is the most amenable to control. Of particular interest is the response of savings bank deposits to changes in base money. In the literature and in popular discussion these deposits are invariably treated as being determined by demand and the role of possible supply contraints has been neglected.

A second issue is the definition of the 'monetary base': that is, whether the base is defined narrowly as the issues of non-interest bearing government debt (cash) or broadly as the total liabilities of the monetary authorities (cash plus government securities i.e. L.G.S. assets). A broad definition has generally been favoured in the literature and Governor Phillips endorsed this view ("in the Australian context, I think the monetary base is best regarded as the quantity of cash and government securities held by the private sector").

Thirdly, an issue closely related to the definition of the base is the size of the 'money multiplier'. In a cash-based system the theoretical deposit multiplier is the reciprocal of the S.R.D. ratio; in an L.G.S. based system it is the reciprocal of the S.R.D. plus L.G.S. ratio. Admittedly both are likely to overstate the size of the real world multiplier by their neglect of 'leakages' to currency holdings and excess reserves. But in either regime it would be expected that the multiplier would exceed unity, so that injections of reserves give rise to 'secondary' expansions of bank credit and deposits. A common practice in Australia, however, is to treat the base multiplier as unity. For example, in policy discussion of the budget and of the impact of the budget deficit it is assumed that increases in the cash and government security base add to the money supply dollar for dollar. Banks' intermediation is assumed to be constrained either by the publics' demand for advances or by government directives as to the rate of new lending, but not by the supply of reserves. Consequently variations in the supply of reserves have a primary ('outside') impact on the money supply, but do not alter secondary ('inside') money creation. A third area of investigation concerns the size of the money multiplier and thus, implicitly, the existence of a supply constraint upon bank intermediation.

Finally, there is the question of the role of the Statutory Reserve Deposit ratio in the control of bank credit creation and the money supply. Once this monetary instrument was regarded as being the centre-piece of central banking in Australia; now it is given a back seat to open market operations, which are seen as being "more pervasive". Much of this unfavourable comparison indicates a failure to distinguish the potential of the S.R.D. ratio from the actual role it has performed. Nonetheless the impact of changes in the S.R.D. ratio vis-a-vis open market operations is a matter of considerable importance for the implementation of monetary policy, and this is the fourth question which is examined.

The Governor's statement about the determination of the Australian money supply is an important document and we wish to scrutinize it in detail. It is useful to begin by clarifying the definition of the monetary base and measures derived from it.

Monetary Base Measures

The monetary base defined on a cash basis, B, consists of the currency and central bank cash held by the private sector and is known otherwise as 'high-powered money'. It may be defined either to include or to exclude the savings banks' holdings of central bank cash. Dewald (1967) excludes this item, Sharpe (1976a) includes it. This difference reflects the ambiguity about the role of savings banks in the money supply process and indicates further the value of investigating this matter. If savings banks' holdings are excluded, base money is then held either by the non-bank public, as notes and coinage, or by the trading banks, as S.R.D., Term and Farm Development Loan Funds and free cash reserves. This base expands whenever the Reserve Bank purchases government securities, discounts bills or notes, and makes loans, whether to the public (including savings banks), the trading banks or to governments for domestic expenditure. Monetarists tend to regard the base as an indicator of monetary policy *par excellence*.

One obvious omission from the definition of the base is changes in banks' required cash reserve ratio. An increase in the S.R.D. ratio, for example, causes a switch in the composition of the banks' total reserves, giving rise to a 'less-intensive' use of a given quantity of base money. One way to take account of the consequences that these policy actions have for the money supply is Dewald's concept of potential money (M*) defined in chapter 4 as:

$$M^* = \frac{B}{\text{S.R.D. ratio}}$$

An alternative way of allowing for the S.R.D. ratio is Brunner and Meltzer's (1964a and 1964b) concept of the extended base, E.B., which adds to the quantity of base money the cumulated dollar amount of reserves liberated from or impounded into frozen reserves by changes in the required reserve ratio, denoted by L. Thus

$$EB = B + L$$

Both of these measures take a stand on the magnitude of the impact that changes in the S.R.D. ratio have upon the money supply. Dewald's potential money calculation assumes that the actual multiplier is identical to the theoretical multiplier (which for an S.R.D. ratio of 10 per cent of deposits is 10). Brunner and Meltzer assume that a one dollar increase in liberated reserves has the same (multiplier) impact upon the money supply as a one dollar open market purchase of securities. It follows that these indicators will be unreliable if their implicit assumptions are not borne out in practice.

Australian economists have generally preferred to treat the various L.G.S. assets (cash and government securities of all types) as being equivalents from the viewpoint of money supply determination, so that the monetary base is equivalent to the total liabilities of the monetary authorities, viz

$$B^* = B + G.S.$$

where G.S. is the private sector's holdings of government securities (bonds and treasury notes). As with the cash based definition of the base, this can be similarly modified to incorporated modifications to the required reserve ratio; where required reserves now include the minimum conventional L.G.S. ratio. For potential money,

$$M^{**} = \frac{B + G.S.}{S.R.D. + L.G.S.\ \text{ratios}},$$

and for the extended base,

$$E.B.^{*} = B + L + G.S. + G$$

where G is the cumulated sum of L.G.S. assets liberated or impounded by variations in the conventional L.G.S. asset requirement.

<u>The Governor's Statement</u>

The full statement from the Mills Memorial Lecture (cited in part above) is:

> "Until recently, monetary theory tended to treat the quantity of money supplied as being determined by the central bank. The usual analysis of the supply of money ran in terms of fairly fixed money multipliers translating changes in the 'monetary base' mechanically into changes in the quantity of money. [1] In the Australian context, I think the monetary base is best regarded as the quantity of cash and government securities held by the private sector.
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> [2] Two criticisms can be made against this approach. Firstly , it ignores the fact that the monetary authorities may, and frequently do, adopt a passive role with regard to the quantity of money. This could be the case when interest rates are held steady for significant periods. In such circumstances the quantity of money held is really determined by demand. [3] Secondly, and more importantly, it is clear that (in the Australian situation) the supply of money depends not only on the level of cash and government securities but also on the willingness of the banks and the public to hold them. For example, if trading banks can indúce the public to reduce their holdings of currency and government securities and lodge the proceeds with them, a given level of cash and government securities is likely to be associated with a larger volume of money. In this way, portfolio choices influence the quantity of money supplied. To generalise, the contemporary theory of money supply has, in the words of Harry Johnson, incorporated 'all the relevant influences of the choices of the public among competing monetary and near monetary liabilities and of the financial institutions among reserves and other assets'.

[4] The implication of this for monetary policy is that the supply of money cannot be controlled by simply controlling the level of the monetary base, because of the possibility of substantial switches between the bank and non-bank sectors in holdings of the monetary base. The link is also broken if there is a change in the banks' preferences for holding government securities (and cash) relative to making loans or other investments."

In the first proposition marked the Governor indicates his preference for a broad (L.G.S. asset) definition of the monetary base, which seems to be similar to that which we have termed B*. However in footnote 11 later in the lecture a different definition of the base is implied. The footnote states that the base would contract with an increase in the S.R.D. ratio (unmatched by a decrease in the L.G.S. ratio), and this does not apply to B*. Rather the base definition seems to be one extended to include reserves liberated from or impounded into, banks' required reserve ratios, which suggests that it is identical with E.B.*

Irrespective of the precise definition of the base considered by the Bank it is difficult to reconcile either of these two possible definitions with the Governor's statement that open market operations are the "key instrument of monetary policy." A base which includes *both* cash and government securities embodies the view that bonds and cash are very close substitutes from the viewpoint of the private sector. If this view is valid (and in chapter 8 we provided evidence that it is not so for the non-bank public) then although the total of cash and bonds is important, the distribution of these liquid assets between cash and bonds is not of any particular importance. Only the net issue of L.G.S. assets imposes a constraint upon banks' behaviour. Alternatively, if the base used excludes bonds, this implies that cash and government securities are imperfect substitutes, in which case the division within the total stock is significant. The Bank's preference for viewing the total supply of L.G.S. assets as the constraint upon banks (which requires it to ignore the composition of L.G.S.

assets in the system), would seem to conflict with its avowal of the primacy of open market operations for monetary control (for which the composition is important).

One interpretation of the Banks' view would include in the base concept banks', but not the public's, holdings of government securities. Then transactions in government debt between the Reserve Bank and the non-bank public would alter the amount of base money; transactions between the Reserve Bank and the banks would not. Such a hybrid definition of the monetary base is in fact adopted by Sharpe, who follows an earlier suggestion by Purvis (1976). Sharpe (1976b) assumes that "banks may convert their excess L.G.S. assets into base money (or excess cash reserves into L.G.S. assets) at the pegged interest rate." So as to render the traditional money supply analysis appropriate to the "Australian institutional context" he augments the monetary (cash) base by the banks' government security holdings. This concept, termed the liquidity augmented base, is used along with the S.R.D. ratio and various measures of lending directives in a regression analysis of money supply determination.

Several comments can be made about this approach both as an interpretation of the Reserve Banks' thinking and as an appropriate way of studying the Australian monetary system. As to the former, it is clearly not what the Governor said. He explicitly defined the monetary base as the quantity of cash and government securities held by the *private sector*, not just the holdings of the banks. In defining the liquidity augmented base, Sharpe makes the assumption that "trading banks trade government securities only with the Reserve Bank." This was once the case, but it is no longer so. The trading banks now have few, if any, direct dealings in securities with the Reserve Bank. The banks and the Reserve Bank deal separately with brokers and operators in the short term money market, and transactions involving not just the Reserve Bank and the banks but also transactions involving the non-bank public are channelled through them. There is no one-for-one correspondence between the banks' and the Reserve Banks' portfolio.[1]

Sharpe's assumption about the nature of transactions in government securities is not only false, it also misses the point. Dewald (1969) argues that the issue is *not* "whether banks get their bonds to meet L.G.S. asset needs from the central bank or the public" but rather "how the market considers the stock of funds and government securities." He does not expand upon the statement, but the reason seems clear. If the Reserve Bank makes government securities a near perfect substitute to cash for the banks by pegging the interest rate and purchasing (and selling) securities to validate the pegged rate, it must also do so for the non-bank public. Sales made by the non-bank public either to the Reserve Bank or to the banks themselves will expand cash directly or indirectly. The control device of the monetary authorities is then their total obligations outstanding, whether held by the public or the banks. It is hardly surprising that Sharpe's liquidity augmented base performs no better than the traditional base formulation in his regressions, for both remain within the cash-based framework. The relevant question, which he ignores, is whether monetary control is exerted through a cash base or a liquid assets base. That is, does a one dollar issue of government securities have the same impact upon the money supply as a one dollar increase in cash liabilities? This is investigated later in this chapter.

The second proposition in the Governor's statement refers to the Bank's need to purchase securities when interest rates are held steady.

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1 The evidence is examined later in this chapter.

His concern presumably comes about because open market purchases in such circumstances leave the broad base measures of B* or E.B.* constant while the money supply expands. This is a peculiarity of the base definition which the Governor employs. The cash-based measures of B or E.B. do not treat this increase as a slippage. Indeed, monetarists such as Friedman see the central bank's interest rate strategy as a major contribution to instability in the money supply arising via the monetary base.[2]

The third proposition recognizes that the monetary base is not the sole determinant of the money stock. A catalogue of the sources of change in the money stock would include:

(i) changes in high-powered money.

(ii) changes in the S.R.D. ratio.

(iii) net changes in government debt outstanding to the private sector.

(iv) changes in the required L.G.S. ratio.

(v) variation in the "desired" excess cash of L.G.S. reserves of the banks.

(vi) utilization by the public of unused overdraft facilities which use up "unwanted" excess reserves.

(vii) switches by the public between currency and deposits.

(viii) switches by the public between current and fixed deposits. These may occur directly or indirectly via other transactions. (for M1)

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2 To interpret switches out of bonds during a period when interest rates are being stabilised as a case of the demand for money determining the supply is to take a narrow view of the substitutability between assets. In a simple money-bonds model there is admittedly a one for one correspondence between the demand for bonds and the demand for money. Once we allow for real assets and other securities, this equality disappears. For example, the public may intend to switch from bonds to equities, and hold money temporarily. If the Reserve Bank purchases the bonds to keep the bond rate unchanged, despite the fall in the yield on equities, the resulting increase in the supply of money cannot be seen as merely accommodating a prior increase in the demand for money.

(ix) switches by the public between trading and savings deposits; these alter the distribution of cash and government securities between the institutions. (for M1 or M2)

(x) switch of deposits between the State governments and the private sector.

(xi) payments to and from the Term and Farm Development Loan Funds.

Depending upon the definition employed, changes in the base extended for reserve ratio changes represent only two or four of the ways by which the money stock might change, out of the eleven listed. Nevertheless, the third statement is not really relevant to the issue under examination. Brunner and Meltzer, who pioneered the development of a money supply function incorporating porfolio choices such as those listed here and referred to in the Reserve Bank's statement, and other economists who adhere to the usefulness of the monetary base appreciate that it does not embrace the entire catalogue of determinants of the money supply. This knowledge does not prevent them from concluding that variations in the monetary base are the single most important determinant of changes in the money supply. They find that changes in the base, extended for variations in reserve requirements, are able to account for approximately two-thirds of the variability of changes in the money supply. From this result, they conclude that the central bank has the means at its disposal to control the money supply for the purpose of monetary policy.

Hence the issue is not the existence of variations in the money supply brought about by items (iii) - (xi) above, but rather their importance *relative* to the first two items. The third of the Governor's statements need not imply the fourth. It is not asserted that there is *no* elasticity in the link between the base and the money supply, but the *possibility* of cash slippages need not render the money supply uncontrollable.

We are thus brought back to the fourth proposition of the Governor. This is essentially an empirical one of whether the extent of the variations in the money supply arising from the behaviour of the public and banks is such as to vitiate monetary controls. Conversely, how much of the variability of the money supply can be accounted for by movements in the monetary base and changes in required reserves? This is the question to which we now address ourselves.

Preliminary Evidence

In view of the importance of the Governor's suggestion that the Reserve Bank may be unable to control the money supply, it is interesting to reflect upon the type of evidence which prompted it. An outsider is not privy to all of the information influencing the Bank's thinking, but it appears that the Bank was influenced in part by an examination of the money supply decomposed into the base and the 'money multiplier'. The most commonly used framework of analysis decomposes the money supply into three 'proximate determinants': (1) the stock of base money, B; (2) the ratio $d = {}^{C}/_{D}$ of the public's holdings of currency, C, to bank deposits, D; (3) the ratio $r = {}^{R}/_{D}$ of bank reserves of base money, R, to bank deposits. From these elements the money supply is identically equal to

$$M = \frac{1 + d}{d + r} \cdot B$$

$$= m \cdot B$$

where m is the money multiplier.[3]

[3] This is the approach of Friedman and Schwartz (1963) and Cagan (1965). The similarity with the framework developed in the previous chapter is obvious, once non-bank intermediaries are excluded. The analysis in that chapter is a more general version of the system.

This formula is purely an arithmetic tautology, but the logic of the expression appears to run as follows: base money is determined by the government and the central bank, the currency-deposit ratio by the non-bank public, and the reserve-deposit ratio by the banking system. Stated alternatively, the monetary authorities determine the quantity of base money, whereas the public and the banks determine to what extent this amount is multiplied up through the 'money multiplier' into the money supply.

Figure 10a shows the division of the money supply, M2, into the monetary base (defined in cash terms exclusive of savings banks' deposits at the central bank) and the money multiplier, all data being in monthly seasonally adjusted terms. As the Governor's lecture was delivered in April 1971, the years 1971-1974 are included mainly for interest. On first appearances, there appears to be considerable support for the Governor's views. A pronounced upward trend exists in the money supply, but this increase derives almost as much from the increase in the multiplier as the expansion of base money. In broad terms, the money supply increased by slightly less than four-fold while base money only doubled, the money multiplier increasing from 2.9 to 5.3. Four cyclical fluctuations are also evident in the money supply; these are in 1960/61, 1964/65, 1969/70 and 1973/74 and they appear to be roughly synchronous with the fluctuations in general business. For each of these four fluctuations there is a matching fluctuation in the monetary base, but it is notable that in all except the 1969/70 cycle the movement in the monetary base has a much larger amplitude. It would seem that changes in the money multiplier offset or at least substantially modify the effect that changes in base money have upon the money supply. Thus both the secular and cyclical behaviour of the money supply seems to lend some credence to the Bank's view that the money supply cannot be controlled by achieving control of the supply of base money, and that "substantial

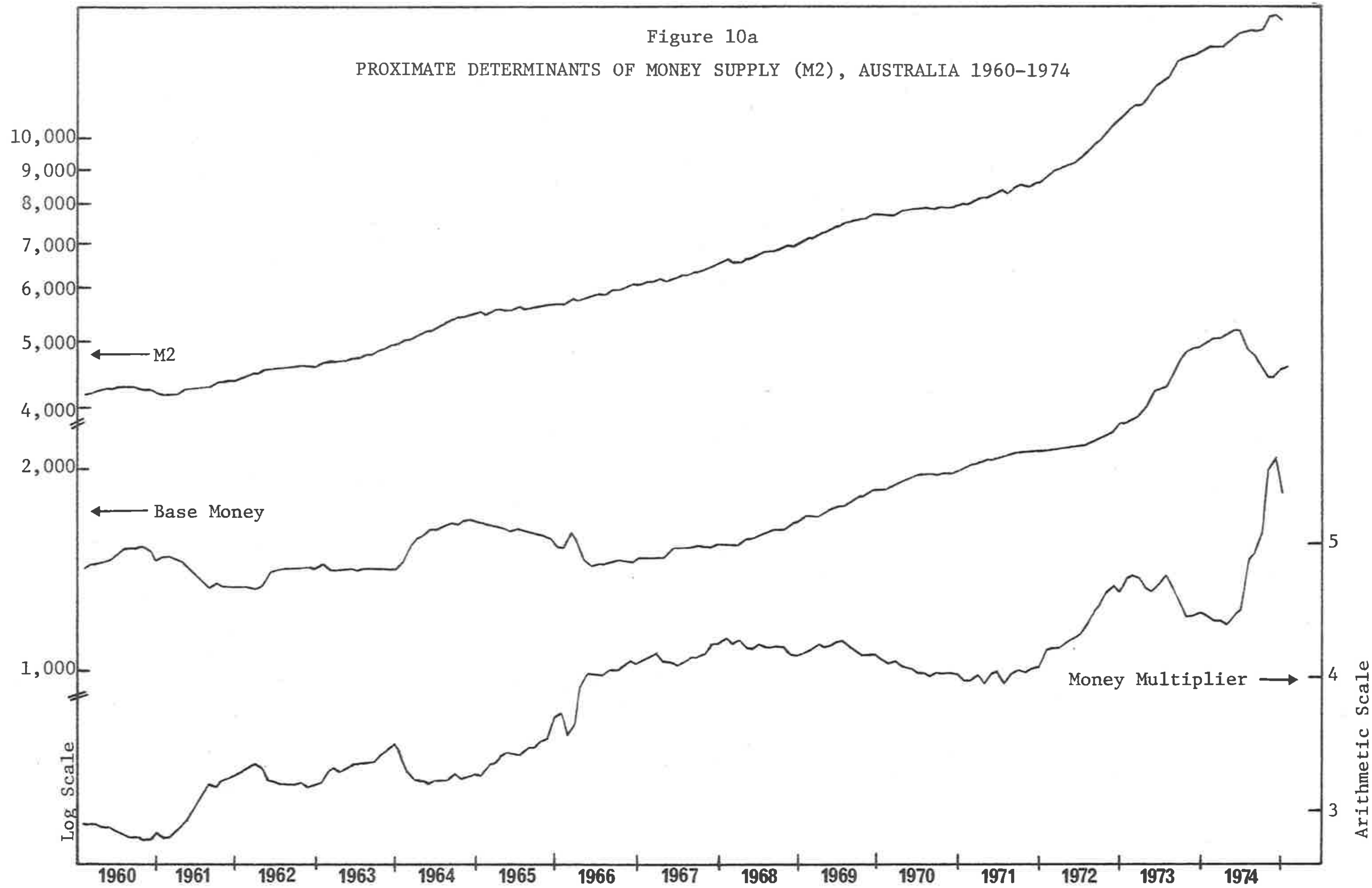

Figure 10a
PROXIMATE DETERMINANTS OF MONEY SUPPLY (M2), AUSTRALIA 1960-1974
10,000
9,000
8,000
7,000
6,000
5,000
M2
4,000
2,000
Base Money
1,000
Log Scale
5
4
3
Money Multiplier
Arithmetic Scale
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974

switches" may occur in the public's and bank's preferences for high-powered money.

This is the conclusion which follows if we continue, incorrectly, to treat the money multiplier as evidencing the public's and the bank's behaviour. The reserve-deposit ratio consists of required reserves and excess reserves, and variations in the former have been an important tool of monetary policy. It is convenient to break up the reserve ratio, r, into the required (S.R.D.) ratio, s, and the excess reserve ratio, e, so that the multiplier is now

$$m = \frac{1 + d}{d + s + e} \quad .$$

These components of the money multiplier (i.e. d, s, and e) are shown in figure 10b.[4] Both the required and the excess reserve ratio enter only the denominator of the multiplier and thus influence the money multiplier inversely. A close relationship between the money multiplier and the S.R.D. ratio is evident, particularly during the four cycles identified earlier. It would seem that the substantial fluctuations in the money multiplier derive from this source and not from changes in either the public's or the bank's preferences for base money.

Considered together, variations in the quantity of base money and in required reserves appear to account for much, if not most, of the behaviour of the money supply. This is not what the Governor's statement would lead one to expect, and the Banks' consistent underrating of the role of the S.R.D. ratio can be seen as a reason.

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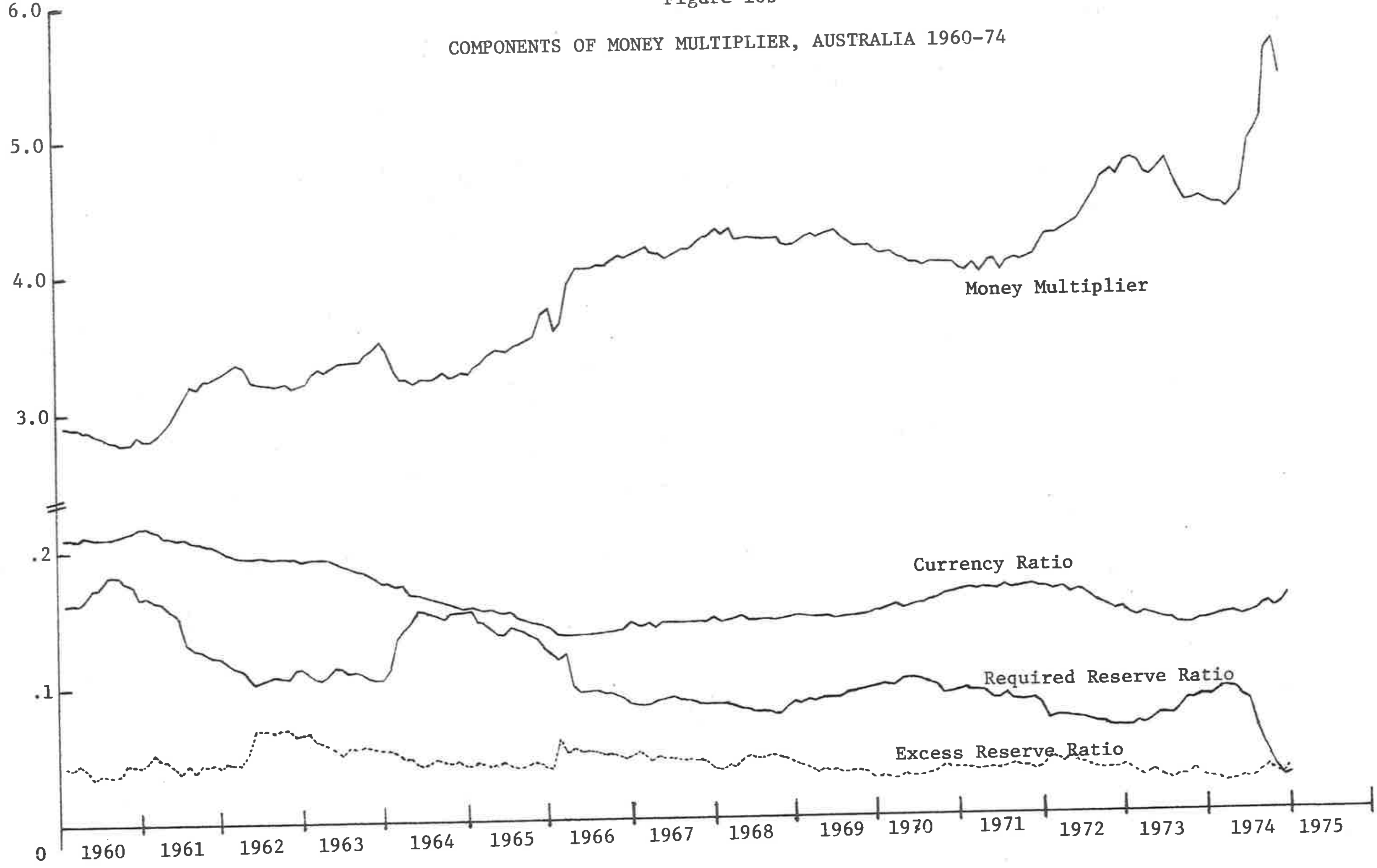
4 The required reserve ratio is the Statutory Reserve Deposit ratio. Excess reserves comprise banks' holdings of currency, their term loan and farm development accounts, and other deposits at the Reserve Bank, expressed as a ratio to total deposits. All data are seasonally adjusted.

Figure 10b

COMPONENTS OF MONEY MULTIPLIER, AUSTRALIA 1960-74



Visual examination of time series can be misleading, and evidence presented by Sharpe (1976b) appears to support the Governor's view and conflict with our own. He also employs the 'proximate determinants' framework and regresses the growth rate of the money supply against the growth rate of the monetary base and of required reserves ratio, weighted according to its contribution via the multiplier expression, using quarterly data over the period 1962-1975. It is found that only 20-30 per cent of the variability of the growth rate of the money supply, whether defined as M1 or M3, is accounted for by the two explanatory variables. Only when complex Almon lag structures are introduced, with the effects of changes in the base upon the money supply lasting for at least a year and in some cases two years, do percentage changes in the base and the reserve ratio account for around 50-60 per cent of the money supply. Lags of such length and complexity do not help to settle the question of the controllability of the money supply. Rather they heighten the problem, for policy-makers must forecast over a long period merely to operate a simple policy of stable monetary growth.

It would seem that the relationship between the money supply and the monetary base warrants a more careful investigation than we have given it, using regression methods. The 'proximate determinants' framework used both here and in the previous chapter is not entirely satisfactory for this purpose. First, the model involves non-linearities and for regressions analysis, and also for the cross-spectral analysis used in chapter 18, it is desirable to have a linear system. Second, the model is a tautology: it must always account for the behaviour of the money supply.[5] It incorporates no hypothesis about the determination of the money supply and

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[5] Goodhart (1975) strongly criticizes the 'money multiplier' approach (or proximate determinants approach) on this score. He correctly points out that any aggregate can be sub-divided in this way. The only way to judge its usefulness is by its empirical usefulness. All theory normally *begins* with a tautology.

does not enable us to examine the third of our questions: is the money supply constrained by the supply of reserves or by the demand for loans and conditions in the credit market?

An alternative and more suitable approach for our purposes is Brunner and Metlzer's 'linear hypothesis' of the supply of money. Determination of the money supply is carried out within a 'monetarist' context where the controlling variable of the size of the money supply is the amount of the monetary base in the hands of the trading banks and where the (nominal) money supply is independent of the demand for money and credit market conditions. Deposit creation is constrained by the reserve position of the banks, and there is nothing else to prevent them from using these to the full.

The Linear Hypothesis of Money Supply[6]

The linear hypothesis is essentially a sophisticated version of the text book analysis of deposit creation. It contains the description of two mechanisms. One is the response of the banks to the presence of surplus reserves; the other specifies the factors which generate or extinguish surplus reserves independent of banks' own portfolio responses. Both mechanisms incorporate hypotheses about the behaviour of the banks and the non-bank public, while the monetary authorities enter into the second.

Assume that the economy is in equilibrium and that the public and trading banks' portfolios are at their desired positions. For an individual trading bank this implies that its liabilities equal assets, required reserve ratios are maintained, and that no reserves surplus to requirements exist, so that earning assets are also at their desired level.

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6 The hypothesis is set out fully in Brunner (1961), and abbreviated accounts are in Brunner and Meltzer (1964a and 1964b).

A bank is postulated to seek to maintain a portfolio of its choice. Surplus reserves of S, which are generated for example by the actions of the monetary authorities and accrue to an individual bank, upset the balance and the bank will take action to restore portfolio equilibrium. This can be achieved through an asset expansion of X, and the optimum acquisition of assets is that which reduces surplus reserves to zero, enables required rate of reserves to be maintained, and allows for all reserve withdrawals.

For an individual bank expanding earning assets, reserves are lost in four ways: (1) to the non-bank public's holdings of currency as deposits increase; (2) to enable some of the deposits generated by the asset expansion to be transferred to other banks in the system; (3) to accommodate the higher level of required reserves necessitated by deposit creation; and (4) to add to desired excess reserves, i.e. reserves held in excess of those required to meet statutory requirements. Reserves lost through all of these ways are λX, where λ is the 'loss coefficient'. The maximum asset expansion occurs when surplus reserves, net of all drains, are zero. That is, when

$$S = \lambda X$$

or alternatively

$$X = \frac{S}{\lambda}$$

The deposits transferred to other banks in the system modify their reserve position, inducing a 'secondary' expansion of earning assets and deposits. The gain in surplus reserves at other banks per dollar of asset expansion by the expanding bank is called the 'gain coefficient' - denoted by u.

Aggregating over all banks, and thus allowing for both the primary and secondary expansions of earning assets, the following expression is obtained for the total change in banks' earning assets, E,

$$\Delta E = \frac{1}{\lambda - u} \cdot S$$

$$= m_o \cdot S \tag{10-1}$$

where m_o is referred to as the money multiplier.[7]

The assumption that banks make the fullest possible use of surplus reserves is thus implicit in the multiplier formulation. For this to be the case, an adequate supply of interest bearing securities for the banks to purchase is assumed to exist, if the conditions for making loans are not favourable. There are no unwanted excess reserves arising from an insufficient demand for loans, and deposit creation is constrained by the surplus reserves position. Because the supply of securities to the banks is assumed to be infinite, the change in deposits can be considered without reference to credit conditions and interest rates, so that stability of the multiplier is assured. As only the public's asset supply function (which is infinitely elastic at the ruling interest rate) is considered, the increases in deposits are independent of the public's demand for money: that is, the nominal money supply is considered without reference to money demand.

Secondly, the multiplier formulation needs to be supplemented by a specification of the factors which generate surplus reserves, S. These are:

(i) Changes in the monetary base. Previously we saw that the base summarizes transactions involving the balance of payments, government

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[7] A full description of the factors governing λ and u is given in Brunner.

financing, open market operations, discounting and central bank loans. Only changes in base money which find their way directly into the accounts of the banks are relevant for deposit creation. These are denoted by $b\Delta B$, where $0 < b < 1$.

(ii) Changes in statutory reserve requirements. This is given by ΔL, where L designates the cumulated sum of reserves liberated from, or impounded by, changes in reserve requirements.

(iii) Public's demand for currency. The demand function is assumed to take the form

$$C = d\ (\Pi_1, D).$$

where Π, is a vector of cost and yield elements associated with asset holdings, and D is the holding of deposits. The response of currency holdings to changes in deposits is incorporated in the λ coefficient. Changes in currency holding behaviour induced by interest rates and such factors are an element generating surplus reserves. Denoting such changes as

$$\Delta C_o = d\Delta\Pi_1 \quad ,$$

the response of surplus reserves is given by $a\Delta C_o$, where $o < a < 1-s$, s indicating banks' statutory cash ratio.

(iv) Banks' demand for reserves. The demand for reserves over and above required reserves is of the form

$$W = e\ (\Pi_2, D).$$

As with (iii), the loss coefficient, λ, takes into account the transfer of surplus reserves to desired holdings which occurs as a consequence of asset and deposit expansion. If we denote the other changes by

$$\Delta W_o = e\Delta\Pi_2 \quad ,$$

this is an additional factor which adds to or reduces surplus reserves.

(v) Finally, there are miscellaneous factors associated with the structure of interbank deposits, and transfers from and repayments to the specialized loan funds (Term and Farm Development Loan Funds). These are seen as inducing significant 'noise' into the behaviour of surplus reserves, but are unlikely to be a significant longer term element of money supply determination and are therefore ignored below.

Aggregating the factors promoting surplus reserves we obtain

$$S = b\Delta B + \Delta L - a\Delta C_o - \Delta W_o \qquad (10\text{-}2)$$

Substituting (10-2) into (10-1) gives

$$\Delta E = m_o b\Delta B + m_o\Delta L - m_o a\Delta C_o - m_o\Delta W_o \qquad (10\text{-}3)$$

where

$$m_o = \frac{1}{\lambda - u} \quad .$$

The money supply, M2, consists of currency holdings plus bank deposits,

$$M_2 = C + D \qquad (10\text{-}4)$$

A further adjustment to (10-3) is needed to obtain a money supply function. Whereas discounting operations, central bank loans and direct central bank purchases of the banks' securities add only to bank reserves, other transactions involving the monetary base add directly to deposits on the first round, independent of the deposit increases generated by the asset expansion. The proportion of base money which affects simultaneously banks' reserves and deposit liabilities is represented by q. Combining the elements together we have

$$\Delta M_2 = \Delta E + \Delta C + q\Delta B \qquad (10\text{-}5)$$

where $\Delta C = (1-b)\Delta B$. Substitution from (10-3) gives

$$\Delta M_2 = m_1\Delta B + m_o\Delta L - m_2\Delta C_o - m_o\Delta W_o \qquad (10\text{-}6)$$

where $$m_2 = m_o a$$

$$m_1 = m_o b + (1-b) + q.$$

To obtain a formula for the M1 definition of money, two adjustments are required. First, the relevant money multiplier, m_o', is smaller than m_o because some of the deposits created by the asset expansion triggered by surplus reserves are lodged in time deposits as well as in current deposits. Second, if the demand for time deposits is of the form

$$T = f(\Pi_3, D)$$

where Π_3 is a vector of relevant interest rates, allowance needs to be made for conversions of demand deposits to time deposits induced by factors other than changes in deposits, viz

$$\Delta t_o = f\Delta\Pi_3 \quad .$$

Thus we obtain

$$\Delta M_1 = m_o'.S + \Delta C + q\Delta B - \Delta t_o \tag{10-7}$$

Substituting,

$$\Delta M_1 = m_1'.\Delta B + m_o'\Delta L - m_2'\Delta C_o$$

$$- m_o'\Delta W_o - \Delta t_o \tag{10-8}$$

Considering (10-6) and (10-8), it necessarily follows that $m_o > m_2$ and $m_o' > m_2'$. What is of interest, in the light of the Bank's comments about the greater efficacy of open market operations compared with variations in the S.R.D. weapon, is the size of m_1 relative to m_o. Three cases can be considered:

(a) when $b = 1$, $0 < q \leqslant 1$,

$$m_1 = m_o + q$$

and m_1 exceeds m_o by the extent that base items, such as transactions in securities with the public, add directly to bank liabilities simultaneously with the addition to bank reserves.

(b) When $b = 1$, $q = 0$,

$$m_1 = m_o$$

and expansion of base money by discounting operations, or transactions in securities with the banks, exert the same expansionary impact dollar for dollar as reductions in the S.R.D. ratio.

(c) When $b = 0$, $q = 0$,

$$m_1 = 1$$

and the money supply increases only by the direct lodgement of base money into currency holdings. It follows that $m_1 > m_o$, by the extent that changes in the monetary base, such as derive from open market operations and foreign exchange flows, produce a 'primary' increase in bank deposits. Conversely, $m_1 < m_o$ by the extent that transactions which alter base money bypass the banks and find their way directly into the balance sheets of the public, without being banked.

Thus the size of the multiplier for base money relative to that for liberated reserves cannot be determined in advance; it is a matter for empirical investigation. Brunner and Meltzer assume that $m_1 \triangleq m_o$, and in their empirical work for the U.S. find this to be the case. The multiplier for ΔB ranges from 2.50 to 2.64 (for ΔM1 and ΔM2 respectively); that for ΔL ranges from 2.53 to 2.67. Both are considerably less than the theoretical multipliers implied by the inverse of the required cash reserve ratio. Changes in the extended base, EB (= B + L), 'explain' between 50 and 66 per cent of the variability of the money supply, depending on the time period and the definition of money. Interestingly, they find the coefficient of determination between changes in money and changes in the extended base to be higher for M1 than for M2. Their data was quarterly changes (between corresponding quarters) over the period 1949-1962. We now look to the Australian evidence.

Regression Analysis

Our regression study of the applicability of the linear hypothesis for Australia proceeds in four steps. First, the model is examined using annual data commencing in 1946 and finishing in 1970, so as to correspond with the data of Governor Phillips' lecture. Second, the relationship between the money supply, and various components of the monetary base and liberated reserves is examined with both quarterly and monthly data over the same time periods. Third, the analysis is extended to include savings bank deposits and the M3 definition of money. Fourth, the definition of base money is broadened to include issues of government securities. Some of these latter regressions examine data ending in 1976.

The model to be tested is, for the broad definition of money,

$$\Delta M_2 = m_1 \Delta B + m_o \Delta L - m_2 \Delta C_o - m_o \Delta W_o$$

where the multipliers m_i, $i = 0....2$, are to be determined by the data. The first step is to define B and L, and devise measures of ΔC_o and ΔW_o. The concept of the monetary base has already been discussed in this chapter. As we deal initially with the trading banks, the base is defined exclusive of savings banks' holdings of base money, as described in the data appendix. The concept of cumulated liberated reserves has also been discussed, and its calculation is described in the appendix. The S.R.D. ratio has been altered for two purposes. One has been to effect changes in banks' reserve base to serve as both an "indicator and support" for credit policy; the other has been to replenish the specialist frozen Term Loan and Farm Development Loan Funds. Of nineteen reductions during the 1960's, nine were to transfer reserves into these funds. Are such transfers an expansionary action? If drawings from these Funds were at the trading banks' discretion, then the answer is clearly "yes". Such drawings would liberate reserves for lending; in the first round of the credit multiplier they would constitute Term Loans, but would then give rise to increments of overdraft lending. In fact the drawings do not occur immediately, they require the consent of the Reserve Bank, and it can be assumed that the drawings are in accordance with the Reserve Bank's credit policies. Accordingly, the surplus reserves generator is calculated as liberated reserves other than for loan funds transfers. The ability to exclude this source of S.R.D. changes is a further advantage of the linear hypothesis over the alternative framework.

The model portrays the non-bank public as both a generator of surplus reserves and as a drain upon reserves as deposits change. To determine the value of ΔC_o (that portion of changes in the public's demand for cash acting as a surplus generator), it is necessary to subtract that part of the cash holdings induced by deposit changes. Changes in currency holdings were regressed in turn against changes in current and total deposits, and the regression coefficients obtained were .15 and .14 respectively, neither being significantly different from zero at the 10 per cent level.[8] These regressions indicate that the response of currency to deposits is negligable as compared to the response to other forces - a conclusion supported by the Reserve Banks' study of currency demand which excludes any reference to bank deposits or the money supply. On the basis of these results, all of the changes in the non-bank public's holdings of currency are treated as this sector's contribution to surplus reserves.

In the case of the trading bank's demand for base money we are faced with the difficulty of distinguishing desired reserves from surplus reserves and possibly unwanted holdings, and it is necessary to deduce

8 The writer is indebted to Miss Guay Lim for performing these regressions.

factors which contribute to ΔW_o. The demand function hypothesized envisages desired cash substituting with non-cash assets in the banks' balance sheet. In the Australian context these assets range from money market securities through Treasury notes, short-term government debt, long-term government debt to advances. The yield on short-term government securities is used as a proxy for the rates on these alternatives to cash, for it is the only short-term rate available continuously since 1946.

Annual data. Table 10.1 presents the results of regressions between annual first differences of the money supply and various combinations of the factors which are likely to generate surplus reserves. For expositional reasons we identify changes in the monetary base, ΔB, and liberated reserves, ΔL, as the policy injections, the remaining factors as the non-policy injections. Some discussion of this classification comes later. Those equations prefixed by *a* and *b* focus on the policy injections. These explain 83 and 60 per cent of the variability of annual first differences of M1 and M2 respectively. That part of base money which adds to bank deposits along with reserves on the first round may be expected to exert a larger multiplier impact upon changes in the money supply. The one item of base money which can be identified with certainty as having such a direct impact upon the money supply is the movements in gold and foreign exchange holdings, and equations 1*b* and 2*b* divide changes in the base into the foreign and domestic components. Little difference is noted in the size of the multipliers which attach to the two components. By contrast, the multiplier for the monetary base consistently exceeds that for liberated reserves. This feature is discussed later.

Equation *c* and *d* add the changes in currency holdings of the public (ΔC_o) and the proxy for interest rate induced variations in banks' desired excess reserves (Δr_s). The sign to be expected on ΔC_o is negative as

TABLE 10.1

Regressions between changes in 'money' and some explanatory variables, 1946 - 1970 yearly data.

Dependent variable	Regression No.	Explanatory variables and their coefficients (constant terms omitted and '*t*' values in parentheses)	R^2	D.W.
ΔM_1	1*a*	$\underset{(6.79)}{3.06}\ \Delta B + \underset{(4.90)}{2.14}\ \Delta L$	.82	1.56
ΔM_1	1*b*	$\underset{(6.75)}{3.11}\ \Delta G + \underset{(6.72)}{3.00}\ \Delta(B-G) + \underset{(4.83)}{2.24}\ \Delta L$	.83	1.46
ΔM_1	1*c*	$\underset{(3.20)}{2.74}\ \Delta B + \underset{(2.30)}{1.88}\ \Delta L + \underset{(0.63)}{0.60}\ \Delta C_o - \underset{(0.89)}{56.22}\ \Delta r_s$	.83	1.33
ΔM_1	1*d*	$\underset{(2.94)}{2.46}\ \Delta G + \underset{(2.63)}{2.31}\ \Delta(B-G) + \underset{(2.10)}{1.65}\ \Delta L + \underset{(1.00)}{0.99}\ \Delta C_o - \underset{(0.29)}{20.56}\Delta r_s$	.84	1.19
ΔM_2	2*a*	$\underset{(3.66)}{3.02}\ \Delta B + \underset{(2.53)}{2.03}\ \Delta L$	.60	.88
ΔM_2	2*b*	$\underset{(3.55)}{3.06}\ \Delta G + \underset{(3.55)}{2.96}\ \Delta(B-G) + \underset{(2.44)}{2.11}\ \Delta L$	.61	.78
ΔM_2	2*c*	$\underset{(2.69)}{4.25}\ \Delta B + \underset{(2.10)}{3.18}\ \Delta L - \underset{(0.91)}{1.61}\ \Delta C_o + \underset{(0.00)}{0.26}\ \Delta r_s$	.62	.91
ΔM_2	2*d*	$\underset{(2.46)}{3.91}\ \Delta G + \underset{(2.31)}{3.85}\ \Delta(B-G) + \underset{(1.92)}{2.88}\ \Delta L - \underset{(0.68)}{1.27}\ \Delta C_o + \underset{(0.18)}{24.05}\Delta r_s$	.62	.86

reductions in currency holdings add to surplus reserves net of transfers to S.R.D. accounts. A positive sign is expected for Δr_s, for increases in short-term rates encourage banks to economize on cash holdings and add to earning assets. The expected signs for the regression coefficients are obtained for M2 but not for M1. But in neither instance are the coefficients significantly different from zero. Also, the addition of these variables adds little to the explanatory power of the equations. Because of these results, and because our prime objective is to examine the importance of the policy injections relative to all other sources of variability (including unexplained variance), the non-policy injections are ignored in what follows.

Quarterly data. It is well known that the seasonal movement in bank deposits and the money supply in Australia arises from flows of export proceeds and rural financing and from government financing, which are components of the monetary base. Of greater interest is the variability which occurs after the seasonal pattern is allowed for, and seasonality in the data is removed by the X-II variant of U.S. Bureau of Census methods. For the quarterly analysis, the data were converted to central differences.[9] The first set of regressions in Table 10.2 replicate the annual regressions with quarterly data. Three differences are noted. First, in this case the policy injections account for between 50 and 65 per cent of the quarterly changes in money. While these correlations are, as would be expected, lower than

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9 These are calculated as

$$\Delta M_t = \frac{(M_{t+1} - M_t) + (M_t - M_{t-1})}{2} = \frac{1}{2}(M_{t+1} - M_{t-1})$$

This transformation gives a good approximation to a smooth change at a point of time.

TABLE 10.2
Regressions between changes in 'money' and some explanatory variables, for various time periods.

Time period	Dependent variable	Explanatory variables and their coefficients (constant terms omitted and '*t*' values in parentheses)	R^2	D.W.
1946-1969 quarterly	ΔM_1	1.65 ΔB + 1.02 ΔL (5.27) (3.21)	.53	.90
	ΔM_1	2.23 ΔG + 1.96 Δ(B-G) + 1.60 ΔL (7.63) (7.08) (5.41)	.65	.93
	ΔM_2	1.76 ΔB + 1.04 ΔL (4.39) (2.56)	.47	.84
	ΔM_2	2.39 ΔG + 2.12 Δ(B-G) + 1.66 ΔL (6.12) (5.67) (4.22)	.56	.87
1953-1969 quarterly	ΔM_1	1.59 ΔB + 0.94 ΔL (4.40) (2.40)	.46	.87
	ΔM_1	2.01 ΔG + 1.84 Δ(B-G) + 1.31 ΔL (5.76) (5.49) (3.55)	.54	.83
	ΔM_1	2.02 ΔR + 1.80 Δ(B-R) + 1.31 ΔL (5.65) (5.22) (3.46)	.55	.91
	ΔM_2	2.08 ΔB + 1.38 ΔL (4.03) (2.48)	.36	.77
	ΔM_2	2.62 ΔG + 2.39 Δ(B-G) + 1.86 ΔL (5.22) (4.95) (3.50)	.45	.81
	ΔM_2	2.89 ΔR + 2.52 Δ(B-R) + 2.06 ΔL (5.95) (5.41) (4.04)	.53	.98
1962-1969 quarterly	ΔM_1	1.87 ΔB + 1.43 ΔL (4.06) (2.92)	.46	1.01
	ΔM_1	2.39 ΔG + 2.11 Δ(B-G) + 1.93 ΔL (5.85) (5.43) (4.49)	.64	1.14
	ΔM_1	2.25 ΔR + 1.95 Δ(B-R) + 1.83 ΔL (5.96) (5.31) (4.55)	.67	1.04
	ΔM_2	2.43 ΔB + 1.78 ΔL (5.07) (3.50)	.59	1.09
	ΔM_2	2.82 ΔG + 2.61 Δ(B-G) + 2.17 ΔL (5.96) (5.80) (4.34)	.66	1.11
	ΔM_2	2.79 ΔR + 2.50 Δ(B-R) + 2.16 ΔL (6.73) (6.22) (4.91)	.72	1.49
1946-1970 monthly	ΔM_1	1.63 ΔB + 0.04 ΔB_{-1} + 0.81 ΔL_{-1} (9.51) (0.29) (4.27)	.45	1.23
	ΔM_1	1.05 ΔG + 0.93 Δ(B-G) + 0.30 ΔL + 0.23 ΔL_{-1} (6.27) (5.37) (1.75) (2.26)	.37	2.00
	ΔM_2	1.66 ΔB + 0.03 ΔB_{-1} + 0.82 ΔL_{-1} (8.65) (0.18) (3.82)	.42	1.11
	ΔM_2	1.05 ΔG + .82 Δ(B-G) + 0.21 ΔL + 0.23 ΔL_{-1} (5.68) (4.10) (1.12) (2.07)	.33	1.86

those with the annual data, they are much higher than comparable regressions by Sharpe, in which only 20 per cent of quarterly changes in M1 are explained by changes in the monetary base and in required reserves. We use a definition of the base which is more appropriate for M1 and exclude S.R.D. changes related to term loan funds. It may be noted that our coefficients of determination correspond in size almost exactly with those reported by Brunner and Meltzer in the U.S. Second, the multipliers estimated with quarterly data are lower than those calculated from annual data. It would seem that the credit rounds are not worked out within the quarter. In contrast to Sharpe's study, in which less than 30 per cent of the yearly impact occurs in the initial quarter, here the multiplier is 70 to 80 per cent of the annual equivalent. Third, the difference between the multipliers for G and (B-G) is larger than with the annual data, although not of statistical significance. Changes in overseas reserves may show up earlier in deposits than other items of the base, and may be identified as a 'permanent' addition to reserves more quickly by banks; these differences in timing may be of greater importance when quarterly data is being considered.

In two shorter time periods commencing at 1953 and 1962 respectively the possibility of structural changes arising from the policy-makers' operating strategies are investigated, but the relationships appear to be relatively consistent. The availability of data on the lending activities of the Rural Credit division of the Reserve Bank of Australia enables advance payments to farmers to be included as an 'overseas' component of the base, for like increments of foreign exchange these loans add directly to bank deposits. R denotes the sum of gold and foreign exchange holdings plus the outstanding rural loans. Some improvement in the explanatory power of the equation occurs in the period 1962-1969 and particularly with respect to the M2 definition of money: 72 per cent of the quarterly changes in M2 can be attributed to the policy injections. With the higher interest rates being offered by the banks on time deposits and the general 'up-grading' of these deposits which occurred, more of deposits created on the basis of reserve injections may have been flowing into time deposits in these years.

Monthly data. Regressions with monthly data are shown in the bottom panel of Table 10.2. Some reduction in both the value of the money multiplier and the coefficient of determination would be expected, as less of the deposit creation mechanism is complete and more 'noise' is present. This is the case. Nevertheless, contemporaneous changes in base money and the previous month's liberated reserves together provide an explanation for 45 and 42 per cent of the monthly changes in M1 and M2 respectively. Liberated reserves appear to have a less immediate effect upon the money supply than do changes in base money. This may be a consequence of the 'q' factor discussed earlier.

Savings deposits. The data period used for the study of savings deposits and the M3 definition of money is determined by the need to include savings banks' holdings of high powered money in the definition of money, the amended base concept being called B_B. This data became available in July 1955, and the time period considered is from the 3rd quarter of 1955 to 1971. The regressions are set out in the top panel of Table 10.3. Because of the different time period and measure of base money, the regressions with M3 are not directly comparable with those for M2 and M1. However, comparing the second equation with its counterparts for the 1953-1969 period (the nearest comparable), the size of the coefficients on ΔG and ΔL are of an order that is consistent with the model, given that M3 $>$ M2 $>$ M1. Some of the proceeds of inflows of foreign exchange or government

Table 10.3

Regressions between changes in various monetary aggregates and some explanatory variables, for various time periods.

Time period	Dependent variable	Explanatory variables and their coefficients (constant terms omitted and 't' values in parentheses)	R^2	D.W.
1955_3-1971 quarterly	ΔM_3	1.76 ΔB_B + 0.86 ΔL (5.74) (2.02)	.41	1.01
	ΔM_3	3.11 ΔG + 2.84 $\Delta(B_B-G)$ + 2.03 ΔL (5.69) (4.96) (3.26)	.51	1.28
	ΔS.B.D.	0.66 ΔB_B + 0.32 ΔL (4.58) (1.58)	.31	.62
	ΔS.B.D.	1.16 ΔG + 1.10 $\Delta(B_B-G)$ + 0.77 ΔL (4.12) (3.73) (2.41)	.32	.61
1960-1969 quarterly	ΔM_1	2.74 ΔB + 1.99 ΔL + 0.43 ΔGS (6.50) (4.42) (5.55)	.71	1.25
	ΔM_1	2.67 ΔG + 2.73 $\Delta(B-G)$ + 1.92 ΔL + 0.45 ΔGS (6.55) (6.83) (4.48) (4.41)	.73	1.10
	ΔM_2	2.88 ΔB + 2.01 ΔL + 0.41 ΔGS (5.54) (3.60) (4.42)	.64	1.46
	ΔM_2	2.92 ΔG + 2.91 $\Delta(B-G)$ + 2.01 ΔL + 0.38 ΔGS (5.80) (5.90) (3.81) (2.96)	.67	1.42
1960-1971 quarterly	ΔM_3	2.33 ΔG + 2.30 $\Delta(B_B-G)$ + 1.02 ΔL + 0.42 ΔGS (5.13) (4.62) (1.87) (3.34)	.68	0.85
	ΔS.B.D.	0.68 ΔG + 0.70 $\Delta(B_B-G)$ + 0.07 ΔL + 0.20 ΔGS (2.97) (2.85) (0.26) (3.15)	.54	0.71
1960-1976 quarterly	ΔM_2	3.34 ΔB + 2.17 ΔL + 0.32 ΔGS (6.97) (4.44) (2.89)	.55	1.23
	ΔM_3	2.51 ΔB_B + 1.31 ΔL + 0.61 ΔGS (5.56) (2.09) (3.46)	.50	1.00

financing transactions may be lodged directly as savings deposits. Also, some of the deposits generated by trading banks' asset expansion may flow to savings banks, triggering an expansion of earning assets comparable to that which the trading banks initiated in response to the initial injection of surplus reserves. Such behaviour would be a direct consequence of the public's use of savings deposits as a temporary abode of purchasing power. The response of savings deposits to policy injections of base money is examined directly in regressions with changes in these deposits, ΔSBD, as the dependent variable. While a far from complete explanation is provided of savings banks portfolio behaviour, evidence of policy-induced supply responses exists. In particular, savings banks participate in the deposit creation (or destruction) set in train by the liberation of trading bank reserves by S.R.D. changes.

Liquid assets base. The availability for the period after 1960 of data of government securities holdings in quarterly form enables us to broaden the analysis to include issues of government securities, ΔGS, as well as changes in the case. Governor Phillips indicated his preference for including government securities in the concept of the base. Adding GS to B gives the broad base, B*, the quantity of cash and government securities held by the private sector. For consistency with liberated reserves, ΔL, those liquid assets impounded by changes in the minimum conventional L.G.S. ratio should be included along with the net issue of L.G.S. assets. During the time period under consideration the L.G.S. convention ratio increased only once - in April 1962 - and there were no decreases. Unlike its counterpart in 1959, this change appeared to be related to long run factors and was neither designed nor timed to exert a short run impact on credit policy. It is omitted from the regressions, which are set out in the bottom panel of Table 10.3 and relate to all three definitions of money and to savings deposits. As we have said, a close substitutability of government securities for cash in the money supply process is a key assumption underlying the Reserve Bank's thinking. The regressions provide evidence that the money supply *does* respond to issues of government securities as well as to issues of high-powered money, as the coefficient of ΔGS is statistically significant in all cases. Government securities provide a base for trading and savings banks' credit creation, a fact which is ignored by monetarists. However, the magnitude of the respective responses is such that transactions involving the issuance of cash need to be distinguished sharply from those involving bonds. Whereas a one dollar issue of government securities adds 41 cents to the money supply, M2, issuance of the same dollar value of high-powered money adds \$2.88 to M2. It follows that transactions which expand the private sector's cash holdings and contract its holdings of government securities by an equivalent amount, leaving the total issue of liquid assets unchanged, exert a significant net impact on the money supply. The difference is such that high-powered money and government securities cannot usefully be combined with equal weights in a definition of base money, as the Governor recommended doing.

The Role of S.R.D.'s

Contrary to the impression given by the Governor in the Mills Memorial lecture of 1971, we find changes in S.R.D.'s, measured by liberated reserves (ΔL), to be a powerful and consistent factor generating changes in the money supply. A multiplier value of around 2 shows that more is added to (subtracted from) deposits than the amount of reserves liberated (impounded), evidencing that a 'secondary' asset expansion (contraction) is occasioned by the changes in the ratio.

A feature of all the regressions reported, however, is that the multiplier which attaches to liberated reserves is lower than that associated with the components of the monetary base. The findings of Brunner and Meltzer for the U.S. provides us with a direct contrast, for they find no difference in the response of the money supply to the respective injections.

Perhaps too much should not be made of the difference in the sizes of the multipliers. Referring to equation (10-6), we recall that the two multipliers need not be of equal size. It may be that transactions which add directly to bank reserves without simultaneously adding to deposits, such as the discounting of bills and notes, have contributed less to the expansion of bank reserves in Australia. If all of the changes in the monetary base are banked with the trading banks, then $b = 1$ and

$$m_1 = m_o + q$$

where m_1 is the multiplier for ΔB, m_o is the multiplier for ΔL and q designates the proportion of base money injected that affects simultaneously the banks' reserve position and deposits. The value of q is constrained by the range 0 to 1, and in none of the regressions does the base multiplier exceed the liberated reserves multiplier by greater than unity: the maximum difference is 0.99, the minimum difference is 0.36. In only two cases is the difference of statistical significance, these being the equations for M1 for the period commencing 1946 in both annual and quarterly form. In the other regressions we cannot reject (at the 5 per cent level of significance) the null hypothesis that the difference between the multipliers arises only from sampling variations. Hence the difference may be more apparent than real, or may be due to the differential impacts of the two type of injections. Appropriately calibrated changes in the S.R.D. ratio would have the same impact upon the money supply as do open market operations.[10]

Nevertheless, the Governor *did* make an unfavourable comparison between the efficacy of changes in S.R.D.'s and open market operations. As S.R.D.'s have been, and still are, an important part of the Reserve Banks' arsenal, it is worthwhile investigating the matter in greater detail.

The Reserve Bank sees the essential impact of changes in S.R.D.'s (in this case, calls) as operating by squeezing the margin of free L.G.S. assets.

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10 We in fact make an allowance for this difference when constructing a 'money indicator' in chapter 18.

This view is put in the official booklet, *Reserve Bank of Australia*, published in 1966:

> "If the Reserve Bank thought a more restrictive policy were needed, it would, in addition to informing the trading banks of this view, consider the desirability of administering S.R.D.'s to bring the actual L.G.S. ratio closer to the conventional minimum."

Stated simply, changes in S.R.D.'s are the lever, the minimum conventional L.G.S. ratio is the fulcrum, and the aim is to lever L.G.S. assets from the banks and alter their lending. Only then is an effect upon deposits envisaged, and do the impacts spread beyond the balance sheets of the banks.

> "The objective of Statutory Reserve Deposit determinations is to influence directly the liquidity and balance sheets of the trading banks. ...It is clear that this type of action has an immediate impact on the willingness and ability of banks to lend. ...However, the balance sheet adjustments that are *then* made by other groups may not necessarily result in any great change in spending."
> [our emphasis] Phillips (1971)

Greater emphasis is now placed upon open market operations because an open market sale not only reduces the banks' free reserves but also directly reduces the public's deposits and, in addition, has a direct impact upon the structure of interest rates. The Governor pointed out that:

> "... open market transactions have an impact on the balance sheets of most groups in the economy and ... the effects on spending come about through ... interest rates, the availability of credit, wealth, expectations and the volume of money."

It is true that the necessary direct effects of an increase in the S.R.D. ratio do not include any change in the money supply or rates of interest. But if an increase in the S.R.D. ratio *always* gives rise to secondary effects, the alleged superiority of open market operations appears to be a semantic, not a substantive, one. Of course the thrust of this point depends upon the nature of the secondary effects of S.R.D. changes.

An increase in the S.R.D. ratio has two aspects: a *liquidity* aspect and a *cash* aspect. The liquidity aspect consists of the direct matching reduction in the banks' margin of free reserves. It is this aspect which the Bank and most Australian academic writers emphasize. The cash aspect refers to the fact that the banks' surplus cash holdings are reduced dollar for dollar by the increment of impounded reserves, so that the composition of free L.G.S. assets is altered.

This cash effect of S.R.D. changes has received little attention by Australian writers; it was emphasized by the American, Willian Dewald. It was natural for an American visitor to ask: "Where do the banks get the cash to meet the call to S.R.D.'s?" By contrast, Australian academics rarely raised the question explicitly, although they had an implicit answer for it, found in the central banks' former practice of making direct bond transactions with the banks when the latter wished to replenish their cash. For example, Dr. Coombs in his evidence to the Radcliffe Committee in 1958 said:

> "... the Bank ... frequently negotiates sales or purchases of large blocks of securities directly with banks ..." (para 30) "... While the Central Bank .. play(s) so large a part in the day-to-day conduct of the Government security market, the authorities tend to acquire undue responsibility for movements of yields of these securities. ..." (para 31)

Australian economists believed that the banks met their needs for cash by a sale of bonds to the Central Bank. There were some interesting lesser questions,[11] but the basic point was that the cash aspect of a call to Special Accounts (or S.R.D.'s) was believed to be trivial, and it was appropriate to concentrate upon the liquidity aspect.

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[11] For example, whether the Central Bank might make the purchases at a penalty rate to inflict capital losses upon banks selling bonds. But if the Bank tried to do this, might not the trading banks threaten to sell the bonds on the open market and so force the Bank to buy at prices more favourable to the banks to preserve the desired pattern of yields?

Today it appears that the banks make no direct bond sales to the Reserve Bank. Consequently they must meet their cash needs by sales on the market, or by other means (such as a call upon the short term money market) which are likely to set off a chain of responses and a reshuffling of the porfolios of some groups in the community. (One exception would be the case where an increase in the S.R.D. ratio coincides with the maturing of a bond issue; this case is tantamount to the monetary authorities accommodating a switch by the banks from bonds to cash.) If, for example, the banks called in loans to the money market dealers, the dealers must respond and they are likely to shift out of securities; if the dealers respond with an increase in their borrowing rates this change will spill-over onto bond rates.

In effect, once the cash aspect is permitted to operate, a call to S.R.D.'s is almost tantamount to an open market sale by the Central Bank. There are some differences. In the case of open market sales the Bank effects the sales and decides upon the maturity of the bonds sold. A call to S.R.D.'s involves sales from the banks' portfolios; this is an important consideration for the Reserve Banks' own portfolio has, on occasions, proven inadequate for the desired scale of explicit open market sales.[12] Calls to S.R.D.'s have an equal initial impact on the individual banks, whereas the initial distribution of open market sales may be haphazard. S.R.D.'s are, in effect, a tax on banks' intermediation, and variations in this tax rate may add to a stimulatory or contractionary impact of policy.

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12 The Bank's portfolio of government securities frequently has been inadequate for extensive selling operations; the requisite open market sales to equal the inflow of foreign exchange in 1950 and 1951 would have required a portfolio two and one half times as great as the Bank usually held, and even as late as 1964 the inflow of reserves was as large as the Bank's portfolio. The Bank's portfolio was stretched to the limits in 1972.

Changes in S.R.D.'s have distinctive announcement effects, and these may on occasions provide a desirable addition to policy.

But in broad terms, both actions inevitably result in a reduction of the total assets of the banks, in pressure upon interest rates, in a reduction of the publics' holding of deposits, and in an increase in the public's holdings of government debt. In both cases the Reserve Bank can take secondary actions to modify the initial impact or determine the speed of subsequent responses; for example, if the banks meet a call to S.R.D.'s by calls upon the market dealers, the Central Bank can soften the total effects of the call by lending on easy terms to the money market. A similar secondary response can be envisaged for the open market sale.

These similarities were overlooked by the Governor in the Mills Memorial lecture. Several factors may have shaped the Banks' thinking; all turn on the Banks' own attitude and its behaviour prior to and following a change in S.R.D.'s.

(i) The Bank may find itself at the end of a chain of bond transactions initiated by the trading banks' responses to the 'cash' aspect of S.R.D. changes. Its bond support may be considered to be consistent with the moveable peg philosophy of interest rate policy, or to arise unintentionally from operations designed to shelter the bond market from seasonal liquidity changes and other temporary financial shocks. In figure 10c we compare the average seasonal movements in major trading banks' (M.T.B.) and the central bank's (R.B.A.) government security holdings, and in figure 10d we compare these holdings after removing the average seasonal behaviour, along with the S.R.D. ratio and short term and long term bond rates.[13]

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[13] Prior to 1960, the S.R.D. ratio is the level of amounts held by the central bank in Special Accounts, expressed as a percentage of trading deposits.

Figure 10c

AVERAGE SEASONAL INDICES OF BANKS' AND RESERVE BANK HOLDINGS OF GOVERNMENT SECURITIES, 1953-1970

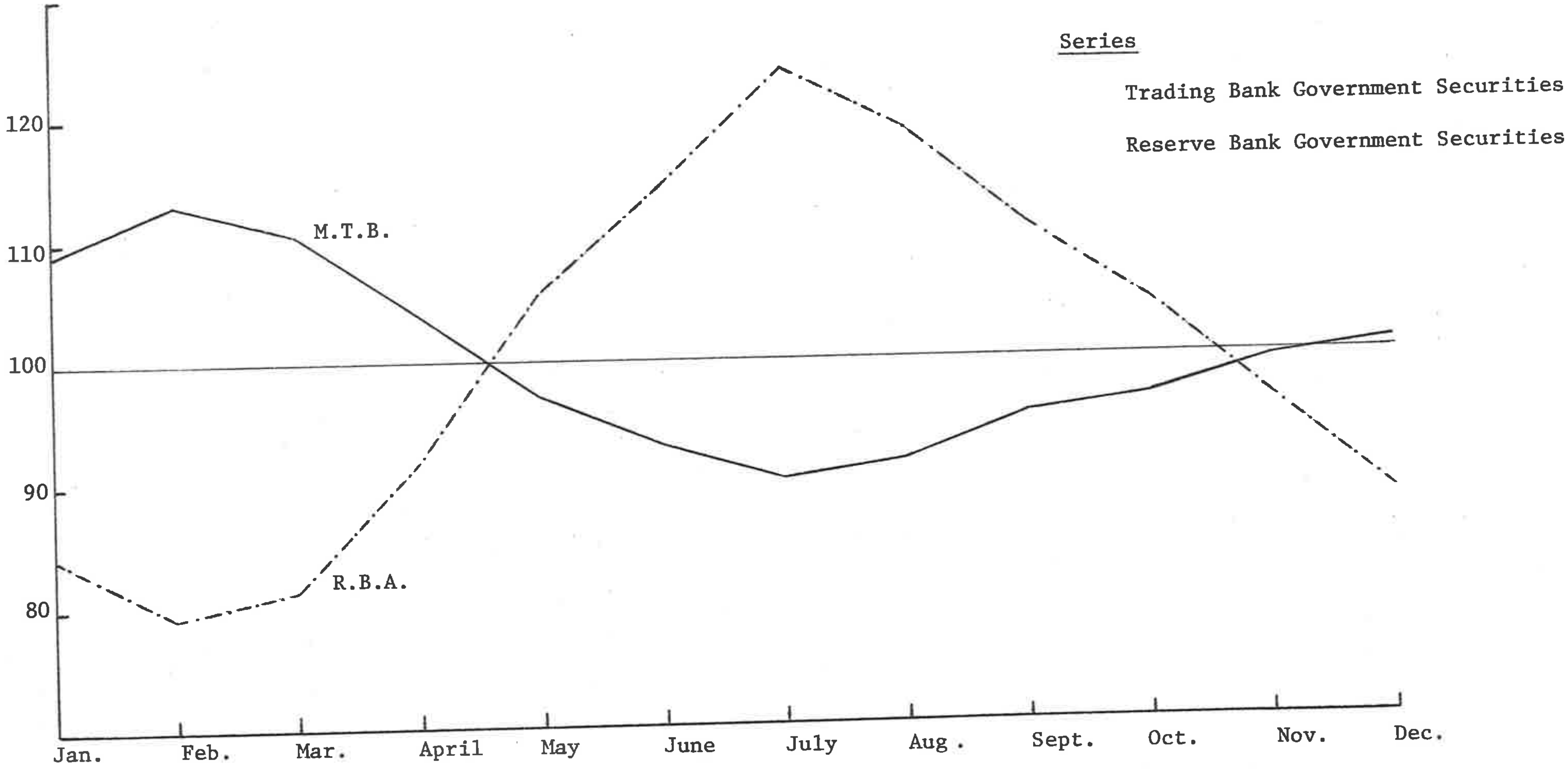
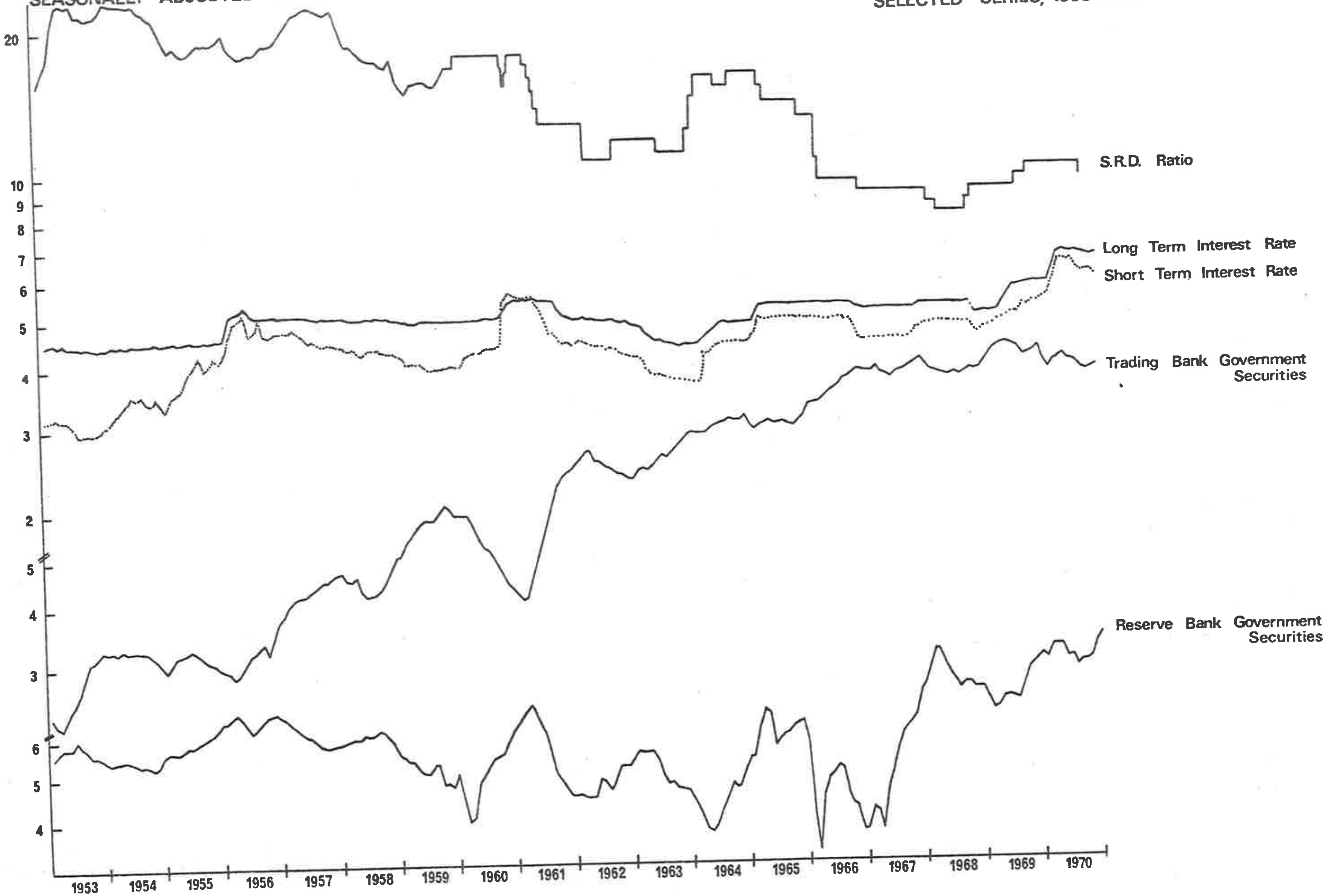


FIGURE 10d

SEASONALLY ADJUSTED HOLDINGS OF BANKS' AND RESERVE BANK HOLDINGS OF GOVERNMENT SECURITIES AND SELECTED SERIES, 1953–1970.



A clear inverse relationship exists between the seasonal patterns, and we presume them to be directly related. If so, it may be difficult for the Bank to distinguish an 'abnormal' seasonal sale from a sale arising from other causes. Some support for this contention comes from the behaviour of the seasonally adjusted series. The Reserve Bank series is difficult to interpret because of the inability to separate transactions with the public and banks from transactions with the Treasury and various trust funds. Nevertheless, the series of government security holdings of the Reserve Bank and the major trading banks mirror each other up to end of 1963, indicating the extent to which the Reserve Bank may have 'picked up' the banks' transactions in securities. After 1963, the correspondence between trading bank and central bank security holdings is not as close, but an inverse relationship is still in evidence.

To the extent that the negation of the cash effect of S.R.D. changes arises from the Bank's desire to stabilize interest rates, it is pertinent to ask why the 'cash' effect of open market operations is not offset in similar fashion, so that these exert only a 'liquidity' effect (the initial change in interest rates to effect the transaction being unsupported by banks' subsequent asset expansion). Perhaps the Bank accepts that in the case of open market operations bond transactions which initiate changes in interest rates are needed, and the subsequent pressure upon interest rates as banks' adjust their earning assets is seen as being desirable; whereas S.R.D. changes are seen merely as a means of altering bank lending, and the interest rate effects are not sought.

Purchases of securities by the central bank which vitiate the cash effect of S.R.D.'s expand the monetary base. The separate effect of S.R.D. changes would be unaltered. In a multivariate analysis, such as we have conducted, an accurate measure of the partial multiplier of liberated reserves, holding variations in base money constant, would be obtained. A direct bivariate comparison of changes in S.R.D. with the apparent resulting changes in the money supply may give little inkling of the efficacy of the weapon. This is particularly so if neutralisation of the cash effect is unintentional. It would *seem* that variations in S.R.D. have only a minor and unpredictable impact upon the money supply.

(ii) Neutralisation of the cash effect has frequently been concealed. Calls to S.R.D. have occurred during the months when the banks are flush with liquidity. Prior to 1973, there had been only one call to S.R.D. in the months of seasonal 'low', April-September. Releases have been made more generally throughout the year, but April (a month when payments of company taxation exacerbate the seasonal decline of bank liquidity) has been the most common month for releases from S.R.D.'s. Presumably this practice would enable banks to meet S.R.D. calls with the least disturbance to their portfolio (and consequently to the bond market). Further, banks are often given some notice of calls (and releases). It is only obligatory for the Bank to give extensive notice (45 days) when the S.R.D. ratio is in excess of 25 per cent, otherwise only one day's notice is required. So as to help the banks plan their credit policy, some outline of the factors expected to impinge upon their liquidity, including S.R.D. changes, is provided every quarter. Banks have the opportunity to time the maturities of Treasury notes and other items, and re-assess their demand for cash, so as to minimize the impact of the S.R.D. changes upon their cash. Some tendency for banks' excess holdings of cash to vary inversely with the impounding or release from S.R.D.'s can be discerned in Figure 10b. The offset does not seem to be large, but in contrast with the other factors, such responses would reduce the value of the multiplier for liberated reserves relative to the base multiplier.

(iii) S.R.D. changes undertaken for "defensive" reasons are likely to have different consequences from changes for "dynamic" operations. Dynamic operations are designed to change the reserve base, whereas defensive operations insulate reserves from exogeneous forces, such as change in gold and foreign exchange holdings of the Reserve Bank. The S.R.D. and Special Account mechanisms were designed specifically to reduce the secondary repercussions arising from violent swings in Australia's balance of payments; and in government financing. The aim was to insulate bank lending.

If the S.R.D.'s are used mainly to impound any abnormal cash flows which are swelling bank reserves, while open market operations are reserved for offensive operations then it is understandable that they may seem to be less potent. The extent to which S.R.D.'s have been used for defensive reasons is set aside for examination later in this study.

There is nothing 'wrong' with using S.R.D.'s for defensive policies, in timing changes to coincide with increments of cash, and in enabling banks to meet calls to S.R.D. in part by the sale of securities. By such actions, calls to S.R.D. are made analogous to increases in the minimum conventional L.G.S. ratio. But if these actions were not undertaken, calls to S.R.D. would be much more potent. The device would then give rise to a cash effect. Banks would have to sell bonds on the market and this would have an impact more akin to open market sales.

Implications of the Findings

The analysis is subject to all of the qualifications which should be attached to single equation models and to the use of the partial equilibrium analysis of what is, in fact, a general equilibrium system. However, if our results are substantially correct, important implications follow for monetary policy. First, variations in the base items 'explain' far more of the variability in the money stock than the Governor's statement had led us to expect. We find that 40 per cent of the monthly changes in the money supply, 50-70 per cent of the quarterly changes, and 60-80 per cent of the annual changes are accounted for by contemporaneous changes in the monetary base and liberated reserves. Further, the 'multipliers' connecting changes in the money supply to these injections of reserves seem to be relatively stable over time. The Governor's view that the link between the base and the money supply is elastic is unnecessarily pessimistic.

All three of the definitions of money respond to injections of base money and liberated reserves. From the viewpoint of the definition of money, there is little to choose between M1 and M2 on this score, those for M3 are the lowest. Savings bank deposits respond to injections of reserves, and when issues of government securities are taken into account, over half of the variance of the deposits can be 'explained'. This result has important implications for the interpretations of financial trends. During policy discussions in 1971/72 and 1975/76 many economic commentators pointed to the large growth of savings deposits as evidence of the public's uncertainty about the economy and their high propensity to save. Such interpretations focus upon demand considerations to the neglect of supply factors. In these years the impact of the balance of payments (in 1971/72) and expansionary monetary policies (in 1975/76) suggests that an alternative interpretation is possible.[14]

Another question investigated concerned the absolute size of the money multiplier. These consistently and significantly exceeded unity. Those analyses of money supply which give attention only to the 'first

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[14] For a further discussion of these points as they relate to 1975/76, see the author's article - Lewis (1976).

round' effects of reserve injections and ignore the secondary repercussions are mistaken. So appears to be the view that banks' intermediation is constrained by the public's demand for advances and by conditions in the market for credit governing the supply of securities. The assumption that banks' capacity to expand earning assets is constrained only by their reserve base is implicit in the hypothesis tested, and the ability of the regressions to explain as much as 70 to 80 per cent of changes in the money supply attests to its apparent appropriateness.

A further question concerned the extent of substitutability of government securities for cash in the money supply process. There are those (monetarists) who favour focusing upon the transactions which involve high-powered money, and ignore other claims of the monetary authorities. On the other hand, the more popular approach in Australia, favoured by the Reserve Bank, lumps all L.G.S. assets as one and ignores the composition of these as between cash and government securities. Dewald thinks that neither extreme makes sense and favours developing a set of multipliers by weighting the components in terms of their 'liquidity' and substitutability. On the strength of the evidence presented here, the cash component of L.G.S. should be given a much larger weighting, for we find that its multiplier value is 7 times that of government securities. Of the two polar positions, the one emphasizing the cash base seems to be closer to the actual position.

The Reserve Banks' neglect of the cash composition of L.G.S. assets is of relevance to the fourth question examined - the efficacy of S.R.D.'s. In absolute terms we find that a one dollar change in the frozen reserves alters the money supply by about two dollars. The Governor's statement that "research in the United Kingdom has shown that ... sales of bonds have tended to offset completely the call to special deposits (their equivalent of S.R.D.'s)," gives a misleading picture of the potency of this weapon. He was, of course, primarily concerned with the *relative* efficacy of S.R.D.'s compared with open market operations. There are technical differences in the way the two instruments operate, but once these are allowed for no significant difference in their potentiality is apparent. To the extent that the potentiality of S.R.D.'s has not been realized, the actions of the Bank itself in neutralising the 'cash' effect of S.R.D. changes can be seen as the principal contributing factor.

Viewed in this context, the action taken by the Bank in January 1976 to raise the minimum conventional L.G.S. ratio from 18 to 23 per cent of deposits for monetary policy reasons is a retrograde step. An increase in the L.G.S. ratio, even if it has desirable consequences for bank profits, is neither a substitute for open market operations nor for S.R.D.'s (correctly conceived). It operates only with a 'liquidity' effect (upon the margin of free L.G.S. assets) and not with a cash effect. The official view about the substitutability of the L.G.S. assets appears to be unchanged.

Concluding remarks on Section II

At the beginning of this section three preconditions for the effective operation of monetary policy were specified. These were: first, that 'money' is important; second, that the demand for money is stable enough for variations in money to have predictable consequences; and third, that the monetary authorities must be able to control the supply of money. Friedman (1956) saw these three issues as providing the litmus test for deciding whether someone is or is not a 'monetarist' (then 'quantity theorist').

On the basis of the evidence presented here, a tentative answer in the affirmative can be given to each. First, in chapter 7, the factors which give money significance for determining economic activity and a special role in monetary policy were identified. It's liquidity and non-reproducibility in supply give to variations in the demand for money an importance for economic fluctuations not shared by other assets. Characteristics of the demand for money mean that shifts in the supply function have effects on the economy which are more wide-ranging and speedy than are changes in the supply of other assets, making money an ideal vehicle for financial policies.

In chapter 8, the demand for liquid assets was examined. It was shown that the share of narrow money, M1, in the personal and unincorporated enterprises sector's holdings of liquid assets varies in a predictable way to movements in real income per head and interest rates on interest bearing assets in the portfolio. Attention was given to the substitutability of non-bank and other assets for currency and bank deposits ('money') and, as may be expected, it was found that the non-bank financiers have churned out substitutes for money. Contrary to the fears expressed by many writers, it appears that the substitution relationships involved are relatively predictable in terms of the movements of real incomes and of the structure of interest rates. Consequently, the activities of non-bank intermediaries need not vitiate monetary controls; once the substitutions are known, the non-banks may actually aid monetary policy by spreading the effects of policy beyond the banking system. Evidence supporting this view comes from chapter 9. There it was shown that the behaviour of interest rates and non-bank borrowings and lending appear neither to exacerbate the Australian business cycle, nor to counteract monetary policy operating through the money supply and bank lending. Although the evidence is highly tentative, the activities of the non-banks exhibit a tendency if anything to follow bank behaviour, reinforcing and strengthening monetary policy. A theoretical framework was developed to indicate why this result might be so. Banks' capacity to expand total credit in the economy vastly exceeds that of the N.F.I., and while the N.F.I. cannot be neglected, indeed they are part of the transmission of policy, the prime duty of monetary policy is to control the intermediation of banks.

The supposition that bank intermediation can be controlled for monetary policy has not gone unchallenged, but we find that changes in base money and reserves liberated from or impounded by changes in the S.R.D. ratio 'explain' between 70 and 80 per cent of changes in the money supply. Issues of government securities by the authorities serve as an additional, though less powerful, control device. Provided that the quantity of base money is controlled, control of the money supply does not seem to be a major difficulty.

Combining the elements and recalling Friedman's litmus test, is an affirmation of support for the monetarist position warranted? Not necessarily. The analysis of the demand and supply of liquid assets provides results that are not inconsistent with changes in the money supply being an effective force, but no direct evidence of the association of the money supply with changes in the economy has been presented. Nor have we investigated the length and stability of the lags between monetary impulses and economic activity. While interest rates do not appear to be an important factor governing the determination of the money supply, they may be important for the short run and cyclical behaviour of the velocity of money - the connecting link between the money supply and economic activity. Interest rates may also be important as a transmitter of the effects of monetary changes via investment spending. Nor have we established that the monetary base is in fact under the central bank's control.

Stated alternatively, an analysis of whether money is an important asset, supplemented by an examination of the supply of money and the demand for money relative to other assets establishes the *possibility* of variations in the quantity of money being able to influence the level of income. A further question remains as to whether such influence has in fact occurred, which necessitates examination of the historical relationship between money and business cycles. In broad terms, this is the task which lies before us.

Two issues are dispensed with in the following analysis. In seeking to explain the behaviour of the money supply during cyclical fluctuations in the economy, we ignore the market for credit, the public's demand for currency and bank advances, and banks' preferences for excess reserves, and focus upon the behaviour of the monetary authorities. Also, in studying the lags in monetary policy we concentrate upon the relationship that the money supply bears to economic activity, and ignore other financial influences such as government securities, bank credit behaviour and non-bank intermediary claims. In short, monetary policy is henceforth defined in terms of the central bank's control of the money supply to influence the economy.

Two final comments serve further to link this section with the rest of the thesis. Recalling the discussion in chapter 4 regarding indicators of monetary policy, to the extent that there *is* a difference between the multiplier for changes in base money, ΔB, and for liberated reserves, ΔL (produced by the q factor), indicators which combine the two (or components of them) equally give an unreliable indication of the thrust of policy actions upon the money supply. An example of such an indicator in

Australia is Porter's ΔNDA, which in our terminology is $\Delta(B-G)+\Delta L$. The reader is referred to the earlier discussion. In addition, because the actual money multipliers are much less than their theoretical values, Dewald's concept of potential money is inappropriate.

Having made the decision to use the money supply to measure the outside lag of monetary policy, if follows that this must be used also to measure the intermediate lag, which is the time it takes changes in the instruments of policy to impinge upon the intermediate target of policy. Changes in the money supply are the intermediate target and open market operations, discounting operations and liberated reserves are the instruments. The results here indicate that the intermediate lag of policy is relatively short. By comparing the regressions with monthly, quarterly and yearly data it can be deduced that approximately 50 per cent of the total effect occurs within the month, and 70-80 per cent within the quarter.

Issues such as the relationship between income and the money supply, and the lags involved, can be studied in two ways. One can examine structural relationships such as the demand for money and the supply of money and draw inferences from these about the aggregate relationships. Alternatively, one can directly examine 'reduced form' models of the money and income relationship.

These two approaches are in fact complementary, one establishing the plausibility of a relationship between the two, the other documenting its nature. Consequently, both approaches are used in this study. We now turn from the structural relationships to consider the 'reduced form' models.

Appendix to Chapter 10

Description and Sources of data

The data below marked by an asterisk have been seasonally adjusted using the U.S. Bureau of Census method (X-11 variant). Unless otherwise noted, the source of all data is the Reserve Bank of Australia, *Statistical Bulletin* (various issues).

* *Money Supply*. M_1 is the sum of notes and coin in the hands of the public and current deposits at cheque-paying banks. M_2 adds fixed deposits at cheque-paying banks to M_1. Government deposits are excluded from both series. M_3 adds deposits at savings banks to M_2.

* *Base (B)*. The monetary base is derived from the Reserve Bank's balance sheet. The 'uses' of the base are notes held by the public and banks' holdings of free cash, S.R.D.'s, term and farm development loan funds. The items making up the 'sources' of the base are G.F.E., Australian Government securities, and loans and advances *less* capital and reserves and deposits of savings banks, the Treasury and others at the *Bank*. The series was smoothed between December 1965 and March 1966 because of the disturbance from the introduction of decimal currency.

* *Base B* (B_B). Transfers deposits of the savings banks at the Reserve Bank from a 'source' to a 'use'.

Cumulated Liberated Reserves. Prior to 1960, liberated reserves comprise the 'calls' and 'releases' of Special Accounts. After 1960, liberated reserves are calculated by applying the change in the S.R.D. ratio to bank deposits of the preceding month. Reduction in the S.R.D. ratio made to increase the loan funds were omitted.

* *G.F.E. (G)*. The Reserve Bank's holdings of gold and foreign exchange. Data prior to 1958 was supplied to us by the Bank. Figures between May 1961 and March 1962 were adjusted to exclude a $156 m. drawing from the I.M.F., and figures for 1970 and 1971 were adjusted to exclude Special Drawing Rights. Advances of the Rural Credit Department of the Reserve Bank were added to G to calculate R.

* *Domestic Sources of Base (B-G)*. Base *less* G.F.E.

* *Government Securities (G.S.)*. Calculated by deducting the authorities' holdings from the total outstanding issue of government bonds and Treasury notes.

Currency (C). Notes and coin in the hands of the public.

Interest Rate (r_s). Theoretical yield on 2 year government bonds.

Section III

Preliminary Evidence of the Timing and Effectiveness of Monetary Policy

Chapter 11

The Impact of Money on Aggregate Expenditures: Some Empirical Tests

Introduction

In section IV we shall be using the powerful statistical tool of cross-spectral analysis to study the association of money with the Australian business cycle, and to examine the length of and the type of lags which exist between the series used. Later in this section preliminary evidence of these relationships is presented when we both review and update the studies which measure the lags in the effect of monetary policy by the standard methods of time series analysis.

These studies have little merit in themselves and their results cannot be interpreted meaningfully unless we precede them with an analysis of the following questions:

(a) To what extent is the cyclical association of money and income evidence that money is exerting an independent ('causal') influence on expenditures, or of income influencing money, or to what extent is some common factor exerting an influence on both?

(b) If money does alter the course of the business cycle, does it do so only by varying the third factor, or is there a direct mechanism linking the two?

(c) Are the lags which exist between money and income providing information of the workings of this mechanism, or are they merely reflective of a lagged dependency of both money and income upon the other determinants, with money responding first?

These are not easy questions to answer, nor can we pretend to do so here. They lie at the heart of the present debate between those who adhere to the 'quantity theory' approach and the adherents of (for want of a better description) the 'Keynesian' approach - see Laidler and Parkin, 1975 section 2. Friedman (1964, 1973) has couched his answer to them in terms of "the combined weight of evidence", involving studies of the structural relationships of the demand and supply of money, time series evidence of the cyclical behaviour of the quantity of money, examination of the qualitative historical circumstances underlying changes in the money supply, and a statistical comparison of the roles of money and 'investment' in the cycle. The last (a study by Friedman and Meiselman, 1963) is of particular interest here, both because no comparable evidence is available for Australia, and because it enables us to specify what the other factors influencing the course of the cycle might be.

An alternative to the monetary explanation of the business cycle is provided by an income-expenditure relationship, in which there is hypothesized to be a stable relationship between investment expenditure (more generally autonomous expenditures) and income via an expenditure multiplier. In a closed economy, autonomous expenditures encompass elements of private investment and government spending. In an open economy, autonomous expenditures include exports or the foreign trade balance and these items provide a mechanism alternative to the banking system whereby foreign impluses may be transmitted to the domestic economy. The study is thus particularly relevant to an economy like Australia that is subject to external disturbances and in which international trade is an important factor determining aggregate output.

The Models Tested

Friedman and Meiselman sought to establish whether money matters, in the sense that changes in the quantity of money serve better to explain changes in aggregate expenditures than do 'autonomous expenditures'. They did this by comparing the predictive power of two simple relationships, one based on the income-expenditure approach, the other deriving from the quantity theory approach.

In the former, expenditures are divided into an induced component, referred to as consumption (C), and autonomous expenditures (A), such that

$$Y_t = C_t + A_t \tag{11-1}$$

Let induced expenditures be a stochastic function of income,

$$C_t = a + cY_t + w_t \tag{11-2}$$

where c is the marginal propensity to consume. The two equations define the reduced form

$$C_t = \alpha_1 + KA_t + u_t \tag{11-3}$$

where $\alpha_1 = {}^{a}/_{1-c}$

$K = {}^{c}/_{1-c}$

and $u_t = {}^{w_t}/_{1-c}$

Note that K is one less than the standard income multiplier, and that u_t has the same properties as w_t except for a different variance. Induced expenditures are made the dependent variable to obviate correlating income with a component of itself. The question is: how much of the variance of C_t can be explained by A_t?

The quantity theory model is a derivative of the simple 'Cambridge' model. The demand for money is proportional to income,

$$Md_t = d + mY_t + e_t \tag{11-4}$$

Setting the demand for money equal to the supply of money

$$Md_t = M_t \tag{11-5}$$

we derive

$$Y_t = -{}^{d}/_{m} + {}^{1}/_{m}\, M_t + {}^{e_t}/_{m} \tag{11-6}$$

So as to make (11-6) directly comparable with its Keynesian rival, we make C_t the dependent variable,

$$C_t = \alpha_2 + V\, M_t + v_t \tag{11-7}$$

where $\alpha_2 = (-{}^{d}/_{m} - A)$

$V = {}^{1}/_{m}$

and $v_t = {}^{e_t}/_{m}$.

Here the question involves how much of the variability of C_t can be attributed to M_t. Further, is it more or less than was explained by the variability in A_t? Clearly, induced expenditures must be the same in both in order to facilitate the comparison.

A further test is provided. A_t may be influencing C_t through its effect on the stock of money and, alternatively, M_t may be influencing C_t through its effect on autonomous spending. One may be a disguised influence of the other. An independent check on these possibilities is obtained by combining the two relationships,

$$C_t = \alpha_3 + KA_t + VM_t + e_t \qquad (11\text{-}8)$$

If the partial correlation between C_t and A_t is higher than the partial correlation between C_t and M_t then one would suspect that a high simple correlation between C_t and M_t is reflecting the disguised influence of A_t. Conversely, if it is found that $r_{CM.A}$ is greater than $r_{CA.M}$ then one would be led to believe that the high simple correlation r_{CA} is being produced by the disguised effect of M_t. How much of the simple correlation is produced by the disguised effect of the other variable is indicated by a comparison of the simple and partial correlation coefficients.

Though we have followed Friedman-Meiselman and others in specifying the two models (11-3) and (11-7) separately, and obtaining (11-8) by an arbitary combination of the two, these three models are reduced form equations of a larger and more comprehensive system in which the income-expenditure theory and the quantity theory are special cases. They are not *ad hoc* equations, as claimed by many participants in the debate.[1] Consequently the results of the correlations are capable of being interpreted in an economically meaningful way. This can be shown following Rao (1974), by commencing with the well known Hicks-Hansen model of the economy:

$$Y = C + I \qquad (11\text{-}9)$$

$$I = A - ir \qquad (11\text{-}10)$$

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1 For example, Edge (1967), Parkin (1970), Laidler (1971) and Chick (1973).

$$C = cY + bM \qquad (11\text{-}11)$$

$$M = mY - lr \qquad (11\text{-}12)$$

where Y is real income, C is real 'induced' expenditures, I is real 'investment', r is the real rate of interest, and M is the real money supply. This specification differs from the standard one by the addition of a 'real balance effect' on consumption expenditures. Substituting (11-12) into (11-10), and (11-10) and (11-11) into (11-9), we obtain the following expression for real income:

$$Y = \left[\frac{l}{im + l(1-c)}\right]A + \left[\frac{i + bl}{im + l(1-c)}\right]M \qquad (11\text{-}13)$$

Here real income is related functionally to autonomous expenditures and money, the latter determining income through a 'direct' mechanism (b) and an 'indirect' mechanism (i). For convenience, we write (11-13) as follows:

$$Y = \pi_1 A + \pi_2 M \qquad (11\text{-}13a)$$

where $\pi_1 = {}^{l}/_{im + l(1-c)}$

$\pi_2 = {}^{i + bl}\big/_{im + l(1-c)}$

In order to obtain an expression in nominal terms, both sides of (11-13a) are multiplied by P (the price index) giving

$$Y' = \pi_1 A' + \pi_2 M' \qquad (11\text{-}14)$$

where Y', A', and M' denote the nominal magnitudes.

The consumption function (11-11) can also be written in nominal values by multiplying both sides by P. Thus

$$C' = cY' + bM' \qquad (11\text{-}15)$$

Substituting (11-14) into (11-15) we obtain

$$C' = c\pi_1 A' + (c\pi_2 + b)\, M' \qquad (11\text{-}16)$$

By adding a constant term and error term to allow for the mean value and distribution of excluded influences upon income, we derive

$$C' = \pi_0 + c\pi_1 A' + (c\pi_2 + b)\, M' + e' \qquad (11\text{-}17)$$

which has the same form as equation (11-8) above.

Three special cases of (11-17) are of interest. First, when $l = 0$ we have the rigid version of the quantity theory case, and (11-17) simplifies to

$$C' = \pi_0 + (c\pi_2 + b)\, M' + e' \qquad (11\text{-}18)$$

where $\pi_2 = {}^1/_m$. This equation is of the same form as (11-7) above.[2]

Secondly, if i = 0, b = 0 we have the extreme variant of the income-expenditure approach, for (11-17) simplifies to

$$C' = \pi_0 + \frac{c}{1-c} A' + e' \qquad (11\text{-}19)$$

which is of the same form as (11-3) above.

Thirdly, when b=0 then we have the standard LS-LM model, and (11-17) becomes

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2 With a vertical LM curve, the real balance effect governs the composition of nominal income.

$$C' = \pi_0 + c\pi_1 A + c\pi_2 M' + e' \qquad (11\text{-}20)$$

where $\pi_2 = {}^{i}/_{im} + l(1-c)$.

There is only an indirect (interest rate) mechanism linking money to income.

Comparing (11-20) and (11-17) in conjunction with (11-8), it is possible to shed some light on the interpretation of the results. The term 'autonomous' expenditures is used in two senses (Laidler, 1971). Sometimes it is taken to mean those expenditures which are independent of current income flows, which is the meaning implicit in equation (11-8). Alternatively, it is used to describe those expenditures whose value is independent of income *and* the interest rate, which is implicit in (11-17) and (11-20). Which of these definitions is appropriate? This is conditioned by what one wishes to obtain from the analysis. Suppose that monetary policy works entirely through interest rate effects, so that (11-20) is the correct description of reality, and autonomous expenditures include items which respond to interest rate movements. All monetary effects would be embodied in A, and in addition there would be other forces (animal spirits etc.) affecting autonomous expenditures, offsetting or intensifying the monetary changes. The relation between autonomous expenditures and induced expenditures would be closer than that between money and induced expenditures ($r_{CA} > r_{CM}$). Also, the partial correlation coefficient $r_{CM.A}$ would be low, for little or nothing would be left over for money to explain once autonomous expenditures enter the relationship. On the other hand, if we find that $r_{CM} > r_{CA}$, and the partial correlation $r_{CA.M}$ is low, then there is a presumption that the quantity of money exerts a substantial influence upon expenditures over and above that working through the rate of interest. The results thus have implications for the transmission mechanism of monetary policy and the way in which the lags in monetary policy should be measured. This is a convenient result, for the practical difficulties of distinguishing A from I are formidable.

Friedman and Meiselman tested the three basic models (11-3), (11-7) and (11-8) in both nominal and real terms, in absolute and first differences, with annual data for 1897-1958 and quarterly data 1945-1958. Attention was focused more on relative stability than on the absolute stability of models (11-3) and (11-7) over time. Structural changes in both the expenditure multiplier, K, and the income velocity, V, are to be expected, and neither model is expected to hold over long periods. Friedman and Meiselman broke the period into sub-periods based on trough-to-trough or peak-to-peak of the business cycle, and examined whether A or M explained more of the variance of C within each period. With the exception of the 1930's, the results overwhelmingly favour the 'monetary' explanation.

Considerable literature has been generated by this study. Ando and Modigliani (1965), Burns (1975), De Prano and Mayer (1965), Hester (1965), Lewis (1967) and Phillips (1969) conducted additional tests for the U.S. The authors replied to the criticisms of Ando-Modigliani, De Prano and Mayer, and Hester, and supplemented the results in the original study in Friedman and Schwartz (1963), Friedman and Meiselman (1965) and Meiselman (1968). Tests for the U.K. were made by Barrett and Walters (1966) and Walters (1969), and for Canada by Macesich (1966 and 1969). The various studies were critically assessed by Bronfrenbrenner (1963), De Prano (1968), Dewald (1965), Edge (1967), Fisher and Sheppard (1972), Laidler (1971), Pesek (1968), Teigen (1970) and Walters (1970).

Criticisms of Friedman and Meiselman's Approach

The discussion is focused around three issues: the simplicity of the models used, reverse causation, and the definition of autonomous expenditures.

Simplicity of Models. Both Ando and Modigliani and De Prano and Mayer argued that the models used by Friedman and Meiselman (henceforth FM) do greater violence to the income-expenditure approach than to the quantity approach. In particular, the need to classify expenditures into broad groupings of autonomous and induced, and treat the former as exogenous was criticized as limiting the 'Keynesian' model.

The issues go much deeper than this, and Ando *et al* have been subsequently criticized for being seduced into accepting Friedman's methodological position. Fisher and Sheppard argue that FM commit two econometric heresies: "disregard for structure and the spurning of disaggregation." Econometricians generally eschew reduced form models, preferring to specify structural relationships in which the precise interaction between exogenous and endogenous elements is allowed for. Since FM's equations are not *ad hoc* but are reduced forms of an accepted model of the economy, it is not altogether clear why the econometrician's preference should be over-riding. That is, since the reduced form incorporates structural form information, the two methods should yield approximately the same amount of statistical information. Fisher and Sheppard see the inability to conduct diagnostic checks and utilize *a priori* information as an important loss when the structure is not made explicit in the statistical model. Presumably some information must be lost through using a reduced form, what is gained is simplicity. Friedman sees this as a virtue, others do not.

Friedman (1953, chapter 1) judges a theory to be "important" if "it explains much from little, that is, if it abstracts the common and crucial elements from the mass of complex and detailed circumstances surrounding the phenomena to be explained." This concept of efficiency is obviously not important to the builder of a 100 equation econometric model. Further, there is the quality of robustness and the desire to test the alternative models over a broad sweep of time and a variety of historical circumstances, in which case data limitations necessitate limiting the comparison to simple models. FM examine the period 1897-1958; in Australia the data exists to commence in 1880 or even earlier. Whether one wishes to do so is a matter of taste, like the previous methodological point. As Strotz states: "each is welcome to his private judgement as to whether it is better to derive knowledge from a simple theory tested over a long period of time and a considerable variety of historical circumstances or from a more sophisticated theory tested over more limited but more recent experience."

Reverse Causation. The form of the models treat both A and M as independent variables. Both are questionable, and if the reduced form equations do not contain truly exogenous variables the well known statistical problems of simultaneity inherent in the structural models reappear. It is true that empirical tests were made by FM to determine the appropriate groupings of items in A and M, but these do not ensure that either is independent of C. Since FM find r_{CM} generally exceeds r_{CA}, the possibility of feedback from income to money has been the one most discussed. It has been asserted that the equations should perhaps be read from left to right, with variations in consumption somehow inducing variations in money. Alternatively, money might be responding to current or prior values of autonomous spending or some third factor may be inducing changes in both induced expenditures and money.

Any of these are possibilities, and the burden on those arguing them is to provide a plausible mechanism by which expenditures might induce changes in the quantity of money. Most discussions of reverse causation focus upon three mechanisms: the finance of investment expenditures by the drawing down of overdrafts; the finance of government expenditures by borrowings from the central bank, and the monetary consequences of foreign trade flows. These channels run predominantly from A to M not from C to M, and a multiple regression analysis involving C, A and M enables us to see to what extent M is a disguised influence of A. Similarly, we can test for whether the correlation r_{CM} is a disguised influence of prior values of A (or C) by allowing for lags and including A in these correlations.

Autonomous Expenditures.[3] Awkward conceptual difficulties are inherent in the selection of autonomous expenditures. As Y = C + A, each definition of A implies something about C or Y. If C remains unchanged, then different definitions of A imply different concepts of income. In the interchange between FM and Ando and Modigliani, De Prano and Mayer, and Hester four concepts of income were suggested: personal disposable income (on a cash basis, personal disposable income on an accrual basis, net national product, and gross national product. Any definition selected must serve as the measure of overall activity being predicted, the constraint in the consumption function, and implicitly the aggregate determining money demand. The broader is the measure of economic activity being predicted, the less relevant it is for the consumption function; and vice versa.

On the other hand, if the income aggregate which is to be predicted is left unchanged, then each definition of autonomous expenditures implies a different grouping of induced expenditures. This was overlooked by some of the critics of FM. FM's definition of autonomous expenditures comprised net private domestic investment, the government deficit, and the net foreign balance. Symbolically,

$$A = I + (G - T) + (X - M)$$

Each of these elements were queried: expenditures on consumer durables were thought to contain an autonomous element, while tax revenue and imports

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3 The criticisms of the FM study are surveyed by Edge. As the reader of this will find out, she has been influenced by my article (Lewis, 1967) and my ideas, and I shall draw freely upon them without accreditation in what follows.

were thought to be more appropriately treated as induced items. When alternative definitions of autonomous expenditures, incorporating these suggested amendments, were in fact tried the results were much more favourable to the income-expenditure model, and the superiority of the quantity theory evaporated - in part this may have been because A became larger and U smaller, so A had less work to do.

FM concede that the concept of autonomous they selected may have been less favourable than others to the autonomous expenditures relationship, but contend that it had the merit of being" ... derived by a specifiable and reproducible procedure ...", meaning that items were tested one after another to determine whether or not they were autonomous or induced. Unfortunately, as the present writer (Lewis, 1967) pointed out, their defense is weakened in two respects. First, FM failed to consistently apply their own criteria, and also failed to perform all the tests which were relevant. Secondly, the possibility arises that an item appears to be both autonomous and induced. In dealing with the doubtful cases, and there were many of them, FM fell back on what they considered to be "accepted convention", arguing that the budget deficit and the balance of payments surplus or deficit have traditionally been regarded as autonomous. When the literature is inspected in detail, it turns out that several articles written in the late 1930's and early 1940's did treat these items as autonomous, but this is not to say that economists now regard this treatment as accepted convention, as indeed the criticisms made by others indicate.

In our own work in selecting autonomous expenditures it is important to ensure that, unlike FM, the tests are performed consistently, and that where the results are inconclusive, any definitions selected on *a priori* grounds provide an adequate coverage of "accepted conventions."

Having spelt out the underlying theory and derived the models which are to be tested, and having seen what modifications to the test procedures are needed to meet the criticisms made of the approach, three steps remain to render the analysis operational. These are: determination of the time period, selection of autonomous and induced expenditures, and specification of the definition of money.

Time Period Studied

The author shares FM's view that it is desirable to confront the models with as long a time series of data as is practicable. One is interested in the stability of the relationships over time (perhaps robustness would be a better word), and the extent of correlation during particular historical episodes may throw up interesting evidence.

Our monetary series begin at 1880 and we take this year as the earliest possible starting date. For the years following this date, the following series are available:

Annual Data. Four series are available:

[1] 1880-1938/9. Butlin's estimates of Capital Formation and National Production.

[2] 1928/9-1937/8. Official revisions to Clark and Crawford's earlier estimates of National Production.

[3] 1938/9-1947/8. Official estimates on the old basis from *National Income and Expenditure*.

[4] 1948/9 onwards. Official estimates on the current basis from *Australian National Accounts*.

Quarterly Data. Two series are available:

[5] 1950/51-1957/58. Private estimates on the current basis by Kennedy.

[6] 1958/59 onwards. Official estimates on the current basis from *Australian National Accounts.*

Of these series [4], [5] and [6] are on a similar basis, and permit us to make a preferred selection of autonomous and induced expenditures, using tests along the lines suggested by FM. Lengthening the data period to incorporate the earlier data involved making considerable adjustments to each of the series in order to put them on a consistent basis. The choice of autonomous expenditures was also limited. Nevertheless two additional data runs were obtained, and four definitions of autonomous expenditures were provided.

The first data run comes from combining [2], [3] and [4] to cover the years 1928/9-1966/67. Series [2] was adjusted to include estimates of consumption expenditures by Brown (1957), and adjustments were made to series [4] to render the private investment data consistent with that in [2] and [3]. Details are provided in the Appendix to this chapter. The two definitions of autonomous expenditures and the concept of income are similar to those used by Friedman and Meiselman.

A second series covered the longer time period 1880-1966/67, by combining [1], [3] and [4]. Data for 1880-1900 are on a calendar year basis, and for combining with later data were converted to a financial year basis by linear interpolation. The income concept is net domestic production, and two additional definitions of autonomous expenditures were provided.

Altogether four definitions of autonomous expenditures are determined by the nature of the data used. These are:

$$A_1 = I + (G_K + G_C - T) + (E - I_m - R)$$

$$A_2 = I + (G_K + G_C - T) + (E - I_m)$$

$$A_3 = I + G_K + (E - I_m - R)$$

$$A_4 = I + G_K + E$$

where

I = Net Private Investment

G_K = Net Public Investment

G_C = Public Current Expenditure

T = Tax and Other Government Receipts

E = Exports

I_m = Imports

R = Net Overseas Remittances (net foreign debits)

The first two broadly correspond to Friedman and Meiselman's A, which in some instances uses net foreign investment i.e. the balance of payments on current account (A_1) and in others uses the net foreign balance i.e. the trade balance (A_2). A_4 roughly corresponds to De Prano and Mayer's A** definition, whereas A_3 is a hybrid definition using the only available data. We now examine the post-war data to see whether a more appropriate definition of autonomous expenditures can be found.

Selection of Autonomous Expenditures

The technique used by FM employs correlation analysis to examine the technical substitution of expenditure items in the role as generators of income flows. An earlier suggestion along these lines was made by Friend and Jones (1960). FM's description of their test has proved to be confusing both to others and to themselves, and a more general formulation is provided here. Total income, Y, is divided into three parts: (1) a doubtful item, D, which it is desired to classify as an autonomous or induced item; (2) autonomous expenditures, A, which *exclude* the doubtful item; and (3) induced expenditures, N, which also *exclude* D. If, as a result of the tests, D is classified as a component of autonomous expenditures, autonomous expenditures will be D + A for the purposes of the model. Hence the question is whether D + A or A alone is the preferable definition of autonomous expenditures. FM argue that if D and A were perfect substitutes as income-generating expenditures, then N would tend to have a higher correlation with D + A than with either D or A alone. This is the first test. As the sum of autonomous expenditures, induced expenditures, and the item in doubt equals income, the test can be performed in reverse to determine whether or not D is a perfect substitute for N. This is the second test, and so the two tests are:

(i) Autonomous test

$$r_{N(D+A)} > \begin{bmatrix} r_{ND} \\ \text{and} \\ r_{NA} \end{bmatrix}$$

(ii) Induced test

$$r_{A(D+N)} > \begin{bmatrix} r_{AD} \\ \text{and} \\ r_{AN} \end{bmatrix}$$

Both tests are required by FM to classify an item as an autonomous or induced expenditure. The doubtful item, D, would be included as a component of autonomous expenditures if test (i) were satisfied, and test (ii) not satisfied. It would be considered induced if these results were reversed. If neither of these combinations holds, then the results must be considered ambiguous. We cannot be sure that FM's criteria actually do identify autonomous expenditures. At best, the tests they conduct only show that D and A are substitutes as income-generating expenditures, not that these items are independent of current income flows.

In order to render the procedure operational we must commence with an arbitrarily chosen definition of autonomous expenditures. FM commenced with net private domestic investment, the government deficit and net foreign investment, and used personal disposable income on an accrual basis as the income concept. We use as a base a definition of autonomous expenditure similar to Ando and Modigliani's, namely gross private investment, government expenditure and exports (I + G + E). The income concept is gross domestic product (Y_G). The items placed under consideration are:

(a) Consumer durables

(b) Exports

(c) Imports

The first item considered is expenditure on consumer durable goods, i.e. purchases of motor vehicles and household durables i.e. H. According to our interpretation of FM's criteria for allocating items between autonomous and induced we have:

$$D = H$$

$$N = C - Im - H$$

$$A = I + G + E$$

The results with annual data for 1948/9 - 1966/7 are set out in the first column of Table 11.1. Neither test is satisfied and we conclude that durables are a 'mixed' item.

Next we considered exports, treating imports as induced. The classification is:

$$D' = E$$

$$N' = C - Im$$

$$A' = I + G$$

The ineqality (i) was satisfied, and on that basis exports appear to be autonomous. When the induced test (ii) was carried out, the inequality was also satisfied which it should not be if exports are autonomous.

Table 11.1

Experiments with Different Definitions of Autonomous Expenditures
1948/9 - 1966/7

Nature of test	Durables	Exports	Imports
Autonomous test			
$r_{N(D + A)}$	.940	.945	.967
r_{ND}	.963	.889	.894
r_{NA}	.933	.941	.978
Induced test			
$r_{A(D + N)}$	.946	.951	.945
r_{AD}	.977	.903	.950
r_{AN}	.933	.941	.978

Finally, we considered imports, treating exports as autonomous. The classification is:

$$D'' = Im$$

$$N'' = C$$

$$A'' = I + G + E$$

The first inequality was not satisfied, indicating that imports are not autonomous. In the second test imports are tested directly as an induced item, but the inequality is also not satisfied.

All three tests are thus inconclusive. In particular, our *a priori* selection of exports as autonomous and imports as induced is not substantiated. This is surprising as it is the classification which has been adopted in all of the econometric models of the Australian economy. It makes sense to treat exports as autonomous in the short run, but exports cannot be so treated in the long run because they must be paid for by other countries' exports (and thus Australian imports). This is the basis of Friedman and Meiselman's treatment of the foreign balance as autonomous - the treatment we have used in the definitions A_1, A_2 and A_3. Our results may be seen to lend some support to this viewpoint.

In view of the inconclusive nature of these tests, a potentially more powerful variant of FM's test procedure is tried.[4] Consider again FM's test (i) for autonomous expenditures. If A and D are perfect or very close substitutes in the role of autonomous expenditures it is expected that the correlation between N and the sum (A + D) would be greater than that between N and either D or A alone. This is the same thing as saying that a dollar of expenditure shifted from A to D or from D to A would have no effect upon induced expenditure N but a change in A and D considered together would. Suppose we undertake the following regression:

$$N = \alpha_0 + \alpha_1 A + \alpha_2 D + u_1 \qquad (11\text{-}21)$$

If D is autonomous we should find $\alpha_2 > 0$ and if, further, D is a perfect substitute for A then the coefficients on A and D will be the same, $\alpha_2 = \alpha_1$. On the other hand, if D is wholly induced and a substitute for N, a dollar increase in D will be associated with a dollar decrease in N, with A being held constant, and $\alpha_2 = -1$. If $-1 < \alpha_2 < \alpha_1$, D is a mixed item.

[4] This test follows through a suggestion made by Juster (1964), without the FM work in mind. As far as the author is aware, this is the first time this method has been employed.

As with Friedman and Meiselman's procedure, a check upon the results of (11-21), can be obtained from the regression:

$$A = \gamma_0 + \gamma_1 N + \gamma_2 D + u_2 \tag{11-22}$$

If D is induced and a substitute for N we should expect to find $0 < \gamma_2 \leqslant \gamma_1$. Conversely if D is autonomous, then γ_2 will be -1.

The results of these two tests for the treatment of (a) consumer durables, (b) exports and (c) imports are given in Table 11.2. Those for consumer durables are as confusing as were the previous tests. Nor do the tests shed much additional light on the desirable treatment of exports. In the first test exports appear to be autonomous, and the coefficient α_2 is not significantly different from α_1. However, exports fail to show up as autonomous in the second test. More light is shed upon the treatment of imports. If imports are an induced item, the coefficient α_2 in the first of the tests should be -1 and it turns out not to be significantly different from this figure at the 5 per cent level. For confirmation as an induced item, in the second test γ_2 should be positive signed and equal to γ_1. It satisfies the first of these criteria. Considered together, the two tests favour treating imports as induced.

In summary, the results with consumer durables are completely ambiguous, and we retain our *a priori* classification of these as induced expenditures. The experiments with exports are a little confusing, but the evidence points to imports being an induced item, and on this basis we leave exports as autonomous and imports as induced. This still leaves us with the other items: in particular inventory investment and government current expenditure (and taxes). As two of the other definitions (A_3 and A_4) treat inventories as induced, a better contrast with these definitions is provided by retaining

Table 11.2

Regressions involving Different Definitions of Autonomous Expenditures

Tests for Durables

$$N = 249.4 - \underset{(-.55)}{.137A} + \underset{(3.56)}{5.251D} \qquad R^2 = .92$$

$$A = 716.5 - \underset{(-.55)}{.144N} + \underset{(5.30)}{6.428D} \qquad R^2 = .95$$

Tests for Exports

$$N' = -138.5 + \underset{(3.82)}{.919A'} + \underset{(1.08)}{.827D'} \qquad R^2 = .89$$

$$A' = -776.3 + \underset{(3.82)}{.536N'} + \underset{(1.86)}{1.021D'} \qquad R^2 = .91$$

Tests for Imports

$$N'' = 700.3 + \underset{(9.21)}{1.597A'} - \underset{-(2.56)}{1.519D''} \qquad R^2 = .97$$

$$A'' = -453.0 + \underset{(9.21)}{.523N''} + \underset{(5.46)}{1.297D''} \qquad R^2 = .99$$

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the specification of this item as autonomous. Similarly, none of the other definitions enabled us to have *total* government expenditure (gross of taxes) as an autonomous item and for this reason we retain the *a priori* specification. The result of these decisions is the definition,

$$A_5 = I + G + E$$

which is similar to Ando and Modigliani's preferred classification.

Selection of Definition of Money

In chapter 8, evidence was presented of the demand for liquid assets and of the substitutability of interest bearing liquid assets for the narrow definition of money, M1. When the choice was confined to the bank-oriented definitions M1, M2, M3, the substitution relationships favoured the M3 definition in the post-war years. For the purpose of a longer study including pre World War II years, the evidence did not suggest any need to go beyond the M2 definition.

Friedman and Meiselman conduct tests for determining the definition of money which are similar to those for autonomous expenditures. They examine the extent of substitutability of different money definitions as generators of income flows. For example, the narrow definition of money is expanded to (say) M2 if income is more closely correlated with M2 than with M1 and (M2 - M1) separately. The second test for induced expenditures suggested by FM as a check on the autonomous test cannot be carried out for money, because this test relies on the additive property of N, D and A. It is for this reason that the tests for expenditures and money differ in execution, although the idea underlying them is the same.

Results of conducting tests with 3 definitions of money are set out in Table 11.3. They generally confirm the desirability of expanding the definition of money M1 to either M2 or preferably to M3. As M3 is not available on a consistent basis from 1880, and it seems desirable to employ a consistent definition of money in the tests with autonomous expenditures, we shall use the definition M2. This choice penalises the monetary model to some extent.

Empirical Results

The basic models examined are

(i) $U_t = a_1 + b_1 A_t + e_{1t}$

(ii) $U_t = a_2 + b_2 M_t + e_{2t}$

(iii) $U_t = a_3 + b_3 A_t + b_4 M_t + e_{3t}$

Table 11.3

Experiments With Different Definitions of Money

(Each entry in the table is the coefficient of determination, i.e., square of correlation coefficient, between variables indicated by relevant row and column. All correlation coefficients are positive signed).

Income concept	Data Period	M_1	I.B.D.	M_2	S.B.D.	M_3
Y_G	1938-9/1949-50	.8813	.0169	.8653	.7317	.8203
Y_G	1950-1/1961-2	.7910	.8653	.9690	.9859	.9884
Y_G	1938-9/1961-2	.8959	.7486	.9518	.9530	.9657
		M_1'	F.D.	M_2'	S.B.D.	M_3'
Y_E	1948-9/1962-3	.7880	.6916	.9189	.9328	.9596
Y_N	1948-9/1962-3	.8319	.6962	.9563	.9374	.9805

Definition of variables

(1) Income Concepts

Y_G = Gross National Product at Market Prices

Y_E = Gross National Expenditure at Market Prices

Y_N = Net National Product at Market Prices

(2) Money

M_1 = Notes and Coins in public circulation plus Deposits not bearing interest at Major Trading Banks

M_2 = M_1
plus Deposits bearing interest at Major Trading Banks

M_3 = M_2
plus Savings Bank Deposits

M_1' = Notes and Coin in public circulation plus Current deposits of the public with all trading banks

M_2' = M_1'
plus Fixed deposits of the public with all trading banks

M_3' = M_2'
plus Deposits with all Savings Banks

where U_t is induced expenditures, A is autonomous expenditures (variously defined) and M is currency holdings of the public plus current and fixed deposits of trading banks. The coefficients b_1, b_3 and b_2, b_4 are the current period impact multipliers of A and M on U, as derived earlier in this chapter.

The goodness of fit of equations (i) and (ii) can be compared using the standard error of estimate or the correlation coefficient. As errors of estimation are inversely related to the correlation coefficient when the same dependent variable is used, which is the case here when A and M are being compared, we use the simple correlation coefficients, r_{UA} and r_{UM}. For the combined model (iii) we are interested in comparing the separate contribution of A and M to the variability of U. This is by means of the partial correlation coefficients, $r_{UA.M}$ and $r_{UM.A}$. As standard statistical package programs present only zero order partials (i.e. simple correlations), the extension to first and second order partials necessitated that a special program be written to undertake these calculations.[5] The extent of collinearity between the two independent variables is also recorded.

Table 11.4 describes the 5 definitions of A used in the study, along with the associated definitions of induced expenditures used as the dependent variable in (i)-(iii) and the implicit concept of income. These give a good representation of the views expressed in the FM debate about the desirable composition of autonomous expenditures, and most of the suggested alterations to FM's definition are incorporated in one or another of the definitions. Large differences exist between the definitions in the size of autonomous expenditures relative to the income concept implicitly being

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[5] I am indebted to Mrs. M. Vaughton of the Mathematics Department of the University for writing this sub-program and to the Reserve Bank of Australia for providing the finance for this project.

Table 11.4

Definition of Variables used in Analyses

Time Period Examined	Definition of Autonomous Expenditures	Definition of Induced Expenditures	Definition of Income	Price Index Employed	Ratio of A/Y (per cent)
1928/9 - 1966/7 and Quarterly 1950_{III} - 1968_{II}	A_1 = Net Private Domestic Investment + Government Deficit + Net Foreign Investment	C = Personal Consumption Expenditure	Y = Personal Disposable Income + Undistributed Company Income + Other Retained Income and Provisions	Retail Price Index	19.1
	A_2 = as for A_1 using Net Foreign Balance rather than Net Foreign Investment	C = as above	Y = as above	as above	21.3
1800/1 - 1966/7	A_3 = Net Private Fixed Capital Formation + Net Public Investment + Net Foreign Investment	U_3 = Personal Consumption Expenditure + Public Current Expenditure + Inventory Investment	Y_N = Net Domestic Product	Implicit Price Deflator for Gross Domestic Product	22.8
	A_4 = Net Private Capital Formation + Net Public Investment + Exports	U_4 = U_3 - Imports	Y_N = as above	as above	40.9
1948/9 - 1966/7 and Quarterly 1950_{III} - 1968_{II}	A_5 = Net Private Domestic Investment + Government Expenditure + Exports	U_5 = Personal Consumption Expenditure + Current Expenditure of Financial Enterprise - Imports	Y_G = Gross Domestic Product	Consumer Price Index	55.2

predicted. Using model (i) for forecasting involves three steps:

1) Knowledge or forecasts of A.

2) Using the multiplier relationship in (i) to predict U.

3) Adding A and U to obtain Y.

In the case of the FM based definitions A_1 and A_2, the 'job' of the autonomous expenditures model (i) is to use knowledge (or estimates) of 20 per cent of income to provide an estimate (step 2) of the remaining 80 per cent of income. With the De Prano and Mayer type definition A_4 the 'task' of autonomous expenditures is reduced to saying what is to happen to 60 per cent of income. The Ando and Modigliani type defintion A_5 treats over half of income as known, and the multiplier has the job of predicting only 45 per cent of income. Even without knowledge of the composition of the items, one might expect the model (i) to predict 'better' when A_4 and A_5 are used.

Of the three steps listed above, only the second step uses the autonomous expenditures model, and the comparison with the monetary models must involve this step. This is why induced expenditures are the dependent variable in (ii). But the quantity theory in the first instance implies a relationship between money and *total* income, and a less close relationship may exist between the quantity of money and a particular component of income. When induced expenditures are U_1 and U_2, M has the task of predicting 80 per cent of income. With U_5, the quantity theory is related to only 45 per cent of income. The job of the quantity theory becomes more difficult as that of autonomous expenditures becomes easier.

Approximately 430 correlations are presented in synchronous terms, and 360 in lagged terms. These are set out in four groupings of two tables:

1. Absolute correlations in nominal terms — Tables 11.5 and 11.6

2. Absolute correlations in real terms — Tables 11.7 and 11.8

3. Correlations with first differences — Tables 11.9 and 11.10

4. Lagged correlations with quarterly first differences — Tables 11.11 and 11.12

Absolute Correlations in Nominal Terms. The analysis is based on 87 years of annual data commencing at 1880 and 72 observations of quarterly data (seasonally adjusted) commencing from the third quarter of 1950. In the latter case the comparison is limited to two definitions of autonomous expenditures, A_2 and A_5. The time periods chosen in Table 11.5 for comparing the models is based on the breaks in the data sources (as previously discussed). In Table 11.6 the pre-war years are examined decade-by-decade. FM divided their data series into cycles, but the pre-war business cycles in Australia have not been dated.

A comparison of the simple correlation coefficients is markedly one-sided. In 35 of the 41 periods examined the quantity of money is more closely correlated with induced expenditures than is autonomous expenditures. The correlations do not appear to be influenced markedly by the need to combine data series drawn from different sources. Also, the correlations calculated from annual data and quarterly data covering similar time periods are in the same direction. The results would not seem to be attributable to the 'quality' of the data.

In view of the continuing debate[6] about the cause of the great depression of the 1930's, it is noteworthy that 5 of the 6 instances in which $r_{UA} > r_{UM}$

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6 The reader is referred to a recent book by Temin (1976) and an article by Meltzer (1976) for a survey of both sides of the argument, and for references to the literature.

Table 11.5

Correlations Between Variables in Nominal Terms

Definition of A	Period	Autonomous Expenditures Relation		Quantity Theory Relation		
		r_{UA}	$r_{UA.M}$	r_{UM}	$r_{UM.A}$	r_{AM}
A_3	1880-1900	-.048	-.027	.686	.686	-.042
	1900/1-1938/9	.783	.349	.953	.890	.748
	1880/1-1938/9	.873	.396	.971	.894	.848
	1948/9-1966/7	.951	-.046	.991	.898	.962
	1880/1-1966/7	.979	.716	.987	.832	.960
A_4	1880-1900	.643	.531	.692	.602	.428
	1900/1-1938/9	.929	.757	.971	.905	.862
	1880/1-1938/9	.961	.775	.981	.897	.919
	1948/9-1966/7	.984	.258	.987	.492	.991
	1880/1-1966/7	.988	.706	.984	.577	.977
A_1	1928/9-1966/7	.959	.194	.983	.778	.967
	1928/9-1937/8	.858	.805	.604	-.378	.831
	1938/9-1947/8	.517	-.159	.743	.639	.785
	1948/9-1966/7	.922	.175	.989	.932	.925
A_2	1928/9-1966/7	.967	.272	.983	.726	.971
	1928/9-1937/8	.828	.711	.604	-.042	.748
	1938/9-1947/8	.529	-.181	.743	.631	.808
	1948/9-1966/7	.919	-.088	.989	.925	.935
	Quarterly					
	$1950_{III}-1968_{II}$	.783	-.082	.987	.966	.801
	$1950_{III}-1958_{II}$	.041	.171	.951	.952	-.012
	$1958_{III}-1968_{II}$	.704	-.191	.995	.991	.720
A_5	1948/9-1966/7	.952	-.520	.970	.739	.994
	Quarterly					
	$1950_{III}-1968_{II}$	.936	-.239	.960	.628	.987
	$1950_{III}-1958_{II}$	.622	-.238	.850	.756	.816
	$1958_{III}-1968_{II}$	.953	-.458	.981	.816	.987

Table 11.6

Correlations between Variables in Nominal Terms for Various Sub-Periods 1880-1938/9

Definition of A	Period	Autonomous Expenditures Relation		Quantity Theory Relation		
		r_{UA}	$r_{UA.M}$	r_{UM}	$r_{UM.A}$	r_{AM}
A_3	1880-1890	-.289	-.414	.981	.983	-.216
	1891-1900	.225	.160	.204	.129	.395
	1900/1-1912/3	.953	.242	.977	.736	.960
	1913/4-1919/20	.194	-.725	.925	.964	.471
	1920/1-1928/9	-.217	.066	.838	.830	-.300
	1929/30-1938/9	.583	-.483	.813	.779	.880
	1880-1900	-.048	-.027	.686	.686	-.042
	1900/1-1938/9	.783	.349	.953	.890	.748
A_4	1880-1890	.832	.034	.979	.931	.846
	1891-1900	.756	.769	.411	.456	.154
	1900/1-1912/3	.946	.050	.955	.407	.988
	1913/4-1919/20	.393	-.689	.856	.913	.738
	1920/1-1928/9	.402	.611	.854	.893	.099
	1929/30-1938/9	.950	.748	.889	.224	.904
	1880-1900	.643	.531	.692	.602	.428
	1900/1-1938/9	.929	.757	.971	.905	.862

are years in which the Australian economy was in severe depression, 1891-1900 (using A_3 and A_4), 1928/9-1937/8 (with A_1 and A_2), and 1929/30-1938/9 (using A_4). These findings parallel those of Friedman and Meiselman for the U.S. during the years 1929-1939, and of Macesich for Canada during the 1930's. A general factor would seem to be at work. Friedman and Meiselman see the multiplier as a "special case", Hester and others argue the possible existence of a liquidity trap.

At the other extreme, Laidler (1971) has suggested that much of the 'superiority' of the quantity theory in the other years follows necessarily from the existence of conditions of full employment. It is difficult to see how this criticism can be sustained. None of the years studied here appear to exhibit the type of 'hyper inflationary' conditions in which 'normal' economic relationships would be swamped by monetary developments. Many of the years had decidedly less than what would be described as full employment.[7] There seems no reason why monetary conditions should dominate in theory if we accept the Hicks-Hansen model as a useful first approximation to reality. In this model increases in the price level, with real output constant, can be due equally to increases in the quantity of money or to increases in autonomous expenditures.[8] In the former case, the rising prices are financed by money; in the latter, by an increase in the velocity of circulation of money. If it is found that velocity-financed increases in the price level are rare, then this is an important *empirical* finding in favour of the monetary explanation. It is *not* a theoretical proposition.

A positive correlation between induced expenditures and one of the independent variables A and M might simply reflect the influence of the other variable in disguise. The intercorrelation between A and M is generally positive and high, showing this to be a definite possibility. Some of the correlation of A and U may be a disguised reflection of the monetary effect upon expenditures, for the partial coefficients $r_{UM.A}$ are in general much higher than the coefficients $r_{UA.M}$. Nevertheless, in some periods the correlation between U and A, holding M constant remains considerable (see the A_4 and A_3 definitions).

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7 During the 1920's, for example, the unemployment rate amongst trade unionists did not fall below 5.7 per cent and averaged 8.8 per cent of members.

8 These are not the sole sources of increases in prices in the model. In addition, there may be reductions in the demand for money, which is an increase in the velocity; in addition, there may be cost-push or wage-push inflation which requires accommodation by either an increase in the quantity of money or an increase in autonomous expenditures (velocity increase).

Table 11.7

Correlations between Variables in Real Terms

Definition of A	Period	Autonomous Expenditures Relation		Quantity Theory Relation		
		$r_{\frac{UA}{PP}}$	$r_{\frac{UA}{PP}\cdot\frac{M}{P}}$	$r_{\frac{UM}{PP}}$	$r_{\frac{UM}{PP}\cdot\frac{A}{P}}$	$r_{\frac{MA}{PP}}$
A_3	1880-1900	-.016	-.156	.801	.806	.095
	1900/1-1938/9	.552	.251	.911	.878	.508
A_4	1880-1900	.672	.362	.800	.655	.629
	1900/1-1938/9	.797	.657	.943	.910	.674
A_2	1928/9-1966/7	.843	.306	.853	.376	.913
	Quarterly 1958_{III}-1967_{II}	.805	.013	.978	.936	.822
A_5	1948/9-1966/7	.815	.291	.800	.132	.953
	Quarterly 1958_{III}-1967_{II}	.910	-.090	.944	.616	.971

Interest attaches also to which of the five definitions of autonomous expenditures fairs the best. This appears to be A_4, which treats as autonomous private and public net capital formation, plus exports. With this definition imports (entered negatively), inventory investment and government current expenditure are treated as induced. Surprisingly, the autonomous expenditures relationship appears to be shown in its worst light with the A_5 definition. When M is held constant, the correlation between U and A is negative! As might be expected, the two variants of FM's definition (A_1 and A_2) behave similarly and in the following analysis, we consider only the A_2 definition.

Absolute Correlations in Real Terms. The multiplier analysis was initially formulated as a relationship between real autonomous expenditure and real output, and it seems desirable to see whether analysis in real terms would place the autonomous expenditures model in a better light. This is done in two ways: by deflating all the variables by prices (Table 11.7), and by entering the price level as an additional variable in the correlation analysis (Table 11.8). The price indices used in these calculations are described in Table 11.4.

Generally speaking, the results in real terms are similar to those in nominal terms. In the great majority of cases the correlation between real induced expenditures and real money exceeds that between real induced and autonomous expenditures. These results are sustained when the first order partial correlation coefficients with real variables, and the second order partials, holding prices constant, are considered. It necessarily follows from the simple correlations that $r_{UM.AP} > r_{UA.MP}$, what is of interest is the size of the separate effects, and in most cases these are low or negative for autonomous expenditures, holding money and prices constant. The principal exceptions occur during the years of depression in the 1890's. This is a contrast with the findings of Friedman and Meiselman; they found the multiplier less 'stable' in real terms during depression years (but more stable in nominal terms.) In an open economy such as Australia more of the short run behaviour of prices may be set by overseas markets and variations in A and M may correspondingly have a greater short run impact on real income (and output).

Correlations with First Differences. First differences are used as a means of removing any common trends in the series which may be contributing to an upward bias in the correlation coefficients. This transformation has the effect of approximately doubling the random component.[9] In Table 11.9

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[9] Consider equation (ii), for example,

$$U_t = a_2 + b_2M_t + e_{2_t},$$

where e_{2_t} has a mean of 0 and a variance of θ^2.

Table 11.8

Correlations Between Variables, Corrected For Price Changes

Definition of A	Period	Autonomous Expenditures Relation		Quantity Theory Relation	
		$r_{UA.P}$	$r_{UA.MP}$	$r_{UM.P}$	$r_{UM.AP}$
A_3	1880-1890	-.212	-.096	.987	.986
	1891-1900	-.268	-.210	-.452	-.425
	1900/1-1912/3	.744	.257	.874	.712
	1913/4-1919/20	-.693	-.551	.837	.774
	1920/1-1928/9	-.648	-.446	.843	.775
	1929/30-1938/9	.508	-.493	.771	.766
	1880-1900	-.068	-.108	.858	.859
	1900/1-1938/9	.253	.036	.863	.854
A_4	1880-1890	.834	.037	.979	.930
	1891-1900	.409	.382	-.157	.009
	1900/1-1912/3	.774	.143	.813	.411
	1913/4-1919/20	-.619	-.621	.645	.647
	1920/1-1928/9	-.169	.302	.858	.868
	1929/30-1938/9	.804	.017	.922	.762
	1880-1900	.639	.461	.892	.853
	1900/1-1938/9	.503	.433	.915	.907
A_2	1928/9-1966/7	.687	.417	.621	.191
	1928/9-1937/8	.851	.169	.947	.795
	1938/9-1947/8	-.676	-.682	-.022	-.121
	1948/9-1966/7	.795	.128	.914	.749
	Quarterly	.639	.461	.892	.853
	1950_{III}-1968_{II}	.626	.183	.956	.929
	1958_{III}-1967_{II}	.737	.410	.930	.868
A_5	1948/9-1966/7	.771	-.565	.855	.741
	Quarterly				
	1950_{III}-1968_{II}	.749	.078	.771	.289
	1958_{III}-1967_{II}	.438	-.540	.737	.774

Table 11.9

Correlations Between First Differences of Variables in Nominal Terms

Definition of A	Period	Autonomous Expenditures Relation		Quantity Theory Relation		
		$r_{\Delta U \Delta A}$	$r_{\Delta U \Delta A . \Delta M}$	$r_{\Delta U \Delta M}$	$r_{\Delta U \Delta M . \Delta A}$	$r_{\Delta A \Delta M}$
A_3	1880-1900	-.364	-.314	.466	.432	-.196
	1900/1-1938/9	-.364	-.394	.450	.472	-.028
	1880/1-1938/9	-.345	-.387	.470	.498	-.007
	1948/9-1966/7	-.630	-.765	.577	.736	-.008
	1880/1-1966/7	-.162	-.527	.716	.800	.268
A_4	1880-1900	.069	.060	.449	.448	.035
	1900/1-1938/9	.391	.286	.348	.220	.422
	1880/1-1938/9	.402	.283	.406	.289	.410
	1948/9-1966/7	.147	-.173	.446	.453	.606
	1880/1-1966/7	.561	.105	.670	.452	.763
A_2	1928/9-1966/7	.167	.006	.654	.642	.247
	1928/9-1937/8	.508	.050	.696	.554	.693
	1938/9-1947/8	-.230	-.296	-.452	-.483	-.074
	1948/9-1966/7	-.015	-.177	.620	.636	.195
	Quarterly					
	$1950_{III}-1968_{II}$	-.042	-.071	.494	.496	.039
	$1950_{III}-1958_{II}$	-.212	-.159	.401	.378	-.171
	$1958_{III}-1968_{II}$	.144	.156	.607	.609	.032
A_5	1948/9-1966/7	-.359	-.386	-.146	.210	.760
	Quarterly					
	$1950_{III}-1968_{II}$	-.597	-.658	-.040	.346	.476
	$1950_{III}-1958_{II}$	-.793	-.760	-.352	-.014	.434
	$1958_{III}-1968_{II}$	-.261	-.319	.257	.315	.167

the correlations between first differences of the variables expressed in nominal terms are presented. As expected, the correlation coefficients are lower than those with the variables in absolute terms. Nevertheless for the period as a whole (1880/1-1966/7) the partial correlation coefficient between induced expenditures and money, holding A constant, is .800 when the definition A_3 is used, and .452 when A_4 is used.

The comparison which seems to be favoured by FM's critics is the use of first differences for the post-war years alone. This comparison is provided for all of the four definitions of autonomous expenditures used, and in all cases the simple and partial correlations between induced expenditures and money exceed those between induced expenditures and autonomous expenditures: indeed the latter are negative. In the six sets of correlations with quarterly seasonally adjusted data, the 'superiority' of the monetary explanation relative to that of the multiplier mechanism is further exemplified. The correlations are lower for the sub period 1950-1958 which may indicate some unreliability in the Kennedy estimates of income.

Table 11.10 contains the first order and second order partial correlations with first differences, holding prices constant. With one exception, the correlations involving money are higher than those between induced and autonomous expenditures. Using annual data, the second order partial correlation coefficient between induced expenditures and money, holding prices and autonomous expenditures constant, is .553. (By comparison, the

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9 *continued*

Taking first differences,

$$U_t - U_{t-1} = b_2(M_t - M_{t-1}) + e_{2_t} - e_{2_{t-1}}$$

Considering the residuals,

$$E(e_{2_t} - e_{2_{t-1}})^2 = E(e_{2_t})^2 + E(e_{2_{t-1}})^2 + 2E(u_t u_{t-1})$$

If the cross product term is ≃ 0, we see that the transformation of the models to first differences approximately doubles the random component, lowering the correlation coefficients.

Table 11.10

Correlations Between First Differences of Variables, Corrected For Price Changes

Definition of A	Period	Autonomous Expenditures Relation		Quantity Theory Relation	
		$r_{\Delta U \Delta A.\Delta P}$	$r_{\Delta U \Delta A.\Delta M \Delta P}$	$r_{\Delta U \Delta M.\Delta P}$	$r_{\Delta U \Delta M.\Delta A \Delta P}$
A_3	1880-1900	-.241	-.232	.321	.315
	1900/1-1938/9	-.559	-.516	.346	.250
A_4	1880-1900	.092	.080	.318	.315
	1900/1-1938/9	.265	.241	.239	.212
A_2	1928/9-1966/7	.257	.115	.586	.553
	1928/9-1937/8	.385	.126	.478	.330
	1938/9-1947/8	-.415	-.538	.470	-.576
	1948/9-1966/7	.086	-.069	.650	.649
	Quarterly				
	1950_{III}-1968_{II}	-.027	-.051	.530	.531
	1958_{III}-1967_{II}	.163	.187	.651	.655
A_5	1948/9-1966/7	-.358	-.392	-.140	.219
	Quarterly				
	1950_{III}-1968_{II}	-.601	-.618	-.112	.210
	1958_{III}-1967_{II}	.250	-.309	.254	.312

.05 significance level for the correlation coefficient is .32).[10] When quarterly data is used, the highest second order partial correlation is .655. The correlations are much lower when the A_5 definition is used, but when all the correlations in the Table are considered, the overall impression gained is suggestive that money exerts a consistent impact on real expenditures.

Correlations with Lagged Variables. The availability of quarterly data since 1950 enables us to examine how the results may be altered if allowance is made for lagged responses to the independent variables. On the basis of overseas evidence, and Friedman-Meiselman's study, there is reason to believe that the impact of the independent variables might be of greater magnitude in other than the concurrent quarter. FM confined their correlation analysis to simple correlations between C and A and C and M. This ignores the intercorrelation which exists between lagged values of A and M. For example, the correlation coefficient between A and M lagged one quarter is .991 in absolute terms, and .470 in first differenced form. We are also interested in the lagged relationships between money and expenditures in real terms, obtained by holding prices constant. There is no reason, other than the difficulties of computation, why first and second order partial correlation coefficients cannot be calculated with lags, and this is what is done.

Evidence from other studies suggests that the lags are too short for annual data to be useful, and the study was confined to quarterly data, seasonally adjusted. Because an upward trend exists in all three series U, A and M in the post-war data sample, the analysis was confined to first differences. As the lagged analysis provides useful information about the timing behaviour of the money supply relative to economic activity, all

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10 Obtained from Appendix Table IV of Mills (1955).

three definitions of money, M1, M2 and M3, are used in the study. Finally, while the correlations were conducted with the lead of the independent variables ranging from -4 to 4 quarters, the maximum values fall within the lags -2 to 2 quarters and to economize on space only those results are shown.

In Table 11.11 are shown the results based on the A_2 definition of A, which employs consumption, C, as the dependent variable. The zero, first and second order correlation coefficients between C and M follow a relatively consistent pattern, whereby the coefficients exhibit a maximum value when C lags M by one quarter, and tail off fairly evenly in both directions. In all cases the highest correlation with C occurs when the M3 definition of money is used. The maximum values of the coefficients are statistically significant at the .05 level, and are notably higher than those reported by FM. (The highest correlation $r_{AC.AM}$ they report is .343, whereas in our case it is .623, both with a one quarter lag.) A different story exists for A. Here the coefficients frequently acquire their maximum value when C leads A by one quarter!

Table 11.12 presents results using the A_5 definition of autonomous expenditures and the U_5 concept of induced expenditures, and neither relationship shows up well. In the simple correlations, the maximum (positive) values occur when U_5 leads both A and M. When contemporaneous values of the other independent variable is included, a marked change occurs. When M is held constant, A continues to show the highest positive correlation when C leads A, and a negative relationship when A leads C. If U and A follow a sharp cyclical pattern with A lagging C, a negative concurrent relationship between the two is to be expected. As a result, when A is held constant so that the separate effect of M is distinguished, a significant positive relationship is found to exist between U and M in the

Table 11.11

Simple and Partial Correlations from the Regression $C = \alpha + KA_2 + VM + BP + e_1$ for Various Definitions of Money and Where the Independent Variables' Lead Varies from -2 to 2 Quarters

	M_1					M_2					M_3				
	-2	-1	0	1	2	-2	-1	0	1	2	-2	-1	0	1	2
$1950_{III}-1968_{II}$															
r_{CA}	-.156	.081	-.042	-.053	.112	-.156	.081	-.042	-.053	.113	-.156	.081	-.042	-.053	.113
r_{CM}	.019	.326	.412	.527	.311	.103	.380	.494	.573	.463	.257	.496	.573	.629	.560
$r_{CA.M}$	-.158	.081	-.051	-.057	.118	-.165	.070	-.071	-.078	.112	-.177	.069	-.081	-.082	.112
$r_{CM.A}$	.027	.326	.413	.527	.313	.115	.378	.497	.574	.462	.270	.495	.576	.631	.559
$r_{CA.MP}$	-.148	.114	-.036	.050	.108	-.161	.111	-.051	-.063	.106	-.174	.116	-.060	-.064	.109
$r_{CM.AP}$	.055	.336	.406	.523	.324	.216	.459	.531	.593	.457	.370	.584	.620	.655	.554
$1958_{III}-1968_{II}$															
r_{CA}	-.236	.205	-.032	-.041	.094	-.236	.205	-.032	-.041	.094	-.236	.205	-.032	-.041	.094
r_{CM}	.195	.456	.476	.548	.415	.221	.433	.495	.559	.503	.363	.508	.539	.623	.557
$r_{CA.M}$	-.261	.188	-.082	-.083	.070	-.277	.174	-.099	-.107	.055	-.294	.195	-.082	-.089	.077
$r_{CM.A}$	.225	.450	.480	.551	.411	.265	.421	.502	.565	.499	.400	.505	.543	.626	.555
$r_{CA.MP}$	-.301	.259	-.069	-.077	.076	-.311	.236	-.086	-.104	.058	-.331	.259	-.066	-.088	.078
$r_{CM.AP}$	.316	.541	.538	.555	.415	.300	.456	.530	.565	.498	.436	.528	.559	.625	.553

Table 11.12

Simple and Partial Correlations from the Regression $U_5 = a + KA_5 + VM + BP + e_2$ for Various Definitions of Money and Where the Independent Variables' Lead Varies from -2 to 2 Quarters

	M_1					M_2					M_3				
	-2	-1	0	1	2	-2	-1	0	1	2	-2	-1	0	1	2
$1950_{III}-1968_{II}$															
r_{UA}	.285	-.109	-.601	-.274	-.063	.285	-.109	-.601	-.274	-.063	.285	-.109	-.597	-.276	-.060
r_{UM}	.407	.083	-.111	-.306	-.436	.213	-.065	-.118	-.106	-.032	.217	.068	-.040	-.205	-.295
$r_{UA.M}$	.131	-.164	-.617	-.166	.151	.239	-.093	-.598	-.255	-.056	.212	-.162	-.658	-.208	.091
$r_{UM.A}$	.328	.149	.207	-.217	-.453	.142	-.033	.087	-.025	-.014	.098	.137	.346	-.088	-.302
$r_{UA.MP}$	.122	-.175	-.618	-.153	.183	.236	-.096	-.598	-.254	-.053	.214	-.160	-.658	-.210	.091
$r_{UM.AP}$	.327	.158	.211	-.236	-.491	.119	-.047	.085	-.015	.002	.073	.123	.346	-.074	-.286
$1958_{III}-1968_{II}$															
r_{UA}	.469	-.030	-.509	-.380	-.082	.469	-.030	-.509	-.380	-.082	.470	-.030	-.509	-.380	-.082
r_{UM}	.482	.260	.169	-.258	-.395	-.006	.047	.152	-.141	-.020	.165	.172	.191	-.138	-.194
$r_{UA.M}$	.323	-.172	-.662	-.307	.107	.476	-.037	-.546	-.366	-.080	.446	-.010	-.614	-.358	-.022
$r_{UM.A}$	.344	.307	.513	-.110	-.400	-.090	.052	.272	-.091	-.007	.014	.197	.436	-.020	-.177
$r_{UA.MP}$	.331	-.164	-.660	-.327	.105	.485	-.025	-.544	-.383	-.083	.449	-.107	-.616	-.370	-.023
$r_{UM.AP}$	.340	.303	.510	-.094	-.397	-.108	.022	.267	-.069	-.002	.027	.234	.443	-.034	-.181

concurrent quarter.

Two Puzzles

In commenting upon the Friedman and Meiselman study, Arthur Okun (1963) wrote:

> "Had I known what variables were going to be correlated, I would have been willing to bet my nickel on the side that turned out to be the decisive loser. Until or unless there is a satisfactory explanation of these results, the unconverted cannot rest easily."

Two puzzling aspects of the present study are considered. One of these is the negative correlations between induced expenditures and autonomous expenditures, when money is held constant, which seems to be a clear invalidation of the multiplier approach. The other is the mechanism linking money and expenditures. FM argue that a direct route from money to income provides a more satisfactory explanation of changes in income than an indirect mechanism from money to interest rates to investment to income. Okun and others have found their explanation of the direct mechanism to be unconvincing, and we shall investigate this issue.

Negative Multipliers? The simple correlations between autonomous and induced expenditures are predominantly positive. But autonomous expenditures and money are intercorrelated and when the influence of the money supply is held constant, a large number (but by no means all) of the partial correlation coefficients $r_{CA.M}$ or $r_{CA.MP}$ are negative. FM's explanation for this apparently bizarre finding is to look to errors of measurement in national income series and the appropriateness of their definition of autonomous expenditures for the analysis of short run changes. Neither makes much sense when seen in the light of similar results here, derived from data measured in a variety of ways and employing five different concepts of autonomous expenditures.

For an alternative explanation, suppose that there exists a relatively stable demand for money function with an interest rate elasticity such that the potentiality for velocity-financed increases in income are small. As the nominal stock of money is the principal determinant of aggregate income, an increase in expenditures for one class of goods must decrease expenditures for other classes of goods if the money stock is unchanged. More spending on adding to capital goods will be associated with less spending for consumption goods, and vice versa. But unless the increase and the decrease exactly offset each other, a net increase in income results. A negative partial correlation between A and U need not imply a negative income multiplier.

Because induced expenditures (C or U) are used as the dependent variable in the analysis, the coefficient on A does not give a direct estimate of the income multiplier. Referring to the Hicks-Hansen model analyzed earlier, in the extreme case when $i = 0$, $b = 0$ and the simple two sector income expenditure system applies, the coefficient on A is $^{c}/_{1-c}$. This differs from the income multiplier $^{1}/_{1-c}$ by unity. In the model which integrates monetary and expenditure relationships,

$$C' = \pi_0 + c\pi_1 A' + (c\pi_2 + b)M' + e' \qquad (11\text{-}17)$$

the difference between the coefficient on A' and the income multiplier is

$$\frac{l}{l(1-c) + im} - \frac{cl}{l(1-c) + im}$$

$$= \frac{l(1-c)}{l(1-c) + im}$$

which we assume to be approximately unity. Under the rigid constant velocity version of the quantity theory, the expected value of the coefficient on autonomous expenditures when induced expenditures on money and autonomous expenditures is minus one. If the value of the coefficient is greater than minus one, then evidence exists of an impact of autonomous spending on income. In particular, if $r_{UA.M} = 0$, the multiplier is unity, and it exceeds unity if $r_{UA.M} > 0$. As long as the coefficient on A exceeds minus one, $r_{UA.M} < 0$ does not indicate a perversion of the expenditure multiplier.

Table 11.13 gives the results of regressions of induced expenditures upon autonomous expenditures and money for various definitions of autonomous and induced expenditures, encompassing both annual and quarterly data. In three of the nine regressions, the coefficient of A exceeds zero by a statistically significant margin, implying that the autonomous expenditures multiplier is greater than one. In the other six cases, the coefficient upon A does not differ significantly from zero (although five coefficients are in fact negative), and if our interpretation is correct, the implied income multiplier is unity. When the data is first differenced, in Table 11.14, there is the expected reduction in explanatory power,[11] and both multipliers are reduced in absolute size, although the relative significance of the monetary variable is unaltered. While the coefficient on M is around unity or higher, in 8 of the 9 regressions the coefficient on A is not significantly different from zero. In the other case, the coefficient on A is less than zero, implying an income multiplier less than unity.

Thus our results are not inconsistent with an income multiplier varying between 1 and 2, depending upon the items included as autonomous and the time period considered. At the same time, the 'money multiplier' (not to be confused with that in the previous chapter) exerts both a larger and a

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11 There is, however, little evidence of the marked serial correlation which plagued the studies by Barrett and Walters (1966) and Phillips (1969).

Table 11.13

Regressions Between Induced Expenditures, Money and Various Definitions of Autonomous Expenditures in Nominal Terms

Definition of A	Period	Regression Coefficient of ('t' value in parentheses) 1	A	M	R^2	D.W.
A_3	1880-1900	75.15	-.079 (0.11)	1.035 (4.00)	.47	.60
	1900/1-1938/9	39.68	.861 (2.24)	1.643 (11.76)	.92	1.07
A_4	1880-1900	7.13	.949 (2.66)	.589 (3.20)	.63	1.24
	1900/1-1938/9	-7.40	.699 (6.96)	1.004 (12.78)	.98	1.21
A_2	1928/9-1966/7	-7.10	.805 (1.70)	1.668 (6.34)	.97	1.50
	1948/9-1966/7	-31.98	-.139 (0.35)	2.702 (9.71)	.98	1.20
	Quarterly 1958_{III}-1967_{II}	-115.57	-.035 (0.300)	2.363 (22.67)	.98	1.19
A_5	1948/9-1966/7	-40.28	-.342 (0.91)	2.958 (3.22)	.94	.88
	Quarterly 1958_{III}-1967_{II}	-103.35	-.207 (1.64)	2.242 (6.17)	.96	.65

Table 11.14

Regressions between First Differences of Induced Expenditures, Money and Various Definitions of Autonomous Expenditures in Nominal Terms

Definition of A	Period	Regression Coefficient of ('t' values in parentheses) 1	A	M	R^2	D.W.
A_3	1880-1900	.240	-.500 (1.36)	1.382 (1.98)	.30	2.17
	1900/1-1938/9	-2.147	-.647 (2.54)	2.343 (3.17)	.33	1.99
A_4	1880-1900	-.409	.075 (0.24)	1.126 (2.07)	.21	2.44
	1900/1-1938/9	4.864	.343 (1.77)	.723 (1.33)	.20	2.28
A_2	1928/9-1966/7	132.713	.004 (0.03)	1.193 (4.95)	.43	.72
	1948/9-1966/7	408.957	-.059 (0.70)	0.700 (3.19)	.40	1.26
	Quarterly 1958_{III}-1967_{II}	114.22	.028 (1.23)	0.793 (4.41)	.40	1.22
A_5	1948/9-1966/7	469.33	-.351 (1.62)	0.371 (0.83)	.17	2.75
	Quarterly 1958_{III}-1967_{II}	83.29	-.009 (1.90)	0.832 (1.88)	.16	1.83

more consistent influence upon expenditures. Although the rigid version of the quantity theory is not upheld, the monetary component of the joint relationship linking induced expenditures to autonomous expenditures and the quantity of money seems to be more 'critical' in the sense of having greater importance empirically. This gives the question about the transmission mechanism considerable importance.

Direct Monetary Effects? In the Hicks-Hansen model underlying (11-17), the linkages between money and income are twofold. An indirect mechanism runs from money to interest rates (i) to investment to induced expenditures; while, depending upon the source of the monetary change, an increase in monetary wealth stimulates consumption expenditure (summarized by the coefficient b). As noted earlier, were monetary policy to operate solely via the indirect mechanism, it is doubtful if M would be more closely correlated with U than is A, for the indirect effects would presumably be supplemented by variations in A which are completely independent of M. In all of the 8 tables of correlations, it is indeed found that M is more closely associated with U than is A, pointing to there being a substantial real balance effect in operation. But this effect is generally thought to be a weak reed, certainly not strong enough to explain the sort of correlations obtained. Not all variations in money have a wealth effect; only those increases unmatched by an increase in the private sector's indebtedness are relevant ('outside' money as opposed to 'inside' money).[12] Moreover, the real balance effect does not impinge upon all of what is termed consumption. In the life-cycle and permanent income theories of consumption-savings behaviour, only the consumption of *services* responds to variations in wealth (monetary or otherwise). How then can we account

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12 For a discussion of the distinction, see Patinkin (1965 and 1972).

for there being such a close association of money with induced expenditures U_3, which include some purchases of consumer durables and inventory investment along with current consumption (which itself includes many asset-type items)? Unless a plausible mechanism is provided, those who wish to read the equations from left to right may have a point.

FM see the answer lying in the range of assets considered, drawing a distinction between what they label (somewhat confusingly) as the "credit" view and the "monetary" view. In the former, changes in the supply of money affect 'the rate of interest' and thereby induce changes in the flow of investment expenditures which in turn alter the flow of income through the multiplier. The monetary view, on the other hand, focuses upon the entire spectrum of explicit and implicit interest rates and sees a change in the quantity of money impinging upon the entire range of expenditures and not investment flows exclusively. The definition is not entirely valid when real balance effects are allowed for, nevertheless we agree with FM's view that the crucial issue is "the range of interest rates, and accordingly, types of expenditures considered."

A useful frame of reference[13] is the simple construction in Figure 11 used by Archibald and Lipsey (1958). A representative individual devotes a fixed proporation of his permanent income flow stemming from his wealth to the consumption of services. He also has a portfolio decision involving the division of his wealth as between various assets. In the Hicks-Hansen world these assets are money and bonds, represented in the figure by X and Y respectively. Total wealth is initially such that the budget constraint is AB. As long as relative prices given by the interest rate remain as given

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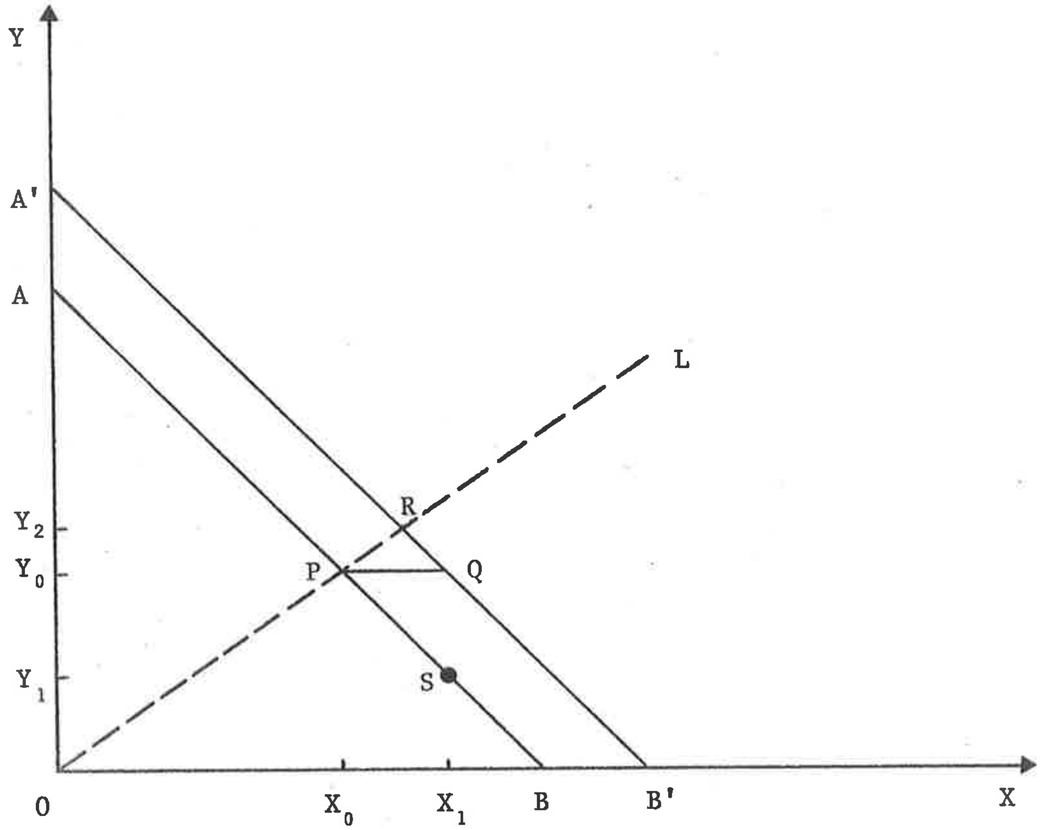
[13] Friedman's description of the transmission mechanism is given its fullest account in Friedman and Schwartz (1963). It has clear similarities with that of James Tobin, see Tobin (1969). My thinking has also been considerably influenced and clarified by the Patinkin references cited in the preceding footnote.

Figure 11

DIAGRAMMATIC REPRESENTATION OF PORTFOLIO BALANCE
BETWEEN MONEY (X) AND 'SECURITIES' (Y)



by the slope of AB, the individual is presumed to move along the expansion path OL, so that the relative composition of the portfolio is unchanged. Initially, the holdings of money are X_0 and of bonds, Y_0.

In response to an increase in outside money of X_0X_1(=PQ), the individual moves from P to Q. Until the relative price of X begins to decline, the wealth constraint facing the individual moves from AB to A'B'. The individual will wish to restore the portfolio composition indicated by the ray OL, and will attempt to move from Q to R by using money holdings to acquire bonds of Y_0Y_2. Of course, the economy as a whole cannot move to R, for the overall stock of money (in nominal terms) has increased, and the attempted purchases of securities succeed only in lowering the rate of interest and rotating A'B' until Q becomes the desired point. As far as the individual's responses are concerned, however, the wealth (or real balance) effect manifests itself in the movement from Q to R. In consequence, there is no direct impact upon demands for assets other than bonds. These other assets respond only *indirectly*, as the attempted bond purchases alter the structure of interest rates and asset substitutions occur.

Once allowance is made for other assets to enter the portfolio these conclusions are broken down. Portfolio decisions involve money and equities, real goods and stocks of consumer durables as well as money and bonds. In the diagram, these wider portfolio choices can be represented by letting the Y axis represent bonds and the other assets which enter the asset portfolio. Consequently, the movement from Q to R will involve acquisitions of shares, physical goods and a wide range of assets in addition to bonds. The real balance effect of an increase in outside money has implications for a broad range of expenditures; it is not confined solely to the consumption of services.

Similarly broad effects stem from monetary increases arising due to actions such as open market purchase of securities in which only substitution effects and not wealth effects are involved. The operation can be illustrated by a movement along AB from P to S, with the stock of money increasing by X_0X_1, and the number of bonds falling by Y_0Y_1. At the same time, the budget line AB moves in a counter clockwise direction absorbing some of the increase in money balances into desired holdings (not shown in the figure). It seems unlikely that all of the increment to money holdings will be so absorbed, for money serves as a temporary abode of purchasing power for assets as well as commodities. Bond holders were coaxed into the transaction by the offer of higher bond prices and they obtain money as a necessary byproduct of the favourable selling opportunity. They will not wish to hold all of the money permanently. Restoring the portfolio to the desired composition will involve moving from S part way towards P. As assets other than bonds are now included on the Y axis, the movement back from P seems unlikely to involve only bonds; presumably other non-monetary assets will be acquired.

The movement out of money into a broad range of assets gives rise to a correspondingly broad effect upon expenditures. If newly produced goods are acquired then production of each of the various goods will be directly stimulated. On the other hand, if existing stocks of assets are bid for, market prices are raised relative to reproduction costs, encouraging production indirectly. In both cases the expenditures affected are what are commonly termed consumption, but are really consumer expenditures on assets, i.e. on acquiring the sources of consumption services. As market prices of consumer durables and other assets are raised, the relative price on non durable consumer goods is commensurately lowered, which stimulates 'consumption' of the permanent income hypothesis. Each asset involved in the process can be thought of as having an 'own' rate connecting the flow of services (including non-pecuniary ones) per dollar outlayed to the market price of the asset. What we have described in terms of asset prices can be thought of instead as a lowering of interest rates. The so-called 'direct' mechanism is an 'indirect' mechanism involving many rates. This is what Friedman and Meiselman mean when they say that the crucial issue is the *range* of interest rates considered.

The expanded portfolio adjustments to a change in the quantity of money, whether of an inside or outside variety, suggest the likelihood of effects flowing not only through the increased demand for investment goods (fixed capital formation) but also through an increased demand for stocks of goods, consumer durables and non durable consumption goods. A close correlation between *both* money and autonomous expenditures and money and induced expenditures, as we have found, is not inconsistent with the mechanism described.

Since changes in the stock of money appear to produce changes in a wide range of interest rates reflecting the yields on all classes of assets, including many implicit 'own' rates, there would seem to be a case for concentrating our analysis on the relationship between the stock of money and changes in a wide range of expenditures, summarized by broad measures of economic activity, rather than focusing on the effects upon some much narrower category of expenditures. This is not to say that the interest rate mechanism can be ruled out nor that details of the 'direct' transmission mechanism can be ignored, and we do not do so; merely that it is difficult to trace out an exact order and time sequence of events in advance. Examination of the link between money and income is seen to be of the first importance, and the one to which most attention is given.

Conclusion

The principal features and conclusions can be summarized as follows:

1. In order to allow for some of the criticisms made against Friedman and Meiselman's study, the combination of data employed, tests performed, and time period studied is much broader than that used in other studies:
   (i) Five definitions of autonomous and induced expenditures were used, embracing three different concepts of income. Four of these were selected on *a priori* grounds, or determined by the data sample. The other was selected after extensive testing of individual expenditure components using a more powerful variant of Friedman and Meiselman's selection procedure.
   (ii) Annual data covered the years 1880-1966/7, broken into numerous sub-periods, and the quarterly seasonally adjusted data covered the years 1950-1968. Various data bases were combined to provide this length of time series.
   (iii) The relationships were examined in nominal and real terms, in absolute values and in first differences, in synchronous terms and with lags. Investigation of lagged relationships was extended beyond simple correlation analysis to first and second order partial correlation analysis.

2. Whatever was the form of the correlations and regressions and the definitions of autonomous expenditures employed, the monetary variables exerted the dominant influence upon expenditures. Much of the observed correlation between induced and autonomous expenditures appears to be induced by the strength of the relationship between money and income. The principal exceptions occurred during the years of deep depression

in the Australian economy during the 1890's and the 1930's, which in the latter case parallels the findings of Friedman and Meiselman.

3. While the quantity of money exerted a stronger and more consistent influence upon induced expenditures than did autonomous spending, both contribute to the variations in income. This is to be expected in an open economy where external fluctuations might be transmitted to the domestic economy through both channels; for example, an improvement in the trade balance or an inflow of direct foreign investment generally[14] expands A and M simultaneously. From the results we surmise that the income multiplier, holding M constant, lies between 1 and 2.

4. In seeking an explanation for these findings, we found that the Hicks-Hansen framework used to derive the reduced form relationships tested provides an inadequate description of the channels by which monetary changes might impinge upon expenditures. The mechanism outlined by Friedman and Meiselman provides a more satisfactory basis, once this is broadened to incorporate expanded wealth effects as well as substitution effects. Estimation of this link between money and income would seem to provide the most fruitful area for research in this study.

5. Some important implications follow from this chapter for other parts of the study. First, the results here provide indirect confirmation of the extent of stability of the demand for money (in this case M2), and establish a presumption in favour of the proposition that changes in the quantity of money could have a stable and predictable impact

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[14] The qualification is needed because retention of profits by foreign companies or stand-by credit for foreign subsidiaries may not immediately be used for investment.

on income. Secondly, while potentiality exists for velocity-financed increases in income, this would appear to be limited, at least in comparison with the potentiality for variations in income financed by variations in the money supply. Thirdly, evidence of the outside lag of monetary policy is given in the form of zero order, first and second order lagged correlation coefficients between first differences of two measures of induced expenditures and three definitions of money. As measured, the lag varies from 0 to 6 months in length, and averages 3 months. This lag is now examined in more detail.

Appendix to Chapter 11

Sources of Data used in the Analysis

Data Sources 1880-1900, 1900/1-1938/9

The following series were used:

Y_N = *Gross* Domestic Product at market prices *less* depreciation allowances.

A_3 = *Gross* Private Fixed Capital formation
plus Public " " "
equals Domestic Capital formation
less Depreciation Allowances
equals Net Domestic Capital Formation
plus Net Foreign Investment
equals Net National Capital Formation

U_3 = $Y - A_3$
= Current expenditure of persons and public authorities plus inventory investment

A_4 = *Gross* Domestic Capital formation
less Depreciation Allowances
plus Exports (calculated as below)

U_4 = U_3 + Imports

All data series except exports were drawn from Table 1 of N.G. Butlin, *Australian Domestic Product, Investment and Foreign Borrowing 1861-1938/9.*

Data of exports were obtained in the following way.

1880-1900	Merchandise Exports plus gold production equals Total current credits	Table 247
1991-1903	Merchandise Exports plus gold production plus ships' stores plus port expenditure	Table 262
1904-1927/8	Exports	Table 256 '
	less gold exports	Table 258
	equals Merchandise Exports	
	plus gold production	Table 258
	plus port expenditure	Table 256
	plus foreign travel	Table 259

1928/9-1938/9	Merchandise Exports plus gold production plus tourist expenditure plus transport (or port expenditure)	Table 264 A & B

Data for 1900/1-1913/14 obtained by linear interpolation of calendar year figures.
For the purpose of combining data for 1880-1900 with that for 1900/1-1938/9, series for 1880/1-1899/1900 obtained by linear interpolation of the calendar year figures.

Data Sources, 1928/9-1966/7

A_1 : This series is the sum of
Net Private Domestic Investment
Government Deficit and
Net Foreign Investment

For the period 1928/9 to 1937/8 data has been taken from *The Australian Balance of Payments 1928/9 to 1949/50*, table XXVII. This data comprises official adjustments to earlier estimates by Clark and Crawford.

Figures for 1938/9 to 1947/8 are from *National Income and Expenditure* 1955/56 and 1950/51.

Figures for 1948/9 to 1966/7 are from *Australian National Accounts*, 1948/9 to 1964/5, and 1953/4 to 1965/6, and from *Quarterly Estimates*, September 1967. To retain consistency with data for 1938/9 to 1947/8, purchases of new motor vehicles have been included in domestic investment. The Government Deficit consists of Government capital expenditure (including purchases of existing assets) less Government savings.

A_2 : This series is similar to A_1, except that the Net Foreign Balance rather than Net Foreign Investment has been used. Figures for the Net Foreign Balance have been taken from the sources listed above.

C : Personal Consumption Expenditure. Figures are from:-

1928/9 to 1937/8: Estimates by H.P. Brown published in Arndt and Cameron, "An Australian Consumption Function", *Economic Record*, April 1957.

1938/9 to 1947/8: N.I.E. 1955/6.

1948/9 to 1966/7: Sources as for A_1, data adjusted to exclude purchases of new motor vehicles and include current expenditure of financial enterprises.

Data Sources, 1928/9-1966/7 *(continued)*

Y : Sum of C and A. This income concept is Personal Disposable Income on an accrual basis, consisting of the sum of the following for 1948/9 to 1966/7.

Personal disposable income
Undistributed company income
Retained income of life assurance etc.
Increase in dividend and income tax provisions

P : Consumer Price Index 1952/3 = 100. Financial year averages of linked "C" series Index and Consumer Price Index. Source: Labour Report 1962/3 and Quarterly Summary of Australian Statistics (various issues).

Data Sources Annual, 1948/9-1966/7

A_5 : This series is the sum of
Net Private Domestic Investment
Current and Capital Expenditure of Public Authorities
Exports
Source: as above

U_5 : The sum of
Personal Consumption Expenditure
Current expenditure of financial enterprises
less Imports

Y_G : The sum of A_5 and U_5, being Gross National Product at market prices less the statistical discrepancy.

Data Sources, Quarterly 1958_{III}-1967_{II}

Variables are as defined for annual work 1948/9-1966/7.

Figures for the expenditure series are quarterly seasonally adjusted at annual rates. Unadjusted data from *Quarterly Estimates* (various issues). Seasonally adjusted using the Bureau of Census Method II X-II variant. All data converted to annual rates.

Chapter 12

Measuring the 'Outside' Lag of Monetary Policy

Introduction

This chapter commences with a broad survey of estimates of the length of the outside lag of monetary policy drawn from three different sources: time series analysis, studies of the demand for money and econometric models. A detailed examination is then made of the time series evidence, especially an Australian study by Beck, Bush and Hayes (1973) conducted under the auspices of the Reserve Bank. Their estimates of the timing of money relative to Australian business cycles are found to be biased upwards by their treatment of the 1956/57 fluctuation. A re-examination is made of Australian reference cycles, including new estimates of the turning points, using the latest recommended procedures of the N.B.E.R. Also, a revised dating is made of specific cycles in the monetary series, enabling fresh estimates of the outside lag. These are supplemented with cross-correlation analysis. A detailed assessment is then made of the methodology of the procedures employed, some deficiencies common to all studies are noted, and an alternative approach is suggested.

Evidence of the Existence of Lags

It is only during the last 10-15 years that the length of the lags in the effect of monetary policy has been of concern to economists and policy-makers. While there was (and still is) disagreement about the effectiveness of monetary actions - as exemplifed by questions about the interest elasticity of investment expenditures, the controllability of the money supply and bank credit, and the sufficiency of monetary controls - there seemed to be an implicit acceptance that monetary policy had reasonably quick effects. Naturally the length of the lag in policy only assumes relevance *after* a presumption about the effectiveness of monetary policy is established, which is why we examined the demand and supply of liquid assets, the behaviour of non-bank intermediaries and the impact of money upon expenditures in earlier chapters. There may also have been a recognition amongst economists that what was interpreted as ineffectiveness may have been the result of lags.

Whatever the reason for the change in attitudes, the conventional view that monetary policy was speedy in operation was challenged by three different types of evidence. The first was Friedman's finding that peaks in the rate of change in the stock of money precede peaks in general business by about 17 months and troughs in the rate of change of the stock of money precede troughs in business by about 12 months. Friedman's measure of the lag in policy and the policy prescriptions based on them have been hotly disputed, but evidence from two other sources has lent support to his views.

Indirect evidence of the lags in effect of monetary changes is obtained from studies of the demand for money. Under the 'monetary' view, variations in the nominal supply of money react against a stable demand for money function, leading to adjustments in the money market or the economy until balances are restored to their desired level. Most studies which provide for lags in the money market find that the portfolio adjustments occur slowly. For Australia, the Reserve Bank's study (see Norton, Cohen and Sweeny, 1970) of the demand for current deposits reports that only 19 to 20 per cent of any portfolio disequilibrium is eliminated within the first quarter. This result implies that approximately three years elapse for the desired portfolio changes to be 90 per cent complete! Slower adjustment speeds and thus even longer implied lags are not uncommon in overseas studies. These findings have led to the belief that the monetary system adjusts very sluggishly to policy changes.

Both Friedman's approach and the demand for money approach attempt to short cut a detailed examination of all of the links connecting changes in monetary policy to expenditures. Large scale econometric models which specify the structure (though following an indirect 'credit' mechanism rather than a direct 'monetary' one) invariably find that even longer lags are involved. The Reserve Bank of Australia's model, R.B.A.1., reports substantial but long delayed effects ensuing from changes in monetary policy. The instruments of policy are interest rates on government bonds, bank advances, time and savings deposits, and on house mortgages, and variations in these rates are transmitted to expenditures through the supply price of capital, wealth and the money supply (the latter altering bank lending). The effects upon spending begin after a lag of one or two quarters, but take a considerable time before they are of substantial size. For the economy as a whole the *maximum* effects occur 12 quarters after the initial change and a much longer time elapses before the effects tail off completely. With prices, there is no diminution until 20 quarters elapse. As business cycles in Australia average less than four years in period, any attempt at 'fine-tuning' the cycle is virtually precluded if these results are believeable.

One response to the findings of long lags is the appearance of a considerable literature which provides additional estimates of the timing relationships between money and business activity, which discusses the problems of estimating distributed lags and econometric models, and which attempts to reconcile one lag estimate with another. In the latter context, the model of Tucker (1966) is of considerable interest. If a lag in the money market (from money to interest rates) is added to the lag from interest rates to expenditures (as measured from the econometric models) we are faced with a total lag in excess of 5-6 years. Tucker contends that the interest rate 'overadjusts' in response to a change in the money supply (that is, the short run response of the interest rate exceeds the long run response) so that a lag in the money market actually reduces the total lag. This ingenious, but we will argue incorrect, argument is considered later in chapter 17. For the present we confine ourselves to the literature emanating from Friedman's estimate of the outside lag. Before doing so, one matter deserves attention.

Should Long Lags Exist?

Another reaction to the long lags which have been measured has been one of simple disbelief. Culbertson (1960) argued "if we assume that government stabilization policies ... act with so long and variable a lag, how do we set about explaining the surprising moderateness of the economic fluctuations that we have suffered in the past decade?" His own conclusion was that monetary and fiscal policies "can be counted on to have their predominant direct effects within three to six months." In similar vein, Governor Phillips, when discussing the long lags estimated by his Bank's model, wrote:

> "One could question the length of lags generally quoted on a number of grounds. ...It seems to me probable that sharp and substantial shifts in policy are likely to cause strong and fairly quick changes. ... The relatively sharp change in policy about a year ago did produce some obviously quick and sharp effects."

This skepticism by policy-makers and policy-oriented economists deserves more consideration than it has been given. While the strengths and weaknesses of the different methods of measuring the lag in monetary policy has been discussed at length, the question of *why* the lag should be long has been neglected. After all, in chapter 7 we argued that money derived much of its importance from characteristics which permit money holdings to be adjusted more rapidly than is possible with other assets.

> "At any moment, economic agents are in a position to adjust their money balances from existing towards desired levels either by spending more or buying less. ... This adjustment is never prefect, but it can reasonably be suggested that the discrepancy between the actual and desired value of money holdings is always relatively small." (Allais, 1966).

Rapid adjustment of money holdings is possible, but it is not necessary that an excess supply or excess demand for money be immediately eliminated. Money could conceivably be used as a 'shock absorber' in the balance sheet, added to when receipts are unusually high and run down when expenditures rise. Adjustments may occur only when money holdings deviate substantially from the norm, and money may adjust more slowly than other assets. Also, money's low 'carrying costs' may make for the portfolio adjustments being spread out over a considerable length of time. In addition, even if an individual's balance sheet adjustment is rapid, the adjustment for the economy as a whole is likely to be slower. Whereas an individual can dispose of his or her excess money by lending or spending and thus transferring balances to another individual, all holders cannot do so, and the discrepancy between actual and desired balances in aggregate may last for a considerable time.

In short, the length of the lag cannot be specified *a priori*. Money's special properties merely create a presumption that the adjustment is likely to be rapid; whether the aggregate response which eventuates is rapid or slow can be determined only by examining the actual effects of policy. The question becomes one of whether the lags revealed are so long as to defy rational explanation. In the author's opinion the finding that the money market takes three years or more to clear *is* implausible, and the burden of our argument in chapter 17 is to see if a plausible alternative explanation of these lags can be offered.

Survey of Lag Estimates from Time Series

Table 12.1 summarizes features of 10 studies of the outside lag for the United States, 3 for Canada, and one each for the U.K. and Australia. Friedman and Schwartz give three timing comparisons. The one to which reference has already been made is a comparison of turning points in the rate of growth of the money stock with National Bureau of Economic Research reference dates (which mark out peaks and troughs in a large number of series corresponding to 'general business activity'). They found that cycle phases in the rate of change of money series are marked more by high and low levels then by rises and falls. Where the series drops from one level to a decidedly lower level or rises from one level to a decidedly higher level is designated to be a 'step date'. A comparison of these with the reference dates gives their second measure of the lag. In a later study (Friedman, 1964) the technique was applied to the reference series as well, and a comparison was made of step dates in the rates of change of both money and industrial production. Third, Friedman and Schwartz correlate moving standard deviations of the rate of change of money and net national product. Where the length of the standard deviation corresponds to the period of the underlying cycle in the data, the measure approximates a pure sine wave and hence is a crude form of fourier analysis. A variety of leads and lags were tried, but the correlations were highest when the two series were coincident in timing (with annual data).

Friedman's method of comparing monetary changes with business cycle turning points has been used also by Sprinkel (1959) for the U.S., and by Macesich (1962) and Hay (1967) for Canada. Considerable controversy has surrounded this particular measure, Culbertson (1960) arguing that the *level* of the money supply should be used and Kareken and Solow (1963) preferring rates of change of both the money and the reference series to be used.

TABLE 12.1

TABULAR SURVEY OF STUDIES MEASURING THE OUTSIDE LAG OF MONETARY POLICY IN U.S., CANADA, U.K. AND AUSTRALIA

Study	No.	Time Period and data	Method employed	Monetary measure	Reference series	Average lead (-) lag (+)	Average dating at Peaks	Troughs
United States								
Friedman and Schwartz (1963)	1(a)	1870-1960 monthly and semi-annual data	turning points	Rate of change of M2	NBER reference dates	-14.8 months	-17.6	-12.0
	(b)	"	"	Step dates in rate of change of M2	"	- 5.6 months	- 7.1	- 4.1
	(c)	1870-1960 annual	cross-correlation	Moving standard deviation of rate of change of M2	Moving standard deviation of rate of change of Net Nat. Product	coincident	n.a.	n.a.
Friedman and Meiselman (1963)	2(a)	1948-1958 quarterly	cross-correlation	Rate of change of M2	Deviations of C and Y from trend	(-)9-12 months	n.a.	n.a.
	(b)	"	"	Rate of change of M2	Rate of change of C and Y	coincident	n.a.	n.a.
	(c)	"	"	First differences of M2	First differences of C and Y	-3 months (C) -6 months (Y)	n.a.	n.a.
Friedman (1964)	3	1957-1963 monthly	turning points	Step dates in rate of change of M1 and M2	Step dates in rate of change of Industrial Production	-4 months	-5	-3
Friedman (1972)	4(a)	1953-1970 monthly	turning points	Rate of change of M1 and M2	Rate of change of Industrial Production	-6.6 months (M1) -9.0 months (M2)	-6.2 -7.4	-7.0 -10.6
		"	cross-correlation	"	"	-3.0 months (M1) -6.0 months (M2)	n.a. n.a.	n.a. n.a.
	(b)	"	turning points	"	Rate of change of Consumer Prices	-13.6 months (M1) -16.6 months (M2)	-14.4 -15.6	-12.8 -17.6
		"	Cross-correlation	"	"	-20 months (M1) -23 months (M2)	n.a. n.a.	n.a. n.a.
Warburton (1950)	5(a)	1918-1950 quarterly	turning points	Deviations from trend of M2	Deviations from trend of final product expenditures	4 months	4.5	3.5
	(b)	"	"	"	Reference dates	3.6 months	5.4	1.8
Warburton (1971)	6(a)	1918-1965 quarterly	"	Deviations from trend of M1 and M2	Deviations from trend of final product expenditures	4.4 months (M1) 4.8 months (M2)	8.25 6.75	.67 3.0

TABLE 12.1 *cont.*

Study	No.	Time Period and data	Method employed	Monetary measure	Reference series	Average lead (-) lag (+)	Average dating at Peaks	Average dating at Troughs
	(b)	1918-1965 quarterly	turning points	Deviations from trend of M1 and M2	Deviations from trend of implicit price index	5.5 months (M1) 6.3 months (M2)	8.00 8.00	3.00 4.50
Sprinkel (1959)	7	1918-1958 monthly	turning points	3 measures of rate of growth of M1	NBER reference dates	10.0-14.4 months	14.6-19.9	5.4-10.6
Kareken and Solow (1963)	8(a)	1918-1959 quarterly	"	Rate of growth of M1	Rate of growth of IP	.82 months	n.a.	n.a.
	(b)	"	cross-correlation	"	"	0-3 months	n.a.	n.a.
Davis (1968)	9	1947-1967 quarterly	"	First differences in M2	First differences in GNP	3-6 months	n.a.	n.a.
Kaufman (1969)	10	1953-1967 quarterly	cross-correlation	First differences in M1	"	0-3 months	n.a.	n.a.
<u>Canada</u>								
Johnson and Winder (1962)	11(a)	1953-1960 monthly	turning points	Level of nominal money (M2)	Canadian reference cycles	7.5 months	8	7
	(b)	"	"	Real money supply	"	6 months	7	5
Macesich (1962)	12	1924-1958 monthly	"	Rate of change of M2	Canadian reference dates	-11.6 months	-16.6	-6.6
Hay (1967)	13	1870-1960 monthly	turning points	Rate of change of M2	Canadian reference dates	-15.2 months	-17.9	-12.4
<u>U.K.</u>								
Crockett (1970)	14(a)	1955-1969 quarterly	cross-correlation	Deviations from trend of M1 and M2	Deviations from trend of G.D.P.	-12.0 months(M1) -15.0 months(M2)	n.a. n.a.	n.a. n.a.
	(b)	"	"	"	Deviations from trend of Private Expenditure	-12.0 months(M1)	n.a.	n.a.
	(c)	"	"	"	Deviations from trend of Private Investment	-12.0 months (M1)	n.a.	n.a.
<u>Australia</u>								
Beck, Bush and Hayes (1973)	15(a)	1950-1971 monthly	turning points	M1 and M3	Australian reference dates	-5.1 months (M1) -5.4 months (M3)	-2.6 -2.4	-8.25 -9.25
	(b)	"	"	Rates of change of M1 and M3	"	-12.1 months(M1) -12.0 months(M3)	-10.4 -10.2	-14.25 -14.25

Friedman and Schwartz's reliance upon visual dating has also been questioned. In response to these criticisms, Friedman (1961) presented an array of measures derived from the Friedman and Meiselman study and using correlation analysis. In Table 12.1, measure 2(a) follows the method 1(a), while 2(b) and 2(c) answer Kareken and Solow's critique by using rates of change and first differences of both the monetary series and the reference series. In later work (Friedman, 1972) the emphasis has switched entirely to the rate of change of money and the rate of change of income. This is the comparison favoured by Davis (1968) and Kaufman (1969). Only Warburton (1950 and 1971) has compared turning points in the *levels* of money and income, both adjusted for trend.

Such a wide variety of measures (rates of change with levels, rates of change with deviations from trend, rates of change with rates of change, first differences with first differences, step dates with levels, step dates with step dates, levels with levels) seems to establish the existence of a lag, but leaves its length in doubt, and later in this chapter we endeavour to reconcile the various measures. If we ignore the studies 1(a), 2(a) and 7, the lags generally fall into the range of from 0 to 6 months; 0-3 months lag for narrow money M1 and 3-6 months for broader money M2. There are some minor exceptions to this general picture: Friedman's visual dating of the timing between rates of change of money and rates of change of industrial production is three months longer than that of his correlations (4(b)), and the lags measured using the rate of change of consumer prices (4(b)), are considerably longer than those using output-type measures.

Four of the U.S. studies, all of the Canadian studies, and the Australian study use National Bureau type reference dates of general business activity. Trueblood (1961) argues that the arbitrariness involved in the selection of peaks and troughs might result in a margin of error of 3-4 months. If he is correct, the error is considerable relative to the indicated lag, raising the question of whether the lag differs significantly from zero (considered later). One advantage of the method is the provision of timing comparisons at both peaks and troughs, and it is interesting that the lead of money relative to income at peaks is generally longer than that at troughs.

Australian Evidence

The study by Beck, Bush and Hayes (1973) compares turning-points in both the level and the rate of change of the money supply (M1 and M3) with Australian reference dates, which they themselves identify. One feature of their study is the length of the lag at troughs. The problem seems to be at the 1958 trough. With the level of M1, the longest lag at the other troughs is 5 months and for peaks is 7 months, but in 1958 the lag is 26 months. This is also the case for M3 and the rate of change of both monetary measures. When this observation is omitted from the sample the length of the lag shrinks considerably and is more nearly comparable with the timing at peaks. The amended timing dates are set out in Table 12.2.

This uncertainty about the treatment of the 1958 period leaves the length of the lags in Australia somewhat up in the air. Beck, Bush and Hayes is only one of five studies which provides reference dates for Australia. The reference dates identified by the others are shown on the left hand side of Table 12.3. Three features emerge. First, three of the studies identify a complete cycle in the period between the peak of 1955 and the trough in 1958, the other two do not. Second, the uncertainty noted by Trueblood surrounding reference dates is evident also for Australia, and the average difference in the dates is 3 months. In two instances the differences are considerable: one is the troublesome 1958 trough; the other is the trough of 1966, when the unemployment series turn in April and the vacancies series

Table 12.2

Amended Dates from Beck, Bush and Hayes Study Omitting
Trough for 1958

Series used	Average lead (-) or lag (+)	Average timing at Peaks	Average timing at Troughs
Stock of M1	-2.5 months	-2.6 months	-2.3 months
Stock of M3	-2.8	-2.4	-3.3
Rate of change of M1	-9.8	-10.4	-8.7
Rate of change of M3	-9.6	-10.2	-8.7

turn in August. Third, only two of the studies cover the 1970-1972 cycle, and the dating of the last trough is highly tentative in one of them.

In order to shed some light on these three issues and to resolve the discrepancy in the timing differences produced by the treatment of the 1956-1958 period, it was decided to examine a small number of indicators in detail. The aim is to provide evidence on the existence of the 1956/57 cycle and a check on the other dates. Another objective is related to the measurement of the inside lag of monetary policy in Chapter 6. There, one of the measures of the need for policy action was defined in terms of periods of above and below normal activity in the economy. Waterman provided such dates in his study, but his data series ended in 1964 and we wished to extend the dating beyond the 1960/61 cycle. A detailed description of the identification of these dates is given in Appendix B. Here we concentrate upon the determination of the reference dates.

Australian Reference Dates

The indicators chosen for the study are:

1. Deflated Gross Domestic Product

TABLE 12.3

SELECTION OF REFERENCE DATES FOR AUSTRALIAN BUSINESS CYCLES, 1951-1972

	Mallyon (44) series	Waterman (36) series	Bush and Cohen (92) series	Beck, Bush and Hayes (151) series	Haywood (60) series	No. of months variation in dates in 5 studies	Lewis (10) series	Final Dates selected
P_1	July 51	June 51	Aug. 51	Aug. 51	Aug. 51	2	July 51	Aug. 51
T_1	Oct. 52	Nov. 52	Sept. 52	Oct. 52	Sept. 52	2	Oct. 52	Oct. 52
P_2	Sept. 55	June 55	July 55	Aug. 55	Aug. 55	3	Aug. 55	Aug. 55
T_2	June 56	June 56	July 56	-	Aug. 57?	1*	July 56	July 56
P_3	-	Oct. 57	(Dec. 57)	-	-	2	Aug. 57	Oct. 57
T_3	Dec. 58	July 58	(Jan. 59)	Sept. 58	-	6	July 58	Sept. 58
P_4	Sept. 60	July 60	Sept. 60	Sept. 60	Aug. 60	2	Sept. 60	Sept. 60
T_4	Aug. 61	July 61	July 61	Sept. 61	Aug. 61	2	July 61	Aug. 61
P_5	n.a.	n.a.	Apr. 65	Apr. 65	Dec. 64	4	Apr. 65	Apr. 65
T_5	n.a.	n.a.	Apr. 66	Aug. 66	Sept. 66	5	Apr. 66	Apr. 66
P_6	n.a.	n.a.	n.a.	Apr. 70	Feb. 70	2	Mar. 70	Mar. 70
T_6	n.a.	n.a.	n.a.	(June 72)	Feb. 72	4	Apr. 72	Apr. 72

* Ignoring Haywood's tentative data

2. A.N.Z. Index of Industrial Production
3. Male Applicants
4. Male Vacancies
5. Brick Production
6. Value of Imports
7. Gold and Foreign Exchange Holdings
8. Share Prices
9. Bank Debits
10. Bank Clearings

Every reader will have his (or her) own preferred selection. The reasons prompting the choice here are as follows. Series 1 is the indicator which most corresponds to what is generally meant by economic activity, and series 2 is the most comprehensive measure of production in the industrial sector of the economy. Series 3 and 4 are recognized to be the most reliable indicators of the state of employment. Brick production (series 5) is included to reflect activity in the investment sector, while 6 and 7 cover the foreign sector and inflow of capital to Australia. Imports are also thought to be a reliable indicator of the pressure of demand. Series 8 incorporates financial investment and business opinion about the state of the economy. Series 9 and 10 have not been widely used in Australia but have had a long history of use in the United States where they were perhaps the first indicator in general use. Their advantage is their generality: all activity involving money payments finds reflection in the series. They are also in value terms, as are imports and share prices. The debit series used is confined to private accounts. Clearings incorporate government transactions as well. All data used commenced on or prior to January 1949, and were extended through to 1974 to date the 1972 trough. No attempt was made to examine cycles in the years 1973/75 in the same detail.

The procedure for determining turning points in the series follows the latest methods recommended by the National Bureau of Economic Research (see Bry and Boschan, 1971). Each time series is regarded as a composite of trend, cycle, seasonal and irregular fluctuations, so that the series (0) is written in the form.

$$0 = T_0 C_0 S_0 I$$

where

T_0C = combination of cycle and trend factors

S = seasonal factor, consisting of intra-year movements which are repeated more or less regularly each year

I = irregular fluctuations which remain after other components are estimated. These comprise unseasonable weather conditions, strikes, political conditions, statistical errors, and defective seasonal adjustment.

0 = arithmetic operator, assumed to be either multiplicative or additive

Five steps are involved in the method used.

1. Adjustment of series for seasonal and trading day variations. The first step is the removal of seasonality. All of the 10 series were adjusted for seasonality using X-11 variant of the Census Method II seasonal adjustment program. This program is used by the N.B.E.R. and it is described in Appendix A. One of the options available with the program is a regression routine which tests for the presence of trading day variation, arising from the number of non-trading days in the month. Series 2, 5 and 6 were further adjusted for this source of month to month variation. If this step is performed correctly, then the seasonally adjusted series consists of T_0C_0I.

2. Isolation of extremes values and substitution of values. Extreme (irregular) values distort not only the timing relationships but also the calculation of a trend-cycle curve. They are defined as values whose ratios to preliminary Henderson moving average (described below) lie outside a specified range of 2.5 standard deviates of the ratios. Extreme values are replaced by the corresponding values from the Henderson curve.

3. Determination of turning points in the trend-cycle curve. The trend-cycle (T_0C) is estimated by a 13 term Henderson weighted moving average of the adjusted series, without extreme values, which smooths the remaining irregular component (I). Being such a long term moving average, the Henderson curve imparts a bell-like smoothness to data and is particularly useful for indicating the likely presence of a turning point. However it does tend to iron out double peaks or troughs, when a series returns to its previous peak or trough level within a short time period without a marked intermediate fluctuation, and the turning points in the Henderson curve may be some months removed from those in the seasonally adjusted series. For this reason a shorter term moving average is used to identify the possible months of turning points.

4. Determination of turning points in an M.C.D. curve. A curve that smooths the seasonally adjusted data by a short-term moving average is the M.C.D. (months for cyclical dominance) curve. This M.C.D. measure provides an estimate of the appropriate time span over which to observe cyclical movements, being the shortest span for which the average change (without regard to sign) in the cyclical component is larger than the average change (again without regard to sign) in the irregular component. It indicates the point at which fluctuations begin to be more attributable to cyclical rather than irregular movements, and the M.C.D. is a moving average of this many months (in most cases here 3-6 months).

5. Determination of turning points in unsmoothed series. Since Slutzky (1937) it has been known that moving averages can convert irregular fluctuations into smooth wavelike patterns. Consequently the analysis of cycles cannot be based on smoothed series alone, even though they come closest to what we think of as economic cycles. In the final step, the turning points are identified from the unsmoothed seasonally and trading day adjusted series, using the Henderson and the M.C.D. curves to pinpoint the months where a turning point is likely to occur.

The turning points determined for each of the 10 series on the above basis are set out in Appendix Table B1, along with the mean mid-points of the turning points. These latter dates are reproduced in Table 12.3 for comparison with the dates determined in the five earlier studies. On the far right hand side of the table is set out the final reference dates chosen for the study. Some explanation is warranted. The first difficulty arises with the 1956/57 cycle. Of the 10 series, only the two employment measures fail to record both a trough and peak in these years, suggesting the desirability of including an additional cycle. Our dates are also closer to those of Waterman than to Bush and Cohen. With the dating of T_3, where a 6 month difference occurs in the dates, a simple average of the 6 studies is used. The next difficult period is the trough of 1966. Beck *et al* were worried because some series indicated a trough in April 1966, others indicated August 1966 which was the date they chose. Only one of the 10 selected series records a turning point after July 1966 and we prefer the earlier April 1966 dating. In the final peak and trough, our dates fall between those of Beck *et al* and Haywood, and these are the dates used.

Revised Estimates of the Lag for Australia

Procedures identical to those used for dating turning points in the economic indicators are used for determining specific cycles in the money supply. We follow Beck *et al* in concentrating upon the M1 and M3 definitions, and employing both levels and rates of change. In Table 12.4 is shown the turning points obtained from the Henderson curve (23 term weighted average), the M.C.D. moving averages (6 month) and the dates selected from the seasonally adjusted series. The dates used by Beck *et al* are also shown. Little discrepancy is evident in the dates used for the levels, nor for half of the rate of change dates. Most of the differences arise in the 1955-1958 period. Beck *et al* do not include a complete cycle in 1956/7; we do. Some support for our choice comes from the monetary series, for associated turning points in the monetary series are clearly evident in the Henderson and M.C.D. curves. Another difference occurs with the dating of the peaks in the rate of change series in the upswing from 1952-1955. Beck *et al* have the peak in the rate of change series in 1955. Our smoothed and unsmoothed series unambiguously point to the peak occurring in 1953.[1]

[1] On the basis of the results in chapter 10, the rate of change of the monetary base was examined in order to provide a check upon this dating. This series also unambiguously exhibited a peak in 1953.

Table 12.4

The Dating of Specific Cycles in the Australian Money Supply Series, 1951-1972

Monetary Measure	Dating at Peaks							Dating at Troughs						
	Aug. 51	Aug. 55	Oct. 57	Sept. 60	April 65	Mar. 70	Average	Oct. 52	July 56	Sept. 58	Aug. 61	Apr. 66	Apr. 72	Average
Stock of M1														
Beck *et al*	July 51	July 55	-	June 60	Sept. 64	Mar. 70		July 52	-	July 56	Oct. 61	Mar. 66	-	
Lewis	May 51 (-3)	Aug. 55 (0)	Nov. 57 (+1)	June 60 (-3)	Dec. 64 (-4)	Mar. 70 (0)	(-1.5)	July 52 (-3)	June 56 (-1)	May 58 (-4)	July 61 (-1)	Mar. 66 (-1)	Dec. 71 (-4)	(-2.3)
Stock of M3														
Beck *et al*	Aug. 51	July 55	-	June 60	Sept. 64	Mar. 70		July 52	-	June 56	July 61	Mar. 66	-	
Lewis	May 51 (-3)	Aug. 55 (0)	Jan. 58 (+3)	Sept. 60 (0)	Mar. 65 (-1)	Mar. 70 (0)	(0)	July 52 (-3)	May 56 (-2)	May 58 (-4)	July 61 (-1)	Mar. 66 (-1)	Dec. 71 (-4)	(-2.5)
Rate of change of M1														
Beck *et al*	Mar. 51	May 55	-	July 59	Jan. 64	Jan. 69		June 52	-	Feb. 56	Dec. 60	July 65	-	
Lewis	Mar. 51 (-5)	Mar. 53 (-29)	Feb. 57 (-8)	Sept. 59 (-12)	Jan. 64 (-15)	Jan. 69 (-14)	(-13.8)	June 52 (-4)	Feb. 56 (-3)	May 58 (-4)	Dec. 60 (-8)	July 65 (-9)	Oct. 71 (-6)	(-5.7)
Henderson curve	Oct. 50	Mar. 53	Feb. 57	Sept. 59	Jan. 64	Sept. 69		Mar. 52	Feb. 56	Apr. 58	Feb. 61	Apr. 65	June 70	
MCD curve	Jan. 51	Apr. 53	Apr. 57	Oct. 59	Jan. 64	Apr. 69		Apr. 52	Apr. 56	Mar. 58	Jan. 61	July 65	July 70	
Rate of change of M3														
Beck *et al*	Mar. 51	May 55	-	Sept. 59	Mar. 64	Jan. 69		June 52	-	Feb. 56	Dec. 60	July 65	-	
Lewis	Mar. 51 (-5)	Mar. 53 (-29)	Sept. 56 (-13)	Sept. 59 (-12)	Mar. 64 (-13)	Jan. 69 (-14)	(-14.3)	June 52 (-4)	Feb. 56 (-3)	Feb. 58 (-5)	Dec. 60 (-8)	July 65 (-9)	July 71 (-9)	(-6.3)
Henderson curve	Dec. 50	Feb. 53	Jan. 57	July 59	Mar. 64	Apr. 69		Feb. 52	Dec. 55	Apr. 58	Dec. 60	July 65	June 70	
MCD curve	Jan. 51	Apr. 53	May 57	Aug. 59	Jan. 64	Apr. 69		Apr. 52	Jan. 56	Mar. 58	Dec. 60	July 65	July 70	

A final difficulty occurs with the timing of the monetary series for the trough of 1972 (which was not examined by Beck *et al*). The unsmoothed series of the rate of change of M1 and M3 exhibits a trough in 1971, but on the basis of the smoothed series this date could possibly be one year earlier.[2]

Estimates of the timing differences between the revised turning point dates for money and the revised reference dates are given in Table 12.5 as studies 16(a) and 16(b), the numbers following on from those in Table 12.1. In consequence of the different treatment of the 1958 trough, in particular the elimination of the artificially long lag from relating a turning point corresponding to one cycle to a later cycle, the average length of the lags are reduced. With the rate of change estimate 16(b), the lag at peaks is now longer than that at troughs which is in line with overseas findings.[3]

Recent Evidence. Sofar we have concentrated upon reference dates ending in 1972, but another complete cycle can be tentatively identified in the years 1973-1975. Haywood suggests that a peak in business activity occurred in August 1973, and a turning point near to this month is evident in the employment and production series (2, 3 and 4). Research at the A.N.Z. Bank indicates the likelihood of a lower turning point in production series in May 1975. As in the 1956/57 period, this latter turning point is not evidenced in the employment series. Although both of these reference dates are highly tentative, in Table 12.6 we compare them with the behaviour of the monetary series. Because of the close proximity of turning points in M1 and M3 we examine only the former, and because the rate of change series seems to change dramatically from one level to another in these years, 'step

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2 Again collaborative evidence comes from the rate of change of the monetary base, which also has a trough date in 1971 (May).

3 Nor is this change merely a consequence of the earlier dating of the rate of change of money for the 1955 peak. Were the later dating preferred by Beck *et al* used, the average lead at peaks would be (-)9.5 months.

TABLE 12.5

FURTHER ESTIMATES OF THE OUTSIDE LAG OF MONETARY POLICY IN AUSTRALIA

No.	Time period and data	Method employed	Monetary measure	Reference series	Average lead-lag	P	T
16(a)	1951-1972 monthly	turning points	levels of M1 and M3	reference dates	-1.9 months (M1) -1.3 months (M3)	-1.5 0	-2.3 -2.5
(b)	"	"	rates of change of M1 and M3	"	-9.8 months (M1) -10.3 months (M3)	-13.8 -14.3	-5.7 -6.3
17(a)	1950_{III}-1968_{II} quarterly	cross-correlation	first differences of M1, M2, M3	first differences of Consumption Expenditure	-3 months	n.a.	n.a.
(b)	"	"	"	first differences of Gross Domestic Product	-0 months (M1) -3 months (M2) -3 months (M3)	n.a.	n.a.
(c)	"	"	rates of change of M1, M2, M3	rates of change of Gross Domestic Product	-0 months (M1) -3 months (M2) -3 months (M3)	n.a.	n.a.
(d)	"	"	first differences of M1, M2, M3	first differences of Gross National Expenditure	-3 months (M1) -6 months (M2) -6 months (M3)	n.a.	n.a.
18(a)	1949-1968 monthly	"	first differences of M1, M2, M3	first differences of Index of Industrial Production	-1 month	n.a.	n.a.
(b)	"	"	3 month moving average of rates of change of M1, M2, M3	3 month moving average of rates of change of Index of Industrial Production	-2 months (M1) -3 months (M2) -2 months (M3)	n.a.	n.a.

Table 12.6

Timing Comparisons of Monetary Measures and General Business Activity, 1973-1975

Monetary measure	Turning points relative to reference dates of	
	August 1973 (Peak)	May 1975 (Trough)
1. Level of M1	Oct. 1973 (+2)	Sept. 1974 (-8)
2. Rate of change of M1	June 1973 (-2)	Aug. 1974 (-9)
3. Step dates in rate of change of M1	Nov. 1973 (+3)	Nov. 1974 (-6)

dates' are included. Their timing is similar to that of the level of M1. A clear lead of the monetary series is apparent for the trough, but not for the peak. In the case of the rate of change of M1 (and of M3) a double peak occurs, and the value of the rate of change at December 1972 is only slightly lower than that at June 1973.[4] No answer in principle exists to the question of which is correct, and in choosing the latter we follow the 'rules of thumb' employed by the National Bureau of Economic Research.[5]

Cross-correlations. These examples illustrate some of the difficulties inherent in the visual dating of turning points. Alternative estimates of the timing differences between various transformations of the monetary series and measures of economic activity are summarized in Table 12.5 (these are studies

[4] An annual rate of 29.7 per cent compared with 31.5 per cent at the latter date.

[5] The basic rules prescribe that the peak be the last high month just preceding the month in which the downward movement occurs, unless the period between the two peaks contains mainly downward movements except for one or two upward movements, in which case the earlier peak is to be selected. See Bry and Boschan (1971).

numbered 17-19). They are derived from cross-correlations between changes in the money supply and various measures of economic activity.[6] No instance of a lag of the monetary series relative to the business measures is recorded. In several cases the series are coincident in timing, but in most instances the money series lead, ranging from 1 to 6 months for the 'real' measures and 6 to 9 months for the price series. These are broadly in line with the estimates obtained from cross-correlation analysis in the U.S.

Interpreting the Estimates

A wide variety of timing comparisons have been employed to provide estimates of the outside lag of monetary policy, and we now attempt to put them in some perspective. Five basic modes of comparison have been used:

(i) Turning points in levels of M and Y, based on de-trended and original series.

(ii) Turning points in rates of change and first differences of M and Y.

(iii) Step dates in the rates of changes of M and Y.

(iv) Step dates in the rate of change of M and turning points in the levels of Y.

(v) Turning points in the rate of change of M and turning points in the level of Y.

Little difference is noted in the *average* length of the lags measured by methods (i)-(iv), all being between 0 and 6 months, although they are slightly longer for upper turning points than for lower turning point comparisons. The lags obtained from (v) are noticeably longer. These

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6 The correlations for the study numbered 17 arise largely as a byproduct of the work in chapter 11. The data for the other correlations is described in chapter 14.

general conclusions hold for Australia as well as for the overseas studies. (Methods (i), (ii), (iv) and (v) were used in our examination of the Australian data, and it is assumed that the third method would yield results in line with overseas studies.)

As an aid to interpreting these findings it is convenient to assume as we did in chapter 6 that economic fluctuations in Australia follow a regular cyclical pattern represented by a cosinusoidal function of the form

$$\log y(t) = A \cos (wt + \varepsilon) \qquad (12\text{-}1)$$

where the characteristics of the oscillation are governed by the parameters A, w, and ε, and t denotes time. Upper turning points occur at any value of t for which $(wt + \varepsilon)$ is zero, plus or minus any multiple of 2π, viz.

$$t = \ldots\ldots\ldots -\frac{2\pi + \varepsilon}{w}, \quad -\frac{\varepsilon}{w}, \quad \frac{2\pi - \varepsilon}{w}, \quad \ldots\ldots\ldots$$

Similarly, the lower turning points are at

$$t = \ldots\ldots\ldots -\frac{3\pi + \varepsilon}{w}, \quad -\frac{\pi + \varepsilon}{w}, \quad \frac{\pi - \varepsilon}{w}, \quad \ldots\ldots\ldots$$

If follows that the period is fixed at $\frac{2\pi}{w}$, given by the parameter w which is the angular frequency measured in radians per unit time. Also, the phase is specified by ε since a peak occurs at $t = -\frac{\varepsilon}{w}$. In each period the shape of the oscillation of $y(t)$ is that of a cosine function with an amplitude varying from +A to -A. For comparative purposes we let the money series $x(t)$ have the form

$$\log x(t) = B \cos (wt + \varepsilon') \qquad (12\text{-}2)$$

Here the period of $x(t)$ is the same as for $y(t)$, i.e. $\frac{2\pi}{w}$, but the amplitude of the oscillation differs ($\pm B$), as does the phase (peak at $t = -\frac{\varepsilon'}{w}$). Obviously the lead or lag depends on the size of ε' relative to ε.

Most economic time series are marked by a non-zero trend and thus differ from functions (12-1) and (12-2), where the fluctuations occur around a constant average level (of zero). A more realistic representation of economic time series can be made by allowing the regular fluctuations to occur around a linear trend, so that (12-1) and (12-2) are altered to

$$\log y(t) = at + A \cos (wt + \varepsilon) \qquad (12\text{-}3)$$

and

$$\log x(t) = bt + B \cos (wt + \varepsilon') \qquad (12\text{-}4)$$

When (12-3) is compared with (12-1) an interesting feature emerges. Turning points in (12-1) occur when

$$\frac{d \log y}{dt} = - wA \sin (wt + \varepsilon) = 0$$

i.e. when $t_1 = -\frac{\varepsilon}{w}$ (for a maximum).

By contrast turning points in (12-3) occur when

$$wA \sin (wt + \varepsilon) = a$$

i.e. when $t_1' = -\frac{\varepsilon}{w} + \frac{\alpha}{w}$

where $\alpha = \text{arsin} \, ({}^{a}/_{wA})$. The addition of a trend delays the occurrence of the upper turning point by a length of time depending upon the slope of the trend: the steeper is the trend, the longer is the time the upper turning point is delayed.[7] Conversely, the existence of trend brings forward

7 When there is no trend, i.e. a=0, the two sets of turning points coincide.

the lower turning point by the same length of time. This feature undoubtedly accounts for the short downswing phases of post-war business cycles. For example, in Australia the downswing phases we have identified average 14 months, whereas the upswing phases average 33 months. Many observers have been led to argue that the traditional N.B.E.R. methods should be applied to trend-adjusted series in order to identify 'growth' or 'deviation' cycles.[8]

We are now in a position to compare the five methods used to measure the outside lag of monetary policy, and the discussion is based on Table 12.7. Our basic frame of reference is the timing difference between turning points in the *levels* of money and income, when these are expressed as deviations from trend. The monetary series peaks at $t_2 = -\frac{\varepsilon'}{w}$, and the reference series at $-\frac{\varepsilon}{w}$, so that the lead of money over business activity is

$$t_2 - t_1 = -\left(\frac{\varepsilon' - \varepsilon}{w}\right) = \frac{\varepsilon - \varepsilon'}{w} ,$$

which expresses the relative phase displacement in time units. Where ε and ε' are constants, independent of w, the lead or lag varies with the angular frequency. In the case where $\varepsilon = w\phi$ and $\varepsilon' = w\phi'$, there is a fixed time delay of $(\phi - \phi')$ in time units.

The next case considered is a comparison of *rates of change* of both money and income. The two series compared when adjusted for trend are:

$$\frac{d \log y}{dt} = - wA \sin (wt + \varepsilon) = wA \cos (wt + \varepsilon + \frac{\pi}{2})$$

and

$$\frac{d \log x}{dt} = - wB \sin (wt + \varepsilon') = wB \cos (wt + \varepsilon' + \frac{\pi}{2})$$

8 See Mintz (1974). Deviation cycles for Australia have been identified by Haywood (1973).

Table 12.7

A Comparison of Five Methods of Measuring the Outside Lag in Monetary Policy

Timing Comparison Employed	Series without trend			Series with trend		
	Reference Series (log Y) $f(t)=A\cos(wt+\varepsilon)$	Money Series (log M) $g(t)=B\cos(wt+\varepsilon')$	Relative Phase Displacement	Reference Series (log Y) $f(t)=at+A\cos(wt+\varepsilon)$	Money Series (log M) $g(t)=bt+B\cos(wt+\varepsilon')$	Relative Phase Displacement
1. Turning points in log Y, log M	$f'(t) = 0$	$g'(t) = 0$	$\frac{\varepsilon - \varepsilon'}{w}$	$f'(t) = 0$	$g'(t) = 0$	$\frac{\varepsilon - \varepsilon'}{w} \pm \frac{\alpha - \beta}{w}$
2. Turning points in $\frac{d\log Y}{dt}$, $\frac{d\log M}{dt}$	$f''(t) = 0$	$g''(t) = 0$	$\frac{\varepsilon - \varepsilon'}{w}$	$f''(t) = 0$	$g''(t) = 0$	$\frac{\varepsilon - \varepsilon'}{w}$
3. Step dates in $\frac{d\log Y}{dt}$, $\frac{d\log M}{dt}$	$f'(t) = 0$	$g'(t) = 0$	$\frac{\varepsilon - \varepsilon'}{w}$	$f'(t) = a$	$g'(t) = b$	$\frac{\varepsilon - \varepsilon'}{w}$
4. Step dates in $\frac{d\log M}{dt}$, turning points in log Y	$f'(t) = 0$	$g'(t) = 0$	$\frac{\varepsilon - \varepsilon'}{w}$	$f'(t) = 0$	$g'(t) = b$	$\frac{\varepsilon - \varepsilon'}{w} \pm \frac{\alpha}{w}$
5. Turning points in $\frac{d\log M}{dt}$, log Y	$f'(t) = 0$	$g''(t) = 0$	$\frac{\varepsilon - \varepsilon' - \frac{\pi}{2}}{w}$	$f'(t) = 0$	$g''(t) = 0$	$\frac{\varepsilon - \varepsilon' - \frac{\pi}{2}}{w} \pm \frac{\alpha}{w}$

It is clear that the percentage rates of change of y and x are sinusoidals with the same frequency as the original series. What differs is the amplitude and phasing. The rate of change series have an amplitude multiplied by w and a phase advanced by $\frac{\pi}{2}$ (or 90°). It follows that the use of the rate of change transformation to both series in no way distorts the relative amplitude or phase differences from what would have been obtained had the original series been used instead. Turning points in $\frac{d \log y}{dt}$ and $\frac{d \log x}{dt}$ occur when

$$\frac{d^2 \log y}{dt^2} = - w^2 A \cos (wt + \varepsilon) = 0$$

and

$$\frac{d^2 \log x}{dt} = - w^2 B \cos (wt + \varepsilon') = 0$$

and the relative phase displacement is $\frac{\varepsilon - \varepsilon'}{w}$, as is the case with the original series. This is an important result that we will make use of in chapter 14.

Use can be made of the sinusoidal characteristics of $\frac{d \log y}{dt}$ and $\frac{d \log x}{dt}$ to examine the meaning of the *step dates* in the rate of change series. When the series are adjusted for trend, the rate of change series oscillate around zero mean with an amplitude of $\pm wA$ and $\pm wB$ respectively, and with a period of $\frac{2\pi}{w}$. Step dates are defined as occurring when the rate of change series cross-over from positive to negative values: that is, when $\frac{d \log y}{dt} = 0$ and $\frac{d \log x}{dt} = 0$. These also define turning points in the original series $\log y$ and $\log x$. Consequently a comparison of step dates (case 3) should provide the same estimate of the outside lag as does a comparison of the deviations from trend of the original series, if our assumption about the form of the fluctuation is correct. Similarly, the same timing differences should arise when step dates in the rate of change of the monetary series are measured against reference peaks and troughs (case 4).

When the series are examined without first removing the trends, the similarity of the estimates provided by methods 1-4 continues *on average*, but there are now differences between the timing at peaks and troughs. Consider case 4 where step dates in the rate of change of money are compared with turning points in the reference series, which includes trend. The rate of change of the monetary series is

$$\frac{d \log x}{dt} = b - wB \sin (wt + \varepsilon'),$$

which is a regular sinusoidal around the average level of b, with a maximum of $b + wB$ and a minimum of $b - wB$. It is possible for the minimum to exceed zero and the oscillations in the rate of change to be marked by high and low levels rather than positive and negative values. Consequently, the step dates need to be redefined as the dates when the rate of change series crosses the average level, viz.

$$\frac{d \log x}{dt} = b$$

from which it is derived that

$$t_2 = -\frac{\varepsilon'}{w}$$

which is the same as the upper turning point in the original series, expressed as deviations from trend. But turning points in the reference series inclusive of trend are affected by trend, so for the upper turning point

$$t_1 = -\frac{\varepsilon}{w} + \frac{\alpha}{w}$$

where $\alpha = \text{arsin}\ (^a/_{wA})$, and the peaks are delayed and troughs are brought forward. Consequently the relative phase displacement

$$t_2 - t_1 = \frac{\varepsilon - \varepsilon'}{w} \pm \frac{\alpha}{w}$$

is longer at peaks than for troughs, as Friedman and Schwartz found. However, as long as the same number of peaks and troughs are considered the length of the average lag is unaltered.

When the levels of both the income series and the monetary series are compared inclusive of trend, the relative phase displacement is affected by the extent of the trends. An upper turning point in the monetary series occurs when

$$\frac{d \log x}{dt} = -wB \sin (wt + \varepsilon') = -b$$

that is, when

$$t_2 = -\frac{\varepsilon'}{w} + \frac{\beta}{w}$$

where $\beta = \text{arsin}\ (^b/_{wB})$. The relative phase displacement is

$$t_2 - t_1 = \frac{\varepsilon - \varepsilon'}{w} \pm \frac{\alpha - \beta}{w}$$

Whether the lag at peaks is longer than at troughs depends on the slopes of the exponential trends. When $a = b$, the relative phase displacement is $\frac{\varepsilon - \varepsilon'}{w}$, which is the same as obtained with the de-trended series. Again it follows that the average lag is unaltered by the presence of trend.

The similarities noted for cases 1-4 do not carry over to the fifth case, when the rate of change of money is compared with the reference peaks (or the levels of income). The rate of change of (12-4) is

$$\frac{d \log x}{dt} = b + w\mathrm{B} \cos (wt + \varepsilon' + \frac{\pi}{2})$$

which is displaced relative to the original series by $\frac{\pi}{2}$ (= 90°). The relative phase displacement between $\frac{d \log x}{dt}$ and log y contains three elements:

$$t_2 - t_1 = - \frac{(\varepsilon' - \varepsilon)}{w} - \frac{\pi/2}{w} \pm \frac{\alpha}{w},$$

namely,the phase displacement of the original de-trended series $(\frac{[\varepsilon - \varepsilon']}{w})$, the time interval by which the peak and trough is altered by trend in the reference series $(\pm \frac{\alpha}{w})$, and the lead of the rate of change series relative to the original series $(\frac{\pi}{2}/_w)$. It follows that if there is no trend in the reference series (a = 0), and the original series are coincident ($\varepsilon' = \varepsilon$), the rate of change of money would necessarily lead the reference peaks and troughs by one quarter of a cycle. With a business cycle of average length of about 40 months, the monetary growth rate would lead income by about 10 months.

To summarize, our earlier finding that the lag estimates provided by methods 1-4 are broadly equivalent is not surprising. These are four different ways of measuring the phase displacement between the original series of money and income, and do not provide separate information of the existence of an outside lag. Rather, the four methods provide a check on the results obtained from any one method. Nor is the tendency for the lag at peaks to exceed that at troughs of significance. This follows from the analysis of series which incorporate an upward trend. A marked difference, however, does exist when the rate of change of money, rather than its level, is measured against the level of income. We now consider which of these comparisons is the relevant one.

Rates of Change Versus Levels[9]

Three considerations led Friedman to consider a comparison of the rate of change of the stock of money with the level of business to be the most relevant for measuring the outside lag.

(i) Business activity, as measured by gross domestic product or industrial production relates to a flow of goods and services per unit time. Money is a stock at a moment of time and therefore dimensionally different. The two are in the same dimension when the rate of change of money is used. Baldly stated, this argument makes little sense, but a more satisfactory justification is provided by Okun (1963). In a portfolio balance approach the public is concerned with the distribution of wealth between money and other assets, including capital goods. Thus the stock of money is on the same terms with the stock of capital, as is the rate of change of money and the flow of investment (and income). Were these arguments accepted, a case would seem to exist for recasting the quantity *theory* (as apposed to the equation of exchange) into the form $\Delta M = kPy$ rather than $M = kPy$.[10] Friedman does not do this. Nor did he run the rate of change of money against autonomous expenditures in the tests of the previous chapter. As to Okun's portfolio argument, if interest rates determine the division of wealth between money and other assets, variations in the *level* of money

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9 The issues were originally debated by Culbertson (1960, 1961), Friedman (1961), and Kareken and Solow (1963). Later comments have come from Selden (1962), Cagan (1965), Mayer (1967) and Strotz (1967).

10 This point was made by Culbertson (1961).

might be related to the flow of investment and income via interest rate changes. This raises the question of what monetary measure is appropriate to the determination of interest rates, a question which is postponed for later analysis. After discussing the dimensional question at some length, Friedman seems to drop the point, as do we.

(ii) As the money stock series is marked by an upward trend, Friedman argues that it is necessary on statistical grounds to remove the trend in order to identify cyclical movements corresponding to reference cycle turning points. According to Friedman the obvious solution is "to express the data in terms of deviations from a trend or to use first differences." Because difficulties are inherent in selecting an appropriate trend for the monetary series, Friedman prefers to use logarithmic first differences (percentage rates of change).

Two comments are in order. First, Warburton did not find the problems of trend removal to be insurmountable. Secondly, we have shown that the step dates in the rate of change of money correspond to the turning points of the stock of money expressed in terms of deviations from trend. It is this series, and not the logarithmic first differences, which would seem to be the correct series to use.

(iii) Economic considerations are also advanced. In a dynamic context, both output and money expand along a constant growth path. It is not increases in the money supply *per se* but (unanticipated) deviations of the money supply from its growth path which cause economic dislocations. These deviations can be measured in two ways: either as departures of the growth rate of the money supply from the constant growth rate, or as deviations from trend.

This argument does not help to decide whether the rate of growth or the trend-adjusted level of the money supply should be used. A further question is whether the output response should be measured by the growth rate of output. Perhaps the trend adjusted money supply should be compared with trend adjusted output. It does not necessarily follow that the rate of growth of money should be compared with the level of output.

Friedman himself seems to be unsure about which is the correct measure. In his earliest work (Friedman, 1960) the rate of change of money was compared to reference peaks and troughs. Step date comparisons were added in response to critics (Culbertson, 1960 and Kareken and Solow, 1963), but Friedman still leaned towards the earlier measure. In his latest work (Friedman, 1972) the emphasis has switched entirely to the rate of change of money and the rate of change of business activity (which we have shown is equivalent to the step date comparison or the use of deviations of the money supply from trend).

Neither timing comparison is seen to provide a full description of the behaviour of money or of the effect upon output. Rather it is envisaged that income reacts to monetary action with a distributed lag; there is no discrete lag like that between thunder and lightning. This makes it difficult to speak of *the* lag.

> "Suppose that the effect on, say, national income of a single instantaneous monetary change could be isolated in full from the surrounding matrix. The effect would no doubt be found to begin immediately, rise to a crescendo, then decline gradually, and not disappear fully for an indefinite time. There is a distributed lag. When we refer to *the* lag, we mean something like the weighted average interval between the action and its effect." (Friedman, 1960)

Friedman further goes on to suggest that the weighted average lag lies between the boundaries set by the rate of change lag measure and the step date measure.

This is all rather confusing and we consider the simple example suggested by Friedman in the quotation above to see whether any sense can be made of the three different measures mentioned. Suppose that $y(t)$ and $x(t)$ are directly related by a distributed lag model

$$y(t) = \sum_{j=0}^{\infty} a_j x_{t-j} \tag{12-5}$$

where the sequence of lag coefficients a_j are called the impulse response function of the linear system (12-5). From the impulse response function the response of $y(t)$ to a 'single instantaneous change' in $x(t)$, maintained forever, can be derived. Suppose that at t_0, $x(t)$ undergoes a unit step

$$x(t) = \begin{matrix} 0 & t < t_0 \\ 1 & t \geq t_0 \end{matrix} \tag{12-6}$$

If follows that the response of $y(t)$ is given by

$$y_{t+n} = \sum_{j=0}^{n} a_j \tag{12-7}$$

for all $n \geq 0$. The path of $y(t)$ is illustrated in Figure 12 for two possible sets of lag coefficients. Case (i) is a single geometric lag (of Koyck fame), and case (ii) is a double geometric lag.[11] The response of $y(t)$ is shown graphically in cumulative form in the upper panel and in time form ($^{dy}/_{dt}$) in the lower panel. Both are illustrated in continuous time. Clearly the second follows the scenario sketched out by Friedman where the effects "begin immediately, rise to a crescendo, then decline gradually." In later descriptions of the adjustment mechanism, Friedman has emphasized more the tendency of income to initially overshoot its ultimate level. Provided that the point of inflection is at time t_1 as in case (ii), the argument

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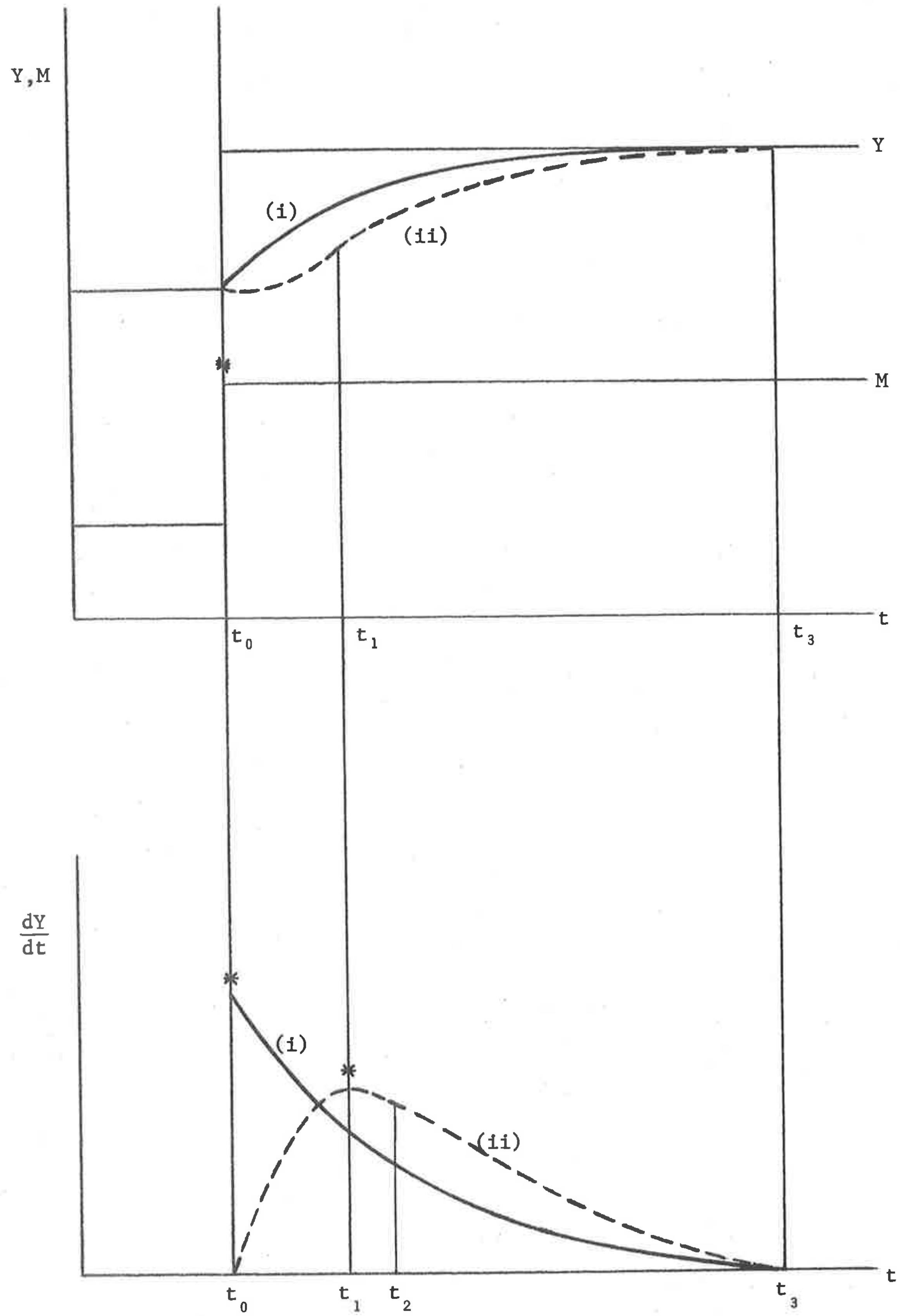
11 These lags are explained in Allen (1959).

Figure 12

SOME POSSIBLE ADJUSTMENT PATHS OF INCOME (Y)
TO A UNIT CHANGE IN MONEY (M)



which follows is unaltered.

If the monetary change is compared with the subsequent point where the cumulative effects upon $y(t)$ are nearly complete, which approximates to the reference peak, the lag is $t_3 - t_0$. Here a measure is obtained of the *total* lag. If the monetary change is compared with the rate of change of income, the lag is $t_1 - t_0$. Here the lag measures the time which elapses between the change in monetary policy and the most significant response of income, or as in case (i) the beginning of the response of income. The weighted average of the lag coefficients, indicated by $t_2 - t_0$, lies between the two other measures.

If this interpretation of Friedman is correct, then if follows that no answer exists in principle to the question of whether the rate of change of money, or its trend adjusted level, is the correct monetary measure to use in cyclical analysis. For some purposes a measure of the total lag may be appropriate, for others the impact lag (for want of a better term) is more appropriate. The total lag may be relevant for the decision whether to undertake stabilization policies or rely upon a fixed monetary rule, which is of course the context in which Friedman first raised the length of the outside lag. When the authorities are actively employing monetary policy, knowledge of the most significant response or of the weighted average lag of $y(t)$ relative to $x(t)$ may be more valuable. Here we concur with Culbertson, and in the next section focus upon the lag between *changes* in money and *changes* in income. We can always take advantage of the inter-relationships derived in Table 12.7 to translate these lag estimates into ones between the *change* in money and the *level* of income if this is so required.

Some Conceptual Difficulties

In the preceding analysis, both the initial monetary change and the subsequent response of income have been assumed to follow a simple pattern. Some complications must be analyzed. Also, we have avoided some difficult conceptual problems inherent in calling the timing differences between money and income a measure of the outside lag of *policy*. It is now appropriate to examine these matters, which we set out in the form of five questions.

1. Can timing comparisons of money and income measure the outside lag of policy?
2. What allowance is made for the presence of counter-cyclical policy in the estimates?
3. What are the characteristics of the money supply relevant for measuring the lag?
4. What type of lag pattern exists and can turning point comparisons measure this lag?
5. Does a lag exist?

A Policy Lag? The example in figure 12 assumed that income responded directly to money and that the monetary change served as an indicator of monetary policy, so that the timing difference measured the outside lag. The question of the direction of causality between money and income is deferred until later when the totality of evidence can be assessed; however, the evidence presented in the previous chapter and the outside lag itself is suggestive of some effect running from money to income. Similarly, our finding that changes in the money supply have been closely associated with variations in base money and reserve ratio changes establishes some presumption that the money supply is dominated by monetary policy actions, but this is also examined later. It is not necessary to establish complete one way causality between money and income to measure the lag. As long as the other influences upon income (and the money supply) tend to average out, the average length of the lag may provide an estimate of what may be expected between an exogenous change in money and the resultant change in income (see Friedman 1961). Estimates were made in the previous chapter of the lag between first differences in consumption and first differences in money, holding changes in autonomous expenditures constant, and these are identical with the lags obtained by the other methods.

Countercyclical Policy. If the money supply is thought to be the result of monetary policy, what sense is there in relating policy to "the occurrence of that event that policy is designed to avoid" (in Culbertson's words)? In the absence of policy, the upswing may have had double the amplitude and the peak may have occurred much earlier. Or, as Kareken and Solow point out, situations where monetary policy has been completely successful may be overlooked. An observer "would see peaks and troughs in monetary change accompanied by a steady level of aggregate activity. He would presumably conclude that monetary policy has no effects at all, which would be precisely the opposite of the truth." Friedman's answer to the first question is that monetary policy has pursued goals other than cyclical stabilization with side effects (albeit significant ones) on output, and that the existence of lags (inside as well as outside) has meant that policy has had consequences which were originally unintended - the attempt to ameliorate the recession produces the next boom and so on. He also points to the stability of the lag before and after the establishment of the Federal Reserve system which is one advantage of studying a long time period.

Kareken and Solow's particular objection would seem to be amenable to testing. Have there been peaks and troughs in 'monetary change' unaccompanied by peaks and troughs in general business activity? For Australia, the answer is a qualified no. The qualification comes from the difficulty of determining cycles in the rate of change of money by eye. When the series is smoothed (by the Henderson and MCD curves described earlier) there are some minor cyclical ripples in the rate of change, which may result from the smoothing process itself. The most pronounced of these cyclical ripples occurred in 1962/3. Some of the 10 indicators of business activity examined earlier also recorded a minor 'cyclical ripple' in 1962/3, indicating the possibility of a Mack-type 'sub-cycle', the existence of which is ignored in the determination of reference cycles.[12] It can be said with a fair degree of certainty that no pronounced cycles in money are unaccompanied by pronounced cycles in general business.

Characteristics of Monetary Change. Our example assumed that the monetary policy change took the form of a unit change, from 0 to 1. This is unrealistic, but what description of the monetary series is realistic? Is the monetary series a largely random summation of shocks or is it marked by a trend rate of growth with sharp changes in the trend rate from time to time, which is Friedman's justification for using the step date measure of the outside lag? (Variable steps in the rate of change of money are equivalent to the money supply having relatively short piecewise linear *trend* segments.) Alternatively, does the money supply exhibit regular cycles of a sinusoidal form, and do these cycles have the same length as the cycles in general business? These matters would appear to be worthy of investigation, for they offer the potentiality for providing additional evidence on the association between money and business. In short, the statistical content of the monetary series needs examination.

12 Ruth Mak coined this term for minor cycles of average duration of approximately 24 months, i.e. about half the period of conventional business cycles.

What Type of Lag? While the transmission mechanism sketched out earlier (at the end of chapter 11 and the beginning of this chapter) denies neither the existence of time lags in the transmission of monetary changes nor that they may be of substantial length, little guidance is given as to the form the lags might assume. There is, however, fairly general acceptance that the time lag is not discrete in the sense that action taken in period t_0 has an impact on income in period t_n. Rather the lag is thought to be distributed through time with some effect occurring immediately and the rest distributed through time, as illustrated in figure 12. If the impulse response is of this form the attempt to summarise the distributed lag in discrete form by examining turning points of the rate of change of money relative to turning points in the rate of change of income would seem to be of questionable value. Knowledge of the actual path of adjustment of income is required to provide an estimate of the time period during which, say, 50 or 75 per cent of the ultimate impact is complete. Solow (1960) argues that "if a distributed lag dependence is actually a closer approximation to the true relation between cause and effect, then it seems that a discrete lag calculation may give rise to misleading interpretations." By admitting to the existence of a distributed lag, Friedman would seem to be condemning his own measure.

This is the conclusion which seems to follow if we examine the impulse response to a step change in money. A different interpretation follows if we assume that the money supply follows an oscillatory time path rather than a unit change. In order to investigate how output responds to the cycle in money we need to consider instead the frequency response function. Our starting point is a linear relationship between $y(t)$ and $x(t)$ as in (12-5), now written in continuous time where the infinite series of coefficients a_1, a_2, a_3 ... is replaced by a continuous set of ordinates of some function $a(\tau)$ of a continuous variable τ, and the summation is replaced by an integral. Hence:

$$y(t) = \int_0^\infty a(\tau)\, x(t - \tau)\, d\tau \tag{12-8}$$

where $\int_0^\infty a(\tau)\, d\tau = 1.$

Suppose that $x(t)$, the input into the linear system, is a cosinusoidal disturbance

$$x(t) = A \cos \omega t \;. \tag{12-9}$$

When (12-9) is substituted into (12-8), it can be shown[13] that the output is

$$y(t) = G(\omega)\, A \cos\, (\omega t + \phi(\omega)\,) \tag{12-10}$$

where $G(\omega) \cos \phi(\omega) = \int_0^\infty a(\tau) \cos \omega\tau\, d\tau$

and $G(\omega) \sin \phi(\omega) = - \int_0^\infty a(\tau) \sin\, d\tau$

Hence the output is a cosine wave at the same frequency but attenuated by a factor $G(\omega)$ called the gain or attenuation factor, and a phase shifted by an amount $\phi(\omega)$. Note that the gain and phase shift are functions of frequency; the reason for this is that the response at a given time t depends on what happened at all previous time instants, as specified in (12-8).

The timing relationship between $y(t)$ and $x(t)$ is thus characterized by a discrete lag $\phi(\omega)/\omega$ which differs at each frequency. Perhaps each

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[13] See Allen (1959, chapter 4), Howrey (1968) and Jenkins (1961).

series has considerable power concentrated in a narrow band of frequencies centred on w_0. In this particular case, the average time difference between turning points in $y(t)$ and $x(t)$ may provide an estimate of $\phi(w_0)/w_0$, the discrete lag at the frequency w_0, and consequently of the phase difference between the input and output at that frequency.

This is not to say that the use of turning points is the most desirable procedure to employ, merely that under certain specified circumstances (which have yet to be established in practice) the method may be capable of providing an estimate of the time form of the response. Direct fitting of a distributed lag model, as Solow recommended, would seem to be preferable *if this type of lag is relevant.* We can't necessarily assume that it is. In some instances, the unit of observation may be sufficiently long relative to the time form of the lag to make specification of a distributed lag unwise.[14] In other cases, a fixed time delay may be the correct model to use where as in the case of, say, imports a fixed ordering lag might exist. An alternative possibility is for short run movements in the money supply to have different effects from long run movements, and the length of the lag may depend on the strength of the monetary change. What would seem to be required is a technique which enables us to determine *what* lag form exists before we attempt to measure it.

Does a Lag Exist? When the estimates of the lag are in the order of 0-6 months, as we have found generally to be the case, the question of the existence of the lag and its sampling variability is pertinent. There are errors inherent in dating turning points in general business acitvity

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14 Bryan (1967) found that banks adjusted cash reserves to desired levels with an average lag of 10 weeks using distributed lag techniques. When the weekly data used to provide this measure was averaged into monthly data, an average lag of 29 *months* was obtained. Calculation of the index is described in Burns and Mitchell (1935).

and in determining specific cycle turns. An estimated lag of 3 months may in fact be a lead or it may be a lag of 9 months, depending on the sampling variance. Our confidence in a particular estimate is directly related to the efficiency of the procedure and the extent of association between the series being compared. The N.B.E.R. procedure is widely recognized to be inefficient because it discards most of the informational content of the time series and relies on two points, the turning point in one series and the associated turning point in the other, to determine the length of the lag. This imprecision is heightened if the extent of association between the series examined happens to be low. The correlations presented in the previous chapter and summarized here are not particularly high (although statistically significant) - first differences in money only rarely 'explain' more than one half of first differences in income. With correlation analysis, a difficulty exists in separating cyclical from random movements: in comparison with the turning point method perhaps *too much* information is included.

Hence the methods employed here in deriving estimates of the outside lag along lines similar to those in overseas studies have severe deficiencies from a statistical point of view. They are inefficient, they provide little information about the make-up of the series used, they do not identify what type of lag structure exists, nor do they give much indication of the statistical significance of the lag. It is our contention that these deficiencies can be overcome by analysis in the frequency domain, used in conjunction with more conventional time domain methods. In particular, a combination of cross spectral analysis and cross correlograms can provide more firmly based estimates of the extent of cyclical association between the series, while enabling us to examine both the form and the length of the leads and lags. Similarly, a combination of spectrum analysis and auto-covariance analysis permits a detailed examination of the structure of the series employed in the lag study.

Appendix A to Chapter 12

The X-11 Variant of the Bureau of Census Seasonal Adjustment Method

1. Decomposition of Economic Time Series

Basically, the method employed by X-11 eliminates the seasonal factor and then irons out the irregular factor so that the trend-cycle stands out more clearly. The program handles either multiplicative or additive relations between factors. It can take into account both absolute and relative relations amongst the components by making additive and multiplicative adjustments sequentially.

2. Calendar Adjustments

An important source of month-to month fluctuations in many time series is calendar variation. This refers to:

(i) *trading-day* (or calendar composition) variation, arising from the *type* of month, i.e., whether it contains 4 or 5 weekends;

(ii) *length-of-month* variation, due to the number of days in a particular month; and

(iii) incidence of *special* holidays, such as Easter.

If no allowance is made for some of these variations, then they distort the seasonal factor curves and enter the irregular component. Adjustment for calendar variation can be justified as reducing the month-to-month fluctuations in the seasonally adjusted series (CI).

Earlier variants of Method II either made no allowances for calendar variations (trading-day in particular) or made adjustments only by the introduction of external evidence. The X-11 enables calendar variation to be handled with the following options:-

(i) *Trading-day (Calendar composition) variation*
Three options are available for computing trading-day weights:

(i) Internally computed: Monthly irregular values are regressed on a *calendar* with number of times each weekday occurs in each month.

or (ii) Externally computed: *A priori* weights are provided by user.

or (iii) Combination of external/internal weights: X-11 adjusts externally computed weights for residual trading-day variation.

(2) *Length-of-Month variation*
Two options are available:

(i) Include an allowance for length-of-month variation with trading-day factors.

or (ii) Include with seasonal factors.

(3) *Holiday variation*
Adjustment for certain holidays is *externally computed* by providing prior monthly adjustment factors (part A).

3. The Program

The X-11 program consists of seven parts, which are briefly described below:-

Part A. This enables original series to be adjusted by external data. External evidence is of two types: prior monthly adjustment factors to allow for the effect of certain holidays or to change the level of the series; and daily weights from which trading-day factors are computed.

Part B.
1. A series reflecting trend-cycle components is estimated by a centred 12 month moving average of original observations (adjusted by prior factors, if supplied). This is divided into original series to obtain SI ratios. A 5-term weighted moving average is applied to the SI ratios for each month to estimate rough seasonal factors. These factors are extended to both ends of series and divided into SI ratios to obtain irregular series. Control limits to identify extreme irregular values are established by an iterated procedure. The extreme values are weighted and the SI ratios are modified. Irregulars beyond 2.5 standard deviation units (σ) are given zero weight, and irregulars between 2.5σ and 1.5σ are assigned a linearly graduated weight between 0 and 1. Seasonal factors are calculated (as before) from these modified SI ratios and used to obtain a *preliminary* seasonally adjusted series.

2. An iterated procedure is now employed. The trend-cycle is estimated by a 9, 13 or 23 term Henderson weighted moving average of the preliminary seasonally adjusted series, and divided into original series to obtain SI ratios. One of the three Henderson moving averages is selected automatically on the strength of the irregular compared with trend-cycle variation in the particular series. Extreme irregular values are again isolated and replacement SI ratios calculated. Seasonal adjustment factors are calculated by a 7-term weighted moving average of the modified SI ratios. An irregular series and a seasonally adjusted series are then computed.

3. This consists of the trading-day routine. The irregular series which has been estimated in step 2 is residual variation after trend-cycle and seasonal factors are estimated: it consists of the 'true' irregular and variation due to non-adjustment for trading days. The trading-day variation component is estimated in terms of seven daily weights, calculated by regressing the irregular series upon seven independent variables representing the number of times each day of the week occurs in a particular month. The program yields estimates of the seven daily weights and tests their significance using the standard t-test. If significant variation exists, monthly trading-day adustment factors are calculated to adjust the original series. The extreme values routine is repeated on the irregular series excluding trading-day variation to calculate preliminary weights for modifying the original series.

Part C. The original series is now adjusted for trading-day variation and is also modified where less than full weight was assigned to an irregular. The sequence of computations outlined in section B are repeated, except that identification and weighting of irregular values occurs only in step 2. The X-11 differs from its predecessors in using an iteration procedure to modify extremes and by reducing the effect of extremes on the trend-cycle estimates. The trading-day factors and irregular weights obtained for adjusting the original series are final.

Part D. The original series is modified by the final trading-day factors and final weights for extreme values. Steps 1 and 2 are then repeated without the extreme values routine. Final seasonal factors, seasonally adjusted series (CI), and estimates of the trend-cycle and irregular values are calculated.

Parts E, F, G. The original series, final seasonally adjusted series, and the irregular, are modified for extreme values beyond 2.5σ in part E. The monthly rate of change of original and final seasonally adjusted series are also calculated. In part F, the M.C.D. moving average of the final seasonally adjusted series is computed, together with various summary measures. Charts of some of the series are printed in part G.

Appendix B to Chapter 12

Examination of Economic Fluctuations in Australia 1948-1972

As described in the text, the first objective is to provide a check upon the dates of reference peaks and troughs in Australia by examining specific cycles in 10 selected series, listed earlier. The methods used to smooth the series were described there, and the seasonal and trading day adjustment methods were outlined in Appendix A. Peaks (P) and troughs (T) in the series log Y = $f(t)$ are defined as

$$P \text{ when } f'(t) = 0, \quad f''(t) < 0;$$

$$T \text{ when } f'(t) = 0, \quad f''(t) > 0.$$

Appendix Table B sets out the peaks and troughs in the 10 series used, and the mean dates selected for comparison with the reference dates determined by other researchers.

The second objection stems from the measurement of the inside lag of monetary policy. A need for a switch in emphasis in monetary policy is thought to occur whenever business activity falls above or below normal; normal being defined by the trend fo the economy. These are Waterman's points of inflation (I) and deflation (D), defined when the trend is $g(t)$ as:

$$I \text{ when } f(t) - g(t) = 0, \; f'(t) - g'(t) > 0;$$

$$D \text{ when } f(t) - g(t) = 0, \; f'(t) - g'(t) < 0.$$

Two types of trend curve are applied to the data,

$$g_1(t) = a + bt$$

and

$$g_2(t) = a + bt + ct^2$$

where $g_1(t)$ is a first order polynomial, $g_2(t)$ a second order polynomial. Both curves are fitted to each of the 10 series by regression analysis and the choice between them in each instance is made by visual inspection. The type of curve fitted to each of the ten series, and the points of inflation and deflation so calculated were given in Table 6.3.

Appendix Table B

Turning Points in 10 Selected Series of Economic Activity

Measure of Business activity	P_1	T_1	P_2	T_2	P_3	T_3	P_4	T_4	P_5	T_5	P_6	T_6
Real G.D.P.	Feb. 51	Jul. 52	Nov. 55	Apr. 56	Apr. 57	Feb. 58	Nov. 60	Jul. 61	Apr. 65	Jul. 66	-	-
A.N.Z. Index	Sep. 51	Sep. 52	Oct. 55	Jun. 56	Jan. 57	Aug. 57	Dec. 60	Aug. 61	Aug. 65	May 66	Jan. 70	Mar. 72
Male Vacancies	Aug. 51	Jan. 53	Jul. 55	-	-	Jul. 58	Sep. 60	Aug. 61	Jun. 65	Jun. 66	Mar. 70	Jun. 72
Male Applicants	Jul. 51	Oct. 52	Aug. 55	-	-	Oct. 58	Oct. 60	Sep. 61	Mar. 65	Sep. 66	Mar. 70	Aug. 72
Brick Production	Aug. 51	Nov. 52	Oct. 55	Dec. 56	Oct. 58	Feb. 59	Nov. 60	Jan. 62	Aug. 65	Mar. 66	Feb. 70	Jan. 72
Imports	Oct. 51	Nov. 52	May 55	Oct. 56	Dec. 57	Dec. 58	Oct. 60	Nov. 61	May 65	Jun. 66	Jul. 70	Sep. 72
G.F.E.	May 51	Jul. 52	May 54	Apr. 56	Oct. 57	Dec. 58	Apr. 60	Feb. 61	Sep. 64	Feb. 66	-	-
Share Prices	May 51	Sep. 52	Jul. 55	Jul. 56	Jul. 57	Jan. 58	Sep. 60	Feb. 61	Oct. 64	Sep. 65	Feb. 70	Nov. 71
Bank Debits	Jun. 51	Sep. 52	Sep. 55	May 56	Apr. 57	Jan. 58	Sep. 60	Jun. 61	Jun. 65	-	Aug. 70	-
Bank Clearings	May 51	Nov. 52	Nov. 55	Jun. 56	May 57	May 58	Oct. 60	Apr. 61	Jun. 65	Jan. 66	-	-
Average of 10 series	Jul. 51	Oct. 52	Aug. 55	Jul. 56	Aug. 57	Jul. 58	Sep. 60	Jul. 61	Apr. 65	Apr. 66	Mar. 70	Apr. 72

Section IV

A Spectral and Cross-Spectral Analysis of Money and Business Cycles

Chapter 13

The Theory and Practice of Spectral Methods

Time Series Analysis

Any time series $\{x_t\}$, $t=1 \ldots\ldots n$ is assumed to be a single sample, of size n, from a generating process $\{X_t\}$, $t= -\infty, \ldots\ldots, -1, 0, 1 \ldots\ldots \infty$. The generating process indicates the manner in which the time series is formed, not its actual values. By 'analysis' is meant the estimation and recontruct-tion of the properties of the generating process from the given sample, in order to deduce the way the value of a variable is in part determined by its own past history, or by other variables.

As the luxury of concurrent sets of data is seldom available, the task is to estimate the properties of the generating process from only one sample of it (described as a realization). Accordingly the modern science of time series[1] deals with generating processes that are stationary in the wide sense. A stationary process is one that is in a state of statistical equilibrium, so that its statistical pattern of behaviour does not change with time. If X_t has an expectation, then this expectation must be independent of time, so that

$$E(X_t) = u \tag{13-1}$$

for all t. In the second place, the series has a constant variance,

$$E(X_t - u)^2 = \sigma^2 \tag{13-2}$$

Furthermore, if X_t and $X_{t+\tau}$ have a co-variance, then this covariance can depend only on τ, the distance between the observations in time, not the dates themselves, so that

1 The classic studies are by Bartlett (1955) and Grenander and Rosenblatt (1957). A useful modern reference is Kendall (1973).

$$E(X_{t+\tau} - u)\ (X_t - u) = \gamma(\tau) \qquad (13\text{-}3)$$

where $\gamma(\tau)$ is the autocovariance coefficient for lag τ.

These assumptions are strong ones and at first glance appear to be extremely restrictive, but where they can be made, analysis of a process is greatly simplified; indeed, it is only because of these conditions that information from the past can be used to describe the present or future behaviour. An intuitive reason for the simplification is that a stationary process provides a kind of hidden replication, a structure that does not deviate too far from the still more special assumptions of independence and identical distribution, assumptions that are common place in statistics and economics. Whether the stationarity assumption is realistic for a particular process depends on how near the process is indeed to statistical equilibrium. Because most economies are evolving over time, economic time series can seldom be regarded as stationary. Only the final data series analyzed need meet the assumptions (13-1) - (13-3), and a suitable transformation of the variable produces a more nearly stationary series. This is considered later.

There are two fundamental statistical approaches to the analysis of stationary (stochastic) processes:

1. Analysis in the time domain
2. Analysis in the frequency domain

The first is based on a study of the autocovariance function (or auto-correlation function) for a single time series, and the cross-correlation function for two series. Under the alternative approach, the basic tools of analysis are the spectrum of the process and the cross-spectrum. We now examine the main techniques employed in each of the two approaches, pointing out their similarities and differences. Although several advantages of the spectral methods will be emphasized in the course of the discussion, this is more to underline the neglect of the frequency domain in econometric work and business cycle analysis, for the two approaches should be seen as complementary in that they process the data in different ways thereby highlighting different facets of the time series.

Time Domain Analysis and the Autocovariance Function

Each observation of a stationary process may possibly be independent of the preceding ones, but for most economic applications there is some suspected dependence between the observations. High correlations between neighbouring observations or seasonal components are important forms of this dependence. Once the process is characterized it may be possible to better forecast its values or infer some information about the model which produced the variable.

One way of defining the nature of the time dependences appearing in a series is by considering the correlations between terms separated by an increasing time lag, as given by the empirical autocovariances:

$$C_\tau = \frac{1}{n} \sum_{t=1}^{n-\tau} (x_t - \bar{x})\ (x_{t+\tau} - \bar{x}) \tag{13-4}$$

where

$$\bar{x} = \frac{1}{n} \sum_{t=1}^{n} x_t \tag{13-5}$$

Because of the assumption of stationarity, (13-4) and (13-5) are efficient estimators of the mean u, and autocovariance coefficient γ_τ respectively. That is,

$$\lim_{n \to \infty} \bar{x} = u$$

and

$$\lim_{n \to \infty} C_\tau = \gamma_\tau .$$

In order to eliminate problems of scale, investigators frequently normalise the autocovariance function by dividing it by the variance of the series, C_o, to obtain

$$\rho_\tau = \frac{C_\tau}{C_o} \tag{13-6}$$

Like cross-product correlation coefficients, these *autocorrelation coefficients* are scaleless and vary between -1 and 1. Of course $\rho(0)$ is always one.

The fact that the upper index of summation in (13-4) is reduced as τ increases,limits the number of lags it is practicable to consider. It is customary to limit the number of lags to between $^n/6$ to $^n/4$. A somewhat different formula to (4) is often used, where the divisor n is replaced by $n-\tau$. When the estimates are to be used in spectral analysis, (13-4) is the most convenient estimator to employ (see Parzen 1961).

In time domain analysis the most common models, following the work of Box and Jenkins (1970), are the class of models known as ARMA - autoregressive moving average models. These may be purely autoregressive (13-7), purely moving average (13-8), or mixed (13-9):

$$X_t = \sum_{i=1}^{p} a_i X_{t-i} + e_t \tag{13-7}$$

or

$$A(L)\ X_t = e \tag{13-7'}$$

$$X_t = \sum_{j=1}^{q} b_j e_{t-j} \tag{13-8}$$

or

$$X_t = B(L)e \tag{13-8'}$$

$$X_t = \sum_{i=1}^{p} a_i X_{t-i} + \sum_{j=1}^{q} b_j e_{t-j} \tag{13-9}$$

or

$$A(L)\ X = B(L)\ e \tag{13-9'}$$

where e is a series of independent random variables; L is a lag operator and A(L) and B(L) are polynomials.

In the autoregressive model (13-7), X_t is a linear sum of its past values plus a white noise residual. The autocorrelation and autocovariance function gradually decay to zero as the lag increases, the actual manner in which this happens depending on the order of the process and the value of the parameters. The moving average model (13-8) is one where X_t is formed by a linear sum of past and present terms of a white noise series e_t. It has an autocovariance function which suddenly drops to zero when the number of lags is the same as the number of terms in the model. With the ARMA model, the autocovariance functions have properties which are a mixture of the autoregressive and moving average properties.

Other models have featured in economic analysis. One is a pure white noise series, for which the autocovariance function is zero except for $\gamma(0)$. Another is what is known as the linear cyclic model,

$$X_t = \sum_{k=1}^{m} c_k \cos(w_k t + \theta_k) \tag{13-10}$$

where the variable is a made up of a number of purely cyclical terms. A mixture of this model with the autoregressive model underlies the widespread notion that an economic variable can be decomposed into the components trend plus business cycle plus seasonal plus autoregressive residual. However, the autocorrelation function is not a very suitable instrument for detecting oscillatory components of a series. For a quarterly series, a three-year cycle implies a positive ρ_{12}; but it also implies positive ρ_{24} and negative ρ_6 and ρ_{18}. Such a pattern is readily identifiable if only one cycle is present. When cycles of different frequencies are combined, each autocorrelation coefficient is influenced by all the cycles simultaneously. What we need to be able to do is to determine the importance of all of the cycles in the process at once. Spectral analysis enables this to be done.

The Frequency Domain

Analysis of the spectrum provides another way of characterizing time series. In this case we think of a series as being made up of a great number of sine and cosine waves of different frequencies which have just the right amplitudes to make up the original series. Harmonic analysis of the periodocities of a process such as (13-10) above is rarely useful in economics since realized economic time series are not harmonic, although some of them are nearly so. Peaks and troughs rarely occur with strict regularity, and a random disturbance at a given date cannot be assumed to have no effect on the future course of a time series. Spectral analysis allows for random disturbances in the amplitudes, periods and phase angles of the harmonic terms.

Although spectral representation in the frequency domain may seem like an unusual way to think of a time series, it is very general since most covariance stationary processes can be described in this fashion.

The advance which makes spectral analysis useful to economics and other disciplines which deal with non-periodic times series is attributable to the work of Wiener (1949) in the area of generalized harmonic analysis. Wiener showed that it is possible to view almost any non-periodic function as being composed of periodic functions when infinitely many of these periodic functions are postulated. A non-periodic time series is thus regarded as being made up of infinitely many purely harmonic components. When each component is plotted against the frequency of that component, the result is a continuous curve, always greater than zero unless there are deterministic elements, known as the spectral density function.

The theory behind spectral analysis is well covered by Jenkins and Watt (1968), Kendall (1973), and Koopmans (1974). Econometric applications are emphasized by Granger and Hatanaka (1964), Godfrey (1967), Fishman (1969), Dhrymes (1970) and Malinvaud (1970). The applicability of frequency domain methods for the analysis of time domain models is examined in Jenkins (1961 and 1965), Granger (1967), Brandes, Farley, Hinich and Zackrisson (1968), Labys and Granger (1970), Engle (1974) and Harvey (1975). Here we discuss the issues involved in the interpretation of the results and the estimation methods.

The basic set of relationships which makes statistical spectral analysis possible was derived from the discovery that the autocovariance function and the spectral density function are Fourier transforms of each other. Two important results are given by the pioneering work of Wiener and Cramér.

(i) A sequence of autocovariances, γ_τ, for a stationary process can always be represented by a spectral representation of the covariance function:

$$\gamma_\tau = \int_{-\pi}^{\pi} e^{i\tau w}\, dF(w) \qquad (13\text{-}11)$$

F(w) is known as the power spectral distribution function, and its first derivative is called the spectral density function and is non-negative. By replacing dF(w) by f(w)dw in (13-11), the simpler Fourier form can be obtained

$$\gamma(\tau) = \int_{-\pi}^{\pi} e^{i\tau w} f(w)\, dw \qquad (13\text{-}12)$$

where f(w) is the power spectrum or spectrum of the process, X_t, measured in radians per unit time.

(ii) Cramér constructed the fundamental decomposition theorem for X_t itself. If X_t is real and covariance stationary as well as continuous, it can be represented as

$$X_t = \int_{-\pi}^{\pi} e^{i\tau w}\, d\, Z(w) \qquad (13\text{-}13)$$

where Z(w) is defined as a complex random function with non-correlated increments. These basic expressions state that, for a wide class of non-periodic functions, all of the information provided by the autocovariance function γ_τ on the time domain may be recovered by the use of the spectrum f(w) on the frequency domain.

Since the autocorrelation function and the spectral density function contain the same information about intertemporal independence, it is natural to ask why a series should be studied in the frequency domain using the spectrum rather than in the time domain using the autocorrelation function. The principal reason is ease of analysis, for the spectral function describes a covariance stationary process in terms of additive contributions to the variance of the process of a set of uncorrelated frequency components. Information is thus given as to the relative importance of the contributions of different cyclical movements which have generated the observed time series, while the autocovariance function does not.

When $\tau=0$ in (13-11), we obtain

$$\gamma_0 = \sigma_x^2 = \int_{-\pi}^{\pi} d\,F(w) = \int_{-\pi}^{\pi} f(w)\,dw. \qquad (13\text{-}14)$$

so that a graph of f(w) from $-\pi$ to π gives the decomposition of the variance of X_t in terms of frequency w. The variance attributable to the frequency band (w, w+dw) is f(w) dw. Any relative peaks in the plot of the power spectrum against frequency will indicate an important frequency band.

The idea of decomposing an economic variable is not new. A commonly used statistical technique (employed in the previous chapter) is to decompose a series into trend, business cycle, seasonal, and irregular, and it is instructive to ask what this type of model implies in the frequency domain. The trend emerges as a slowly changing mean level around which the remaining components fluctuate with different degrees of regularity. It can be thought of as having a very long, possibly infinite, period and so would be defined by frequencies close to zero. (In economic time domain analysis it is customary to describe an oscillation by its period P, the length of time required for one complete oscillation. In spectral analysis it is more convenient to use the inverse, called the frequency, $\theta = {}^1/_P$, measured in cycles per unit time. The term w used earlier is the angular frequency, $2\pi\theta$, measured in radians per unit of time, which is the number of revolutions around the unit circle per unit time).

Business cycles are contained in the next lowest frequency bands, corresponding to periods of between 20 and 100 months. If these cycles exhibit sufficient regularity in their period of oscillation, concentrations of variance would be evident in the vicinity of the corresponding frequencies. For example, a process of type (13-10) has infinite peaks in the spectral density function at the values $w = \pm w_k$, these constituting a line spectrum component. The effect of irregular periods, and amplitudes, in cycles is to make the cyclical part of the spectrum continuous, and cycles show up as peaks in a continuous spectrum spread about a frequency band rather than being concentrated at one specific frequency. Sometimes the cyclical component is so irregular that the corresponding spectrum only a concentration of variance over the whole low-frequency range. However, the absence of a peak does not mean the absence of a cyclical oscillation. A peak in the spectrum identifies the existence of a reasonably regular cycle; the absence of a peak does not preclude the presence of an irregular cycle.[2] This lack of uniqueness is not peculiar to spectral analysis and is widely found in statistics.

Next, the spectrum might have an area corresponding to the seasonal. When monthly data is used, this is found around the frequencies $^{2\pi k}/_{12}$ ($k = 1, 2 \ldots 6$); that is, a cycle of twelve month period and its harmonics. Where the seasonal pattern is changing slowly in character from year to year there will be a broad rounded peak rather than a narrow sharp peak; generally speaking the width of the seasonal peak indicates the rate of change of the seasonal elements relative to the seasonal frequencies. Finally, the last area of the spectral density function might correspond to the erratic component of the particular time series. This area would have no observable pattern and a uniform spectrum. It is well known that the spectrum of a series of independently distributed random variables (white noise) is flat, since all frequencies are equally represented on average.

2 Refer Fishman (1968).

Because the spectrum f(w) can be regarded as a continuous function, analysis is not restricted to processes which are made up only of cycles or even to mixtures of cycles and other elements. Theoretical spectra for generating processes of the type (13-7), (13-8), (13-9) are developed in Fishman (1969) and Kendall (1973). A first order moving average process is marked by an f(w) which is high for low frequencies and falls smoothly as frequency increases. It makes sense to think of the moving average process smoothing out the randomness of e, and the violent high frequency fluctuations are reduced in importance. A first order autoregressive scheme (Markov process) is very similar but gives a somewhat steeper spectrum at low frequencies. A second order autoregressive scheme (Yule series) is capable, at least in theory, of generating a spectrum with smooth peaks, reflecting the well known property that such processes can exhibit pseudo-cyclical movements. Given the basic similarity of these theoretical spectra, as well as that of a process with irregular cyclical movements it is hardly surprising that the estimated spectra of economic series show a continual decrease from low frequencies to high frequencies apart, possibly, from peaks at the seasonal component and its harmonics (see Granger, 1966). Further problems in interpreting the spectrum arise when we consider its estimation.

<u>Univariate Spectral Estimation</u>

For real processes, (13-12) can be written as

$$\gamma_{(\tau)} = 2 \int_0^{\pi} \cos \tau w \, f(w) \, dw \qquad (13\text{-}15)$$

It has a formal inversion

$$f(w) = (\gamma(0) + 2 \sum_{j=1}^{\infty} \gamma(j) \cos wj) / 2\pi \qquad (13\text{-}16)$$

where f(w) is measured in radians per unit of time. As $w = 2\pi\theta$, we can write this alternatively as

$$f(\theta) = \gamma(0) + 2 \sum_{j=1}^{\infty} \gamma(j) \cos 2\pi\theta j \qquad (13\text{-}16')$$

Where $f(\theta)$ is measured in cycles per unit of time. Considering (13-16'), since the cosine is symmetric $f(\theta) = f(1-\theta)$, and only frequencies from 0 to ½ are needed to describe the spectrum. In (13-16), the range of the spectrum needed is from 0 to π. Another important implication is known as the *aliasing effect*. Since f in (13-16') is measured in cycles per period, there is no component from less than one cycle every two periods, (the Nyquist frequency). All information about fluctuations with shorter periods is lost. If a phenomena is observed monthly, weekly fluctuations will be undistinguishable from oscillations with a longer period which have the same value at the moment the observation is taken. The weekly component will therefore be counted with these lower frequencies. Similarly, with quarterly data, fluctuations with periods less than six months will be confounded with the true spectrum in the estimation interval. Clearly this aliasing is likely to be most serious with annual data.

Estimation of f(w) uses

$$C(j) = \frac{1}{n} \sum_{t=1}^{n-j} (x_t - \bar{x})(x_{t+j} - \bar{x})$$

in

$$\hat{f}(w) = \{C(0)\, \lambda_o(w) + 2 \sum_{j=1}^{m-1} \lambda_j(w)\, C(j) \cos wj\} / 2\pi \qquad (13\text{-}17)$$

where m is the number of lags used to estimate the spectrum, $m < n$. The weights $\lambda_j(w)$ are known as the lag window. They are used because if they are not, the spectral estimates are not consistent, in the sense that the variance does not tend towards zero as the sample size, n, increases. With an appropriate weighting scheme it can be shown that $\hat{f}(w)$ is a consistent estimator of $f(w)$.

The ideal purpose of the spectral weighting function is to allow the viewing of the proportion of the total variance which is attributable to a given frequency band. However, no spectral lag window is able to concentrate optimally all of its focusing power on the centre of a given frequency band.[3] Some weight will overlap into frequencies other than the one in question, and there will be a tendency for the lag window to attribute variance to frequencies not responsible for its contribution. This phenomenon is known as 'leakage through the window'. It is especially severe if one frequency band contributes a dominant percentage of the total variance, since this band will tend to 'leak' variance into neighbouring frequency bands. This is why it is preferable to deal with series corrected for seasonal variations rather than crude series, unless it is the seasonal movement which is to be examined. The presence of maxima of the spectrum for the one year cycle and its harmonics can seriously affect the estimate of the spectral density for many other periodicities.

It is also desirable to use a lag window that has good focusing power. Several lag windows are available, and we prefer to use one developed by Parzen, known as Parzen II (see Jenkins, 1961):

$$\lambda_j(w) = 1 - 6(j/m)^2 + 6(j/m)^3, \qquad j \leq m/2$$

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3 The term frequency band is used rather than frequency point because it is impossible to estimate infinitely many frequency points by digital means. To put it another way, point estimates cannot be made of a continuous variable.

$$= 2(1 - {}^{j}/_{m})^3 \qquad {}^{m}/_{2} < j \leqslant m \qquad (13\text{-}18)$$

This has great focusing power and, unlike some other lag windows, will usually give positive spectral estimates; the latter being useful since the logarithm of the estimated spectrum is of considerable interest. In addition, of interest for cross-spectral analysis, this window almost always gives estimates of coherence which are in the proper theorectical range.

Considering (13-17), it would seem reasonable to compute as many autocovariance coefficients as possible, for as the number of autocovariance coefficients approaches n-1 for a given time series, the greater is the resolving power of the spectral estimate. However, as m increases, the instability (i.e. variance) of the estimate increases. Jenkins (1961) has shown that the variance is inversely related to the equivalent degrees of freedom (EDF), which is defined as

$$\text{EDF} = \frac{2\ E(\hat{f}(wj))^2}{\text{Var}\ (\hat{f}(w))} \qquad (13\text{-}19)$$

The value of EDF varies with the lag window chosen: for the Parzen II window

$$\text{EDF} = 3.7{}^{n}/_{m} \sim {}^{4n}/_{m}$$

Hence the larger is m, the greater is the variance of the spectral estimates. But if we employ low variance estimates, frequencies close together become 'smudged', that is the band width increases and the detail in the estimated spectrum is not fine enough to show the important characteristics of the theoretical spectrum. Thus we have to balance smudging and variance. As was discussed earlier with the autocorrelation function, several general rules of thumb have been given and a safe truncation point for m is between 15 and 30 per cent of n-1. Within this desirable range, the more emphasis which one wishes to place on the general shape of the spectrum, the fewer the number of lags which should be chosen. On the other hand, the more emphasis which is placed on the accuracy of determining the frequency bands at which power is located, the greater the number of lags which should be chosen.

Most economic time series are not stationary, due to either a trend in mean or a trend in variance. Trends in mean can be removed by moving averages, polynomial regressions (used in chapter 12), and variate differences, depending on the nature of the data. If the erratic movement is increasing proportionately with the series itself, then a logarithmic transformation $x_t' = \log x_t$ will probably render the variance of the series much more stationary. These issues are examined later.

Bivariate Analysis

Were spectral analysis restricted to univariate analysis, its contribution to econometrics would be limited. Contemporary econometrics is much concerned with model specification and hypothesis testing and parameter estimation, and while determining the extent of autocorrelation in a series and examining its oscillatory behaviour would contribute to model building, that would be all. Cross-spectral analysis enables the econometrician to gain information about what relationships among phenomena are implied by the data. It also enables us to infer how economic phenomena are associated through time.

In the latter context a natural starting point is the covariances between series which are displaced relatively to each other, and regressions involving such displacements. For the moment we disregard regressions, and examine the cross-covariances for two covariance stationary sequences. If we denote these as X_t and Y_t, then the *cross-covariance function* is

$$\gamma_{xy}(\tau) = E[X_t - u_x)\ (Y_{t+\tau} - u_y)] \tag{13-20}$$

which assumes that X_t and Y_t are jointly stationary. Similarly we can define

$$\gamma_{yx}(\tau) = E[Y_t - u_y)\ (X_{t+\tau} - u_x)] \tag{13-21}$$

In general, these cross-covariance functions are not symmetric around the origin, because the effect of the variable X_t on $Y_{t+\tau}$ differs from that of Y_t on $X_{t+\tau}$. However since $\gamma_{xy}(\tau)$ and $\gamma_{yx}(\tau)$ are related with

$$\gamma_{xy}(\tau) = \gamma_{yx}(-\tau) \tag{13-22}$$

we need only look at one of them. As in the case of a single time series, it is generally preferred to remove the effect of scale and consider the cross-correlation function

$$\rho_{xy}(\tau) = \frac{\gamma_{xy}(\tau)}{\sigma_x\ \sigma_y}\ . \tag{13-23}$$

Estimation of (13-20) and (13-23) by

$$C_{xy}(\tau) = \frac{1}{n}\sum_{t=1}^{n-\tau} (x_t - \bar{x})\ (y_{t+\tau} - \bar{y}) \tag{13-24}$$

and

$$\rho_{xy}(\tau) = \frac{C_\tau(xy)}{[C_o(xx)\ C_o(yy)]^{\frac{1}{2}}} \tag{13-25}$$

The cross-correlation function (13-25) estimates the degree of linear association or correlation between the two sequences for different time lags. The value of τ for which ρ_{xy} has a maximum identifies the time lag with the highest degree of correlation. If this time lag is positive, X leads Y, and vice versa for a negative time lag. Let us suppose that X and Y are related such that

$$Y_t = \beta\ X_{t-s} + v_t \tag{13-26}$$

where v_t is a stationary process independent of X_t, and $E(v_t) = E(X_t) = 0$. Multiplying through by $X_{t-\tau}$ and taking expectations,[4] we have

$$E[Y_t X_{t-\tau}] = \beta\ E[X_{t-\tau}\ X_{t-s}] + E[v_t X_{t-\tau}]$$

which can be written as

$$\gamma_{xy}(\tau) = \beta\ \gamma_x(\tau-s)$$

and

$$\rho_{xy}(\tau) = \frac{\beta\ \gamma_x(\tau-s)}{\sigma_x\ \sigma_y}$$

It is clear that the cross-covariance and the cross-correlation function will be at a maximum when $\tau=s$. Its values at other lags will depend upon

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4 This follows Harvey (1975).

the autocorrelation in series X_t. Where successive values of X_t are independent, the cross-covariance function will be zero at all lags except s.

In general X_t will not be white noise, and the cross-covariance will assume a complicated form. This illustrates the point that the smoothness of economic time series plays havoc with the idea of relying extensively upon the theory of correlation to compare several series (with or without lags). Correlation measures assume randomness, that is, irrelevance of the time order in which samples are drawn, but in economic time series a given observation is not independent of the preceding one and this is the case for each series of any pair being correlated. Spectral analysis is not subject to these limitations, and thus provides a better basis from which to analyze the interdependence of series.

Cross-spectral Analysis

The spectral analysis of a single time series can be extended to two or more time series by the introduction of cross-spectral analysis. Consider two stationary time series $\{X_t\}$ and $\{Y_t\}$, whose cross-covariance function is stationary as well, specified in (13-22) above. Analogously to (13-11) and (13-12), we may define the *cross-spectrum* between X_t and Y_t:

$$\gamma_{xy}(\tau) = \int_{-\pi}^{\pi} e^{i\tau w} \, dF_{xy}(w)$$

$$= \int_{-\pi}^{\pi} e^{i\tau w} \, f_{xy}(w) \, dw \qquad (13\text{-}27)$$

where f_{xy} is the power cross-spectrum. As the cross-covariance function is not generally symmetric about the origin, the cross-spectrum is a complex quantity and will be composed of a real and an imaginary part, so that

$$f_{xy}(w) = c_{xy}(w) + iq_{xy}(w)$$

where $c_{xy}(w)$, the real part, is known as the co-spectrum and the complex part, $q_{xy}(w)$ is termed the quadrature part.

Recalling (13-15), when X_t and Y_t are real processes we can define

$$\gamma_{xx}(\tau) = 2 \int_0^\pi \cos \tau w \; f_x(w) \; dw \tag{13-15a}$$

$$\gamma_{yy}(\tau) = 2 \int_0^\pi \cos \tau w \; f_y(w) \; dw \tag{13-28}$$

$$\gamma_{xy}(\tau) = 2 \int_0^\pi \cos \tau w \; c_{xy}(w) \; dw - 2 \int_0^\pi \sin \tau w \; q_{xy}(w) \; dw \tag{13-29}$$

When these are inverted they become:

$$f_x(w) = (\gamma_{xx}(0) + 2 \sum_{j=1}^{\infty} \gamma_{xx}(j) \cos wj) / 2\pi \tag{13-16a}$$

$$f_y(w) = (\gamma_{yy}(0) + 2 \sum_{j=1}^{\infty} \gamma_{yy}(j) \cos wj) / 2\pi \tag{13-30}$$

$$c_{xy}(w) = \{\gamma_{xy}(0) + 2 \sum_{j=1}^{\infty} (\gamma_{xy}(j) + \gamma_{yx}(j)) \cos wj\} / 2\pi \tag{13-31}$$

$$q_{xy}(w) = \sum_{j=1}^{\infty} (\gamma_{xy}(j) - \gamma_{yx}(j)) \sin wj / 2\pi \tag{13-32}$$

From these we define the cross-spectrum as

$$f_{xy}(w) = \sqrt{f_{xy}(w) \; f_{yx}(w)}$$

$$= \sqrt{c_{xy}^2(w) + q_{xy}^2(w)} \qquad (13\text{-}33)$$

The term $c_{xy}(w)$ measures the strength of association (covariance) on the frequency domain between the amplitudes of the two time series which are in phase, while $q_{xy}(w)$ measures the strength of association of the amplitudes which are out of phase by an angle of $\pi/2$ or 90°, or in quadrature.

Although the cross-spectrum summarizes all the information we need, its values are complex numbers and it cannot be plotted directly. Instead, it is convenient to summarize the cross-spectrum in terms of three statistics: C(w), the coherence; G(w), the gain (or transfer); and Ø(w), the phase. These will now be defined, and an extended discussion of their interpretation will be given later.

The coherence (squared) measures the total association between the series:

$$C(w) = \frac{|f_{xy}(w)|^2}{f_x(w)\ f_y(w)}$$

$$= \frac{c_{xy}^2(w) + q_{xy}^2(w)}{f_x(w)\ f_y(w)} \qquad (13\text{-}34)$$

which is clearly between 0 and 1.

The gain was introduced in the previous chapter and is defined as

$$G_{yx}(w) = \frac{|f_{xy}(w)|}{f_x(w)}$$

$$= \frac{[c_{xy}^2(w) + q_{xy}^2(w)]^{\frac{1}{2}}}{f_x(w)} \qquad (13\text{-}35)$$

which measures the relative amplitude of the sinusoidal components in series Y_t at frequency w, compared with those in series X_t.[5]

The phase is given by the relationship

$$\emptyset(w) = \tan^{-1} \left[\frac{q_{xy}(w)}{c_{xy}(w)}\right] \tag{13-36}$$

and measures the timing between the series.

Given the knowledge of how to estimate a single power spectrum consistently, the estimation of the cross-spectrum is straightforward. Estimates of $c(w)$ and $q(w)$ are obtained from

$$\hat{c}(w) = \lambda_o C_{xy}(0) \,/_{2\pi} + \sum_{k=1}^{m} \lambda_k (C_{xy}(k) + C_{yx}(k)) \cos wk \,/_{\pi} \tag{13-37}$$

$$\hat{q}(w) = \sum_{k=1}^{m} \lambda_k (C_{xy}(k) - C_{yx}(k)) \sin wk \,/_{\pi} \tag{13-38}$$

with w taking values $wj = \pi j/_m$, $j = 0, 1 \ldots\ldots m$, and

$$C_{xy}(k) = \frac{1}{n} \sum_{t=1}^{n-k} (x_t - \bar{x})(y_{t+k} - \bar{y})$$

$$C_{yx}(k) = \frac{1}{n} \sum_{t=1}^{n-k} (y_t - \bar{y})(x_{t+k} - \bar{x})$$

As before the Parzen II weights λ_k are used. The same considerations discussed earlier about choosing m are relevant also here. There is also the need to render the series used as near to stationary as possible,

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[5] Sometimes the expression given is written as $G_{xy}(w)$. Our definition follows that in Granger and Hatanaka.

though it may be noted that cross-spectral methods will find the phase lag relationship even between two non-stationary processes provided that the relationship itself is not changing with time (Granger, 1967).

Having calculated the co-spectrum and quadrature spectrum, the estimates of coherence, gain and phase follow:

$$\hat{C}(wj) = \frac{\hat{c}^2(wj) + \hat{q}^2(wj)}{\hat{f}_x(wj)\ \hat{f}_y(wj)} \tag{13-39}$$

$$\hat{G}_{yx}(wj) = \frac{[\hat{c}^2(wj) + \hat{q}^2(wj)]^{\frac{1}{2}}}{\hat{f}_x(wj)} \tag{13-40}$$

$$\emptyset(wj) = \tan^{-1}\ (\hat{q}(wj)\ /\ \hat{c}(wj)) \tag{13-41}$$

Interpreting the Statistics

The *coherence* is similar to the coefficient of determination on the time domain, which is defined as

$$\rho_{xy}{}^2 = \frac{\sigma^2{}_{xy}}{\sigma_x\ \sigma_y} \quad .$$

The analogy with coherence is obvious. As with the coefficient of determination it is constrained within the range 0 to 1. When $f_{xy}(w) = 0$, then $C(w) = 0$. When $f_x(w) = f_y(w)$ then $C(w) = 1$. Naturally we are interested in testing the hypothesis of zero coherence between two sequences, in order to establish whether a 'real' association exists between them. Table 13.1 provides cut off values of coherence (squared) for various values of

Table 13.1

Critical Values for Sample Coherency Squared for Tests of the Hypothesis $C^2 = 0$, for α significance level.

			Coherency Squared	
n/m	EDF	n	$\alpha = .05$	$\alpha = .10$
4	16 (14.8)	8 (7.4)	.348 (.391)	.291 (.319)
5	20 (18.5)	10 (9.3)	.280 (.314)	.226 (.250)
6	24 (22.2)	12(11.1)	.240 (.264)	.190 (.200)

n/m and thus equivalent degrees of freedom (EDF) from (13-19) based on the approximate and exact (bracketed) values for the Parzen II weights. Calculation of the table is based on the method suggested in Koopmans (1974).[6]

Gain measures the amplitude difference, and its square is analagous to the squared linear regression coefficient

$$\beta^2_{yx} = \rho^2_{xy} \left[\frac{\sigma_y}{\sigma_x}\right]^2$$

For example, suppose that Y is determined linearly by X with a residual for noise, viz

$$Y(w) = G_{yx}(w)\ X(w) + u(w).$$

6 Before this procedure was suggested, considerable uncertainty surrounded the precision of an estimate of coherence, and rules of thumb such as values of 0.4 or 0.5 were used to distinguish significant association. See Burley (1969).

Gain indicates the amplification of the variations in X producing variations of the same frequency, w, in Y. Referring to (13-35), it can be seen that G(w) plays the part of a regression coefficient defined at each frequency w since the numerator is the covariance between input and output at frequency w and the denominator is the variance of the input at the same frequency. As in the case of a regression coefficient it is possible to calculate confidence intervals for the estimated gain. G(w) can never be negative, but if it is small, it indicates that at the particular frequency w, X has little effect on Y. When the gain is estimated from logarithmic values of the two processes, there is an affinity with the concept of elasticity, computed by lagging the independent variable by the amount estimated in the cross-spectral phase diagram.

Phase angle measures the phase difference between the frequency components of the two processes, and when $\emptyset(w)$ is plotted against w, $0<w<\pi$, we have the phase diagram. Transposing the series X_t and Y_t only changes the sign of the phase. A natural ambiguity exists about the phase since adding or subtracting one whole cycle from an angle will not change its tangent. Thus the phase is known only up to adding or substracting an integer $k=1, 2 \ldots\ldots$ in $2\pi k$. Care must be taken in interpreting the phase diagram and, as in any attempt to determine leads and lags between economic time series, consistency within the model and prior information are most important. This is one reason why it is helpful to study the phase in conjunction with the cross-correlation function.

The significance of a particular lead or lag relationship indicated by the estimated phase can be judged by considering the size of the phase angle estimate relative to various confidence intervals. As the variance of a particular phase estimated is inversely related to the coherence, more reliance can be placed on estimates where coherence is high. Two methods of calculating confidence bands have been suggested. Most existing work has used confidence intervals suggested by Jenkins (1963). More recently, a different procedure has been suggested by Koopmans (1974). Calculations of 90 and 95 per cent confidence intervals based on both procedures are set out in Table 13.2 for various levels of coherence (squared).[7] If these are designated $\emptyset^*$, then the confidence band for the 'true' value of phase is

$$\hat{\emptyset}(w) - \emptyset^* \leqslant \emptyset(w) \leqslant \hat{\emptyset}(w) + \emptyset^*$$

As there are 2π radians in one complete rotation of a cycle, of 360 degrees, phase angle can be expressed in degrees, as is done in the Table, where the range of $\emptyset(w)$ is 0 to 180°.

A common practice adopted in applied spectral analysis involves inspecting frequency bands where coherency is relatively high, and thus the variance of the phase estimates is least, and calculating the phase angle in time units. This involves dividing the phase estimate by the frequency,

$$\begin{aligned} \emptyset(w)_t &= \emptyset(w) \; [m/\pi j] \\ &= \emptyset(w)/2\pi\theta j \end{aligned} \qquad (13\text{-}42)$$

where θj is frequency is terms of cycles per unit time. An alternative name for this expression is the Tau statistic (see Bonomo and Schotta, 1969). A positive phase shift figure indicates that X_t leads Y_t, whereas a negative phase shift figure indicates the opposite relationship.

This procedure is particularly appropriate if it is evident that one frequency dominates the co-variation of X and Y; a point that was made in

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7 It is beyond the author's competence to venture an opinion on which of these is the more accurate.

Table 13.2

Confidence Bands for Phase Angle, in Degrees (± Ø°)

Estimated Coherency Squared ($\hat{C}^2$)	Jenkins			Koopmans					
	95% Confidence Intervals			95% Confidence Intervals			90% Confidence Intervals		
	$\frac{n}{m} = 4$	$\frac{n}{m} = 5$	$\frac{n}{m} = 6$	$\frac{n}{m} = 4$	$\frac{n}{m} = 5$	$\frac{n}{m} = 6$	$\frac{n}{m} = 4$	$\frac{n}{m} = 5$	$\frac{n}{m} = 6$
.2	45	42	39	-	82	62	70	54	47
.3	37	33	31	60	49	42	46	38	34
.4	31	28	26	44	37	32	35	30	26
.5	27	24	22	34	29	26	28	24	21
.6	22	20	18	27	24	21	22	19	17
.7	18	16	15	22	19	16	18	15	14
.8	14	12	11	16	14	12	14	12	10
.9	4	3	3	11	9	8	9	8	7

the previous chapter. Alternatively, there may be grounds for believing that the interrelationship between X and Y varies markedly in nature as between frequencies. Otherwise, it is probably more instructive to examine the whole of the phase diagram which might be relevant for the particular study.[8] Stated alternatively, it is important to determine the type of lag structure and this is achieved by examining the phase diagram over *all* the relevant frequencies. (As the gain and phase are interrelated, this is true also of the gain diagram).

Three models serve as a benchmark for interpreting the phase diagram.

(i) Pure delay.

$$Y_t = g\, X_{t-b} + u_t$$

$$G(w) = g$$

$$\emptyset(w) = bw$$

Here there is a simple fixed time lag, whose length can be determined from the slope of the phase diagram. We need only find $\emptyset(w)/_w = b$ for complete information recovery.

(ii) Angle lag.

$$Y_t = g\, X_t^{a} + u_t$$

$$\emptyset(w) = a$$

This is called a fixed angle lag as every frequency of Y_t is exactly a

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[8] This is emphasized by Jenkins (1965) and Hause (1971).

different from the corresponding frequency in X_t. We might find that cycles of longer period have a longer time lag and that the two vary linearly. Here $\phi(w)/_w = a/_w$ and the length of the lag varies with frequency.

(iii) Angle lag plus delay

$$Y_t = g\, X_t^{a+bw} + u_t$$

$$= g\, X_{t-b}^{a} + u_t$$

$$\phi(w) = a + bw$$

Here X_t and Y_t are related by both a fixed time and a fixed angle lag. This is an appropriate model when low frequencies have a different timing relationship from higher frequencies.

Where the models (ii) and (iii) are relevant, it is clear that examining $\phi(w)/_w$ misses the point because knowledge of a and b separately is desirable. Even when (i) is relevant, estimation of the lag from the slope of the phase diagram is more efficient than a time domain analysis because of the filtering out of noise (see Hamon and Hannan, 1974). The models we wish to examine are:

(i) $\phi(w) = bw$

(ii) $\phi(w) = a$

(iii) $\phi(w) = a + bw$

The optimum estimates of a and b are derived from a regression analysis applied to the phase diagram which weights the phase shift at each frequency by the coherence (see Hamon and Hannan, 1974 and Praetz, 1973). The following pair of simultaneous equations are iteratively solved for a and b:

$$\sum \sin \{\hat{\phi}(j) - a - b\pi j/_m\} \ \hat{C}(j)/_{(1-\hat{C}(j))} = 0 \tag{13-43}$$

$$\sum j\sin \{\hat{\phi}(j) - a - b\pi j/_m\} \ \hat{C}(j)/_{(1-\hat{C}(j))} = 0 \tag{13-44}$$

Standard statistical criteria can be used to evaluate the appropriateness of these models.

Where there is not a simple delay or angle lag, interpretation of the phase and gain diagrams is more complicated than in the models just considered. *Distributed lag* models provide the most important example. Three features of the gain and phase diagrams of these lag forms are noteworthy. First, none of the three models above should provide a good representation of the phase diagram, for generally the time lag varies with frequency in a way different from any of these models. Further, the gain would not be expected to be constant. Thus the relevance of the models (i)-(iii) above provides a crude, indirect test of the presence of a distributed lag model. As was emphasized in the previous chapter, a distributed lag model is not necessarily appropriate.

Secondly, the gain is a Fourier transform of the lag distribution in a distributed lag model. Suppose that Y is generated by X in a distributed lag system

$$Y = V(L)\ X + u \tag{13-45}$$

where L is a lag operator and X and u are uncorrelated stationary processes. It can be shown[9] that

$$f_{xy}(w) = V(Z^{-1})\ f_x(w) \tag{13-46}$$

[9] See Engle (1974).

where $Z = e^{-iw}$. From (13-46), it is clear that the gain $f_{xy}(w)/f_x(w)$ is an estimator of V(Z)[10]. Where a moving average type of lag distribution exists, the gain is a declining function of frequency, for the lag distribution emphasizes low frequencies and smooths out higher frequencies. Such systems behave like low pass filters, to use spectral terminology. At low frequencies, Z is close to unity and therefore the gain should be close to the long run multiplier. This is a useful result that we make use of later.

Thirdly, the phase estimator incorporates all the information about the form of the lag. Consider the case where (13-45) is a Koyck geometric lag distribution, in which case it can be written

$$Y_t = \alpha \sum_{\tau=0}^{\infty} \beta^{\tau} X_{t-\tau} + u_t \qquad (13\text{-}47)$$

The phase is

$$\emptyset(w) = \arctan \left(\frac{-\beta \sin w}{1-\beta \cos w} \right) \qquad (13\text{-}48)$$

From (13-48), we can see that the 'output' Y_t lags behind the 'input' X_t. From the 'Bode plots' shown in Jenkins (1965) this seems to be a fairly general result which serves as a benchmark for interpreting the phase diagram. Further, the slope of the phase near zero frequency is equal to the average or mean lag of the lag distribution (here $\beta/_{1-\beta}$). In view of the discussion in the previous chapter about the desirability of measuring the average lag in the context of the lag in the effect of monetary policy, the preceding finding is a significant one, and additional importance attaches to the slope coefficient b in the model $\emptyset(w) = a + bw$.

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10 In fact, it is Hannan's inefficient method. See Hannan (1967).

Comparison with Time Domain Modelling

Thus cross-spectral analysis appears to be a powerful tool for investigating the lead-lag structure between economic series, and it is perhaps worthwhile spelling out what are seen to be the advantages of cross-spectral mode of analysis compared with conventional regression analysis on the time domain. These are four-fold.

(a) While the preceding discussion has indicated how cross-spectral analysis can be used to obtain parameter estimates of distributed lag models, the use of cross-spectral analysis for this purpose is controversial. The main disadvantage is the amount of computation necessary, particularly when more than two series are involved. In some cases, they are less efficient than time domain models; in other cases, they are sufficiently superior to justify working from the cross-spectrum.[11] As with time domain models, problems of identification and simultaneity exist, for the gain and phase angle estimates are generally biased when feedback loops are present,[12] although the possibility that feedback may exist at some frequencies but not others provides an escape route not open in time domain methods. Even where cross-spectral analysis is not used for actual parameter estimation, it is particularly useful in identifying the appropriate model to be fitted. The procedures are complementary as well as competitive.

(b) Following on from the last point, spectral analysis would seem to have considerable advantages in testing hypotheses about the existence and form of interrelationships. On the time domain, hypotheses can only be tested by specifying a particular model and a set of assumptions about

11 See Dhrymes (1971). This would seem to answer the stringent criticism of Granger and Hatanaka by Wold (1965).

12 These problems are examined in Akaike (1963).

it. Spectral analysis is based on fewer assumptions, and provides a way of simply comparing a great many types of models. Hypotheses about, say, the form of the time lag can be examined without first specifying and tying down the lag into a particular form to begin with.

(c) Spectral methods are able to throw up and summarize facts about the world that are pertinent to model-building and which will have to be allowed for in future theories. Here spectral analysis overlaps with the procedures employed by the National Bureau of Economic Research. It can be argued that spectral methods perform this role better than do the N.B.E.R. methods because the method of cyclical decomposition is more sophisticated. Rather than attempting to identify a precise *month* as a turning point for an economic fluctuation, only frequency *bands* are examined, which expresses a more realistic view about the irregularity of economic cycles. Lead-lag relationships can be analyzed in a more powerful way, using more information, than is involved in turning point comparisons.

(d) Cross-spectral analysis opens up possibilities which time domain methods cannot discern, for it enables the relationship between a particular frequency in one process and the same frequency in another process to be studied. Cycles may be more closely related to cycles, than cycles to trends or to seasonals. Almost certainly the processes governing short run economic behaviour differ from that for long run movements. For example, the association of money with economic activity is likely to be stronger at lower frequencies because output and employment at higher frequencies are 'contaminated' by occurrences such as strikes which have nothing to do with monetary policy. With time domain methods, all of these frequencies are jumbled together when the overall behaviour of the series is examined. Cross-spectral analysis permits us to see whether the impact of one process on another varies at different frequencies. Engle (1974) has shown how the hypothesis that the marginal propensity to consume out of transitory income differs from that out of permanent income can be analyzed from the gain diagram. Similarly we can use the phase diagram to explore the possibility that the lead-lag relationship varies with frequency, depending on and changing with the short run - long run relationships prevailing amongst economic activities.

In the two chapters which follow these statistical tools are employed to examine the nature of the inter-relationship between the quantity of money and economic activity. Chapter 14 focuses upon the relationship between money and income, output and prices. In chapter 15 the analysis is extended to financial markets to investigate the link between money and share prices, share yields and interest rates.

Chapter 14

Money and Economic Activity

Questions of the Analysis

Most of the impetus for the view that the stock of money is a variable of critical importance for the business cycle and inflation has come from the empirical studies of Milton Friedman and his associates (Anna Schwartz and Phillip Cagan) at the National Bureau of Economic Research, and these provide a useful frame of reference for a study of the Australian series. A feature of their evidence is the distinction between long run movements and cyclical fluctuations, and a further distinction is drawn in the latter between major and minor cycles.

Clearest evidence of the association of money and prices comes from their analysis of cyclically averaged data (that is, the average level of the stock of money and prices during the interval between peaks (or troughs) in reference cycle turning points.) A close relation is found to exist between changes in prices and changes in the stock of money per unit of output. It is convenient to state the point in terms of the income version of the equation of exchange,

$$M. V. = P . y$$

where M is the total quantity of money in the economy, V is the income velocity of circulation of money, P is the price index implicit in estimating national output at constant prices, and y is national output at constant prices, and $Y = Py$ is money national income. In the very long-run, lags between the variables disappear and output variations attributable to cyclical fluctuations dwindle in size relative to output variations attributable to economic growth. When allowance is made for the trend in velocity, prices (P) tend to move roughly in proportion to changes in the stock of money per unit of output ($M/_y$). This statistical connection does not tell us the direction of influence, but from the stability of the association and from an examination of the sources of monetary growth, Friedman is led to the conclusion that "substantial changes in prices or nominal income are almost invariably the result of changes in the nominal supply of money". (Friedman, 1968a).

During the course of business cycles, the inter-relationships are both more complex and more pervasive, encompassing effects on output, relative as well as absolute prices, and involving lags of varying lengths and feedbacks of economic activity on money of varying strength. The corollary is that the link between money and prices is less close and less direct. In addition, the velocity of circulation of money exhibits a consistent cyclical pattern which conforms positively and is coincident with general business activity. Putting aside the behaviour of velocity for later examination, several features emerge from Friedman's analysis. First, the quantity of money has a systematic behaviour over the cycle, such that there is a systematic relation between changes in the quantity of money and changes in economic activity. Secondly, a characteristic feature of this relationship is that the rate of change of money rises during the early phase of a business expansion, reaches its peak well before the peak in general business, then declines and reaches its trough well before the trough in general business. Step dates in the rate of change of money provide an alternative description of this leading association which, as we have shown, corresponds approximately to an examination of changes in money and changes in business. Thirdly, the lag is not only long, but is apparently highly variable. These three aspects of the cyclical behaviour of money were discussed in chapter 12, and do not require documentation here. However, a comment on both the length and the variability of the lag is needed.

In his early work, Friedman emphasized the timing differences between money and reference cycle turning points in general business, where 'general business' incorporates movements in both output and prices. He noted that the substitution of turning points in *wholesale* prices for reference peaks and troughs would produce "roughly comparable" timing comparisons (Friedman, 1960). In later work, Friedman has made much of the division of cyclical fluctuations into output and price movements. Central to this distinction is the difference in timing between money and output and money and *consumer* prices, reported in Friedman (1972) and summarized in Table 12.1. Around these facts Friedman has woven an (oft-repeated) account of the transmission mechanism of monetary changes.

> ".... Let the growth rate of M2 accelerate. For something like six months, the main effect will be that actual balances will exceed desired balances, which may temporarily depress short-term interest rates but will have little other effect. After about six to nine months, the rate of growth of nominal GNP will accelerate, as holders of the excess cash seek to dispose of it. The increased spending ... will 'excite industry' as producers facing unexpectedly high nominal demands treat the increase as special to them and so seek to expand output. For a time they can do so, because their suppliers too, including labourers, take the increase in demand as special and temporary, and do not alter their anticipations [of inflation]. This, if you will, is the temporary Keynesian phase, where output responds more quickly than prices. In its course, prices do respond, rising more rapidly than before, and interest rates stop falling and start to rise. But it takes about eighteen months after output starts to quicken - or two years after money accelerates - for the main effect to have shifted from output to prices." (Friedman, 1975)

These magnitudes refer to the U.S. evidence, where six months is the response of output, and nine months is the response of nominal income

(Friedman, 1973). But Friedman is "astounded at how regularly an average delay of six to nine months is found under widely different conditions. I have studied the data not only for the United States, but also for Israel, for Japan, for India and a number of other countries". (Friedman, 1973). Needless to say, Friedman's explanation of events is controversial, and in particular the monetary explanation of price movements is hotly disputed. The extent of the association, and the nature of the lags, between money and prices is a matter which we can examine along with other elements of this transmission mechanism.

Much of the variability of the length of the lag is attributed by Friedman to the existence of a two-way relation between business and money, with the strength of the feedback from business to money depending on the nature of the cyclical fluctuation. Severe cycles are seen to be mainly a reflex of changes in money. The evidence for mild cycles is more ambiguous, but an independent role is still accorded to the money stock. The observed tendency for monetary changes to precede changes in general business is thought to be suggestive of this role, but most weight is attached to the failure of substantial differences in the relation between cyclical movements in money and general business to emerge over time. It is argued that changes in the character of monetary institutions alter the processes governing the determination of the money supply, but need not alter the relationship between monetary changes and economic activity. On the other hand, if the causality runs primarily from business to money, changes in the structure of the economy and monetary institutions seem more likely to change the cyclical association between the two.

Using these empirical generalizations of Friedman as a basis, we derive five testable hypotheses about the cyclical behaviour of the money supply.

1. Changes in the stock of money and changes in measures of business activity are closely correlated during business cycles.

Once we have specified those frequency bands which incorporate oscillations corresponding to business cycles, this statement can be examined by a study of the spectra and cross-spectra. If the business cycle is an important phenomenum and if the quantity of money is an important factor contributing to it, the series of business and money would be expected to exhibit peaks or considerable power in these frequency bands. The extent of the association between the series can be measured directly from the coherency, which should differ significantly from zero.

2. The nature of the relationship between money and income is conditioned by the period of the cycle.

If Friedman's findings are replicated for Australia, the extent of the association should decline with the frequency of oscillation. With prices, Friedman found a clear relationship existed for very long-run movements, but the association was less close over the cycle. With output, a high coherency should be expected for major cycles, but with the presence of feedback from business to money and with other factors influencing income, a less close association should be evident during minor cycles.

3. Cycles in money lead cycles in business activity; output having a shorter lag than prices.

Phase angle provides a measure of the timing differences between the series. The phase diagram needs to be examined to determine the form of the lag before full meaning can be attached to the phase estimate. Also, as we saw in chapter 12, the length of the lag depends on the particular transformation of the data. Nevertheless, the existence of a lead or lag can be discerned.

4. The lag of fluctuations in business activity relative to cycles in money is highly variable.

As Howrey (1968) points out, the proposition that the lag is variable admits of at least three interpretations:

(i) the variance of the phase estimate may be so large as to introduce considerable uncertainty about the timing difference;

(ii) the phase difference, expressed in time units (e.g. months), may vary according to the frequency of oscillation;

(iii) the length of the time lag may vary over time.

The latter can be tested formally only by the technique of complex demodulation,[1] which is beyond the scope of this study, but any differences might be observed when the data are sampled over different time periods. The others can be examined directly. At a particular frequency series can differ only in amplitude and phase, and the coherence measures the regularity of the amplitude and phase differences. Clearly the variance of an average phase estimate is inversely related to coherence, and the confidence bands for phase angle presented in Table 13.2 enable us to explore (i). For (ii), except when the phase diagram can be modelled in the form $\phi(w) = bw$, the phase difference in time units will generally be a function of frequency.

5. The nature of the relationship between money and income is highly stable (consistent) over time.

By examining the inter-relationship between the series over a wide range of data periods, any differences in the extent of coherency or the length of the average lag can be noted.

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1 This technique is explained (and used) in Burley (1969).

Results of Other Studies

On at least one occasion Friedman has noted the usefulness of spectral analysis for studying the role of the money supply in business cycles, since "it offers a potentially more efficient way of extracting information about timing relations from our recalcitrant time series" than the National Bureau techniques he employed.[2] Four researchers have taken up his suggestion insofar as the United States is concerned, and features of the studies are reported in Table 14.1.

The earliest of them is the study of Cunnyngham (1963).[3] As his reference series, Cunnyngham used the Wholesale Price Index, which is available since 1908 in monthly form. While the choice of the price index may seem a strange one, Friedman and Schwartz found almost identical timing results when turning points in the wholesale price index were used in place of business cycle turning points.[4] Identical timing results were not, however, discerned by the cross-spectral analysis. For the low frequency movements, Cunnyngham found that the money stock series leads the price series. A cross-over point occurs at the frequency point $^1/_{45}$ c.p.m., and for cycles with a period shorter than 45 months, money lags prices. From a visual inspection of the phase diagram provided by Cunnyngham it would seem that over the lag points 2 to 10, covering frequencies of $^1/_{60}$ -$^1/_{12}$ c.p.m., a fixed time lag form may be more appropriate, but money still lags prices.

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2 See Friedman (1961).

3 This study was undertaken at the Money and Banking Workshop in Chicago, and is the one which Friedman was referring to in the previous quotation.

4 This fact is reported in Selden (1962).

TABLE 14.1

Summary of Cross-Spectral Studies of the relationship between Money and Measures of Economic Activity.

Study name	Measure of Business	Measure of Money	Period and data	Summary of Cross-Spectra: Coherence	Summary of Cross-Spectra: Phase
Cunnyngham (1963)	Wholesale Price Index	M2 (FS) (seasonally adjusted)	1908–1960 monthly	Maximum coherence is .16 at frequency of $1/_{60}$ cpm.	Money leads for frequencies shorter than $1/_{45}$ cpm, lags at higher frequencies. Max lead is 4.0 months (at $1/_{120}$ cpm).
Howrey (1968)	G.D.P. (current dollars)	M2 (FS)	1869–1962 annual	Range from .30 to .50 at $1/_{40}$ cpm band.	Money leads for frequencies shorter than $1/_{40}$ cpm, lags at higher frequencies.
	G.D.P. (constant dollars)	M2 (FS) (real balances)		Highest when series in current dollars.	At $1/_{40}$ cpm, money lags from 0.3 to 7.8 months.
Bonomo and Schotta (1968)	F.R.B. Index of Industrial Production	M1 (F.R.B.) M2 (F.R.B.)	1951–1968 monthly	Over frequencies less than $1/_{12}$ cpm are .33 (M1) and .27 (M2).	For frequencies lower than $1/_{12}$ cpm, money leads by 2.38 months (M1) and 1.74 months (M2), but neither is statistically significant.
Bennett and Barth (1974)	F.R.B. Index of Industrial Production (seasonally adjusted)	M1 (F.R.B.) (seasonally adjusted)	1947–1968 monthly	For frequencies $1/_{24}$ - $1/_{96}$ cpm, averages .15 for W.P.I. and .44 for I.P.	Money leads for frequency band $1/_{96}$ cpm, but lags for higher freuqencies. At $1/_{48}$ cpm band, money lags. If by 2.7 months and W.P.I. by 0.6 months. Neither lag differs significantly from zero.
Crockett and Burman (1970)	Index of Industrial Production, multiplied by Wholesale Prices.	M1 Bank Advances	1955–1969 monthly	Maximum at $1/_{36}$ cpm of .38 for Bank lending and .18 for M1.	At $1/_{36}$ cpm frequency, M1 lags by 2.7 months and Bank lending lags by 4.7 months. The authors only examine Phase relationships for cycles ranging in frequency from $1/_{6}$ to $1/_{3}$ cpm.

A similar difference between short run and long run cycles is discerned by Howrey (1968). He investigated the cross-spectral relationships between money and Kuznet's annual estimates of current and constant dollar Gross National Product. Although Howrey was not primarily concerned with studying the length of the lag, he states that "at low frequencies the income series leads the money series and at high frequencies money leads income". A zero crossing point occurs at the frequency $^1/_{40}$ c.p.m. This conclusion is contradicted in a later statement about the significance of money for income movements, and my own reading of the phase diagram suggests that Howrey's statement should be reversed, with money leading at low frequencies and lagging at high frequencies, as in Cunnyngham.

The two remaining studies concentrate upon money and industrial production in post-war years, which they see as belonging to the genus of 'mild cycles'. Despite the similarity of the data and the time period studied, Bonomo and Schotta report that money leads production, Bennett and Barth the reverse. This difference may be more apparent than real. Bonomo and Schotta record the phase difference (their Tau statistic) for *all* frequencies lower than $^1/_{12}$ c.p.m. Bennett and Barth show the break down by frequency and the time difference varies from money leading by 7.6 months at the frequency $^1/_{96}$ c.p.m. to money lagging by 3.7 months at $^1/_{32}$ c.p.m., with an average lag over all frequencies lower than $^1/_{12}$ c.p.m. of .35 months. Given that the average lead or lag in neither case differs significantly from zero, and that different lag windows are used,[5] the remaining differences are probably due to sampling variability.

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5 Bennett and Barth use the Tukey Hanning window, while Bonomo and Schotta use the Parzen II window which we employ.

When the four studies are considered together, three conclusions are suggested: money is a lagging variable for business cycles; a difference exists between 'major' and 'minor' cycles; and money explains less than 50 per cent of the variability of income, even in the post-war data sample. These differ strikingly from the time domain results found by Friedman and raise a significant question mark over some of his most important conclusions. Admittedly, only one study covers a period which is comparable in length to Friedman's and this uses annual data which is not the most useful for studying timing behaviour. Further, all place considerable reliance upon the behaviour of one series to measure business activity. These are deficiencies which we wish to avoid in our own study.

All of the studies for the U.S. analyze the phase differences in an elementary fashion, merely converting the phase angle into time units (months) and ignoring the overall shape of the phase diagram. This particular practice is avoided in the British study, but the way the phase diagram is modelled there is unusual. Their method involved searching the diagram for evidence of a fixed time lag, but they finished up examining only cycles of between 3 months and 6 months in period of oscillation and ignoring the business cycles almost completely. The timing difference reported in Table 14.1 comes from a visual reading of their graphs. Money appears to be a lagging variable.

No study comparable with these for the U.S. and U.K. exists for Australia. Burley (1969) examines the cross-spectra of a number of economic indicators of the Australian business cycle, including the money supply (definition not recorded). He reports:

> ".... none of these earnings or price indicators has a significant coherence with the money supply: an observation which is consonant with the well-known variability in the velocity of circulation which has occurred in Australia in the post-war era."

He also records that the money supply has a 'low' coherence (0.45) with the reference series of employment (vacancies). Burley centres his study in the range $^1/_{4.5} \pm ^2/_{27}$ cycles per year (periods $6^3/_4$ to $3^3/_8$ years). In doing so, he covers only three of the five cycles identified in chapter 12. Measured on either a peak-to-peak or a trough-to-trough basis the two shortest cycles have periods of 26 and 35 months, and Burley's range of 81 to 40½ months does not cover these.

The Data and Period of the Study

Spectral analysis impresses upon one the need to generate a large data sample in order to study cyclical phenomena. Reference cycles identified by the National Bureau of Economic Research in the U.S. have varied in period (peak-to-peak) from 101 months to 17 months, averaging 49 months. Granger and Hatanaka have suggested that ideally we need a series at least seven times the period of the cycle we are interested in. Thus to study a 'major' cycle of 8-10 years in period we would like to have between 50 and 70 years of data. The cycles we identified for Australia in the post-war years vary between 26 months and 59 months in period, averaging 45 months. Consequently the post-war data sample is barely adequate to study cycles of average length. These considerations shape the nature of the data employed.

Money data. The first priority is to obtain a series of the money supply on a consistent basis over a long time span, with a broad coverage.[6] Australia is fortunate to have good private and official data of bank

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6 Work on this section of the thesis commenced prior to the publication of historical data on bank deposits and note issue by the Reserve Bank of Australia - see Butlin, Hall and White (1971). Thus it was necessary to go to the original source material and examine it in detail for content and consistency. Most of the work here has now been duplicated by the team of researchers at the Reserve Bank.

deposits in both non-interest and interest bearing categories stretching back to 1880 in quarterly form. The trade journal of the banking industry, the Australasian Insurance and Banking Record, provides quarterly returns which run continuously from 1880 to the present day. Returns were also provided to the various State Bureaux of Statistics and these were collated and published in the Finance Bulletins from 1908.[7] The latter is a more continuous and easily available source and this has been used in preference to the A.I.B.R. series wherever possible. In order to extend the Finance Bulletin series back to 1880, it was necessary to adjust the two series so as to render them consistent. A June quarter figure is given in the Finance Bulletin for each year prior to 1908, and this enabled the two series to be checked for consistency and the adjustments needed to make them identical determined. Problems arose with the reconstructions of the banks after the closures of 1893, deposits in the Northern Territory and wartime deposits in the Commonwealth Bank of Australia. These, and other adjustments made to the series, are discussed in the Appendix to this chapter.

Greater difficulty was encountered in obtaining estimates of currency holdings. No figures on holdings of coinage are available in other than yearly form; and the study is confined to note issue, which is likely to be the most volatile item as far as the public is concerned. Commonwealth government issue of notes commenced at the end of 1910. Prior to that time notes had been issued by the private banks, backed by the pledge of redeemability into gold coins. They were issued by banks in all states except Queensland, and taxed by the respective state governments at the rate of 2

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7 I am indebted to the Bureau of Statistics for presenting me with a nearly complete set of Finance Bulletins which enabled much of the painstaking work to be done out of the physical confines of the University Library.

per cent per annum.[8] There was only one form of Government paper currency in circulation, namely, Queensland Treasury notes. These superseded the issue of bank notes after 1893. Under the Acts of Commonwealth Parliament passed in 1910, the issue of bank notes and Queensland Treasury notes was effectively ended. Banks were prohibited from accepting State government issued notes as money and were taxed at 10 per cent per annum on their own issue.

Thus the composition of note issue differs markedly before and after 1910 and the data sources vary accordingly. The calculations performed to estimate holdings of the public are described in the Appendix.

These data sources enable the money supply to be calculated for the M1 and M2 definitions from 1880 onwards in quarterly form. This series matches that of Friedman and Schwartz in terms of reliability and coverage. An M3 series was also calculated from 1912. Two considerations led us not to use this prior to 1947. First, there are considerable difficulties in making the series consistent pre and post war due to a change in classification of savings deposits after the war. Secondly, our earlier analysis of the demand for bank deposits found savings bank deposits to be a poor substitute for the other components of money in pre-war years. Accordingly M3 is used only for the post-war period in monthly form.

Economic Activity. Following the example of the U.S. studies surveyed above, two different measures of economic activity employed earlier in this study commend themselves for use. One is the measures of national income and expenditures used in chapter 11. Then 'induced' expenditures were employed; now total income is relevant. Annual series from 1880 and

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8 Royal Commission into the Monetary and Banking System, 1936 chapter 2.

quarterly series from 1951 are used. (See section (a) of Table 14.2). The other type of measure is an index of Australian factory production, which was used in chapter 12 as one of a number of cyclical indicators. At that stage the composition of the series was ignored. In fact, no one index exists for Australia and it was necessary to splice and combine four different series to give a consistent coverage of the whole of the post-war period.

These series enable a comparison of the Australian with the U.S. results, but have severe deficiencies insofar as the questions of the analysis are concerned. Industrial production is only one cyclical indicator, and an examination of the post-war years themselves is not sufficient. The income series has the desirable coverage, but has the disadvantage of being in annual form which poses aliasing problems and conceals timing differences. We accordingly seek long run estimates of prices, expenditures, and employment.

Prices. Three measures of prices are used: wholesale prices, consumer (retail) prices, and an implicit G.D.P. deflator. Melbourne *wholesale prices* were first computed in 1912 and are available monthly since that time, enabling the calculation of a quarterly series for comparison with the money supply. An annual series is available for comparison with the money supply series from 1880. The index is similar to that calculated by The Economist and The Statist in the U.K., in that the items included comprise chiefly basic materials which in the form of raw materials, food or as a source of power, enter into production for domestic consumption.

Consumer Prices are available since 1912, on a quarterly basis, by splicing various indices compiled by the Commonwealth Statistician. These are the 'A' series index, 'C' series index, and the Consumer Price Index.

TABLE 14.2
Measures of Economic Activity used in the Study.

Series	Abbreviation	Period covered
(a) Income		
Gross Domestic Product	G.D.P.	1880 - 1969 yearly
"	"	1951 - 1971 quarterly
National Income	N.I.	1880 - 1969 yearly
"	"	1951 - 1971 quarterly
Gross National Expenditure	G.N.E.	1951 - 1971 quarterly
National Turnover	N.T.	"
(b) Prices		
Wholesale Price Index	W.P.I.	1880 - 1969 annual
"	"	1912 - 1969 quarterly
"	"	1947 - 1970 monthly
Consumer Price Index	C.P.I.	1912 - 1969 quarterly
"	"	1946 - 1971 quarterly
G.D.P. Deflator	D.E.F.	1880 - 1969 annual
(c) Expenditures		
Bank Clearings, Sydney and Melbourne	S.M.	1902-1968 quarterly
Bank Clearings, Australia	BCLEAR	1925 - 1968 quarterly
Bank Clearings (SM), deflated by wholesale Prices	SMDEF	1912 - 1968 quarterly
Bank Clearings (BCLEAR), deflated by Wholesale Price	DEFCLEAR	1925 - 1968 quarterly
Bank Debits	DEBITS	1947 - 1970 monthly
(d) Output		
Index of Industrial Production	I.P.	1947 - 1970 monthly
Index of Industrial Production, in value terms	V.P.	1947 - 1970 monthly
(e) Employment		
Employment Rate	E.M.P.	1913 - 1969 quarterly
"	"	1946 - 1970 monthly
Male Vacancies	VACM	"

All have been extensively used by the Conciliation and Arbitration Commission in wage determinations. Finally, an implicit *G.D.P. deflator* is available from annual income series from 1880-1939 and 1948 onwards and is linked together by retail prices. In addition to items drawn from the other indices, it includes mining, construction, government enterprises and services and distribution costs.

Expenditures. Apart from income, the only statistical series which relates to the money value of aggregate expenditures on final product and which is available for a relatively long time period is *bank clearings*. This series has a long history of use in business cycle research in the U.S. and its reliability has been established.

> ".... dating of turning points of aggregate business based on outside clearings series alone was capable of yielding a chronology of business cycle not much different from the one presently established on the basis of thorough study of a much broader body of statistical and other material." (Garvy, 1959)

They were also chosen by Friedman and Schwartz to measure the amplitude of "cyclical movements in general business". Clearings represent the dollar volume of cheques and bills (and in earlier times, coins, notes and certificates) exchanged daily by the members of a local clearing house association. In Australia, records are kept of clearings at Sydney, Melbourne, Brisbane, Adelaide, Perth and Hobart. All payments made by drawing against a cheque account enters into clearings figures unless the cheque is deposited with the drawee bank. Their usefulness is in providing a measure of the value of aggregate payments involving money whether this be of price or volume, whether the transaction be financial or real, whether for final goods or for intermediate payments.

By extracting data from the archives of the Bank's Clearing House in

Sydney,[9] and from the Australasian Insurance and Banking Record for Melbourne, a series of Sydney plus Melbourne clearings was calculated from 1902. A series of total Australian bank clearings was obtained from 1925. Sydney and Melbourne clearings accounted for 77.05 per cent of the total in June 1925 and represented 77.20 per cent of the total in June 1968, a remarkable consistency. Presumably clearings in the major financial centres in Australia are less dominated by purely financial transactions than is the case in the U.S.

The major problem encountered in analyzing the clearings data stems from its manner of recording. Prior to 1925 the data are in weekly form. After 1925 the data are recorded as average weekly values for 'months', where these consisted of four or five weekly periods depending upon the numbers of Wednesdays in the month. Data can be analyzed in this form but it is exceedingly difficult to do so and it was necessary to convert the series into equal time intervals. After 1925 this involved obtaining and using a calendar of the twentieth century to determine the number of weeks in each 'month' and converting the data into totals for specified periods of time. Before 1925 this could be done directly from the weekly data. The series were then converted into standardized quarters, following procedures outlined in Greenwald (1963) and described in the Appendix.

The main deficiency of clearings data is their failure to include cheques deposited for credit and chargeable against other accounts at the same bank, cheques cashed over the counter, and numerous charges to accounts in addition to those arising from the payments mechanism. Consequently they are affected by bank mergers, such as occurred in Australia in the 1920's,

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9 I am indebted to the Bank of N.S.W. for their assistance in doing this.

which internalize bank transactions. While we are not unduly concerned about this, because of our examination of changes rather than levels,[10] the shortcomings of clearings can be avoided completely by using *bank debits*, the value of cheques and charges against trading bank accounts. This series is available since 1945, and is preferred to clearings for the post-war years. Bank debits are also recorded in (unspecified) four or five weekly 'months', and adjustments similar to those with clearings were needed to convert them into standardized monthly form.

Employment. The various studies of post-war reference cycles examined in chapter 12 were unanimous that the most reliable coincident series in Australia are those relating to employment (registered unemployed and vacancies) and it seemed desirable to extend at least one of these series into pre-war years. A series of unemployment statistics exists for Australia based on Trade Union returns, and these are linked with Department of Labour and National Service figures to provide a continuous series quarterly from 1913. The reliability of the earlier data has been examined by Forster (1965). He found it to be biased towards male workers and manufacturing industry. From the view point of our study these biases are not undesirable, as the male series were found to be more sensitive to cyclical influences in

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[10] Mergers would show up as a change in the trend. Suppose that Bank Clearings are composed of a trend and cycle of the form

$$\log y = at + A\cos(wt + \varepsilon)$$

where a is the slope of the trend line (in logarithms). Taking the first derivative we have

$$\frac{d \log y}{dt} = a + wA\cos(wt + \varepsilon + \frac{\pi}{2})$$

which is the percentage rate of change series. Variations in trend thus show up as changes in the average level, a, around which the cycles occur.

post-war years. For a study of monthly data in post-war years, the employment series is supplemented by male vacancies, which is generally recognized to be the most reliable indicator of business conditions.

Estimated Spectra and Autocorrelations

The theoretical basis of spectral analysis depends on the stationarity of the series being considered; but few economic time series are stationary, which necessitates preliminary 'filtering'. In this way the spectral methods described in chapter 13 are applied not to $\{x_t\}$ but to a series $\{x'_t\}$ derived from it by applying a linear filter. Obviously the effect of such a transform modifies the spectrum, but it does so in a known way with desirable consequences. Two objectives are served by the filtering operations: one is to eliminate trends in means or variance from the series $\{x_t\}$ so that $\{x'_t\}$ better satisfies the assumption of stationarity; the other is to reduce the amplitude of components of the spectrum so that the spectrum of $\{x'_t\}$ is more nearly constant than the spectrum of $\{x_t\}$. As we shall see these are quite separate objectives.

Considerable experimentation was involved in determining the 'best' filtering methods for our purposes, and the reasons which prompted our choice is best explained by considering an example. For illustrative purposes we commence with the spectrum of the untransformed money supply, M1, estimated from monthly data over the period 1946 to 1970.[11] There are 300 data points, and 48 lags are used to give an $^n/_m$ ratio of 6.25.

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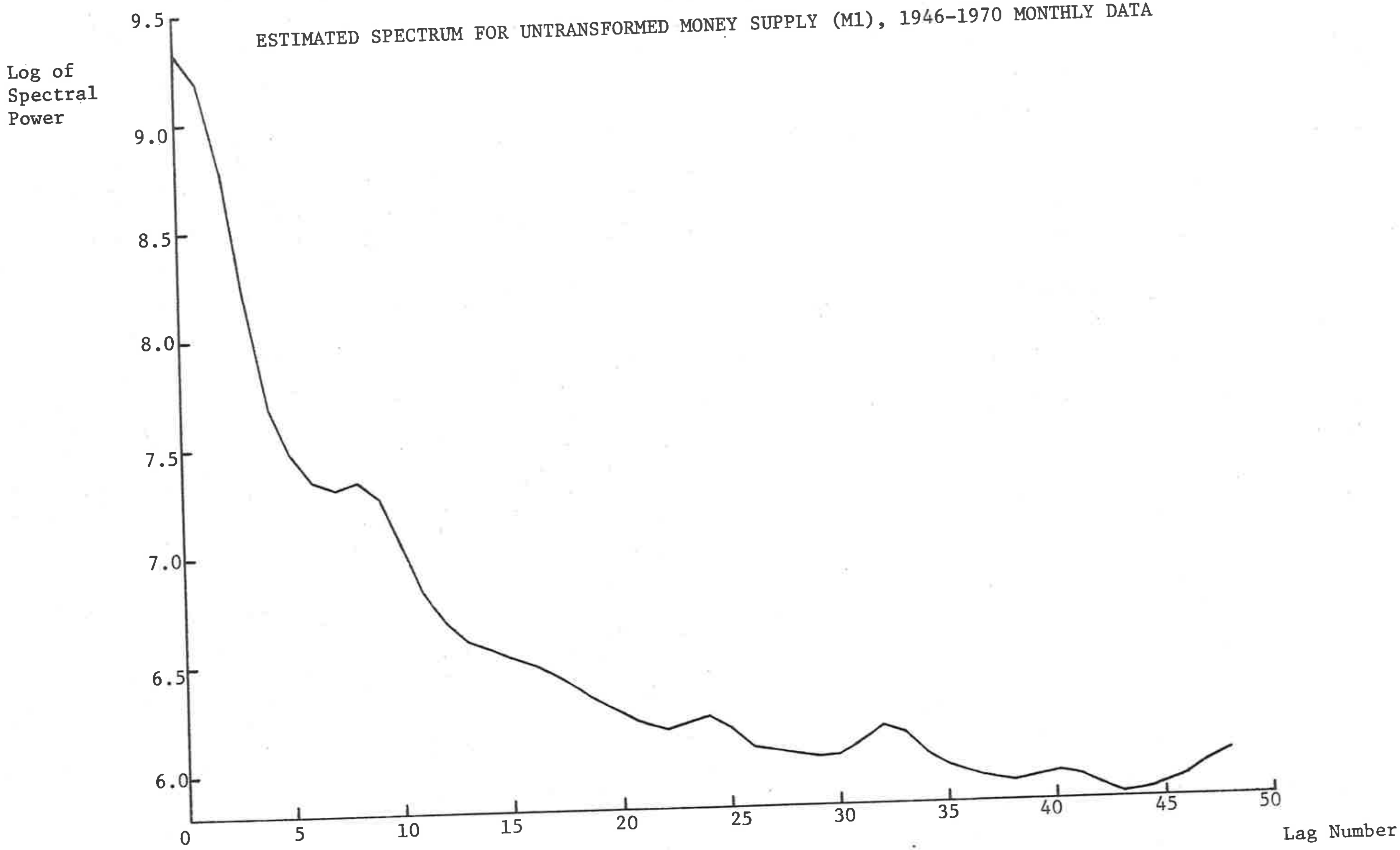
11 The spectral estimates were obtained through the program CROSSPEC originally written by Karreman (1963) and extended by P.D. Praetz at the University of Adelaide. I am much indebted to Dr. Praetz for making his program available to me. As explained in the previous chapter, the Parzen II lag window was used.

FIGURE 14a

ESTIMATED SPECTRUM FOR UNTRANSFORMED MONEY SUPPLY (M1), 1946-1970 MONTHLY DATA



The estimated spectrum is shown in Figure 14a and it pinpoints the problem of the trend in mean (and perhaps also variance). Trends are identifiable as cycles of extremely long length (uncompleted in a finite set of data) and hence of extremely short frequency per month - zero lag or there-abouts. This is clearly evident in the spectral density where the 'power' at zero frequency is 1,200 times that at the frequency of, say, $^1/_{4.8}$ cycles per month. Much of this power is undoubtedly spread to adjacent frequencies and detrending is necessary.

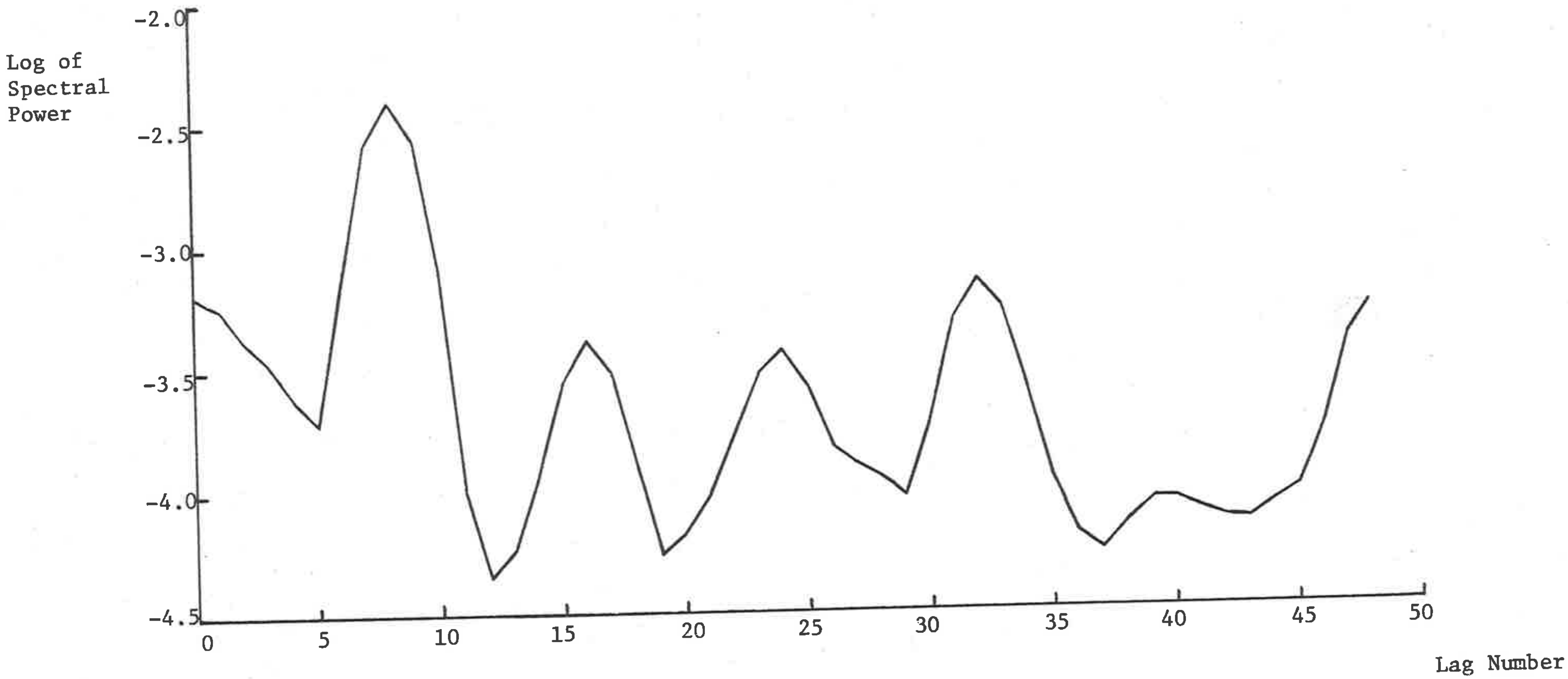
All of the U.S. studies follow Friedman in using the percentage rate of change transformation, and in order to conform with these studies we transform the data as follows:

$$x'_t = ln\ x_t - ln\ x_{t-1}$$

which is equivalent to the transformation employed in the other studies. It is well known that differencing will rarely remove the trend entirely. If the series can be represented by a series of polynomials of order p together with a superimposed random element, only by successive differencing p+1 times will the trend be obliterated and the random component alone be left. Nevertheless the (polynomial) trend component will have less importance in $\{x'_t\}$ than in $\{x_t\}$ (see Kendall, 1971). This is indeed the case in the estimated spectrum shown in Figure 14b. Although the spectrum is dominated by the power contained in the seasonal frequency and its harmonics, the problem of trend has not been eliminated and considerable power still remains at zero frequency. Given that we wish to look at 'major' cycles of 8 years in period which corresponds to lag 1, the possibility of leakage of trend through the window remains. Presumably there is a changing mean value of the logarithmic first differences which it would be desirable to remove

FIGURE 14b

ESTIMATED SPECTRUM FOR LOGARITHMIC FIRST DIFFERENCES OF MONEY SUPPLY (M1), 1946-1970 MONTHLY DATA



by filtering. This is done by applying an equally weighted 36 month and 12 month moving average to the series $\{x'_t\}$, which gives a weighted four year moving average. The logarithmic first differences were then expressed as differences from this moving average. One disadvantage is the loss of data points (47), but as the $^n/_m$ ratio of 5.3 is still well within the recommended range of 6 (maximum) and 3 (minimum) this did not seem to be particularly worrisome.

Figure 14c shows the spectrum after filtering for remaining trend. Power at the zero frequency is now considerably reduced and there is the beginnings of evidence of spectral power in the business cycle frequency bands. With monthly data, these bands correspond to lags 2 to 7 with cycles ranging in period from 14 months to 48 months, though we would also be interested in lag 1 which is centred on cycles with a period of 8 years. However, the frequency bands around lag 8, which contains the seasonal frequency ($^1/_{12}$ c.p.m.), are contaminated by the power of the seasonal cycle and it is necessary, given the possibility of 'leakage through the window', to remove the power from the seasonal and its harmonics. The co-variance function is also relatively uninformative, being dominated by peaks C_{12}, C_{24}, C_{36} with troughs in between.

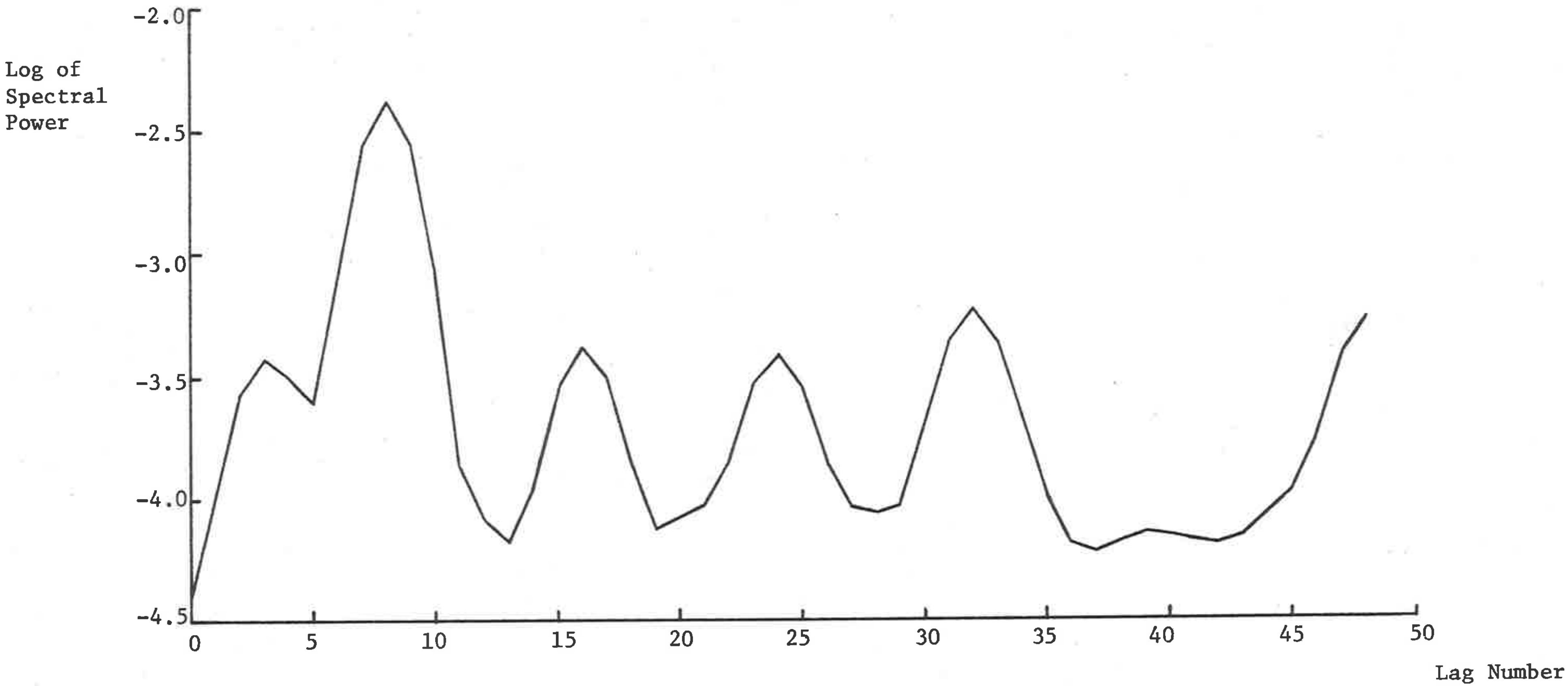
Initially we tried a simple linear seasonal filter of the type used by Praetz (1973), viz

$$\sum_{j=-\infty}^{\infty} a_j \, x_{t-j}, \qquad a_j = a_{-j}$$

where
$$a_0 = -a,$$
$$a_{12} = +.3a,$$
$$a_{24} = +.2a,$$
$$a_j = 0 \text{ for } j \neq 0, \pm 12, \pm 24.$$

FIGURE 14c

ESTIMATED SPECTRUM FOR FILTERED LOGARITHMIC FIRST DIFFERENCES OF MONEY SUPPLY (M1), 1946-1970 MONTHLY DATA



This gives a weighted moving average 2 years on either side of the seasonal component. The spectrum is shown in Figure 14d. Although much of the power of the seasonal has been removed, much remains and an alternative form of seasonal filtering is tried.

The alternative is the U.S. Bureau of Census method X-11, used in Chapter 12. This is a controversial decision and some explanation is clearly warranted. The Bureau of Census methods acquired a bad reputation among spectral analysts for two reasons: one theoretical, the other practical. As to the theoretical, a linear filter of the type used above has an effect upon the gain and phase of the series which can be determined from the frequency response function.[12] The Bureau of Census procedures, in contrast, involve the use of non-linear filters and the precise effects upon the spectrum is unknown. It is not a technique which appeals to the purist. But the relevant question is whether, unlike the linear filter considered earlier, it works. Nerlove (1964) studied the effects of the X-9 method and found that it worked too well and there was consistent evidence of over-seasonal adjustment with dips at the seasonal frequencies and reductions in power at other frequencies. Rosenblatt (1968) has since shown that the substantially revised X-11 variant which we use is largely free of these criticisms. Moreover, he shows that a loss of power at frequencies other than the seasonal is to be expected when the seasonal component changes markedly over time. Nerlove now accepts (Grether and Nerlove, 1970) that his criteria were naive, and concludes with this somewhat churlish comment:

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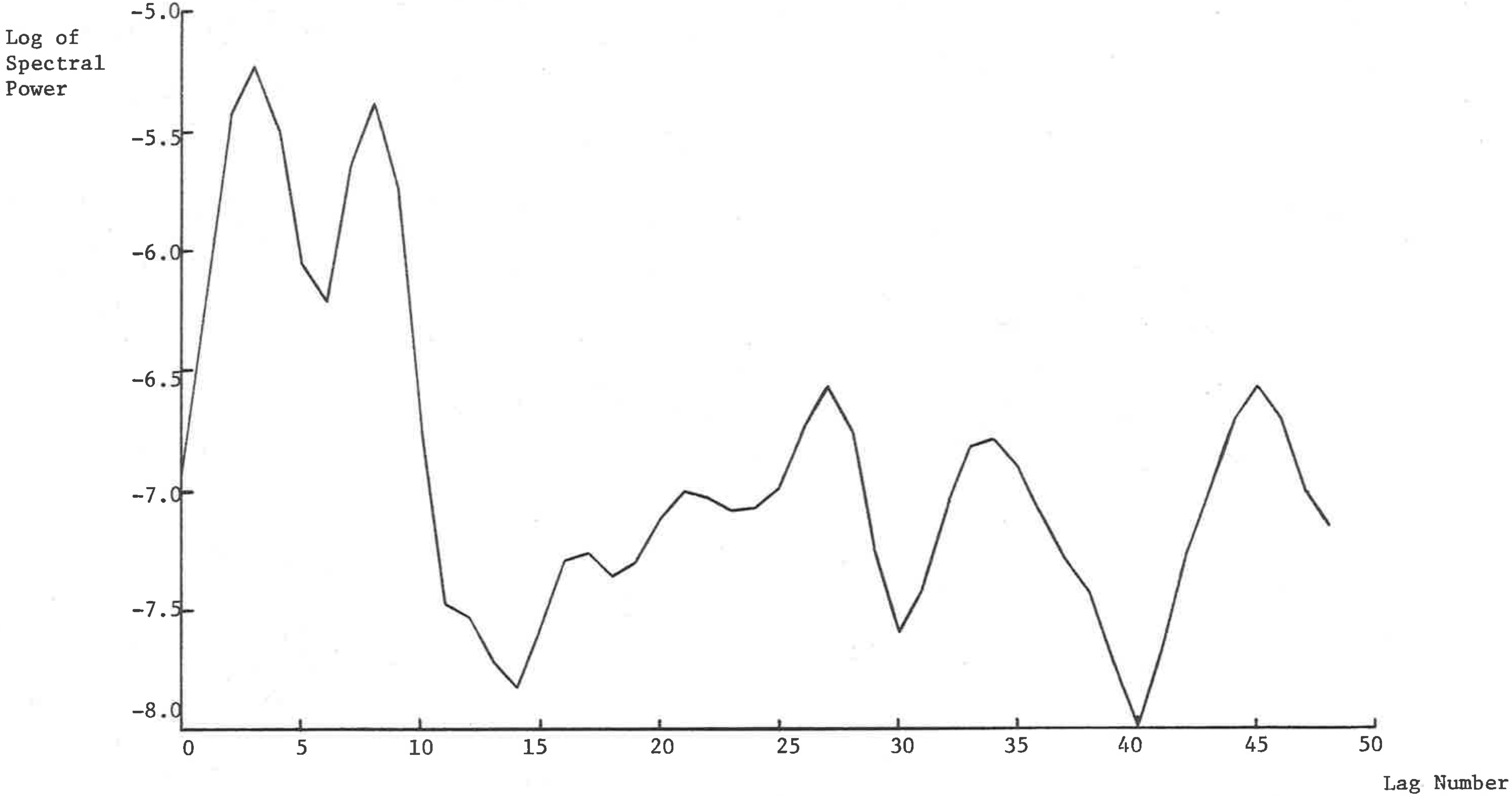
12 The analysis of chapter 12 when we considered the frequency response function of a distributed lag system, which corresponds to a low pass filter, can be recalled.

FIGURE 14d

ESTIMATED SPECTRUM FOR FILTERED LOGARITHMIC FIRST DIFFERENCES OF MONEY SUPPLY (M1), ADJUSTED FOR CONSTANT SEASONAL, 1946-1970 MONTHLY DATA



> "To the extent that the B.L.S. and Census Methods of adjustment have succeeded in matching the characteristics of these 'optimal' procedures .... they represent a truly remarkable achievement of trial and error. The achievement is especially noteworthy in that it is based on no formal model and little analysis of the nature of seasonality."

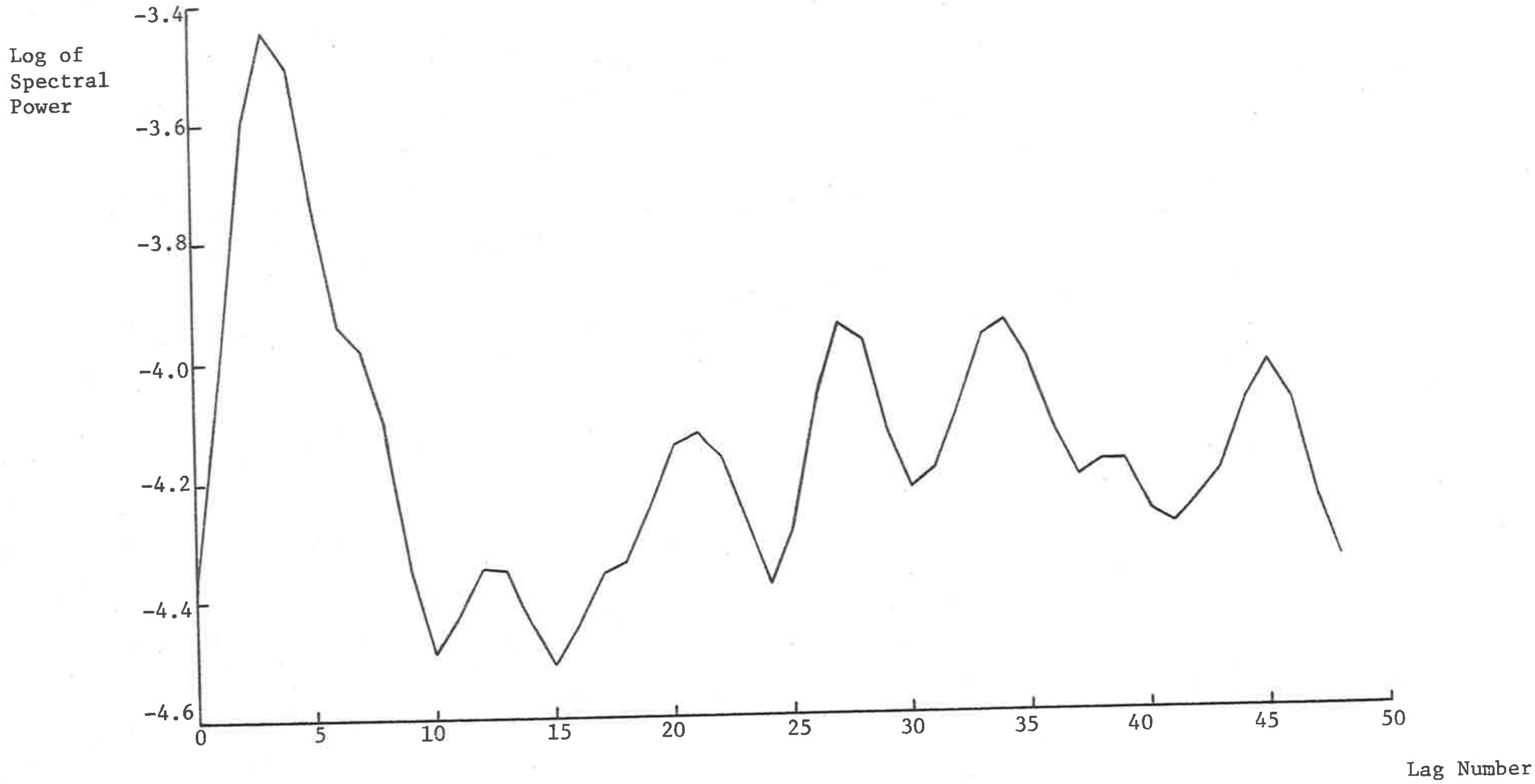
Although Nerlove's qualified acceptance falls far short of an endorsement, it would seem that the X-11 method can be used with care. We first seasonally adjusted the original M1 series, then applied the logarithmic transformation to reduce the variance of the series, took first differences and applied the moving average filter to reduce trend. The result is shown in Figure 14e. At the seasonal frequency, lag 8, there is no evidence of a dip, though there is a slight dip at the 6 month harmonic at lag 16. Overall there appears to be no pronounced over-adjustment for seasonality. At the same time, the spectrum is more nearly constant than was the case prior to filtering for trend and seasonal. A marked concentration of power occurs around the frequency $^{1}/_{32}$ c.p.m., and 25 per cent of the variability of the money supply occurs in this and the two adjacent frequency bands. In addition, considerable power exists in all the cyclical frequencies ($^{1}/_{96}$ to $^{1}/_{13.7}$ c.p.m.) and 40 per cent of the variance of the series is contributed by lags 1 to 7. This pattern is to be expected when the 'business cycle' is irregular in period.

Based upon this investigation, the following preliminary filtering procedures were decided upon.

(i) All data which indicated seasonal variability were adjusted by the X-11 program. This has the advantage of treating series on equal terms. As noted previously, one of the series (the Index of Industrial Production) is only available in seasonally adjusted form in certain periods. Furthermore, the Wholesale Price Index had to be spliced together from seasonally adjusted components.

FIGURE 14e

ESTIMATED SPECTRUM FOR FILTERED LOGARITHMIC FIRST DIFFERENCES OF SEASONALLY ADJUSTED MONEY SUPPLY (M1), 1946-1970 MONTHLY DATA



(ii) The data were then transformed by taking logarithmic first differences.

(iii) Where the spectra indicated that considerable power remained in the spectral density at zero frequency, the series were filtered by moving averages. For the monthly series this is a weighted four year moving average. For the quarterly data, weighted moving averages of five years were employed.

Table 14.3 summarizes features of the results of applying these procedures and estimating the spectrum for each of the series employed in this chapter. An asterisk by the number of data points indicates that the logarithmic first differences have been filtered for trend in mean. In addition, the location of peaks in the auto-correlation coefficients is recorded.

So far we have examined the spectra to ensure that the cyclical components which are the focus of our study are not contaminated by leakage from the zero and seasonal frequencies. An analysis of the spectra of the various series can serve other important objectives and we now look at three of them.

The first is to study the features of cyclical fluctuations in Australia as revealed by the spectra of the chosen measures of economic activity. If we look first at the quarterly series which cover the past 50 or 60 years, a relatively clear picture emerges of a business cycle with a period of 3-4 years. A further peak in the spectra occurs in the frequency bands between $^{1}/_{24}$ and $^{1}/_{12}$ c.p.month. Whether the power in these frequency bands is evidence of a Mack-style sub-cycle, or an 'echo' down the spectrum from the cycle is not clear. When the annual and monthly spectra are examined, the existence of a reasonably regular cycle of about 40 months in length is less obvious. With the annual data most power exists in major

TABLE 14.3

Features of Spectra of Money and Measures of Economic Activity

Series	Data sample	Data points after filtering	No. of lags	$^n/_m$	Location of peaks in spectrum	Percent of variance explained by: Peak band and 2 adjacent frequency bands	All business cycle frequencies	Peak in auto-correlation coefficients
Money Supply - M1	1880 - 1970 quarterly	340*	60	5.7	(i) 40 months (ii) 17 months	27.1 7.2	92.1	36 months
" - M2	"	"	"	"	(i) 36 months (ii) 18 months	26.5 5.7	92.5	36 months
Bank Clearings - SM	1902-1968 quarterly	243*	48	5.1	(i) 41.1 months (ii) 18 months	9.7 10.1	42.4	39 months
" - BCLEAR	1925 - 1968 quarterly	172	32	5.4	(i) 38.4 months (ii) 17.4 months	16.8 11.0	46.2	39 months
Deflated Clearings - SMDEF	1912 - 1968 quarterly	207*	40	5.2	(i) 40 months (ii) 17.1 months	10.9 8.4	43.9	-
Consumer Prices - C.P.I.	1912 - 1969 quarterly	211*	40	5.3	(i) 48 months (ii) 18.6 months	35.4 7.1	77.4	57 months
Wholesale Prices - W.P.I.	1912 - 1969 quarterly	211*	40	5.3	34.2 months	26.8	74.8	60 months
Employment Percentage - E.M.P.	1913 - 1969 quarterly	207*	40	5.2	(i) 40 months (ii) 22 months	22.9 8.7	57.7	45 months
Gross Domestic Product - G.D.P.	1880/1 - 168/9 annual	89	20	4.5	(i) 96 months (ii) 48 months	32.0 15.6	not available	96 months
National Income - N.I.	"	"	"	"	(i) 96 months (ii) 48 months (iii) 32 months	29.4 14.8 16.7	"	96 months
G.D.P. Deflator - D.E.F.	"	"	"	"	(i) 96 months (ii) 53 months (iii) 32 months	29.7 13.1 18.8	"	96 months
Wholesale Prices - W.P.I.	"	"	"	"	(i) 60 months (ii) 30 months	26.8 24.4	"	60 months
Gross Domestic Product - G.D.P.	1951 - 1971 quarterly	84	16	5.3	24 months	24.7	46.0	21 months
National Turnover - N.T.	"	"	"	"	32 months	34.5	61.8	-
Gross National Expenditure - G.N.E.	"	"	"	"	24 months	37.8	66.0	27 months
Consumer Price Index - C.P.I.	1946 - 1971 quarterly	104	20	5.2	-	-	62.5	-
Money Supply - M1	1947 - 1970 monthly	240*	48	5.0	32 months	24.9	38.0	28 months and 32 months
- M2	"	"	"	"	32 months	28.6	41.9	28 months and 32 months
- M3	"	"	"	"	32 months	28.6	42.5	28, 33 and 39 months
Male Vacancies - Vacm	1947 - 1970 monthly	240*	48	5.0	32 months	37.4	58.7	27 and 41 months
Employment Rate - Emp	"	"	"	"	32 months	22.9	37.8	37 and 41 months
Industrial Production - I.P.	"	"	"	"	19.2 months	5.3	9.2	28, 32, 37 and 45 months
" - V.P.	"	"	"	"	24 months	5.9	9.7	25,28, 45 months
Bank Debits - DEBITS	"	"	"	"	32 months	14.6	25.7	33, 40, 42 months
Wholesale Prices - W.P.I.	"	"	"	"	(i) 32 months (ii) 16 months	5.7 5.5	12.5	16, 31, 45 months

cycles of 8 years in period. It may be that annual data, with which the aliasing problem is the most acute, is inappropriate for the study of a business cycle of around 3-4 years periodicity. In the post-war years, the employment series has a spectral peak in the frequency band $^1/_{32}$ c.p.m., but industrial production, gross national expenditure, gross domestic product and the consumer price index have peaks, if at all, at higher frequencies. In the two latter cases, no cyclical pattern at all is discernable from the auto-correlation diagram (correlogram). Nevertheless significant power remains in the whole range of cyclical frequencies.

A second objective of examining the spectra is from the viewpoint of time domain analysis. It is not surprising that the series male vacancies is such a good indicator of the Australian business cycle. After filtering, nearly 60 per cent of its variance is contained in lags 1-7 and nearly 40 per cent in lags 2-4 which cover the frequencies $^1/_{48}$ - $^1/_{24}$ c.p.m. By contrast, industrial production, bank debits and wholesale prices even after the filtering away of trend and seasonal have most power in high frequency movements - they contain considerable noise. Even if a relationship exists with the money supply or other series at the cyclical frequencies, this might be concealed and timing comparisons distorted by the large random component. The series might be usefully analyzed only by the decomposition techniques involved in spectral analysis.

Thirdly, we examine the spectra to determine whether the preconditions exist for a monetary explanation of the business cycle. Bennett and Barth found that they did not exist for the U.S. in post-war cycles.

> ".... an important question is whether there is any systematic behaviour, cyclical or otherwise, in the monetary variable after the removal of trend and seasonality. Although Friedman and Schwartz were able to identify periods of increase (decreases) in their seasonally adjusted and trend adjusted money stock which

> correspond to peaks (troughs) of cycles in business activity, no regular fluctuations of this type can be found. In short, the estimated spectrum fails to produce any indication of 'clearly marked cyclical fluctuations corresponding to reference cycles' in the monetary variable, contrary to the Friedman and Schwartz contention. The step peaks and step troughs they fit to approximate cyclical movements may have been only a manifestation of the errors of measurement and serial correlation .... is a 'monetary theory of business cycles' viable if there are no significant cyclical fluctuations in the money stock when there are cycles in other variables that are measures of business activity?"

This is not a problem in Australia for the money stock series exhibit pronounced cyclical fluctuations and considerable power is manifested over all the frequency bands which encompass the conventional business cycle type oscillations. In this sense, the preconditions exist for the money supply to contribute to the explanation of the business cycle, and it would seem to be worthwhile proceeding with the analysis and investigating the inter-relationship of money with business activity.

Inter-relationship Between the Monetary Series

We commence by examining the inter-relationship between the three definitions of the money supply. Cross-spectral statistics obtained by crossing these series are summarized in Table 14.4 which records the coherence and phase over cyclical frequency bands (greater than $^1/_{96}$ c.p.m. and less than $^1/_{12}$ c.p.m.). In the post-war data sample, the coherence (squared) is close to unity, indicating that the processes governing the determination of M1, M2 and M3 are quite similar. This is not to say that it makes no difference which of the series is used, for the timing of the underlying processes may differ. Any such differences in timing appear to be minimal, and the series differ in timing by less than half of a month. (A + sign means that series 1 leads series 2, a - sign the reverse.)

When data from the pre-war sample are included the inter-relationship

Table 14.4

Cross-Spectral Statistics for Monetary Series
at Cyclical Frequencies.

Period and data used	Series 1	Series 2	Max. (and Average) Coherence	Phase (Tau) in months
1946-1970 monthly	M1	M2	.93 (.91)	-.035
	M1	M3	.96 (.91)	+.388
	M2	M3	.97 (.96)	+.372
1902-1939 quarterly	M1	M2	.85 (.78)	+.282
1913-1939 quarterly	M1	M2	.80 (.77)	+.382
1902-1968 quarterly	M1	M2	.86 (.80)	+.354
1880-1969 yearly	M1	M2	.85 (.70)	+.196
1880-1970 quarterly	M1	M2	.85 (.64)	+.302

is less close but still very high, with coherence of around .80. Again the phasing differences appear to be minimal. It would seem that the processes governing the joint co-variation of the two series have not changed markedly over time, even if the processes governing both have.

In the last two results shown in the Table we cross M1 and M2 over the same time period, but in one case we use annual data and in the other case we employ quarterly data. As might be expected the average coherence is slightly lower with the quarterly data because more high frequency variations are included. What is of interest is that the estimate of the phase difference differs by only .1 of a month. This suggests that perhaps more weight can be given to the phase statistics from annual data than we originally thought might be the case. Certainly this result needs to be borne in mind when the inter-relationships between money and measures of economic activity are considered.

Inter-relationships Between Money and Business

Altogether 52 series pairs are crossed, and this large number precludes an extended discussion of each pair. It was decided instead to provide a summary of each pair examined in tabular form, and supplement this by selecting several of the more significant results for an extended discussion. Then an overall summary is given.

In constructing the tabular summary, the first consideration is the range of frequencies to be studied to cover the N.B.E.R. style reference cycles. Some guidance comes from the spectra of the individual series. While many exhibit peaks at wavelengths of around 40 months, most have considerable power over the whole range of frequencies with periods ranging from 1½ - 8 years. This is to be expected if the cyclical fluctuations are not strongly regular in period and it suggests that, rather than pay attention to a particular frequency band, all frequencies lower than the seasonal (1 cycle per year) and higher than the trend (say $^1/_{10}$ or $^1/_8$ cycles per year, depending upon the number of lags used) merit examination.

In Table 14.5 we record first the maximum coherence in the cyclical frequencies along with the simple average of the coherencies over all the frequency bands lower than the seasonal and higher than the trend or long swings. Coherency is analogous to the coefficient of determination on the time domain, and critical values for the null hypothesis of zero coherency are provided in Table 13.1. Given the quality of economic data which one typically has to employ in time series analysis, there is something to be said for considering as well the robustness of the association for different time periods and for the various measures employed.

Secondly, we record the results of fitting the following three models (explained in the previous chapter) to the phase diagram:

(i) $\phi(w) = a + bw$

(ii) $\phi(w) = a$

(iii) $\phi(w) = bw$.

These models are fitted to lags 2 to MM-1 of the phase diagram, where MM indicates the lag containing the seasonal, by means of a coherence weighted regression analysis. Values of a and b in model (i) are determined iteratively. The significance of model (i) is judged by the F statistic (at the 1 percent level). Phases of the form a and bw are judged to see if they provide a better fit by 't' statistics (at one percent level). Where it seems clear that none of these models summarize the phase relationship satisfactorily, we record the phase angle (in degrees of a circle) over the

TABLE 14.5

Summary of Cross-Spectral and Cross-Correlation analysis between Measures of Business Activity and Money

Measure of business activity	Money	Nature of data	Summary of cross-spectral statistics at cyclical frequencies		Cyclical frequencies where money leads business		Cross-correlation analysis
			Maximum (and average) coherence	Summary of Phase diagram	Period of cycles	Maximum Phase shift in months	
Bank Clearings (SM)	M1	1902-1968 quarterly	.435 (.330)	Fixed time *lag* over frequencies 1/144 cpm -1/32 cpm of 1.7 months (t = 7.0). Clearings *lead* at higher frequencies	2.6 - 11 years	2 months	Coincident
"	M2	"	.482 (.36)	Combined model. Fixed angle *lead* of 19.8° and fixed time *lag* of 3.7 months (F=7.92)	2.8 - 8 years	3.4 months	Coincident
Bank Clearings (BCLEAR)	M1	1925-1968 quarterly	.565 (.36)	No model appropriate. At band of maximum coherence (1/40 cpm), clearings *lag* by 15°. For cycles of around 18 months in period, clearings *lead* money.	2.3 - 7.5 years	2.3 months	Coincident
Bank Clearings (BCLEAR)	M2	1925-1968 quarterly	.590 (.33)	Fixed time *lead* of 1.1 months (t = 3.07).	3.5 - 7 years	2.3 months	Mixed. Peaks with clearings leading by one quarter and also lagging by one quarter.
Bank Clearings (SM)	M1	1902-1939 quarterly	.451 (.21)	Combined model. Fixed angle *lag* of 28°, and fixed time *lead* of 3 months (F = 22.00).	2.8 years and longer.	3.6 months	Coincident
"	M2	"	.510 (.26)	Combined model. Fixed angle *lag* of 46°, and fixed time *lead* of 4.7 months (F=18.37).	2.7 years and longer.	5.5 months	Coincident
Deflated Clearings	M1	1912-1968 quarterly	.252 (.16)	Combined model. Fixed angle *lag* of 42° and fixed time *lead* of 3.4 months (F=14.96).	2.4 - 8 years	6.2 months	Coincident
"	M2	"	.262 (.12)	No clear pattern emerges. Clearings lead at low frequencies (> 6 years) high frequencies (< 1.5 years) but lags in 'middle' frequencies.	1.5 - 5.5 years	5.7 months	Clearings lag by one quarter.
Wholesale Prices	M1	1912-1969 quarterly	.312 (.19)	Combined model. Fixed angle *lead* of 14° and a fixed time *lag* of 2.7 months (F=143.1).	3 - 8 years	2.5 months	Coincident

TABLE 14.5 (continued)

Wholesale Prices	M2	1912-1969 quarterly	.201 (.11)	No model appropriate. At the maximum coherence frequency, prices *lag* by 18°.	3.2 - 10 years	5.9 months	Coincident
Consumer Prices	M1	"	.510 (.18)	Fixed angle *lag* of 48.50° (t = 12.35). At maximum coherence ($^1/_{22}$ cpm), prices *lag* by 65.7°.	1.5 years and longer	11.36 months	Prices lag by two quarters.
"	M2	"	.378 (.13)	Fixed angle *lag* of 65.34° (t = 22.82). At maximum coherence ($^1/_{22}$ cpm), prices *lag* by 69.9°.	all frequencies > 12 months	16.8 months	Prices lag, with peaks at 2, 4 and 7 quarters.
Employment Rate	M1	1913-1969 quarterly	.221 (.16)	No model appropriate. At the frequency of maximum coherence ($^1/_{34.2}$ cpm) employment *lags* by 60.7°.	2.3 - 5.5 years	7.11 months	Peaks when employment is coincident and lagging by 2 quarters.
"	M2	"	.147 (.08)	Fixed angle *lag* of 21.8° (t = 6.21).	1.25-5.5 years	8.11 months	Employment lags by 3 quarters.
Gross Domestic Production	M1	1880-1969 yearly	.558 (.26)	Combined model. Fixed angle *lag* of 18.8° and fixed time *lead* of 4.1 months (F=2.43, not significant).	2.9-5.5 years	8 months	Coincident
"	M2	"	.325 (.31)	No model appropriate. At the 4 year frequency band, income *lags* by 78.0°.	3 - 5 years	10.4 months	Coicident
National Income	M1	1880-1969 yearly	.420 (.28)	Combined model. Fixed angle *lag* of 21.8° and fixed time *lead* of 4.0 months (F = 2.57, not significant)	3 - 5.5 years	8.5 months	Coincident
"	M2	"	.423 (.33)	No overall pattern clear. At the frequencies $^1/_{36}$ - $^1/_{54}$ cpm, income *lags* by 76.8°.	3 - 5 years	11.5 months	Coincident
G.D.P. Deflator	M1	"	.391 (.28)	Combined model. A fixed angle *lead* of 7.2° and a fixed time *lag* of 5.3 months (F=264.5).	2.8 years and longer	5.4 months	Coicident
"	M2	1880-1969 annual	.470 (.30)	No clear pattern emerges. At the frequency band of maximum coherence ($^1/_{48}$ cpm), prices *lag* by 39.2°.	3.3-7.5 years	8 months	Coincident
Wholesale Prices	M1	"	.363 (.25)	Combined model. A fixed angle *lead* of 31.8° and a fixed time *lag* of 10.7 months (F = 14.85).	2.7-7.7 years	12.7 months	Prices lag by one year.
"	M2	"	.379 (.25)	Combined model. A fixed angle *lead* of 47.8° and a fixed time *lag* of 10.9 months (F = 14.38).	2.6-7.3 years	12.5 months	Coincident

TABLE 14.5 (continued)

Gross Domestic Product	M1	1951-1971 quarterly	.518 (.38)	Combined model. A fixed angle *lead* of 17° and a fixed time *lag* of 1.3 months (F=28.71).	1 - 8 years	1.3 months	Coincident
"	M2	"	.315 (.17)	Fixed angle *lag* of 32.3° (*t* = 6.23).	1 - 2.7 years	2.4 months	Coincident,or lag of one quarter.
"	M3	"	.321 (.24)	Combined model. A fixed angle *lead* of 46.5° and a fixed time *lag* of 3.9 months (F = 46.40).	1 - 2.5 years	2.3 months	Coicident, or lag of one quarter.
National Turnover	M1	"	.741 (.56)	Fixed angle *lag* of 37.2° (*t* = 14.0).	all frequencies	6.2 months	Turnover lags by one quarter.
"	M2	"	.682 (.48)	Fixed angle *lag* of 44.01° (*t* = 19.99).	1.14 years and longer.	7.1 months	Turnover lags by two quarters.
"	M3	"	.708 (.51)	Fixed angle *lag* of 40.25° (*t* = 8.02).	all frequencies	5.8 months	Turnover lags by two quarters.
Gross National Expenditure	M1	"	.811 (.55)	Fixed angle *lag* of 56.32° (*t* = 24.84).	all frequencies	7.2 months	Income lags by one quarter.
"	M2	"	.842 (.59)	Fixed angle *lag* of 64.15° (*t* = 40.4).	all frequencies	8.5 months	Income lags by between 1 & 2 quarters.
"	M3	"	.823 (.61)	Fixed angle *lag* of 59.61° (*t* = 5.90).	1.3 years and longer.	7.3 months	Income lags by one quarter.
Consumer Prices	M1	1946-1971 quarterly	.407 (.22)	Fixed angle *lag* of 75.84° and a fixed time *lag* of 2.22 months (F = 75.11).	1 year and longer.	10.7 months	Prices lag by four quarters.
"	M2	"	.390 (.20)	Fixed angle *lag* of 97.44° (*t* = 12.34).	1.4 years and longer.	12.6 months	Prices lag by four quarters.
"	M3	"	.353 (.18)	Fixed angle *lag* of 79.22° (*t* = 8.63).	1.4 years and longer.	12.1 months	Prices lag by four quarters.
Debits	M1	1947-1970 monthly	.832 (.67)	Combined model. A fixed angle *lag* of 22.14° and a fixed time *lead* of 1.72 months (F=15.77).	2 years and longer.	2.04 months	Coincident
"	M2	"	.747 (.56)	Combined model. A fixed angle *lag* of 29.95° and a fixed time *lead* of 2.13 months (F = 10.62).	2 years and longer.	2.6 months	Coincident
"	M3	"	.817 (.58)	Combined model. A fixed angle *lag* of 21.85° and a fixed time *lead* of 2.01 months (F = 11.56).	2 years and longer.	1.19 months	Coicident
Industrial Production	M1	"	.691 (.38)	Combined model. A fixed angle *lead* of 6.83° and a fixed time *lag* of 1.93 months (F = 174.1).	1 - 6 years	1.6 months	Production lags by one and three months.

TABLE 14.5 (continued)

Industrial Production	M2	1947-1970 monthly	.706 (.37)	A fixed angle *lag* of 2.65° and a fixed time *lag* of 1.54 months (F = 215.70).	1 year and longer.	1.9 months	Production lags by three months
"	M3	"	.733 (.42)	Combined model. A fixed angle *lead* of 12.89° and a fixed time *lag* of 2.32 months (F = 596.30).	1 - 6 years.	2.2 months	Production lags by three months
Value of Production	M1	"	.688 (.42)	A fixed time *lag* of 2.17 months (t = 27.20).	all frequencies	3.9 months	Production lags by three months.
"	M2	"	.606 (.37)	A fixed time *lag* of 2.45 months (t = 12.69).	all frequencies	3.5 months	Production lags by three months.
"	M3	"	.670 (.46)	A fixed time *lag* of 2.03 months (t = 40.68).	all frequencies	2.3 months	Production lags by three months.
Male Vacancies	M1	"	.841 (.58)	A fixed angle *lag* of 44.2° (t = 9.44).	1 year and longer.	4.4 months	Vacancies lags with peaks at 3 and 5 months.
"	M2	"	.824 (.59)	A fixed angle *lag* of 50.3° (t = 9.63).	1 year and longer.	5.2 months	Lags at 3 and 5 months.
"	M3	"	.816 (.60)	A fixed angle *lag* of 45.3° (t = 6.39).	1 year and longer.	4.3 months	Lags at 3 months.
Employment Rate	M1	"	.643 (.58)	A fixed angle *lag* of 40.3° (t = 6.22).	1 year and longer.	3.4 months	Lag of 3 months.
Employment Rate	M2	1947-1970 monthly	.572 (.49)	Fixed angle *lag* of 49.7° (t = 8.06).	1 year and longer.	4.1 months	Lag of 3 months.
"	M3	"	.617 (.52)	Fixed time *lag* of 3.49 months (t=9.65).	1 year and longer.	3.5 months	Lag of 3 months.
Wholesale Prices	M1	"	.469 (.32)	Fixed angle *lag* of 73.5° (t = 34.7).	all frequencies	8.2 months	Lag of 5 months.
"	M2	"	.374 (.23)	Fixed angle *lag* of 78.4° (t = 72.8).	"	11.8 months	Lag of 5 months.
"	M3	"	.313 (.24)	Fixed angle *lag* of 65.2° (t = 65.3).	"	9.4 months	Lag of 5 months.

frequency band of highest coherence. In all cases, a 'lag' means that business activity lags money.

Thirdly, since the hypothesis under examination is Friedman's contention that money leads business activity (that there is a lag in the effect of money) we record those frequencies for which a lead of money over business is evidenced, along with the maximum phase displacement expressed in months. The latter is the Tau statistic, described in chapter 13.

Finally, in order to assist further with determining the direction of the lead-lag relationship we report the lead or lag as revealed by the maximum value of the sample cross-correlation coefficient between the series, after all the filtering operations are performed. These correlation statistics also serve as a basis for a comparison of the time domain and frequency domain analysis.

Bank Clearings. Figure 14f and 14g show the coherence and phase shift (Tau, in months) between Sydney and Melbourne Clearings and the two definitions of the money stock, M1 and M2 respectively. Both exhibit a similar pattern, in which a marked difference is evident between high, middle and low frequencies. Clearings lead money for cycles of around 1½ years in period, lag money for business cycles, and there is a tendency for clearings to lead again for very long ('major'?) cycles. At the frequency band corresponding to cycles of 56 months in duration, the coherence is .43 (M1) and .48 (M2), and with an $^{n}/_{m}$ ratio of 5.1 both are significant at the 5 per cent level. Clearings lag M2 by 22°, but from Table 13.2 this phase angle does not differ significantly from zero. Our models suggest that a fixed time lag of 1.7 months best describes the clearings - M1 relationship. For M2, a fixed angle lead and fixed time lag is the more appropriate over the frequencies $^{1}/_{48}$ - $^{1}/_{12}$ cycles per quarter. This model

FIGURE 14f

COHERENCE AND PHASE SHIFT, BANK CLEARINGS (SM) AND M1, 1902-1968 QUARTERLY DATA

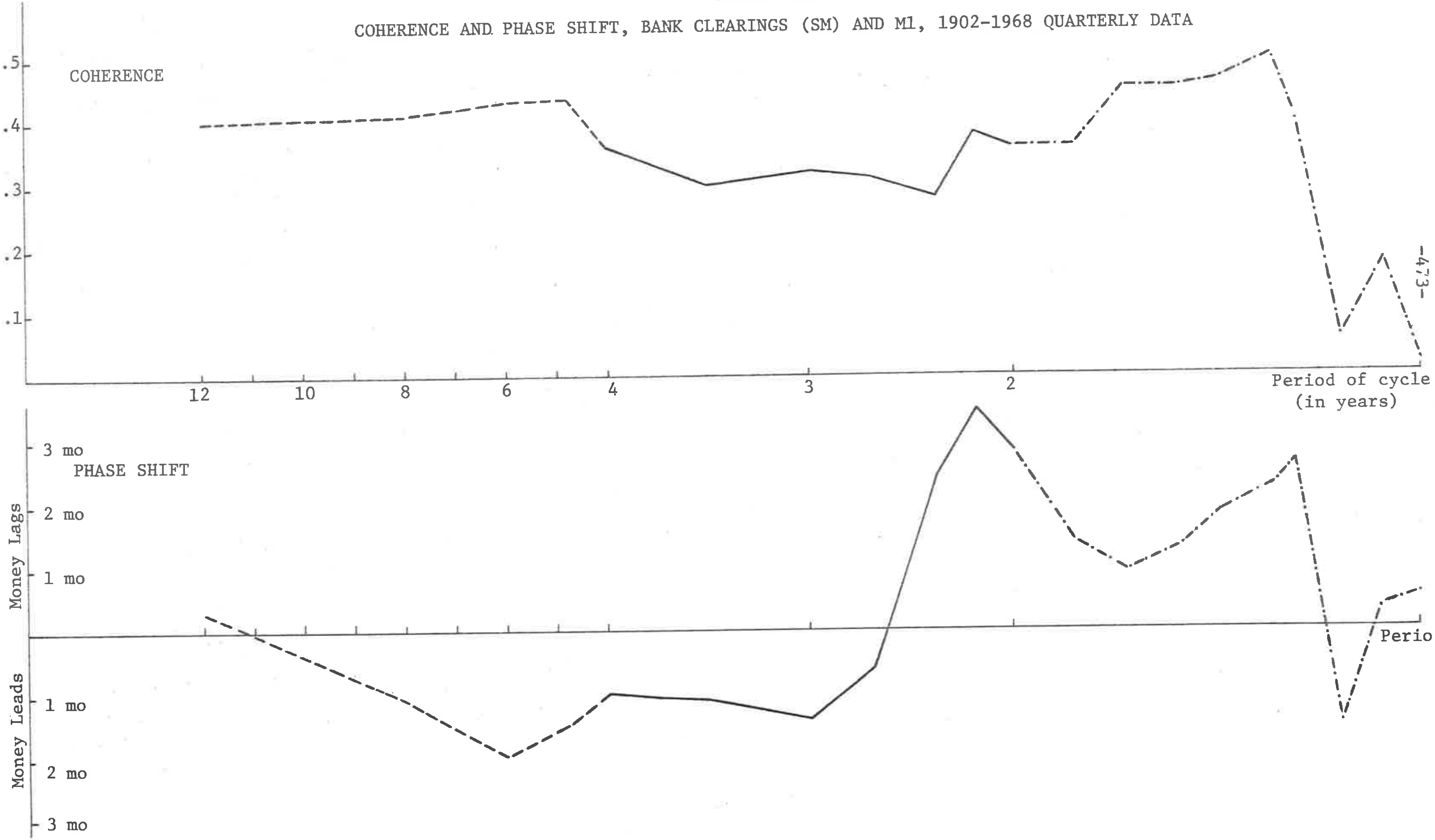
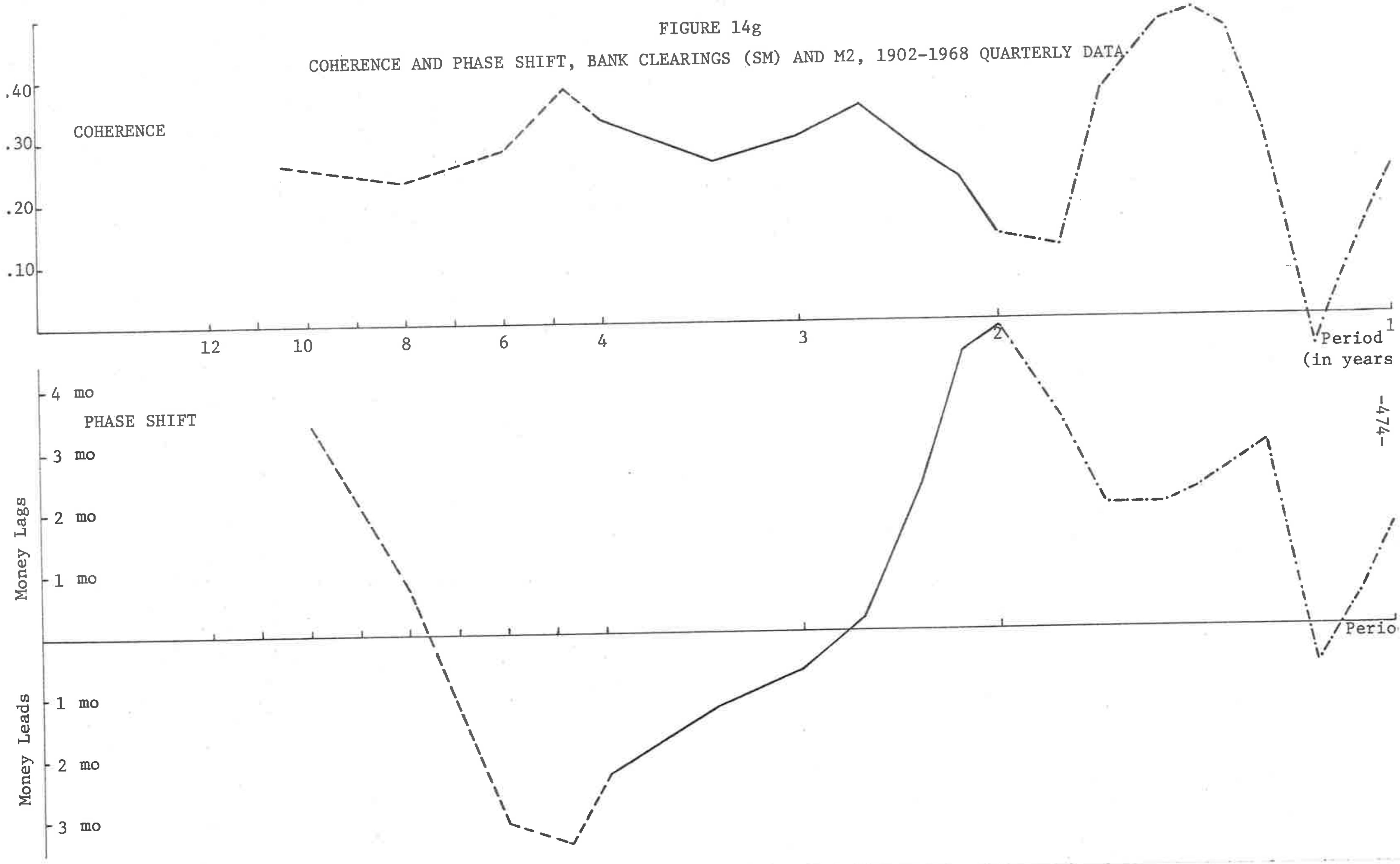


FIGURE 14g

COHERENCE AND PHASE SHIFT, BANK CLEARINGS (SM) AND M2, 1902-1968 QUARTERLY DATA



indicates the tendency for the lead-lag relationship to change between low and middle cyclical frequencies. The time lag is 3.7 months. With the cross-correlation analysis all frequencies are combined and the cross-correlogram is relatively uninformative.

Much the same pattern is revealed when Australian Clearings are used as the reference series, although the coherency is notably higher. When Bank Clearings, deflated by Wholesale Prices, are the reference series the coherence is lower but the length of the lag is longer. The relationship between clearings and money in the pre-war years 1902-1939 is of considerable interest for comparison with later results for the post-war data sample, and the M2 results are shown in Figure 14h. Because of the shortness of the period, little resolution is given to long cycles, but the phase difference between short-run and middle frequencies is again evident. At the frequency $^1/_{24}$ cycles per quarter, the coherency is .48 and Clearings lag money by 28°. With an $^n/_m$ ratio of 6.3, both are significantly different from zero at the 5 per cent level.

Employment Rate. Clearings comprise both price and real effects. The only series available over a long period in real terms is the employment rate, which covers the period 1913-1969 quarterly. Evidence of a lag of employment relative to money is provided by both the cross-spectral and cross-correlation analysis. Figure 14i shows the coherence and phase shift of employment and M1. None of the three models fit the phase diagram, but at the frequency band which corresponds to a cycle of 34 months in period, the coherence is .22 and employment lags money by 60.7°. Both differ significantly from zero at the 10 per cent level. A maximum lag of 7 months between the rate of change of money and the rate of change of employment falls into the 6-9 months time lag popularized by Friedman for the effects

FIGURE 14h

COHERENCE AND PHASE SHIFT, BANK CLEARINGS (SM) AND M2, 1902-1939 QUARTERLY DATA

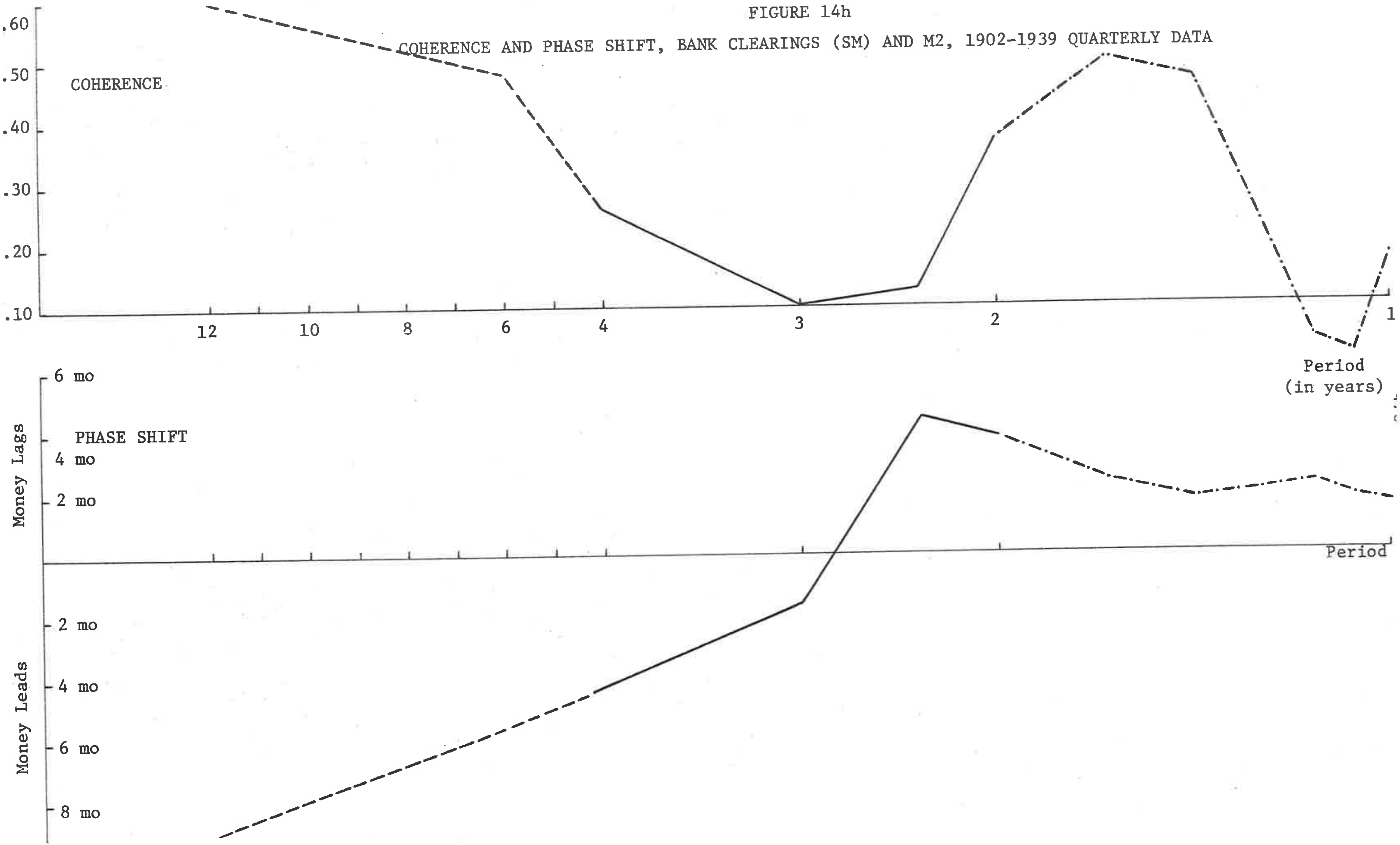
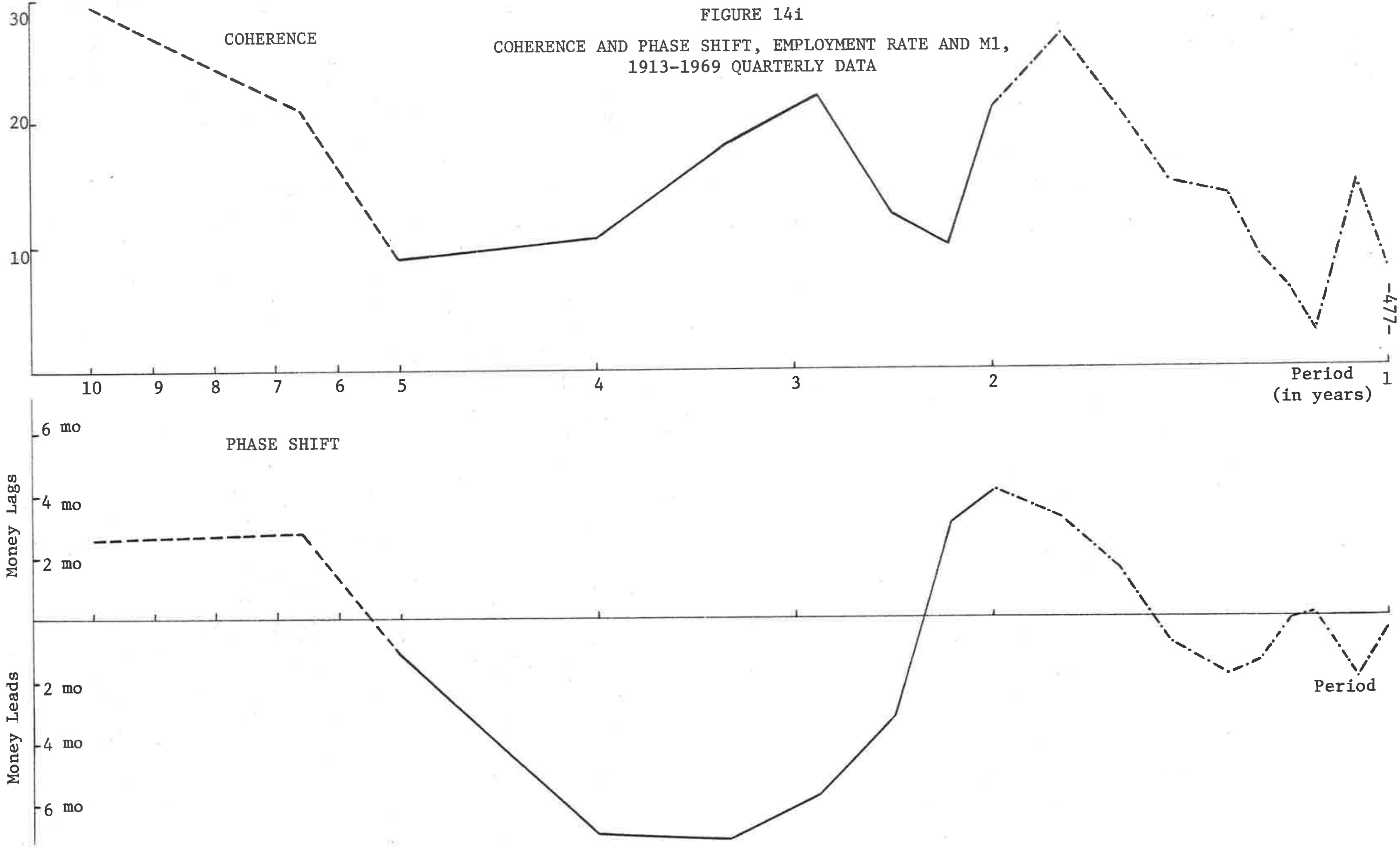


FIGURE 14i

COHERENCE AND PHASE SHIFT, EMPLOYMENT RATE AND M1, 1913-1969 QUARTERLY DATA



of a monetary change to be translated into an effect on output. (See Friedman, 1973). At the same time, the lag clearly varies with the frequency of oscillation, and the crossover from lead to lag and to lead again observed with bank clearings is most noticeable also with employment. Much the same pattern in the coherence diagram occurs when M2 is substituted, but the lead of employment relative to money at high frequencies is less in evidence. A fixed angle lag where a is 22° seems to fit phase diagram best.

Income (annual). Friedman argues that "on the average, a change in the rate of monetary growth produces a change in the rate of growth of nominal income about six to nine months later". (Friedman, 1973 p.27). While evidence of a lag of this length is found for Australia, its existence depends on what frequency is being considered. Rather than examining the relationship with both M1 and M2, we present only the results with M2 (which is the definition used by Friedman). Figure 14j is with G.D.P., and Figure 14k is with National Income. Both are in nominal terms. In both cases, the rate of growth of nominal income lags the rate of growth of money by 10-11 months at maximum. This lag is longer than that discerned by Howrey for the U.S., when he crossed the rate of growth of money and the rate of growth of nominal income over a comparable time period. For cycles of 4 years in periodicity, the coherence is .26 (G.D.P.) and .29 (N.I.) and the lag is 78° (G.D.P.) and 77° (N.I.). Both statistics are significantly different from zero at the 10% (G.D.P.) and 5% (N.I.) levels. As was the case with bank clearings and employment, the inter-relationship varies markedly with frequency. Much the same pattern is evident, with money in a subsidiary position at both high frequencies and very low frequencies. Over the standard 3-5 year reference cycle, money leads income. None of these features emerge in the time domain cross-correlation analysis.

FIGURE 14j

COHERENCE AND PHASE SHIFT, GROSS DOMESTIC PRODUCT AND M2, 1880-1969 YEARLY DATA

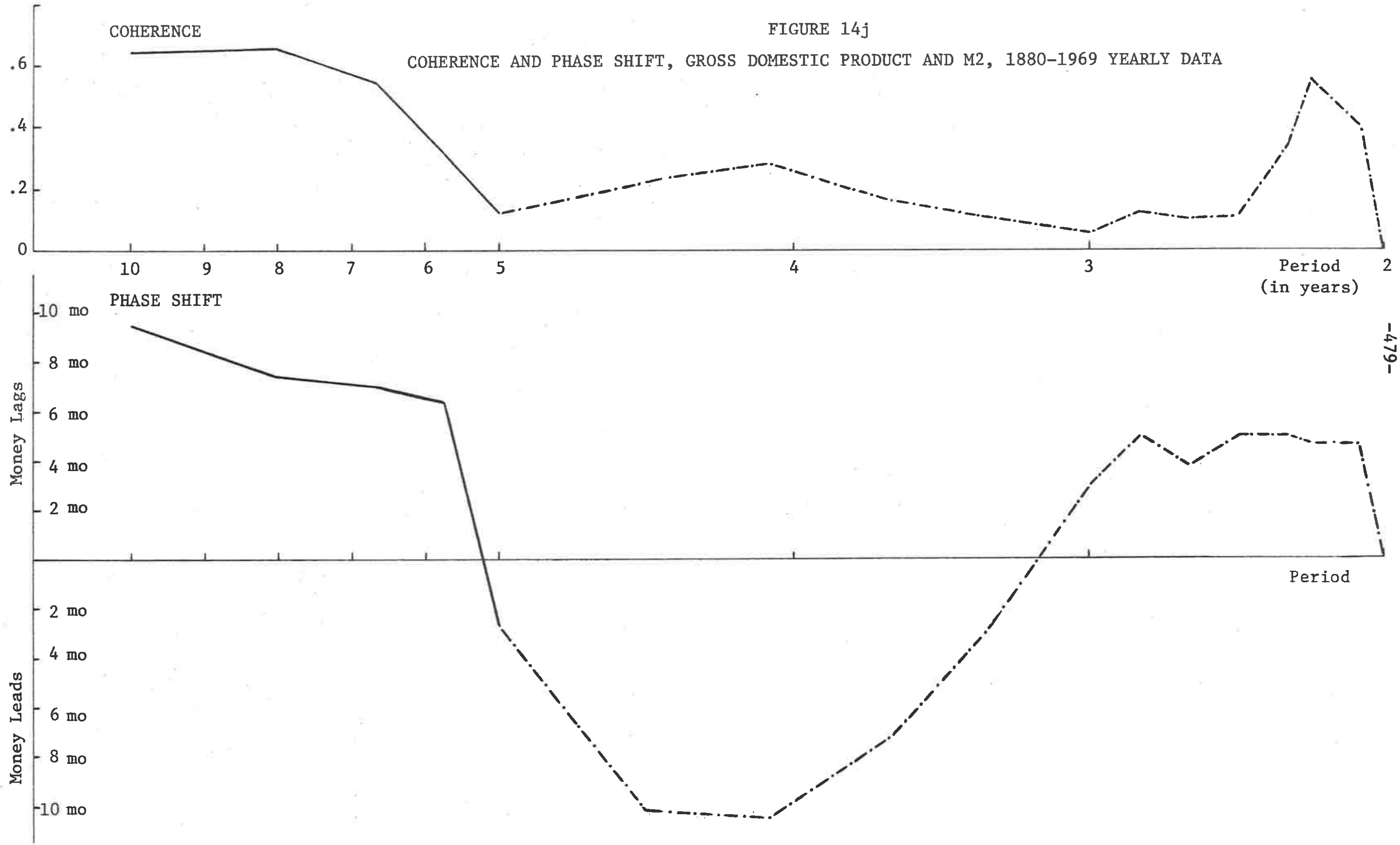
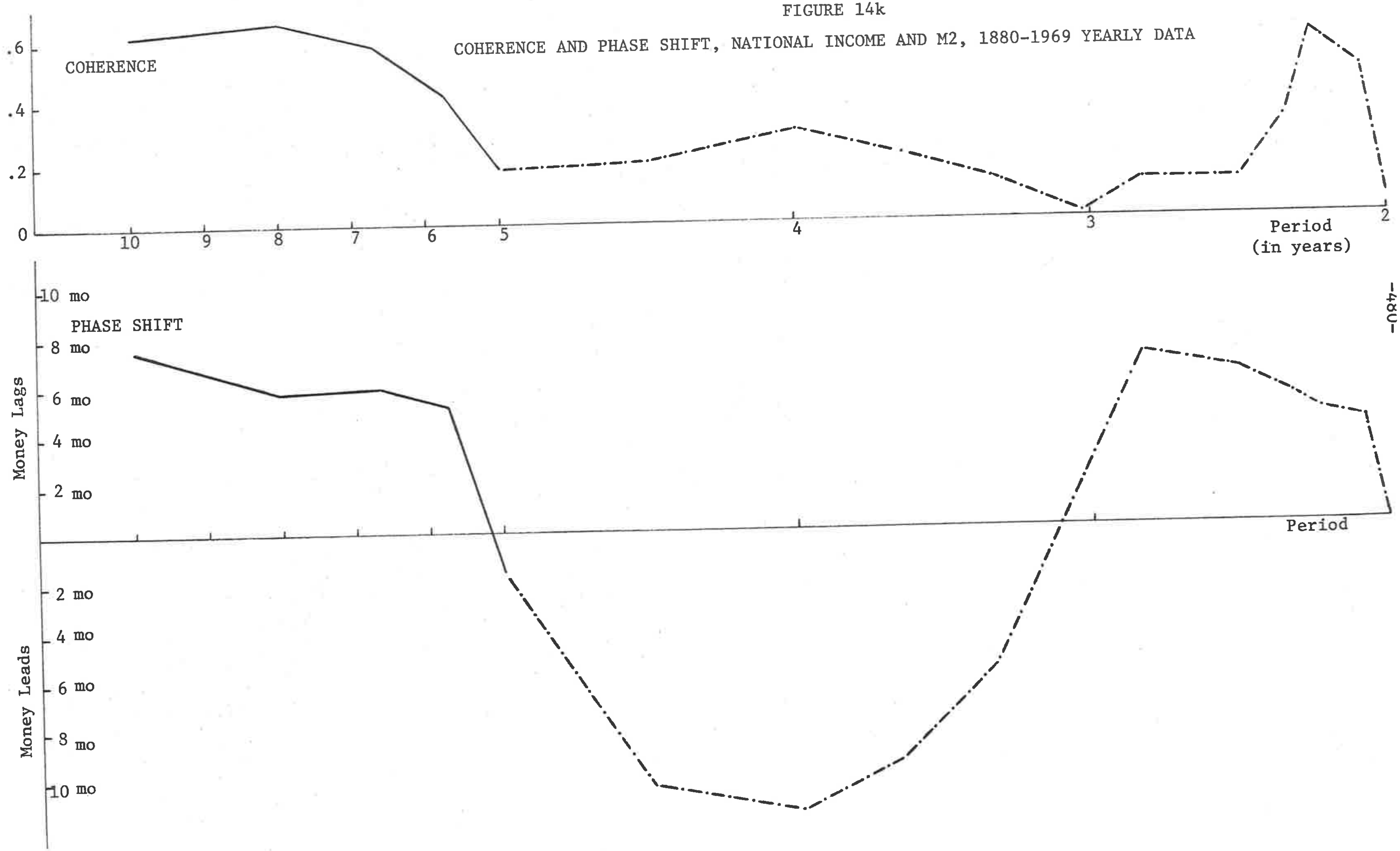


FIGURE 14k

COHERENCE AND PHASE SHIFT, NATIONAL INCOME AND M2, 1880-1969 YEARLY DATA



Price Deflator. As the coherence with M2 is higher, this is shown in Figure 14ℓ. The now familiar cross-over in the lead-lag relationship between short-run, middle-run and long-run cycles is again in evidence. At the frequency band $^1/_4$ cycles per year, the coherencies are .39 (M1) and .47 (M2) and the lag is 30° and 39° respectively, implying in the time domain a lag of 4 and 6 months respectively. All statistics are significantly different from zero at the 10 per cent level. In the case of M1 there is a fixed time lag of 5.3 months for frequencies lower than $^1/_3$ cycles per year. Long-run swings in prices are more closely correlated with money than are the movements of business cycle length. At the frequency band $^1/_{10}$ cycles per year, the coherency between prices and money is .62 and prices lead by 10° (which cannot be distinguished statistically from a coincident movement of the two).

Wholesale Prices. For this series we have data available in both annual form and quarterly form over a long time period, and the coherence and phase shifts are illustrated in Figures 14m and 14n. As was the case with the price deflator, wholesale prices and money are less coherent during fluctuations of reference cycle length. With annual data the maximum coherence in the middle cyclical frequencies is .38 at the frequency $^1/_{4.5}$ cycles per year and prices lag by 42°, which is 6.1 months in the time domain. By way of comparison, this frequency lies mid-way between the bands centred at $^1/_5$ and $^1/_4$ cycles per year with the quarterly data. Averaging these bands, price lag by 39°, or 5.8 months in time units. The reliability of the annual data for determining the phase relationship is surprising. Reflecting the cross-over from lead to lag, the model a + bw provides the best fit to the phase diagram, indicating a fixed angle lead at low frequencies and a fixed time lag of 10 months over the frequencies containing

FIGURE 141

COHERENCE AND PHASE SHIFT, IMPLICIT G.D.P. DEFLATOR AND M2, 1880-1969 YEARLY DATA

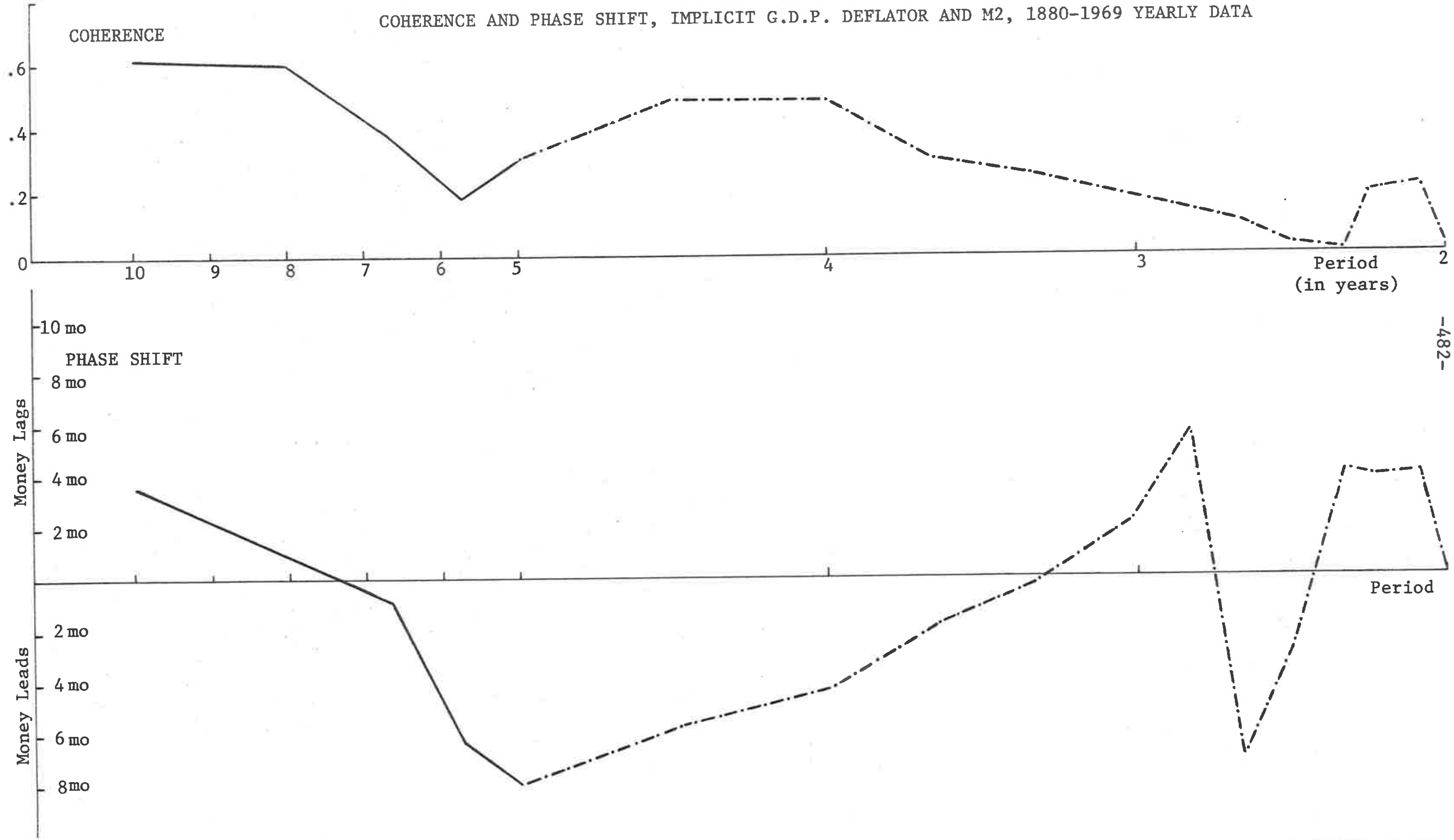


FIGURE 14m

COHERENCE AND PHASE SHIFT, WHOLESALE PRICE INDEX AND M2, 1880-1969 YEARLY DATA

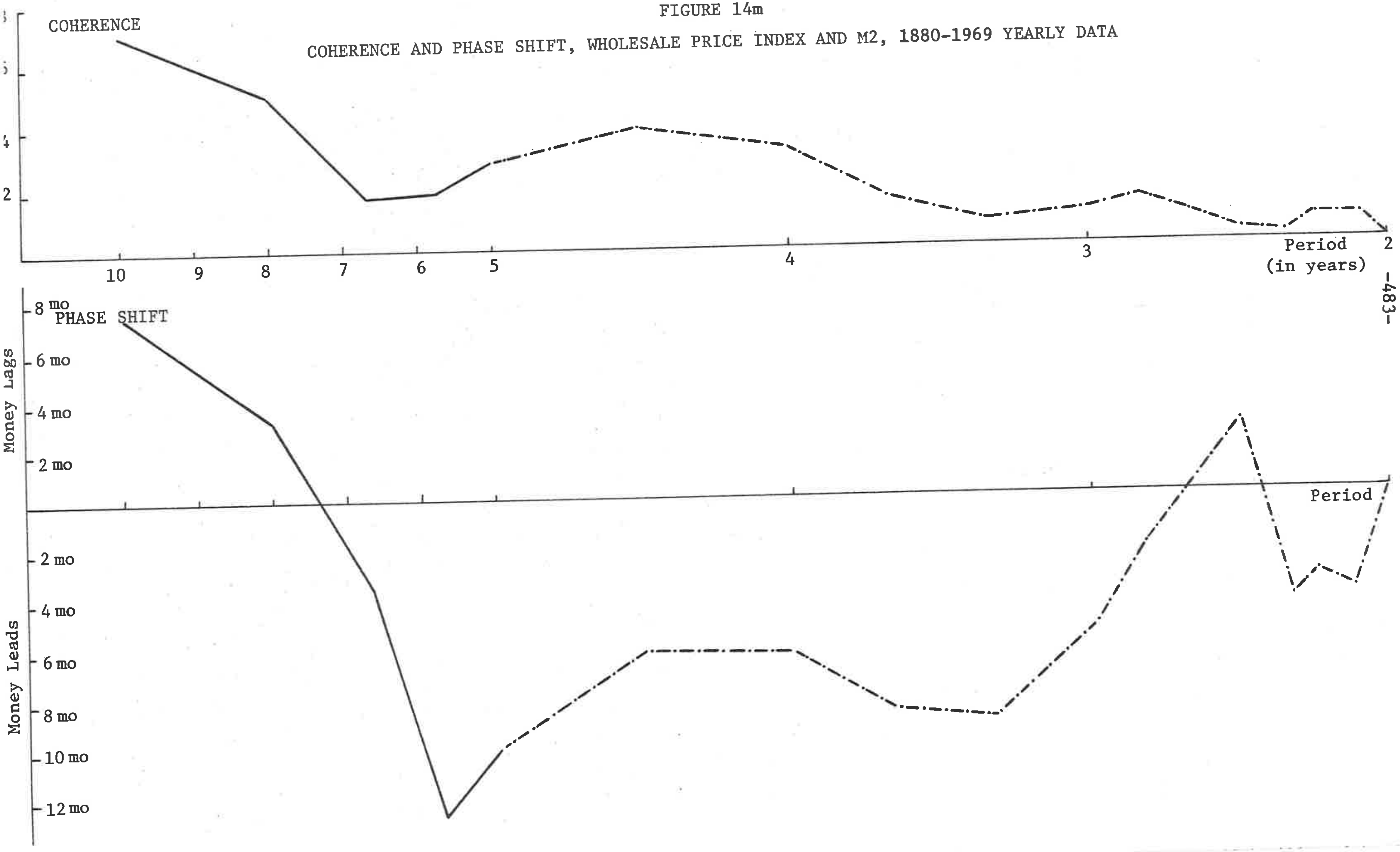
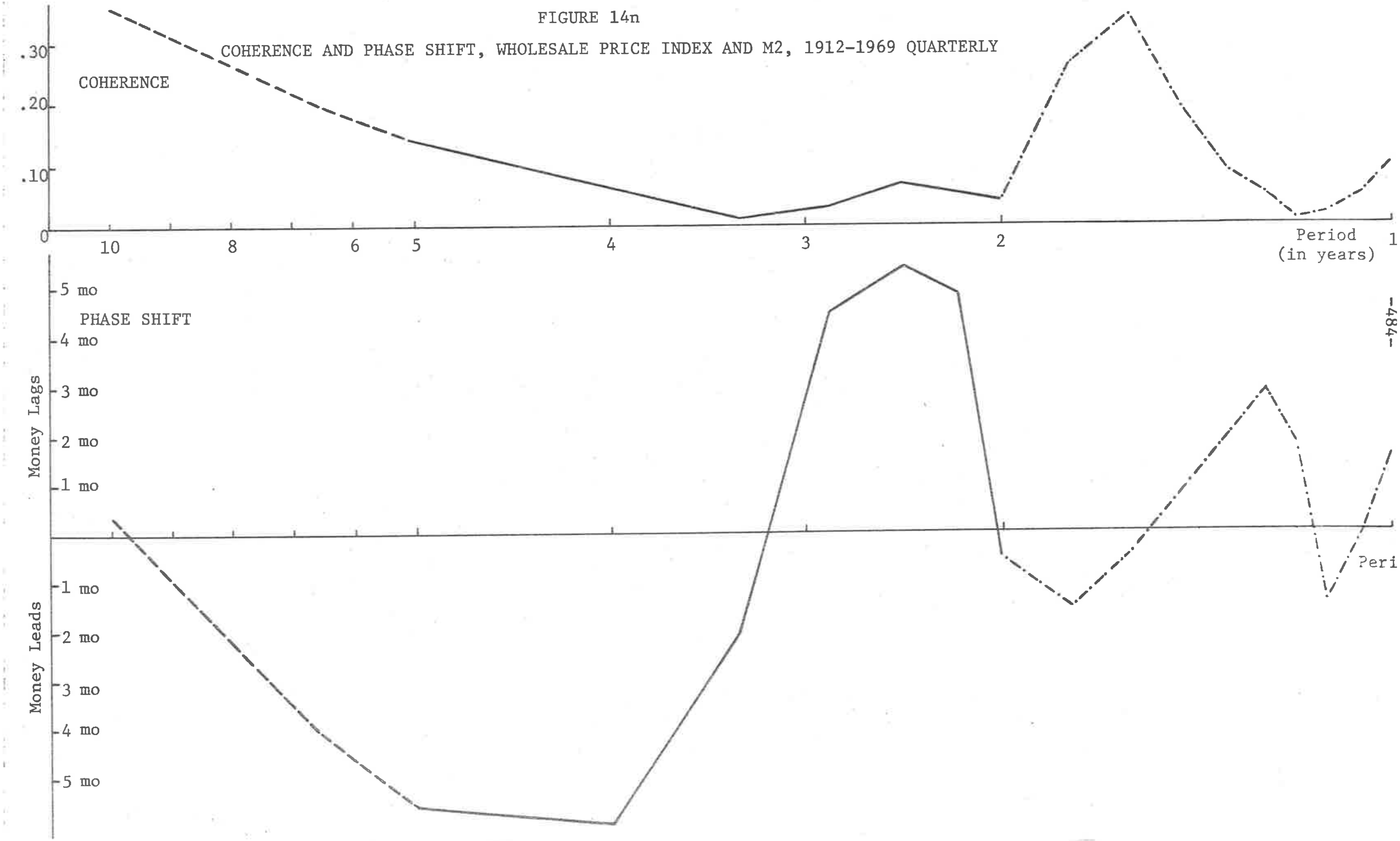


FIGURE 14n

COHERENCE AND PHASE SHIFT, WHOLESALE PRICE INDEX AND M2, 1912-1969 QUARTERLY



reference cycles. This could be an approximation to an average lag of a distributed lag relationship, but most distributed lag models do not imply a change in the sign of the lead-lag relationship with frequency.

Consumer Prices. This is the first instance in which the lead-lag relationship (here a lag) is relatively uncomplicated. Figure 14o and 14p show the coherence and phase shift obtained by crossing consumer prices (1912-1969 quarterly) with M1 and M2, and in both cases prices lag money over all frequencies. Generally the phase shift declines with frequency which is evidence of a fixed angle lag and the model $\phi(w)=\alpha$ provides the best fit to the phase diagram. The estimated angle lag is 48.5° with M1 and 65.3° with M2. A close coherency between prices and money occurs at three places over the frequency range lower than 1 cycle per year. Using M2 for illustration, these are for long swings of periodicity of 20 years (.40), 4-5 year cycles (.22) and 20 month cycles (.40). All are significantly different from zero at the 5 or 10 per cent level. Cycles of 20 months duration are generally ignored in the literature, but both money and consumer prices exhibit peaks in the spectrum around this length of cycle and our finding of a significant association between them throws out a challenge to future model building.

Friedman (1973) argues the existence of long lags between money and (consumer) prices:

> "On average, the effect on prices comes some nine to fifteen months after the effect on income and output, so the total delay between a change in monetary growth and a change in the rate of inflation, averages something like 15 to 24 months."

As we find a fixed angle lag relationship, the length of the lag in time units depends on the period of the cycle. An angle lag of 65° (for M2) implies a lag of only 3.6 months for a cycle of 20 months in duration. For a cycle of 5 years length, the lag is 11 months. Unless the length of lag

FIGURE 14o

COHERENCE AND PHASE SHIFT, CONSUMER PRICES AND M1, 1912-1969 QUARTERLY

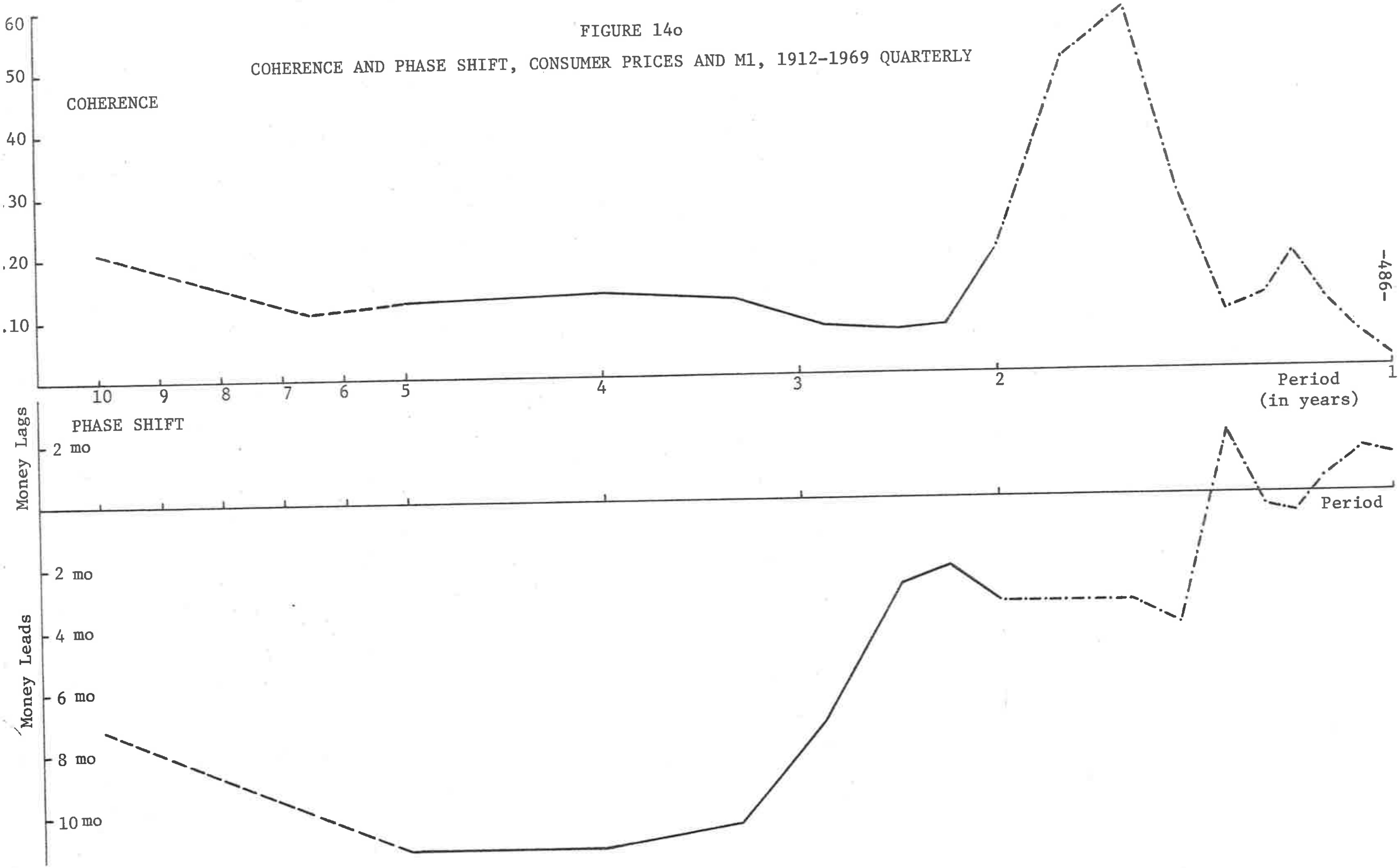
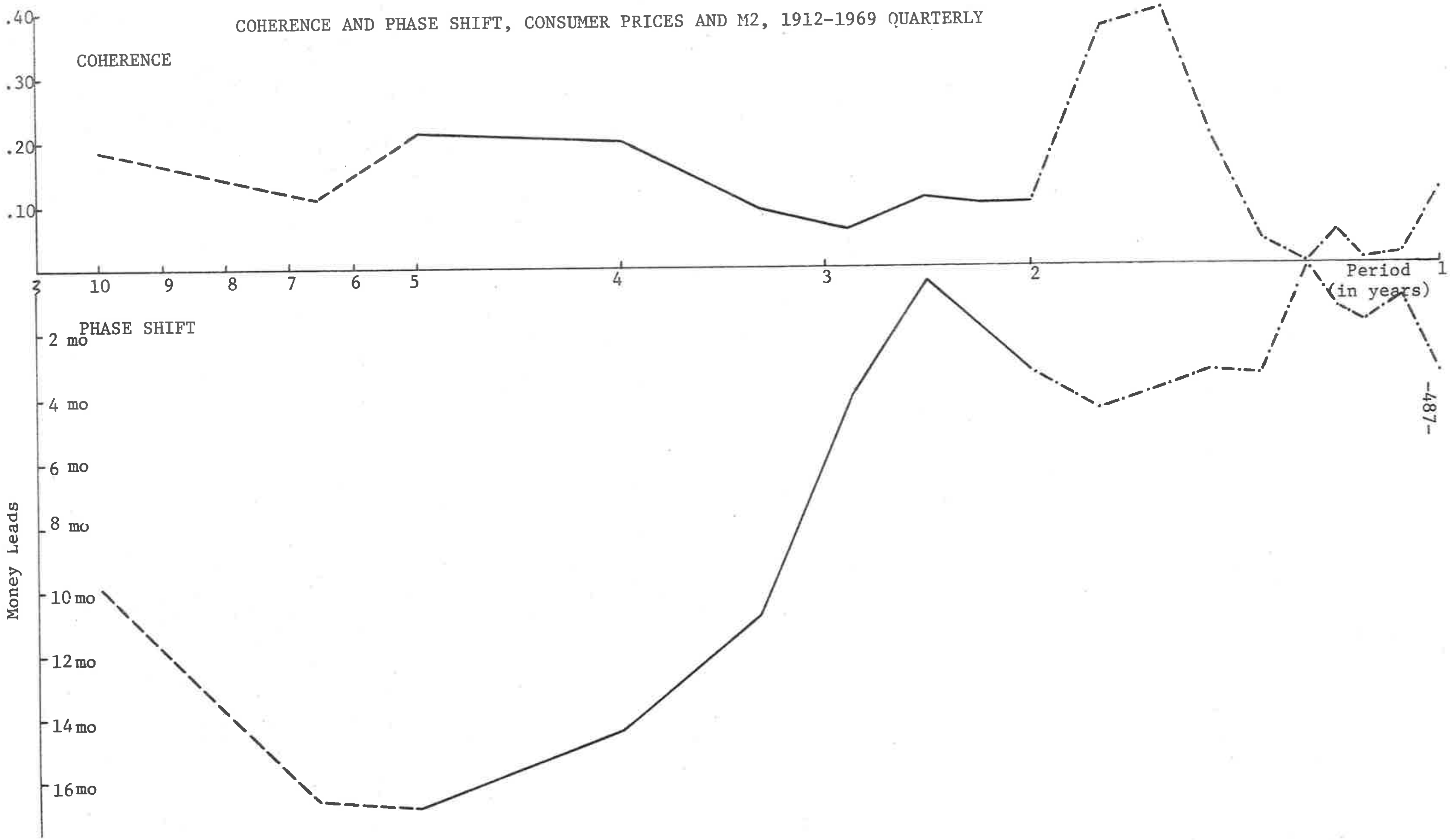


FIGURE 14p

COHERENCE AND PHASE SHIFT, CONSUMER PRICES AND M2, 1912-1969 QUARTERLY



increases over time, much longer cycles than is evident in post-war years is needed to generate a 15-24 month lag for Australia. There is indeed evidence that the length of the lag is longer in post-war years: 75-100° compared with 65° for the full period. In the case of a lag of 90°, a 15 month lag is implied for a five year cycle, which is still at the lower end of Friedman's band. Prices would seem to be more sensitive to the cycle in Australia than in the U.S. : a finding which may surprise most Australian commentators.[13]

Income (quarterly). Three measures of income are used, Gross Domestic Product (G.D.P.), National Turnover (N.T.) and Gross National Expenditure (G.N.E.), where in standard symbols

$$\text{G.D.P.} = C + I + G + X - M$$

$$\text{N.T.} = C + I + G + X$$

$$\text{G.N.E.} = C + I + G \, .$$

While the (maximum) coherence between money and G.D.P. is significant, we find the association of money with the other measures to be much closer, with coherencies ranging from .7 to .8. N.T. and G.N.E. may be better measures of that component of aggregate expenditures which responds to monetary policy, and the widespread use of G.D.P. in monetary analysis requires reconsideration. The lag is also longer when National Turnover and G.N.E. are used as the reference series, ranging from 37° - 64° (or

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13 Jüttner (1975) uses the rate of monetary growth lagged 4 quarters to predict the inflation rate. Our results support the length of lag he has chosen, given that 35 per cent of the spectral density is contained in the frequency bands adjacent to ¼ cycles per year. Because other frequencies contribute to the variability of prices and an angle lag is evident, we should expect considerable variability in the length of the lag.

6-8 months), which is consistent both with the length of lag suggested by Friedman and with that measured earlier with yearly income data.

Monthly data. Bennett and Barth and Bonomo and Schotta examined the inter-relationship between money and both industrial production and wholesale prices for the U.S. over post-war years in monthly form. As we examine equivalent series for Australia over much the same time period (ours is slightly longer) a direct comparison of the results is possible. Figures 14q and 14r show the coherence and phase shift for industrial production and M2 and M3 (introduced in the monthly analysis). Whereas the maximum coherence reported by the other studies is .55, we find that as much as 70 per cent of the co-variation is 'explained' in Australia. A marked difference is also observed in the phase shift. In the U.S. studies money leads for long cycles of 8 years or more and lags production over the bands which contain the reference cycle length fluctuations. In Australia, the reverse is the case, and money leads production over the bands which contain the standard reference cycles. While the phase differences are not statistically significant, the pattern observed previously with the lag changing sign between high, middle and low frequencies can be seen. When the artificially constructed series of the value of production is used, production lags money by 26-32°, a phase angle which is statistically different from zero.

Measures of employment exhibit the highest degree of cyclical conformity in Australia and two series were selected for examining the association with the monetary measures. A close association between the series is found to exist; the average coherence for cycles of $^1/_{96}$ - $^1/_{13.7}$ cycles per month exceeding .50 and for some bands exceeding .80. Clear evidence is provided that employment lags money. Of the three models fitted to the phase diagram,

FIGURE 14q

COHERENCE AND PHASE SHIFT, INDUSTRIAL PRODUCTION AND M2, 1947-1970 MONTHLY

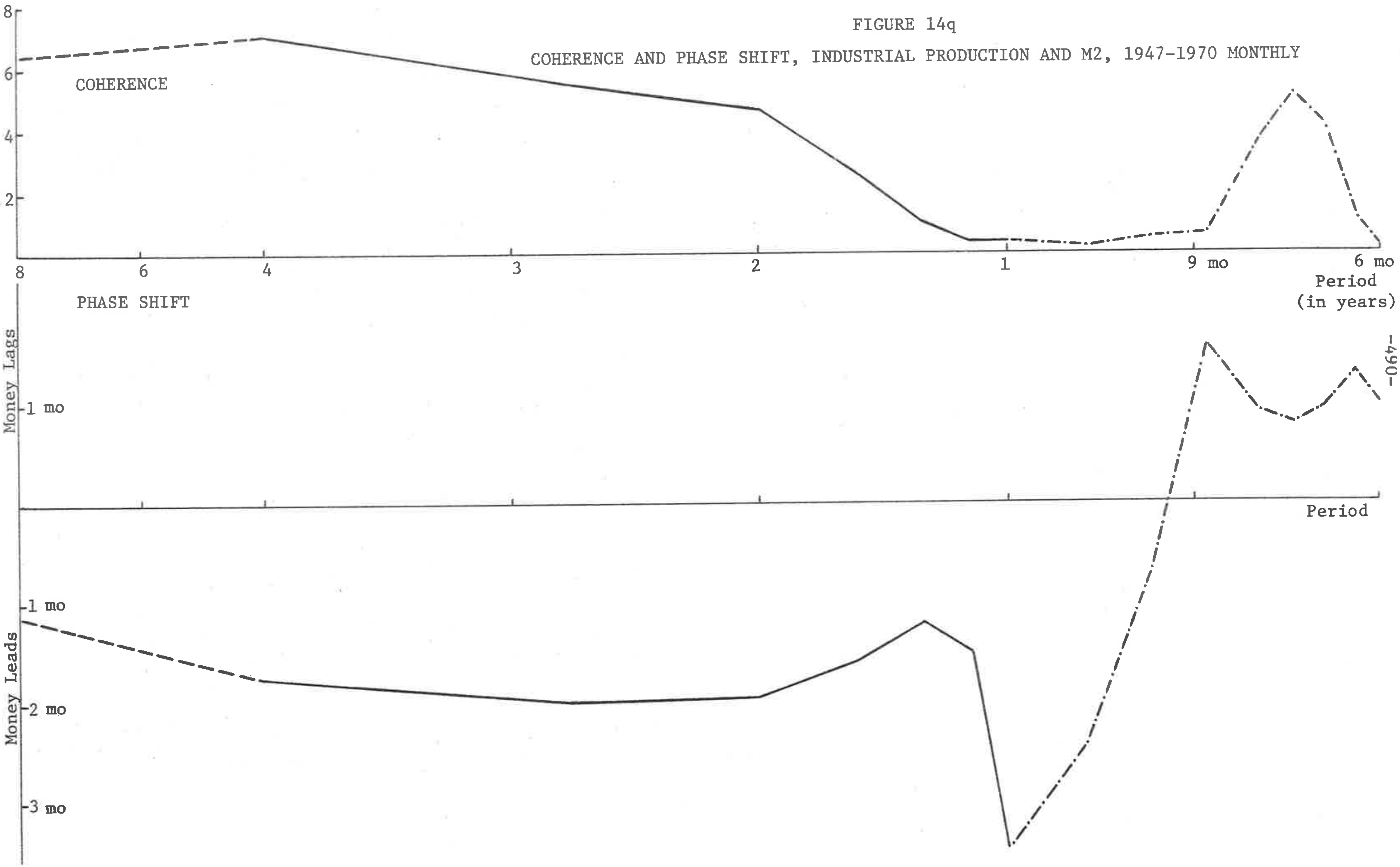
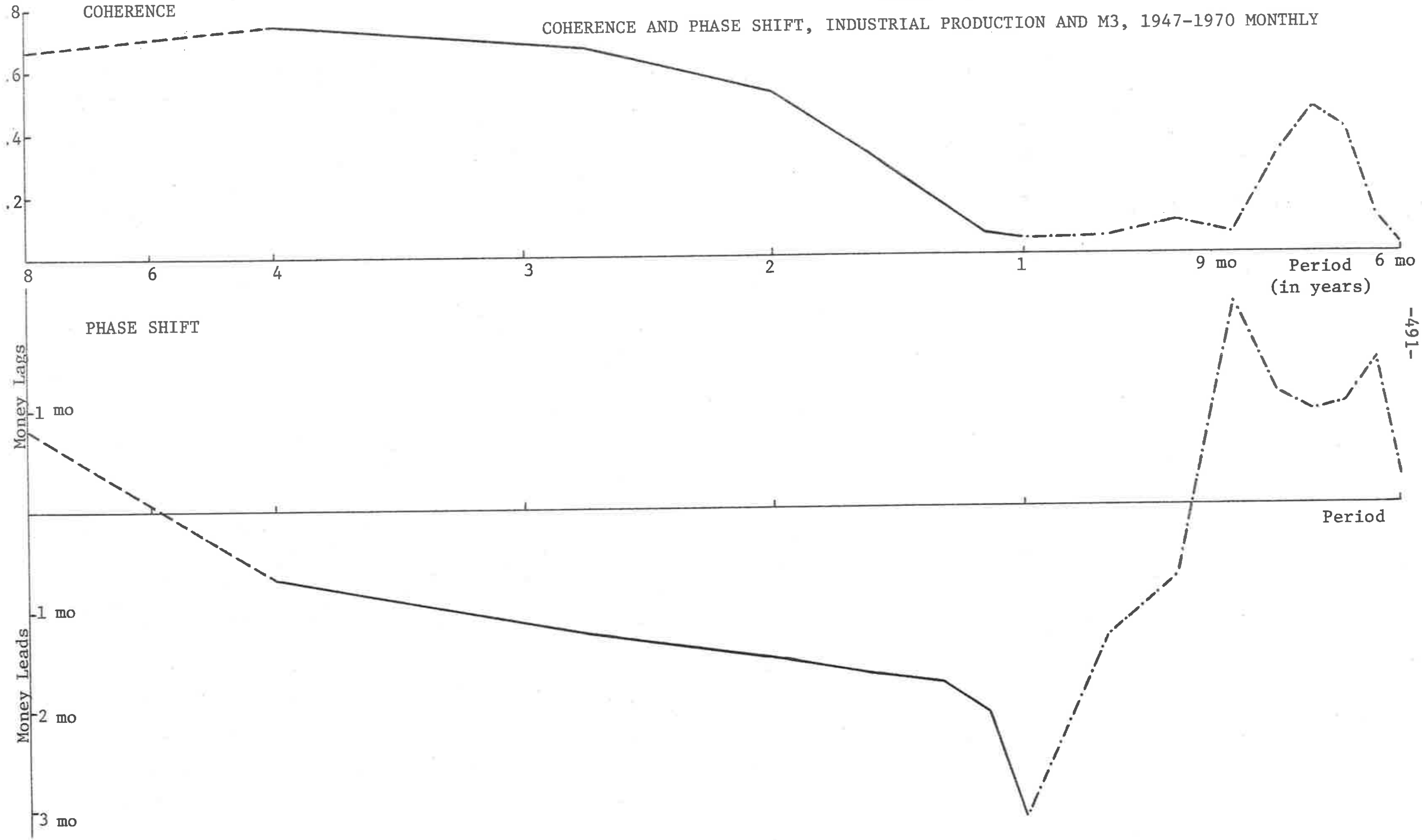


FIGURE 14r

COHERENCE AND PHASE SHIFT, INDUSTRIAL PRODUCTION AND M3, 1947-1970 MONTHLY



the model $\phi(w) = a$ provided the best representation of the lead-lag relationship, where a (in degrees) ranged from 40-50°. This is a highly plausible model for it implies that the length of adjustment depends on the extent of the disturbance. A lag of 50° implies a time lag of 6.7 months for a cycle of 48 months in length. This corresponds with the 6 month output lag, reported by Friedman for the U.S. and other countries.

While many economists would concede the importance of changes in money in explaining major movements in prices, particularly in pre-war times, the importance of money for post-war cycles in prices is hotly disputed. Only wholesale prices are available in monthly form, and we can examine consumer prices in quarterly form for the period 1946-1971. In both cases, a (relatively) long lag is observed, ranging from 65-97° in the cross-spectral analysis and 5-12 months for the cross-correlation analysis. A significant association exists between the two variables, but as the maximum coherency ranges from .31 - .47, much of the variability of prices is unexplained by Friedman's hypothesized association.

Conclusion

The most convenient way of summarizing the results is to return to the 5 propositions raised at the beginning of this chapter, and provide the answers found.

1. Changes in the stock of money and changes in measures of business activity are closely correlated during business cycles.

In post-war years, changes in money generally 'explain' over 50 per cent of changes in business, and in several instances (Gross National Expenditure, Bank Debits, Vacancies) more than 80 per cent. For the full period, encompassing cycles in the late nineteenth and early twentieth century, the estimated coherencies are somewhat lower, between .20 and .60, but in nearly every case are significantly different from zero.

2. The nature of the relationship between money and income is conditioned by the period of the cycle.

This is found to be the case, although the relationship is far more complex than Friedman indicates to be the case in the U.S. (his interpretation is contradicted by other writers). Money and economic activity are more closely correlated for 'major' cycles than for 'minor' cycles, but the extent of association does not uniformly decline with frequency and we find evidence of a significant association during conventional reference cycles. Rather than major or minor cycles, a more useful distinction is between long cycles (more than 6 years), middle-length or reference cycles (2½ - 6 years), and short cycles (around 1½ years). Generally a peak in coherence occurs at each of these bands, and the lead-lag relationship changes in direction.

3. Cycles in money lead cycles in business activity; output having a shorter lag than prices.

For cycles corresponding to N.B.E.R. reference cycles, the rate of change of money consistently leads the rate of change of business activity. As reference cycles in the United States average 49.0 months on a trough-to-trough basis and in Australia reference cycles average 47.0 months on a trough-to-trough basis, we estimate the lags at the frequency $^1/_4$ cycles per year. These are shown in Table 14.6. Subject to the qualifications noted in chapter 12, these provide an estimate of the lag in the effect of monetary policy. With Friedman's view of the transmission mechanism in mind, the length of the lags are not inconsistent with effects running in the following sequence:

Table 14.6

Estimated length of the 'outside' lag at the frequency band $^1/_4$ cycles per year

Reference series	Full period lag	Post-war lag
Clearings - debits	1 - 2 months	0.8 - 1.2 months
Employment	4 - 7 months	3 - 5 months
Nominal Income	8 - 11 months	7 - 8 months
Wholesale Prices	6 - 7 months	8 - 11 months
Consumer Prices	11 - 14 months	10 - 13 months

Money

↓

Spending (Clearings-Debits)

↓

Output (Employment, Vacancies)

↓

Income (National Income, National Expenditure)

↓

Prices (Wholesale, Consumer Prices)

Any attempt to summarize the lags as we do in Table 14.6 begs the question of the type of lag involved, and in each individual case we have provided a summary of the results of fitting three models to the phase diagram. The tendency for the lead-lag relationship to change sign would seem to preclude any simple distributed lag form.

4. The lag of fluctuations in business activity relative to cycles in money is highly variable.

In addition to sampling variability, two reasons can be advanced for an observed variability in the length of the lag. First, the direction of the lags reported in Table 14.6 crosses over to lead relationships at very low and high frequencies. Second, even for the frequency bands which encompass reference cycles, in a large number of cases we find evidence of a fixed angle lag relationship. This implies that the length of the lag in months declines with the frequency of oscillation.

5. The nature of the relationship between money and income is highly stable (consistent) over time.

Three major time periods have been examined: 1880-1969, 1902/12-1969, and 1947-1970. In each period strong evidence is found of the lead-lag relationship, whereby money lags at very low frequencies, leads at reference cycles, and lags again at high frequencies. The apparent stability of this relationship over time poses a major challenge to future modelling of the money-business association.

Data Appendix

Money Supply 1880-1969

The series calculated as quarterly averages of weekly data are:

Notes in the hands of the public

+ All deposits not bearing interest

= M1

+ All deposits bearing interest

= M2

Notes. The following series are used.

1880-1910. Note issue was the province of the Australian trading banks in all States except for Queensland, where Queensland 'Treasury notes' as they were called were issued from 1893-1911 (when they were superseded by Commonwealth government note issue). A series of Queensland Treasury notes in the hands of the public can be obtained by deducting Banks' holdings and the Treasury teller's holdings from the total issue each month. Banking returns provide quarterly information on bank notes in circulation. In order to obtain holdings of the public, bank holdings of notes should desirably be deducted. Banking returns give details only of holdings of notes and bills of other banks. Thus we assume that banks do not record their own unissued notes, and do not have large holdings of notes issued by other banks, and the series is

	Australian trading bank notes in circulation	(Australasian Insurance and Banking Record)
plus	Queensland Treasury notes in hands of public	

1910-1920. Australian government note issue commenced in December 1910. End of month figures of notes in circulation are provided in the Commonwealth Government Gazette, and bank holdings are available from Finance Bulletins.

	Australian notes in circulation	(Gazette)
plus	Bank notes in circulation	(Finance Bulletins)
less	Trading banks holdings of Australian notes	(Finance Bulletins)

1921-1936. Data from following series

	Australian notes in circulation	(Gazette)

plus	Bank notes in circulation	(Finance Bulletins)
less	Trading and savings banks holdings of Australian notes	(Gazette)

1936 onwards.

	Australian notes in circulation	(Reserve Bank Statistical Bulletin)
less	Trading and savings bank holdings of Australian notes	" " "

Bank Deposits. Data is drawn from two sources. The first is the Australasian Insurance and Banking Record which records quarterly returns from Australasia (Australia and New Zealand) from 1880. After 1908, 'official' series are provided in the Finance Bulletins. With suitable adjustments (described below) the series consistency exists when June quarter figures are compared, and allowance made for the exclusion of Northern Territory data in the A.I.B.R.

1880-1908. Australasian Insurance and Banking Record

Commonwealth returns *less* New Zealand returns (equals Major trading banks plus minor banks) less Queensland National Inscribed Stock (1897-1908).

1908 onwards. Finance Bulletins

Trading bank deposits *less* Queensland National Inscribed Stock *less* E.S.A. Bank Inscribed Stock (data for two adjustments from Australasian Insurance and Banking Records).

Between 1880-1902. Tasmanian returns are for total deposits only and these were allocated between interest bearing/non-interest bearing categories using the ratios of the other states in each quarter. A discontinuity exists between data in the war years and in post-war years because of the build-up of interest bearing deposits in the General Banking Division of the Commonwealth Bank. These deposits were largely abnormally large holdings of Savings Banks. Values during the war years were linearly interpolated using holdings in 1939 and in 1946 as a basis.

Money Supply 1946-1970

The following series were calculated in *monthly* form in post-war years

Notes in hands of public

\+ Current deposits not bearing interest (excluding government

= M1

+ Current deposits bearing interest (excluding government deposits)

= M1A

+ Fixed and other deposits bearing interest (excluding government deposits)

= M2

+ Savings bank deposits

= M3

All components of M2 are averages of weekly data for month. Savings bank deposits are end of month and were averaged to obtain mid-month series.

Income series. The annual series are drawn from the same sources as the expenditure series in chapter 11. Data for 1880-1938 from N.G. Butlin (1962), combined with official sources set out in that chapter. G.D.P. is gross domestic product at market prices, and N.I. is net national product at factor cost. Quarterly series comes from sources described in chapter 11.

Wholesale Prices. The series employed is the Melbourne Wholesale Price Index, and the following series were spliced;

1912-1937, base 1911 = 1,000

1937-1943, base 1928/9 = 1,000

1941-1961, base 1939 = 1,000

For the years 1961-1970, the Melbourne series is linked with the Wholesale Price (Basic Materials and Foodstaff) Index. Data from 1920 were extracted from the Quarterly Summary of Australian Statistics (various issues) and then the Monthly Summary of Australian Statistics (various issues). Data between 1912-1919 were supplied by the (then) Commonwealth Bureau of Census and Statistics. Each series was seasonally adjusted before splicing onto a base 1911 = 1,000.

Consumer Prices. The following series are spliced

1911/12-1925/26	Brown's adjusted version of the 'A' Series Retail Price Index, base 1923-27 = 1,000
1924/25-1952/53	'C' Series Retail Price Index, base 1923-27 = 1,000
1948/49 onwards	Consumer Price Index, base 1952/53 = 1,000

Brown's series is in the *Economic Record*, 1964 and the source of the other series is the Labour Report and the Quarterly (later Monthly) Summary of Australian Statistics. The series were seasonally adjusted prior to being spliced onto the base 1952/53 = 1,000. In all cases, the weighted average of the six State capitals was used.

Bank Clearings. Data were drawn from the following sources:

1902-1924	Melbourne Bank Clearings from Australasian Insurance and Banking Record. (Total Clearances, recorded weekly).
	Sydney Bank Clearings from Clearing House Archives, Sydney (Total Clearances, recorded weekly).
1925-1944	Australian Bank Clearings from Quarterly Summary of Australian Statistics (monthly - four or five weekly intervals).
1945-1968	Australian Bank Clearings from Finance Bulletin (monthly - four or five weekly intervals).

From these sources, three series were calculated. First, by combining Sydney and Melbourne Clearings from 1902-1924, and using clearing returns from these capital cities only after 1925. Second, total clearings in quarterly form from 1925. Third, total clearings in monthly form from 1945. Unfortunately this series is not available continuously after June 1969.

As mentioned in the main text, the data required processing prior to seasonal adjustment and the approach used can be illustrated for the monthly series published in the Finance Bulletin.

(i) Data is given as average weekly values for the number of weeks (four or five) ending on Wednesday during the month concerned.

(ii) From a perpetual calendar, the number of weeks involved in each 'month' is identified, e.g. January 1945 contains 5 weeks and February 1945 contains 4 weeks.

(iii) Convert data into four or five weekly totals.

(iv) Convert totals for four or five weeks into 'standardized' monthly form (i.e. 30.41667 days in a standard year and 30.5 days in a leap year).

Bank Debits. Debits to trading bank accounts, excluding debits to government accounts. The latter were excluded to match with the money supply series which excludes government deposits in the post-war monthly series. As in the case of the clearings data, this series was also given in (unspecified) four or five weekly form, and the adjustments outlined above were needed also for the debits series.

Industrial Production. Only one index exists in Australia published by the A.N.Z. Bank. The current index, base 1963-4 = 100, is available in monthly form since January 1963. By splicing this index with two earlier indices base 1948-9 = 100 and base 1958-9 = 100, the series can be taken back to July 1949 when the A.N.Z. Bank first began calculating a production series. A privately calculated series of production has been constructed by Waterman which covers the post-war years prior to the introduction of the A.N.Z. index, and being calculated on the same base it links directly with the bank index. Thus a series can be constructed to cover the period 1947 to 1970 by splicing and linking the four series.

The four series are shown in the table to this Appendix, and it can be seen that they incorporate a variety of adjustments. Waterman's series is the only one provided in unadjusted form, and A.N.Z. 1 is available only in seasonally corrected form although only one category is adjusted. Because A.N.Z. 1 and A.N.Z. 2 can be spliced only with a one month overlap, it is desirable that this be done with seasonally corrected data. But residual seasonality exists in A.N.Z. 1 and A.N.Z. 2 and A.N.Z. 3 have been corrected using the X9 variant of the Bureau of Census which has been superseded by the superior X-11 variant, which we have used. This version also enables adjustments for trading day variance. Hence it was decided to adjust the series as follows:

(1) Adjust Waterman for seasonal and trading day variation.

(2) Adjust A.N.Z. 1 for trading days and *residual* seasonality.

(3) Using A.N.Z. 2 and A.N.Z. 3 in non-seasonally corrected form, and adjust for trading day and seasonal variations.

The series were then spliced in seasonally corrected form, using the overlap of July 1957 and from 1963-1966.

Employment rate. Based on unemployment figures drawn from the following sources.

1913-1945. Percentage of members of trade unions returned as unemployed, excluding persons out of work through strikes or lockouts. The data is collated from returns provided by trade unions on the last week of February, May, August and November, and thus is approximately centred in mid-quarter. It was extracted from Quarterly Summary of Australian Statistics. Forster (1965) examined the data and found it to be generally reliable and on a consistent basis except for 1925/26 when some seasonal unemployment was included. Figures for the fourth quarter, 1925 and first quarter, 1926 have been adjusted in accordance with Forster's suggestion.

1946-1970. Those unemployed registered with the Department of Labour and National Service, expressed as a percentage of the work force. Unemployment figures come from the Labour Bulletin. Estimates of the work force were kindly provided by Professor K.J. Hancock of Flinders University of South Australia.

Appendix Table (Chapter 14)

Comparison of Linked Production Indices

	Waterman	ANZ 1	ANZ 2	ANZ 3
Base	1948-9 = 100	1948-9 = 100	1958-9 = 100	1963-4 = 100
Period covered	July 1945 - June 1949	July 1949 - July 1957	July 1957 - Dec. 1966	January 1963
No. of series	43	86	295	448
Coverage (excl. Fuel and Power)	not available	(25%)	(61%)	(71%)
Weighting (% of all groups excl. Fuel & Power)				
Durable goods	unweighted	47.6	56.0	60.4
Non-durables		52.4	44.0	39.6
Adjustments				
A. Working-day	none	weekends public holidays annual leave	weekends public holidays annual leave (2 patterns)	weekends Easter only -
B. Seasonal correction	none	Simple hand method applied only to series in food, drink & tobacco group.	Census Method II X-9 variant	Census Method II X-9 variant
C. Length of month	none	Yes	Yes	Yes
D. Available without seasonal correction	Yes	No	Yes	Yes

Chapter 15

Money and Financial Markets*

Chapter 14 examined timing relationships relevant to the transmission mechanism of monetary policy to spending, output and prices. In this chapter we seek further information about the transmission mechanism of monetary policy by extending the analysis to financial markets, using spectral analytic techniques.

Theoretical Considerations

In Chapter 11 we outlined a transmission mechanism of monetary policy which allowed for both substitution effects and expanded wealth effects to ensue from a monetary impulse. Variations in the supply of money lead to increased spending on the assets which substitute for money in the asset portfolio. In his restatement of the quantity theory of money, Friedman (1956) classifies the assets which substitute for money into major groupings which, with money itself, makes a four asset world: money, bonds, equities and physical goods.[1]

(i) Money has an implicit yield in terms on the flow of non-pecuniary services, as explained in Chapter 7. Its nominal yield may be zero, negative or positive depending upon the definition of money, and for convenience we assume it to be fixed and unresponsive to monetary injections.

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[1] Friedman in fact considers another asset, human capital. This is a cosmetic addition which serves little useful purpose in empirical work.

(ii) Bonds provide the holder with coupon interest payments and capital gains or losses. The stream of income purchased by outlaying \$1.00 at time $t = 0$ is

$$r_b(0) + \frac{\frac{d}{dt}\left[\frac{1}{r_b(t)}\right]}{1/r_b(0)}$$

where the right hand term is the rate of change of bond prices per unit time per dollar invested.

(iii) Equities give the holder a stream of real dividend payments which increase in nominal terms with the general prices, and capital gains or losses which also increase in nominal terms with the general level of prices. The stream of income purchased by \$1.00 at time $t = 0$ is

$$r_E(0) . \frac{P_t}{P_0} + \frac{\frac{d}{dt}\left[\frac{1}{r_E(t)} \cdot \frac{P_t}{P_0}\right]}{1/r_E(0)}$$

where the term on the right hand side gives the rate of change of equity prices per unit of time per dollar invested.

(iv) Physical goods consist of capital and consumer durable goods (broadly interpreted to include stocks of most non-perishable and even some perishable goods). A holder receives a flow of saleable or consumer services and appreciation or depreciation of the value of the asset in money terms, approximated by the rate of inflation $(\frac{1}{P}\frac{dP}{dt})$.

Composition of the asset portfolio as between money and other assets will be conditioned by the yields of competing assets; conversely, the asset yields will respond to variations in the composition of the portfolio brought about by monetary policy. Following from an unanticipated increase in the supply of money, independent of the demand for money, transactors will have excess holdings of money and will seek to restore portfolio balance by acquiring bonds, equities and physical goods.[2] Prices of each of these classes of assets will be raised and interest rates (yields) will be lowered. In the case of real assets there are, to quote Friedman, "as many interest rates as there are assets", but most of these 'own' rates are unobservable and as many of the goods which are bid for are newly produced, the impacts of monetary changes show up (with a lag) as variations in aggregate output and prices. This is not the case with bonds and equities and three differences can be noted. First, their markets are dominated by trading in existing assets and variations in prices and yields are directly observable. Secondly, the lowered yields on equities and bonds absorb part of the excess money and reduce the 'direct' impact of money on real goods. In place of the reduced direct impact is substituted, thirdly, an indirect mechanism by which lowered yields on equities and bonds stimulate higher output and commodity prices. Increased equity prices encourage firms to undertake investment due to the lowered cost of business finance, while households are likely to feel more wealthy and increase their spending on consumer goods.

In short, variations in the prices and yields of equities and bonds form part of the transmission mechanism of monetary policy. Because the immediate impacts of monetary changes are observable, we should expect the relationship between money, bonds and equities to be marked by shorter lags than those we have observed to exist between money and real goods. Indeed,

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[2] In chapter 11 we argued that such broad portfolio effects would occur even in the case of an open market operation involving no net wealth effects.

if changes in the money supply are anticipated by transactors in securities markets, no lag may be evident and share prices might even lead money. The central bank's policies may follow from a predictable reaction function or changes in the money supply may be reliably related to specific policy actions, and if expectations are profit-maximizing these responses should be incorporated into security prices. On the basis of the analysis in section I, the first possibility can be ignored. Although the authorities do adjust the stance of monetary policy in accordance with changes in the goal variables, these policies do not appear to be translated into money supply changes in a predictable fashion. In chapter 10 we showed that changes in base money and liberated reserves 'explain' between 50 and 80 per cent of changes in the money supply, and this relationship offers more of a possibility; but as the 'intermediate' lag involved is less than a quarter, market participants would need to read the portents and act on the information promptly. This is also a dangerous line to pursue for any timing pattern found can be rationalized by an alleged presence of expectations. Why not argue the same for output or prices? Many money supply changes are clearly not anticipated, nor are financial markets as rational as the rational expectations model assumes. Thus if securities markets are transmitting the effects of monetary policy to the economy, we should expect to observe a lag.

As well as a direct influence of money on share markets, there may be indirect influences via the impact of money on profits, interest rates, inflation, the level of economic activity and so on. Alternatively, fluctuations in income may engender similar fluctuations in both share prices and money. Obviously, the inter-relationship is complex. This is the case also with interest rates: indeed more so, for interest rates may alter the supply of money (although we were unable to discern evidence of this in chapter 10).

Other Studies

Despite clear theoretical support for a link between money and stock prices, the existing evidence is mixed. Following Friedman's lead, and his earlier work on the money supply as a business predicter, Sprinkel (1971) compares the rate of change of the money supply with the level of share prices, and finds that money leads by 9 months at peaks and 2 months at troughs. Cooper (1974) criticizes Sprinkel both for the use of the rate of change transformation and for the use of share prices rather than yields, and in a cross-spectral study of changes in the money supply and changes in share yields he finds that money lags by one to three months. There is a difference in the time periods examined, for Sprinkel compares turning points over the period 1918-1970, while Cooper uses monthly data from 1947-1970. An indirect link between money and share prices is argued by Keran (1971). His estimated relationship is quite complex, involving a 3 quarter 3rd degree Almon lag of changes in the real money supply, a 20 quarter 6th degree Almon lag of real profits, a 17 quarter 6th degree Almon lag of commodity price changes, and an 8 quarter 6th degree Almon lag of changes in real G.D.P. As the dependent variable is the level of share prices, the form and length of the lag corresponds to Sprinkel's. Gowland (1974) found little evidence of a relationship between money and share prices in the U.K. From a cross-spectral study of the filtered money supply and filtered share prices he found a very low coherence and a lead of share prices relative to money.

Only one study (Praetz, 1974) has investigated the relationship for

Australia. He takes no stand on the question of whether the level or rate of change of the money supply should be employed, and uses three series: current deposits, fixed deposits, and the rate of growth of the volume of money (M3). Coherence and phase (in months, for the frequency band $^{1}/_{48}$ c.p.m.) estimated from monthly data 1947-1968 are:

Share prices with	Coherence	Phase
Current deposits	.60	-0.3 months
Fixed deposits	.13	0
Rate of growth of M3	.60	-11.2 months

Money leads share prices only when the rate of change transformation is applied.

Although the relationship between money and bonds has been at the centre of monetary economics for several decades, there are surprisingly few direct statistical studies of the time series evidence. To the author's knowledge there are only two, and both report a significant association between money and interest rates (more correctly, bond yields). One is Cagan's study of the cyclical behaviour of interest rates over the period 1878-1962. Like Friedman with business activity and Sprinkel with share prices, Cagan (1966) relates the rate of change of the money supply to the level of interest rates and finds a close inverted relationship between the two. The other study is by Marcis and Smith (1973) who examine the level of the money supply and interest rates using cross-spectral analysis with monthly data from 1952-1969. They find the series to be significantly related over the cyclical frequencies of oscillation, with money leading interest rates by about 50°, which implies a lag of 5 months for a three year cycle. This appears to be clear evidence of the impact of monetary policy upon the bond market.

Nature of Data

The relationship between money and financial markets can be studied either by using prices or yields, and the following series are used:

[1] All Ordinary Share Index (excluding Financial), Sydney Stock Exchange, 1880-1969 quarterly.

[2] Financial Share Index, Sydney Stock Exchange, 1880-1969 quarterly.

[3] Ordinary Share Yields, Sydney Stock Exchange, 1900-1969 quarterly.

[4] Government Bond Yields, quoted on the Sydney Stock Exchange, 1900-1969 quarterly.

[5] Long-term Government Bond Yields, monthly 1946-1971.

[6] Short-term Government Bond Yields, monthly 1946-1971.

Data sources are given in the Appendix. Series [1] has a wider coverage than [2], but the latter is included because of the possibility that shares of banks, insurance and other financial companies may respond to monetary conditions, particularly if Pesek and Saving type wealth effects occur.[3] Ordinary share yields are calculated by expressing the dividend paid, or indicated, as a percentage of the price, of all ordinary shares. From 1900-1925, series [4] is the yield on all N.S.W. and Commonwealth Government issues of bonds, and after that date it is the yield on long term Commonwealth Government bonds. In [5] and [6], long term is 10 or more years, and short term is 2 years.

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3 Pesek and Saving (1967) attribute to an expansion of 'inside' money a wealth effect on consumption (services) because the monopoly position of banks is made more valuable. If so, any increase should be written up into the value of bank equity.

Spectra and Autocorrelations

In estimating the spectra of the individual series, the procedures developed in the previous chapter were again followed. Data were transformed to logarithmic first differences and then filtered by moving averages to remove any remaining trends in mean. As the theory of efficient markets suggests that a purely seasonal cycle should be removed by speculation, no adjustments were made for seasonal variation.

Features of the spectra and the autocorrelations are summarized in Table 15.1. As spectra for the money supply series over similar periods were estimated in the previous chapter and reported in Table 14.3, they are not re-estimated here. Considerable interest attaches to the spectra of the share market series, for the stock market has been much investigated by spectral techniques.[4] Both prices series have a relatively flat spectrum overall, but we notice significant power at frequency bands encompassing conventional reference cycles, subcycles and the seasonal, although the power at the seasonal is only one-half or one-third that of the 45-50 month cycle. We agree with Granger and Morgenstern that these components are not adequately explained by the random walk hypothesis of stock price behaviour.

The spectrum of government bond yields for 1900-1969 exhibits considerable power in the neighbourhood of 48 and 12 months per cycle, and the existence of both peaks is confirmed by the auto-covariance diagram. Neither peak was found by Jüttner, Madden and Tuckwell (1975) in their spectral study of Australian interest rates for the period 1962-1973. When we examine the spectra of interest rates for the post-war years ourselves,

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[4] In addition to the references previously cited, Granger and Morgenstern (1970) provide a good summary of existing research.

TABLE 15.1

FEATURES OF SPECTRA OF FINANCIAL SERIES

Series	Nature of data	Data points	No. of lags	$^n/m$ ratio	Location of spectrum peaks	Percent of variance of: Peak band and 2 adjacent frequencies	Percent of variance of: All business cycle frequencies	Autocorrelation
Ordinary Share Index	1880-1969 quarterly	340*	60	5.7	(i) 45 months (ii) 18 months (iii) 12 months	18.6 6.5 5.7	62.6	Peaks at 36 and 48 months
Financial Share Index	"	"	"	"	(i) 51.3 months (ii) 15.6 months (iii) 12.9 months	16.0 8.3 7.6	68.1	Peak at 51 months
Ordinary Share Yields	1900-1969 quarterly	259*	48	5.4	41 months	17.6	51.2	Peak at 36 months
Govt. Bond Yields	"	"	"	"	(i) 48 months (ii) 12.5 months	14.0 11.8	56.3	Peak at 12 and 48 months
Long term Govt. Bond Yields	1946-1971 monthly	253*	48	5.3	48 months	53.4	74.6	Peak at 48 months
Short term Govt. Bond Yields	"	"	"	"	48 months	48.8	80.9	Peak at 45 months

we continue to find evidence of the 48 month cycle, but the peak at the seasonal frequency has disappeared, and there is much less density at high frequencies (greater than $^1/_{12}$ c.p.m.). Both changes are undoubtedly due to the intervention of the central bank in the bond market in ironing out the seasonal pattern and absorbing into its own portfolio many of the transactions which would otherwise have been reflected in yield changes.

As all of the series exhibit significant increases in power in the neighbourhood of 45-50 months per cycle, the preconditions exist for the money supply to exert an impact upon financial markets, and we now turn to consider the cross-spectra.

Inter-relationships Between the Series

In examining the relationship between money and financial markets we are faced, as in the case of the money-output relationship, with an indeterminancy about the appropriate mode of measurement. Do we compare the level of share prices (or yields) with the stock of money or the rate of growth of money or both? In this case a more positive answer can be given. The portfolio analysis sketched out earlier implies a relationship between the stock of money and interest rates and yields. It does not imply any relation between yields and the monetary growth rate. Thus we examine the rate of change of money and the rate of change of share prices, share yields and bond yields.

Table 15.2 summarizes the results of cross-spectral and cross-correlation analyses of the 14 series pairs crossed. Unlike the analyses of the previous chapter when all the series were positively related, money and yields should be negatively related and thus we record the cross-correlations on both a positive and an inverted basis.

TABLE 15.2

SUMMARY OF CROSS-SPECTRAL AND CROSS-CORRELATION ANALYSIS BETWEEN MONEY AND MEASURES OF FINANCIAL MARKETS

Financial Series	Monetary series	Nature of data	Maximum and average coherence	Summary of Phase diagram	Sign of association	Location of maximum
Ordinary Share Prices	M1	1880-1969 quarterly	.358 (.12)	No model appropriate. At the band of maximum coherence, share prices *lag* by 33.6°.	positive	coincident
	M2	"	.450 (.16)	Combined model. A fixed angle *lag* of 15.0° and a fixed time *lead* of 1.9 months. F = 4.81.	positive	coincident
Financial Share Index	M1	"	.576 (.17)	No model appropriate. At low frequencies (less than ½ cycles per year), prices *lag* by 23.9°. At higher frequencies prices lead. At maximum coherency (1/45 c.p.m., prices lead by 16°.	positive	coincident
	M2	"	.448 (.11)	Combined model. A fixed angle *lead* of 42.6° and a fixed time *lag* of 2.28 months. F = 21.73.	positive	coincident
Ordinary Share Yields	M1	1900-1969 quarterly	.587 (.20)	A fixed angle *lead* of 26.8° (t = 13.65).	negative positive	Yields lead by 1 quarter Yields lag by 4 and 6 quarters
Ordinary Share Yields	M2	1900-1969 quarterly	.531 (.18)	A fixed angle *lead* of 26.8° (t = 9.16).	negative positive	coincident Yields lag by 4 quarters
Govt. Bond yields	M1	"	.439 (.25)	A fixed angle *lead* of 61.8° (t = 4.77).	negative positive	Yields lead by 1-2 quarters Yields lag by 6-7 quarters
	M2	"	.391 (.25)	A fixed angle *lead* of 67.7° (t = 7.00).	negative positive	Yields lead by 1 quarter Yields lag by 6-7 quarters
Long term Bond Yields	M1	1946-1971 monthly	.538 (.40)	A fixed angle *lead* of 39.4° (t = 12.07).	negative positive	Yields lead by 3 months Yields lag by 13 months
	M2	"	.425 (.32)	A fixed angle *lead* of 28.7° (t = 7.62).	negative positive	Yields lead by 3 months Yields lag by 14 months
	M3	"	.454 (.32)	A fixed angle *lead* of 38.9° (t = 10.83).	negative positive	Yields lead by 3 months Yields lag by 13 months
Short term Bond Yields	M1	1946-1971 monthly	.232 (.11)	No model appropriate. At maximum coherence *lead* of 31.9°.	negative positive	coincident Yields lag by 18 months
	M2	"	.210 (.13)	Combined model. A fixed angle *lead* of 37.3° and a fixed time *lag* of 4.3 months (F = 318.56).	negative positive	Yields lead by 3 months Yields lag by 18 months
	M3	"	.184 (.11)	Combined model. A fixed angle *lead* of 73.1° and a fixed time *lag* of 5.8 months (F = 186.98).	negative positive	Yields lead by 2 months Yields lag by 18 months

In Figure 15a the coherence and phase statistics are given for money and the all *ordinary share index* (excluding financial), for the period 1880-1969. No lead or lag is evident from the cross-correlation analysis, but the phase diagram suggests the interpretation that share prices lag money. Coherence is relatively high around frequencies $^1/_{32.7}$ - $^1/_{45}$ c.p.m. (which contains most of the spectral power of share prices) and also $^1/_{120}$ c.p.m. and at both frequencies share prices lag money. The maximum coherence is .358, and the associated lag of 33.6° (3 months) is significantly different from zero at the 10 per cent level, while the coherence is significant at the 5 per cent level. Figure 15b indicates that the lag is much shorter for M2. When the coherence becomes fairly high, the lead of share prices for low frequencies crosses over to a lag, but the lead at the bands of high coherency is only 12.2°. While M1 leads share prices, M2 and share prices appear to be coincident in timing.

Little can be concluded about the timing differences between M1, M2 and the *financial share index*, despite there being high coherencies of .576 and .448 respectively at the frequency $^1/_{45}$ c.p.m. From the phase diagram there is evidence of both leading and lagging components but no clear pattern emerges, and as the cross-correlation analysis indicates the series to be coincident in timing, this seems to be the only possible conclusion. Given rational expectations, this does not necessarily invalidate there being effects running from money to share prices, particularly with observations at quarterly intervals. A relatively close coherence is also found between money and *ordinary share yields*, but on an inverted basis which is the one expected from portfolio theory it would seem that yields lead money. In both cases the lead is 4 months at the frequency $^1/_{48}$ c.p.m., which corresponds with the cross-correlation analysis.

FIGURE 15a

COHERENCE AND PHASE SHIFT, ORDINARY SHARE PRICES AND M1, 1880-1969 QUARTERLY

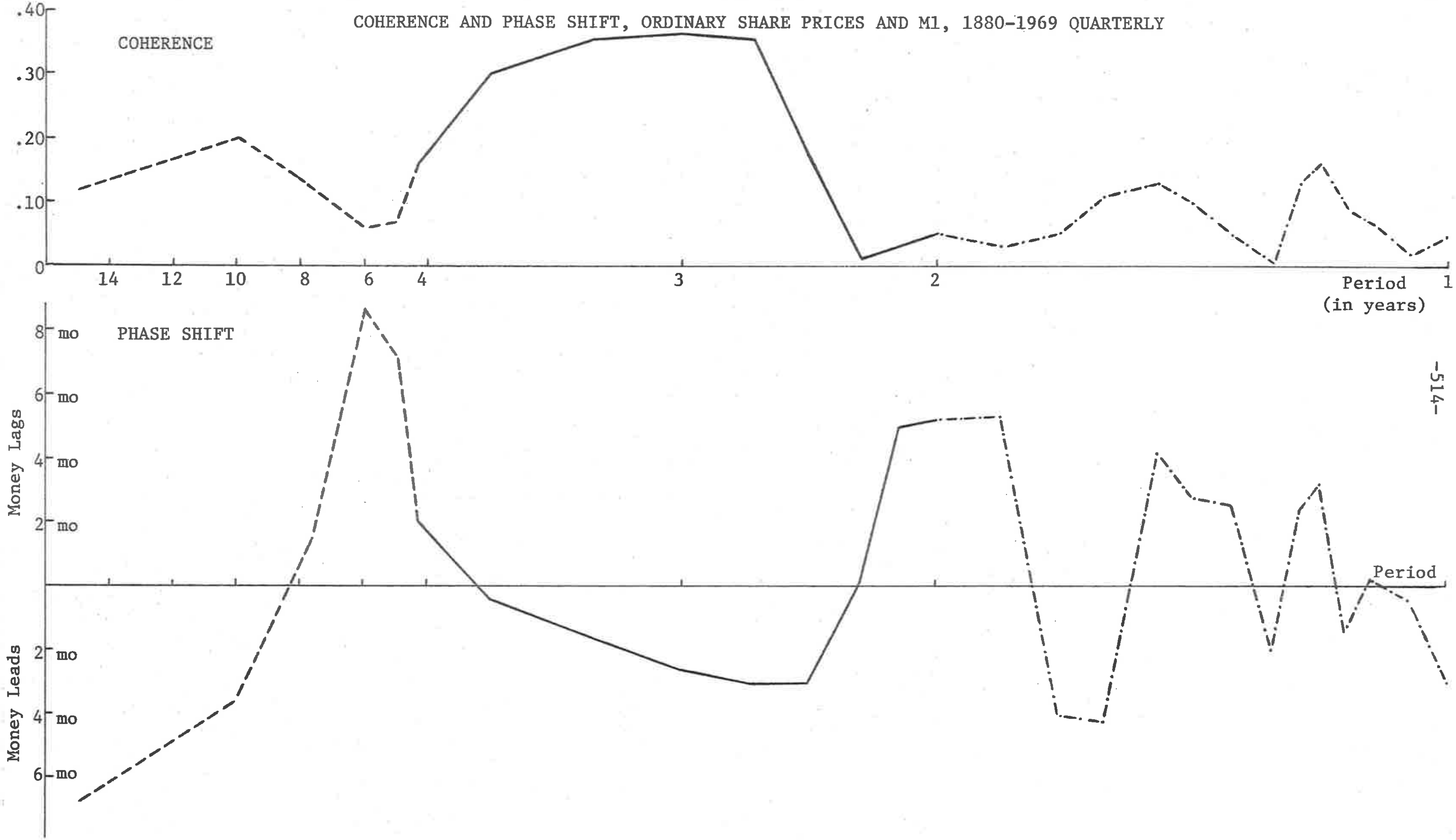
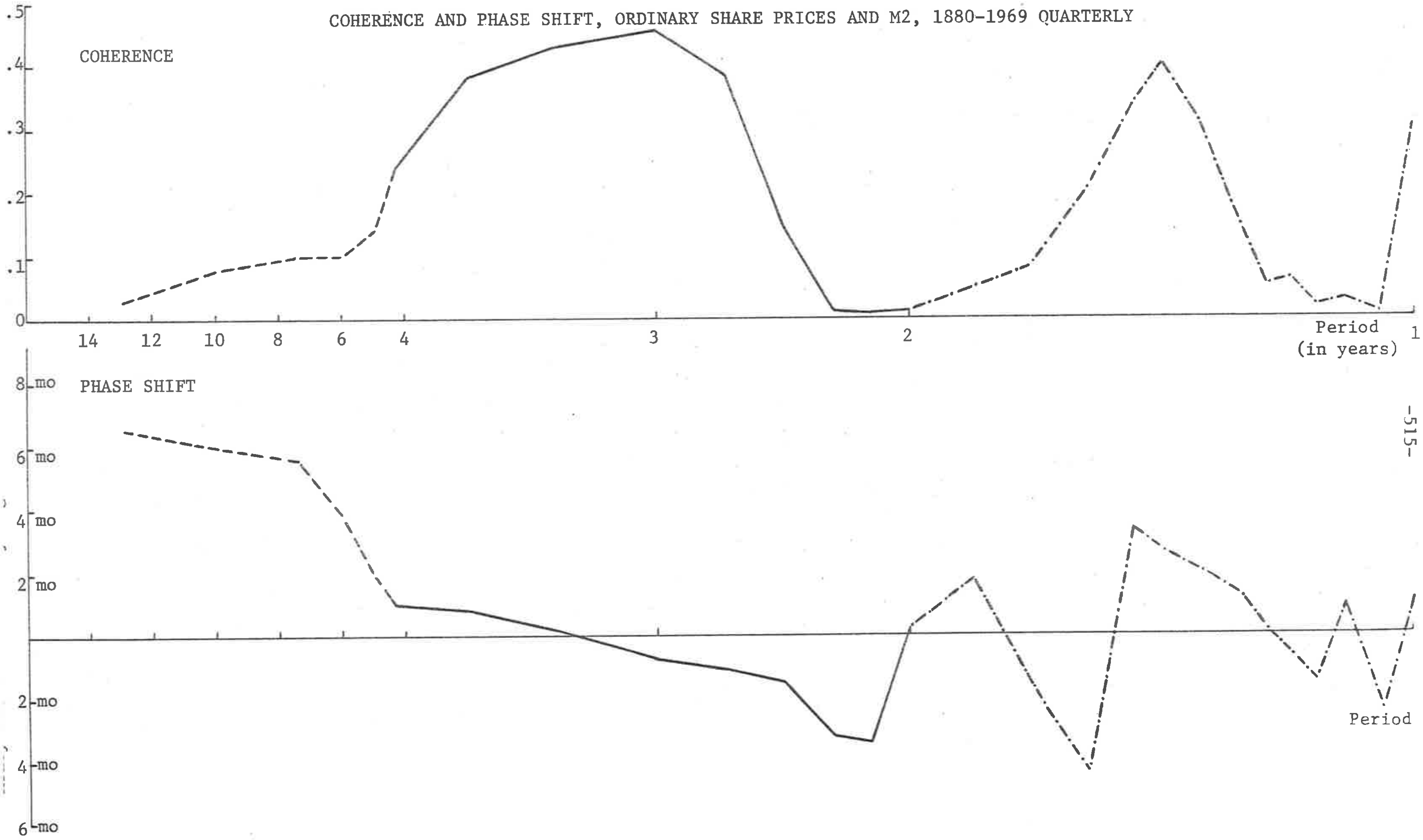


FIGURE 15b

COHERENCE AND PHASE SHIFT, ORDINARY SHARE PRICES AND M2, 1880-1969 QUARTERLY



When the *government bond yields* are crossed with the two monetary series over the period 1900-1969, the results are more difficult to interpret. In both cases a fixed angle lead of between 60° and 70° is indicated, which implies that bond yields lead money by 8 months! Figure 15c shows the cross-correlations between the filtered logarithmic first differences of bond yields and M1. On an inverted basis, the maximum correlation occurs when bond yields lead money by 1 or 2 quarters. These results do not suggest a stimulus running from changes in money to changes in bond yields. Consider again the cross-correlogram in Figure 15c. On an inverted basis the maximum correlation coefficient is -.313. But this is not the maximum correlation coefficient, for on a positive association, the correlation coefficient has a maximum value of +.467. A positive signed relationship is suggested.[5]

This difficulty in interpretation is present also with respect to the relationship between M1, M2 and M3 and long term and short term government bond yields in the post-war years. Money leads interest rates only if a positive association is accepted. On an inverted basis, interest rates consistently lead the money supply.

Thus the results are mixed. In the case of the stock market, we find strong evidence in the case of the all ordinaries index, over a time period which encompasses a wide variety of economic and financial circumstances, of an impact of the money supply upon share prices. Indeed, this appears to be the first study to discern a lag of share prices relative to money at

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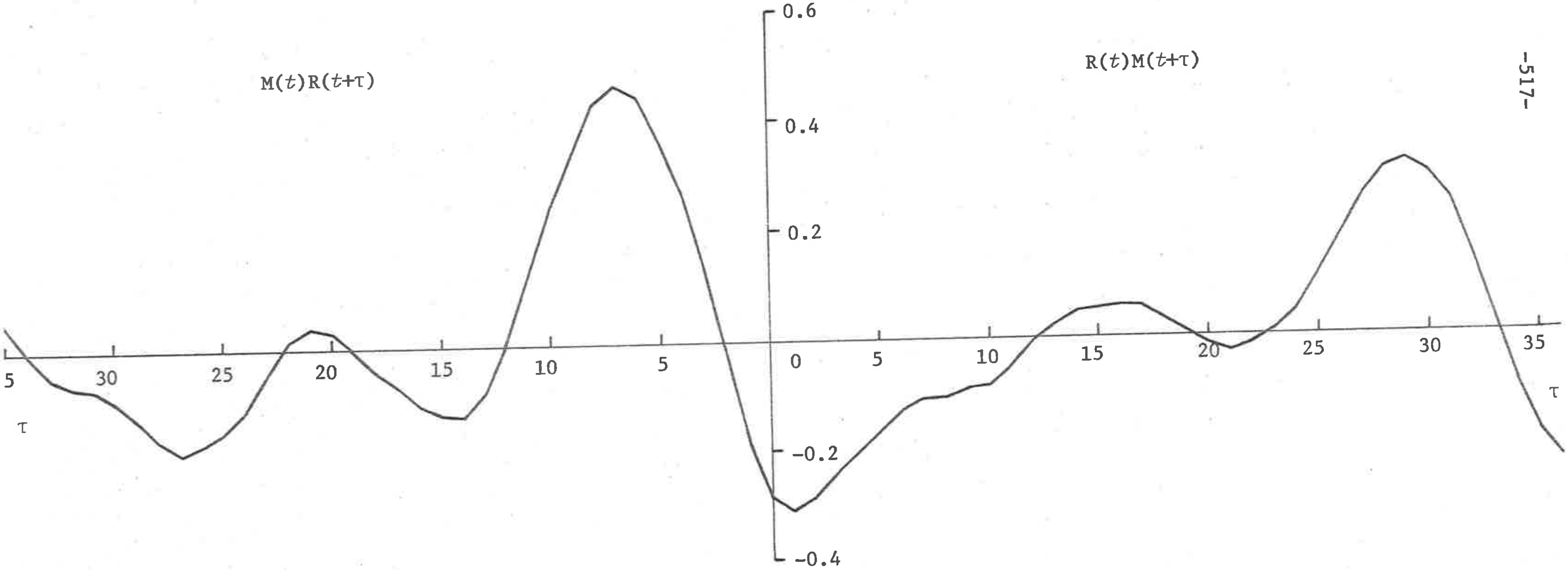
5 In such instances the correlation analysis is invaluable in aiding the interpretation of the phase diagram. The phase is reported for the range $-\pi$ to π, and to obtain timing on a positive basis, an adjustment by π is needed.

FIGURE 15c

CROSS-CORRELOGRAM OF GOVERNMENT BOND YIELDS AND MONEY SUPPLY, M1, USING FILTERED LOGARITHMIC FIRST DIFFERENCES, 1900-1969 QUARTERLY DATA



the cyclical frequencies without having to make recourse to the rate of change transformation. This lag is in the order of 2-3 months, which corresponds to that between money and bank clearings over similar frequencies and is less than the lag of output relative to money. Thus the length of the lag is not inconsistent with share prices participating in the transmission of monetary policy. This interpretation needs to be qualified because of the coincident timing of money and the Financial Share index and the tendency of share yields to lead money. When we turn to the association of money with bond yields, we find the results to be quite ambiguous: interest rates lead money on an inverted basis, and evidence of a positive relationship can be discerned.

Our failure to find a relationship between money and bond yields is surprising. If share prices respond to monetary policy, it would be expected that bond prices would also, especially because the link between money and bonds is emphasized more in theoretical literature and policy discussion than money and the stock market. In other respects we find the role of money in the cycle to be more clearly delineated in Australia than in the U.S. Our cross-spectral analysis of money and economic activity has found a closer coherence and longer lags than did similar techniques with the U.S. data. Similarly with share prices. As clear evidence apparently exists of the inter-relationship between the money supply and interest rates in the U.S., it is something of a puzzle why evidence does not exist for Australia.

Once we look at the U.S. studies in this light several features would seem to be open to enquiry. The fact that only two studies attest to the direct relationship between money and interest rates is in itself strange. We also know that the U.S. money supply follows a generally pro-cyclical pattern. But interest rates apparently do as well, for this is one reason advanced for the tendency of the yield to maturity curve of bond yields to exhibit humps around the time of peaks in general business.[6] How is a negative association possible? And if Marcis and Smith find a relationship between money and interest rates, why did Cagan find it necessary, Friedman-style, to relate the rate of monetary growth to interest rates?

These would seem to be questions worth pursuing for in them may lay the answer to the Australian study.

A Further Look at Interest Rates

The obvious answer is that the studies focus upon cycles of different length. However, this appears not to be the case. Cagan's results are based on N.B.E.R. reference cycles, which average 4 years in length. While Marcis and Smith examine all frequencies from $^1/_{64}$ c.p.m. to $^1/_2$ c.p.m., their conclusions appear to be based on the low frequency movements, making the results directly comparable with Cagan's (and our own).

Marcis and Smith declare their objective in the following terms:

> "The primary hypothesis under investigation is that interest rate variations are related to money supply variations in a simple causal fashion so that the changes in interest rates follow the changes in money supply."

Their test consists of examining the spectra and cross-spectra of two definitions of the money supply (M1 and M2) and four measures of interest rates (rates on 3 month Treasury Bills, 9-12 month Treasury Bills, 3-5 year Treasury bonds and long term Treasury bonds). The data covers the period 1952-1969 in monthly form, is unadjusted for seasonality, and is detrended by means of polynomial regression.

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6 See Conard (1959) and Kessel (1965).

They find that the inter-relationship and the leads and lags vary with the frequency of oscillation. In the case of M1, the covariation with interest rates is closest for short cycles (or 'sub cycles') of frequency $^1/_{16}$ - $^1/_{21}$ c.p.m., declines for cycles corresponding to the standard business cycle (frequencies $^1/_{32}$ to $^1/_{64}$ c.p.m.), and is lowest for the frequencies around the seasonal. The phase angle indicates that money leads interest rates for both the sub-cycles and the business-cycles, but that for the seasonal frequency and its harmonics, interest rates lead the money supply.

What is questionable is the interpretation placed upon this evidence. Marcis and Smith argue that interest rates and the money supply are jointly determined, and that no simple input-output relationship exists. But at the same time they state:

> "the finding that interest rates and money supply display a much higher degree of covariation and that interest rates respond with a relatively short lag to money supply changes over the low-frequency cyclical components of oscillation may indicate that monetary policy operations do have the potential for bringing about counter-cyclical variations in market rates of interest."

This begs the question of *what* changes in interest rates follow from the monetary changes. From the underlying portfolio balance theory, cycles in interest rates and the money supply ought to be inversely related. With incomes and price expectations given, upturns in the money supply can be expected to raise asset prices and produce a downturn in the general structure of interest rates. But other mechanisms are possible, and as M-S do not make clear the sign of association between the series they cross, a further investigation of this point is warranted.

Our re-examination of Marcis and Smith's evidence for the U.S. employs cross-spectral analysis and uses the same data series for the money supply and interest rates, but differs from their study in four respects. First, in addition to the spectral results, we continue with the practice of calculating the zero-order cross-correlation coefficients for every filtered series pair, leading and lagging the series by 36 months. By comparing the time domain and frequency domain results, we are afforded confirmation of the timing relationships and clarification of the sign of association between the series. Secondly, so as to provide for consistency between the correlation and spectral results, we use monetary data adjusted for seasonality. Thirdly, all data were transformed similarly for the study by applying the simple linear filter, $x'_t = ln.x_t - lnx_{t-1}$. Fourthly, in the cross-spectral analysis we focus attention upon the low frequency responses corresponding to the standard business cycle, and ignore for the main part frequencies of $^1/_{18}$ c.p.m. and higher.

Like Marcis and Smith we find that M1 and M2 are closely coherent at low frequency cyclical components (coherence = .92), and differ little in timing. At the frequency $^1/_{32}$ c.p.m., M2 leads M1 by 8.7°. As 36 lags are used in calculating the spectra and cross-spectra, this is in fact significantly different from zero but implies a lead of M2 relative to M1 of 0.71 months. Given the high coherence, use of M2 is likely to indicate a slightly longer lead than M1. That is, the results with M1 are *less* favourable to the monetary hypothesis than are M2, and to reduce the amount of calculation we concentrate upon M1.

In the top panel of Table 15.3 is set out the results of crossing M1 with the four interest rates used by Marcis and Smith. The cross-spectral statistics of coherence and phase are averages over the frequencies $^1/_{72}$ - $^1/_{24}$ c.p.m. While we have some misgivings about reporting the phase diagram in this fashion, it facilitates comparison with the results of Marcis and Smith. Phase angle is shown in degrees of a circle, and a +

Table 15.3

Cross-Spectral and Cross-Correlation Statistics of Interest Rate and the Money Supply, Jan. 1952 - Dec. 1969

		Cross-Spectral Analysis		Cross-Correlation Analysis	
Interest Rate	Monetary Series	Coherence	Phase	Location of Maximum	Sign of Association
3 month	M1	.413	-52.3°	-5, -2	positive
9-12 months	M1	.384	-49.0°	-5	"
3-5 year	M1	.459	-47.8°	-5	"
L.T. bonds	M1	.386	-46.6°	-3	"
3 month	M$\dot{1}$	.580	+35.2°	+2	negative
9-12 month	M$\dot{1}$	.583	+41.1°	+2	"
3-5 year	M$\dot{1}$	.625	+42.3°	+2	"
L.T. bonds	M$\dot{1}$	.671	+48.8°	+4	"

indicates that the particular interest rate leads M1, and a - that the interest rate lags M1. For the correlation analysis, we indicate the location of the maximum cross-correlation coefficient.

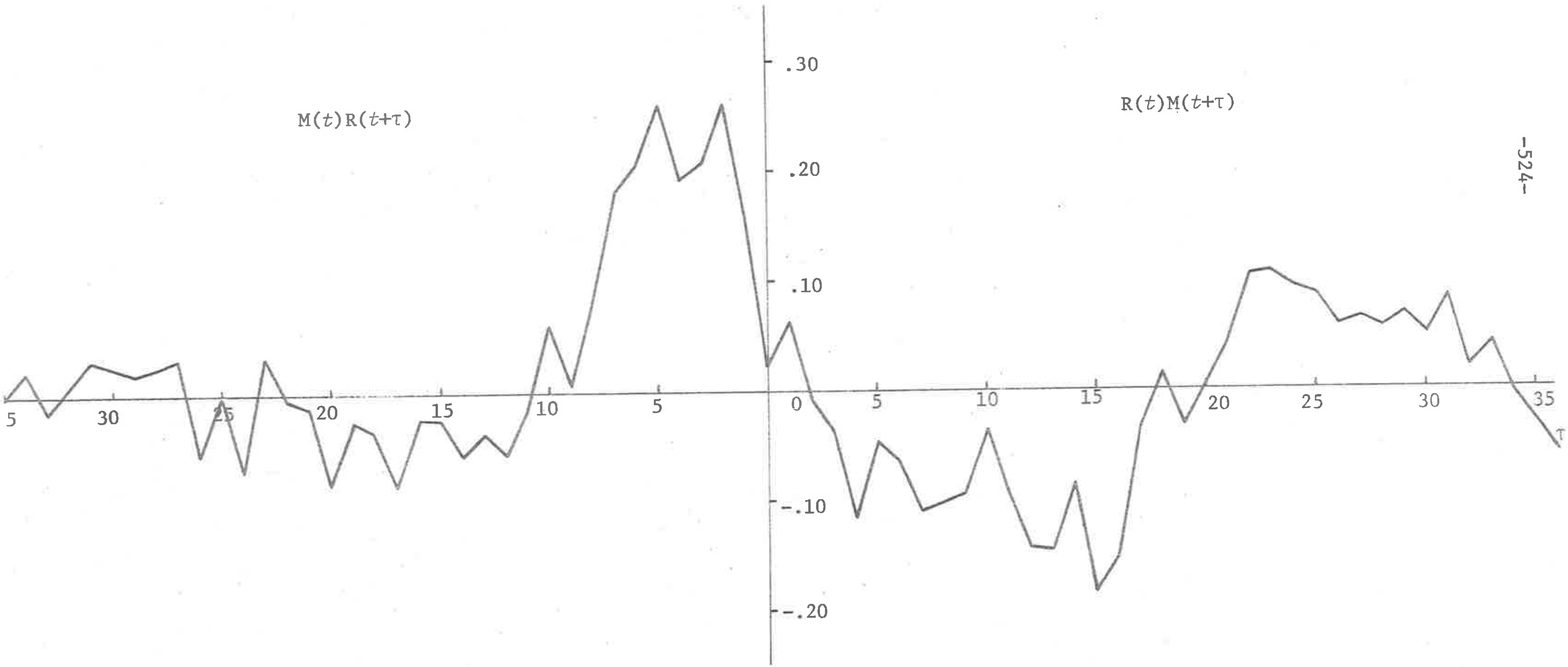
For illustrative purposes we consider the inter-relationship between M1 and the 3-month Treasury Bill rate. The phase shows that M1 leads interest rates by 52°, which compares closely with the 55° reported by M-S. With an $^{n}/_{m}$ ratio of 6 and a coherence of .4, we can see from Table 13.2 that by adding and subtracting 32° to the estimated phase angle gives the upper and lower 95 per cent confidence bands for the phase (in degrees), where the width of the band varies inversely with the coherency. In each instance, the lead is statistically significant. What does this lead imply in the time domain? One month is equivalent to $2\pi w$ degrees at the frequency w. For cycles with a period of 36 months, $w = {}^{1}/_{36}$ and one month is equivalent to ${}^{2\pi}/_{36} = 10°$. Thus the lead indicated is approximately 5 months.

Figure 15d shows the cross-correlation coefficients between the logarithmic first differences of these two series, and there is a relative maximum where M1 leads the 3 month Treasury Bill rate by 5 months. On this basis, we would interpret the sign of association between money and interest rates to be *positive*! On an inverted basis, it is apparent that interest rates lead money by between 12 and 15 months. However, the correlation coefficient is noticeably lower than the correlation on a positive basis.

Thus it would appear for all of the four series pairs summarized in the Table that the sign of association is the opposite of what we would expect from a direct relationship between these variables. These results parallel our findings with interest rates and the money supply in Australia.

FIGURE 15d

CROSS-CORRELOGRAM OF 3 MONTH TREASURY BILL RATE AND MONEY SUPPLY, M1, USING LOGARITHMIC FIRST DIFFERENCES OF SEASONALLY ADJUSTED DATA, JAN. 1952-DEC. 1969



What of the alternative study by Cagan? His use of the rate of change transformation has been hailed as providing the key which enables the interest rates and money supply inter-relationship to be observed for the first time. In a survey of the National Bureau's interest rate project, Conard (1966) described Cagan's study in the following terms:

> "In my view, a signal contribution of Cagan's work is the fact that he has developed strong empirical evidence confirming the kind of relation between money and interest rates that economists have long assumed must exist but have failed to demonstrate empirically ... ... Various past efforts to find empirical support ... have been thwarted by the fact that, in studies of the relation between the supply of money and interest rates, powerful demand influences have masked the supply side. Cagan's use of the rate of change of money supply, instead of the supply as a stock, has clearly revealed the influence we have long presumed and wanted to demonstrate."

Conard further ventured the opinion that "the close association between money behaviour and interest rates is not merely a reflection of the business cycle on each series, but is probably a genuine direct relationship".

From the timing relationships we have identified between the levels of money and interest rates it seems unlikely that the transformation of the money series into a rate of growth would provide appropriate timing relationships. The rate of change series necessarily leads the level by 90°, so that on an inverted basis interest rates ought to lead the rate of monetary growth by about 40°. This presumption appears to be borne out. Our test of the hypothesis involves crossing the logarithmic first differences of the money supply, M1, with the deviation of interest rates from their trend, calculated by a 47 month weighted moving average of the respective series. The results are set out in the lower panel of Table 15.3. For this transformation of the series, the cross-correlation coefficients indicates the association to be correctly negative. Some support for Cagan's hypothesis comes from the coherency, which is slightly higher than in the previous analysis. However, both the cross-spectral and the correlation analysis reveal that interest rates lead the money series. For the $^{n}/_{m}$ ratio and the estimated coherency, the 95 per cent confidence intervals for the phase angle is obtained by adding and subtracting 21° to the estimated phase. As interest rates lead money by between 35° and 49°, we can confidently reject the null hypothesis that the series are coincident in timing. Nor is this interest rate lead a feature of post-war years. From an inspection of the charts presented by Cagan an interest rate lead is evident in the inter-war period: of 5 reference peaks between 1920 and 1937, Treasury bill rates lead the monetary growth rate in 4 of the 5 observations; and bill rates lead money at 3 of the 5 corresponding reference troughs. Other rates also exhibit a tendency to lead money, casting doubt on Cagan's hypothesis.

These results are difficult to interpret in terms of a direct relationship between money and interest rates. A negative association between interest rates and money is suggestive of a movement along a downward sloping liquidity preference schedule, with interest rates leading money because the authorities are pegging the structure of interest rates and allowing the money supply to adjust passively to it. However, the demand for money is usually formulated in terms of an association between interest rates and the *stock* of money rather than its rate of growth, and we have shown that the stock of money is associated positively with interest rate cycles. This positive association is suggestive of a money supply function rather than a demand relationship, as commercial banks contract reserves and expand borrowings from the Federal Reserve system in response to higher rates on earning assets. But in these circumstances interest rates might be expected to lead money rather than exhibit a lagging relationship.

Thus the clear, direct relationship between money and interest rates apparently discovered by both Marcis and Smith and Cagan for the United States is found on close examination to exhibit exactly the same ambiguities which bedevilled our attempt to find such a link from the Australian time series. In both countries it would seem that a direct inverse relationship cannot be sustained because interest rates lead the money supply, rather than the reverse. Instead a positive association exists. This suggests the importance of the other factor mentioned by Conard, namely demand factors whereby increases in the demand for money raise interest rates and reductions in the demand for money lower interest rates. Accordingly in section V we investigate the relationship between the demand for money and interest rates.

Naturally we would expect elements of both the demand *and* the supply of money to influence interest rates, not just the demand or the supply separately. At this juncture it is worth anticipating the results of the next section by noting that we are able to combine elements of both in an explanation of interest rates behaviour.

Appendix to Chapter 15

Data sources: Australia

[1] All Ordinary Share Index (excluding Financial). Source of data is

1880-1936 Commercial and Industrial Index, D.McL. Lamberton, Security Prices and Yields, 1875-1955, Sydney Stock Exchange 1960.

1937-1955 All Ordinary Shares Index, from Lamberton, *Share Price Indices in Australia*, Law Book Co., Sydney 1958.

1956-1969 as above, Sydney Stock Exchange Gazette (various issues), classes 3-14.

[2] Financial Share Index. Source as for All Ordinary Index.

[3] Ordinary Share Yields. The dividend yield is calculated by expressing the paid or indicated dividend as a percentage of price, on all ordinary shares quoted on Sydney Stock Exchange.

1900-1955 From Lamberton (1960)

1956-1969 Sydney Stock Exchange Gazettes

[4] Bond yields. The long term series is calculated by linking the series of redemption yields for long term securities published by the Reserve Bank in its *Statistical Bulletin* with Lamberton's redemption yield series for New South Wales and Commonwealth government securities. The following rates are used, and spliced together to provide a continuous series on a common base:

1900-1925 Average redemption yield on all N.S.W. and Commonwealth Government issues maturing in more than six months.

1926-1940 Average redemption yield on (Commonwealth) government securities maturing in more than 10 years.

1941-1947 Theoretical redemption yield (12 years)

1948-1958 " " " (more than 10 years)

1959-1969 " " " (10 years)

[5] Long term bond yields, as above.

[6] Short-term bond yields. Theoretical redemption yield on 2 year securities, published by the Reserve Bank of Australia. After 1961, yields adjusted downwards by 0.13 per cent per annum brokerage to ensure continuity with earlier series.

United States

Money Supply.

M1 is currency held by the public plus adjusted demand deposits at all commercial banks. M2 includes time deposits other than large C.D's. Source: Federal Reserve Bulletin.

Interest Rates.

Four series are used: rates on 3-month Treasury bills, 9-12 month Treasury bills, 3-5 year Treasury bonds and long term Treasury bonds. Data from Federal Reserve Bulletin.

Section V

The Velocity of Money

Chapter 16

A Cross-Spectral Examination of Cycles in Velocity and Interest Rates*

Introduction

The income velocity of money in both the United States and Australia exhibits pro-cyclical behaviour, so that movements in velocity tend to reinforce cycles in money in explaining the path of income during the course of the business cycle, as well as adding a random element. A Keynesian sees this variability in velocity as providing the mechanism through which non-monetary forces contribute to cycles in income. For example, in the Hicks-Hansen model utilized in Chapter 11 an increase in autonomous expenditures with money held constant raises interest rates leading to an economizing on money balances, so that the increase in expenditure is 'financed' by an increase in velocity. Alternatively, there may be shifts in money demand instead of movements within the function, so that an increase in autonomous spending is matched by an autonomous reduction in cash balances demanded. In choosing between these explanations, the empirical question of the stability and interest elasticity of the demand for money function is relevant.

In 1959 Friedman challenged both of these explanations by arguing that the time series evidence failed to support the interest rate explanation of the behaviour of velocity, and by hypothesizing an alternative which involves neither interest rate changes nor shifts in the demand for money function.

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* An article based upon this and the next chapter has been accepted for publication in the Economic Record.

Friedman's Views on Velocity

Friedman's analysis is based on the demand for money in the total asset portfolio, consisting of the four assets specified in the previous chapter: money, bonds, equities and physical assets. In Chapter 15 we assumed the nominal yield on money to be zero and the return on holding physical assets compared with money is $\frac{1}{P}\frac{dP}{dt}$, the expected rate of inflation. The return on bonds was shown to be

$$r_b(0) + \frac{\frac{d}{dt}\left[\frac{1}{r_b(t)}\right]}{{}^1/r_b(0)} .$$

This equals

$$r_b(0) - \frac{r_b(0)}{r_b{}^2(t)} \cdot \frac{d\, r_b(t)}{dt}$$

which is approximately equal to

$$r_b - \frac{1}{r_b} \frac{d\, r_b}{dt} \qquad (16\text{-}1)$$

at time zero. The return on equities was shown to be

$$r_E(0) \cdot \frac{P_t}{P_0} + \frac{\frac{d}{dt}\left[\frac{1}{r_E(t)} \cdot \frac{P_t}{P_0}\right]}{{}^1/r_E(0)}$$

This equals

$$r_E(0)\ \frac{P_t}{P_0} + \frac{r_E(0)}{P_0}\ \frac{d}{dt}\ [\ \frac{P_t}{r_E(t)}\ ]$$

$$= r_E(0)\ \frac{P_t}{P_0} + \frac{r_E(0)}{r_E(t)} \cdot \frac{1}{P_0}\ \frac{dP}{dt} - \frac{P_t}{P_0} \cdot \frac{r_E(0)}{[r_E(t)]^2}\ \frac{d\ r_E(t)}{dt}$$

which is approximately equal to

$$r_E + \frac{1}{P}\frac{dP}{dt} - \frac{1}{r_E}\frac{d\ r_E}{dt} \qquad (16\text{-}2)$$

at time zero. If we assume that

$$\frac{d\ r_b}{dt} = \frac{d\ r_E}{dt} = 0$$

then we can combine the elements into a demand for money function

$$M = P\ .\ f(y,\ r_b,\ r_E,\ \frac{1}{P}\frac{dP}{dt}) \qquad (16\text{-}3)$$

where M = nominal money balances

P = price level

y = real income scalar.

If we also assume that the demand for real money balances, $^M/_P$, is unit elastic with respect to real income, then by defining $Y = yP$, we obtain

$$M = Y\ .\ f(r_b,\ r_E,\ \frac{1}{P}\frac{dP}{dt}) \qquad (16\text{-}4)$$

which can be written also as

$$\frac{M}{Y} = f(r_b, r_E, \frac{1}{P}\frac{dP}{dt}) \quad (16\text{-}4a)$$

$$= {}^1/V\ (r_b, r_E, \frac{1}{P}\frac{dP}{dt}) \quad (16\text{-}4b)$$

In the form (16-4b), the income velocity of money is related to the cost of holding money as given by the return on bonds, equities and physical goods respectively.

As in any demand analysis, the actual observations of the income velocity of money, $^Y/_M$, can be subdivided into three components: (a) movements along a function such as (16-4b) produced by changes in r_b, r_E, and $\frac{1}{P}\frac{dP}{dt}$; (b) shifts in the demand schedule; and (c) disequilibrium positions where actual balances depart from desired balances. Friedman attempted to determine to what extent the cyclical behaviour of velocity could be accounted for by (a) alone. As measures of the cost of holding money, Friedman employed the commercial paper rate, the corporate bond yield, the yields on long term and short term government bonds, and the rate of change of wholesale prices. The data on income velocity was annual and the period 1870-1954 was examined.

Two factors led Friedman to assign interest rates a minor role in explaining the cyclical behaviour of the velocity of money. First, his regression analysis using cyclically averaged data led him to attribute the secular decline in velocity to the growth in real income per capita, treating money as a 'luxury' good. Measures of the cost of holding money appeared to play no role in this trend relationship: interest rates bore the correct sign but were statistically insignificant; and the rate of change of prices bore no discernible relationship to velocity. Hence the interest elasticity of the demand for money seemed insufficiently high to account for cyclical movements in velocity. Secondly, he observed that the cyclical pattern of interest rates failed to conform with that of velocity. Interest rates exhibited nowhere near as consistent a pattern from cycle to cycle as did velocity. More significantly, interest rates appeared to *lag* velocity: whereas the turning points in velocity corresponded with the National Bureau of Economic Research chronology of general business activity, interest rates were out of phase, lagging at both peaks and troughs. The pattern existed both for short term and long term rates, though the lag for short term rates was much shorter than for the long rates. He concluded

> "... interest rates display cyclical patterns that seem most unlikely to account for the sizeable, highly consistent, and roughly synchronous cyclical pattern in velocity."

Friedman's own explanation downplayed the role of interest rates, and related money demand to 'permanent' values of prices and incomes, viewing the cyclical swings in velocity as a statistical illusion produced as the magnitudes used to measure velocity depart from their permanent counterparts. 'Permanent' income was estimated as a weighted average of past incomes, the weights being obtained from his earlier analysis of consumption (Friedman, 1957). There is no independent evidence that expectations about income are formed adaptively from the past, nor that the measure is appropriate for monetary behaviour; permanent income may be merely a smoothing device. Friedman's test procedure, which led him to reject interest rates and seek out this alternative explanation, relied on relatively crude methodology and data. It is now widely recognized that the N.B.E.R. methods he employed use relatively little of the information available in a time series. Also, in view of the emphasis Friedman placed upon the timing differences between the series, his reliance upon annual observations of velocity and upon evidence at turning points seems unduly restrictive.

Criticisms of Friedman's analysis centred upon his secular money demand function and the implied estimate of the interest elasticity rather than these statistical deficiencies. Laidler (1966 and 1969) argued that in attributing the secular decline in velocity from 1870-1954 solely to income, and ignoring the secular fall in interest rates which occurred during the first half of this century, Friedman assigned too much of the cyclical behaviour of velocity to the distinction between permanent and measured income, and too little to interest rates. Inclusion of interest rates with permanent income was found to improve both the secular regression using cycle average data and 'ex post' predictions of annual real per capita money holdings. Most other researchers have accepted these criticisms and employ some measure of interest rates in their empirical work on the demand for money, thus implicitly explaining the cyclical variability of velocity in terms of the cost of holding money.

Friedman (1972 and 1973) now accepts that interest rates exert a significant influence upon velocity movements. From an examination of velocity trends in both the U.S. and the U.K., he concedes that the 30 or 40 years prior to 1906 was over-emphasized in his previous analysis; accordingly, the secular decline in velocity should have been attributed to changing financial institutions and structures and not to an elastic response to income. It follows that the shorter term movements in money balances and velocity must be attributed to variables *other than* real income. Measures of the cost of holding money are the obvious candidate and in conjunction with Anna Schwartz (1975) he has estimated long run demand for money functions with interest rate elasticities of -.23 and -.35.

This is a surprising change of face for a man who is enthroned in text books as the principal proponent of a vertical LM curve. His new explanation of the pro-cyclical behaviour of velocity is nothing short of startling. It is contained in his "Monetary Theory of Nominal Income" (Friedman, 1971), the key elements of which are:

(i) A unit elasticity of the demand for money with respect to real income, giving a demand for money function of the form of (16-4) above, *viz.*

$$M_d = Y \,.\, l(r) \tag{16-5}$$

(ii) A nominal market interest rate equal to the anticipated real rate plus the anticipated rate of change of prices, kept at that level by speculators with firmly held anticipations,

$$r = \rho + \left(\frac{1}{P}\frac{dP}{dt}\right)^* \tag{16-6}$$

(iii) Full and instantaneous adjustment of the amount of money demanded to the amount supplied; that is,

$$M_d = M \tag{16-7}$$

Combining (16-5), (16-6) and (16-7) we obtain

$$\frac{M}{Y} = l\left[\rho + \left(\frac{1}{P}\frac{dP}{dt}\right)^*\right] \tag{16-8}$$

This model introduces a procyclical movement in velocity which is "an alternative or complement to" the approach he followed in his 1959 article.

> "... the procyclical pattern of velocity ... can be rationalized either by the distinction between permanent and measured income or, as in the monetary approach, by the effect of changes in the anticipated rate of changes of prices." (1971, p. 46)

Friedman did not sketch out the mechanism fully, but presumably we are led to believe that it runs as follows. An upswing in money generates the expectation of a higher growth rate of nominal income, or, what is equivalent, a higher expectation of inflation, seeing that the secular rate of growth is determined exogenously (by assumption). Speculators with "firmly held anticipations" ensure that this expectation is written into nominal interest rates, lowering the ratio of money to income and raising velocity through (16-8).

Friedman stresses that this explanation of the behaviour of velocity is merely a hypothesis, but it is one that "rings the bell", and is "consistent with many of our findings" (1971, p. 46). It is not without its problems. The one mentioned by Friedman is the lags in the reaction of velocity and interest rates at turning points in monetary rates of change.

> "We know that when the rate of growth of the quantity of money declines, the rate of growth of income will not show any appreciable effect for something like six to nine months (for the United States) on the average. During this interval, interest rates continue to rise, indeed generally at an accelerated pace."

This puzzle is, of course, the one we have already noted in the previous chapter. There we found that in both the U.S. and Australia the rate of change of interest rates lagged the rate of change of money when the series are interpreted as being related on a positive basis. (An equivalent statement is for the level of interest rates to lag the level of money on a positive relationship.) Clearly Friedman's analysis does not help us to solve this problem.

The problem *not* mentioned by Friedman is how we are to reconcile his latest work with his earlier analysis. Permanent income only came into the story because cycles in interest rates failed to conform in regularity or timing with cycles in velocity. If interest rates are now to be a significant factor determining velocity, how are we to account for the puzzling differences in timing which Friedman then observed? Are the timing patterns still in evidence in the U.S.? Is a similar pattern of behaviour exhibited in the Australian data? Are cycles in velocity and interest rates significantly associated, or does the Australian evidence support Friedman's original contention that the two are largely unrelated? These are the questions we pursue in this chapter by an extensive examination of the velocity of money and the cost of holding money in Australia. Having introduced time series evidence of the relationship between money and interest rates in the U.S. in the previous chapter, and having cast doubt upon the adequacy of Friedman's explanation of matters, it also behoves us to examine the U.S. data as well.

Nature of Analysis and Choice of Variables

Our examination of the Australian and U.S. time series evidence uses cross-spectral analysis. Given that the question is one of the *cyclical* behaviour of velocity, the evidence from regression analysis is indirect. The typical spectral shape of an economic variable has peaks at the low frequencies corresponding to trend and long run fluctuations, and undoubtedly these frequency bands dominate the parameter estimates of standard regression analysis. Consequently the time series evidence rests largely on the presumption that the same model carries over equally to all frequency bands. It would seem preferable to test directly for the existence of a relationship between velocity and interest rates over the frequencies corresponding to the conventional business cycle. Cross-spectral analysis provides such direct information about the association of velocity and interest rates at the cyclical frequencies of oscillation. At the same time, the lead-lag relationship can be studied in a powerful way. It would seem to be ideal, yet this is the first time that it has been used in a study of the demand for money!

It is now necessary to select measures of velocity and the cost of holding money appropriate for the analysis.

Australian data. Friedman examined the time period 1870-1954 for the U.S. and a time series of comparable coverage was sought for Australia. An annual series of the income velocity of money can be constructed commencing from 1880, but as the interest rate series before 1900 are sometimes sketchy and as Friedman now considers the period after 1905 to be the most amenable to statistical analysis, the study was limited to the twentieth century. By combining official and unofficial estimates of national income, it is also possible to construct a quarterly velocity series commencing at 1950. However, these two series hardly constitute a rich source of material for the application of time series methods.

Data on deposit turnover provides us with a sensitive indicator of velocity movements over the business cycles, as well as having claims for consideration in its own right from the viewpoint of the transactions demand for money, for which a measure of total money disbursements seems appropriate. There is also some doubt as to whether income is the appropriate constraint for a study of business firms' holdings of money, and measures of transactions based on bank debits have been suggested as a possible substitute.[1] Three additional measures of velocity are provided by the turnover series:

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[1] See Enzler, Johnson and Paulus (1976).

a quarterly series covering the period 1902-1968 (using bank clearings), and a monthly series in the post-war years for the turnover of both trading (commercial) bank and savings bank deposits (using bank debits and withdrawals respectively). Table 16.1 provides a summary of the various velocity measures employed.[2]

As measures of the cost of holding money we sought at least one, and preferably more, interest rate series and a proxy of the expected rate of inflation. In view of the number of velocity measures employed, some limitation of the measures of the opportunity cost of holding money balances is in order. Table 16.2 is designed to provide some basis for a selection in the form of simple and partial correlation coefficients between five measures of velocity and various interest rate series, using annual data over the period 1900-1971 for the income velocity series and 1902-1968 for the turnover series. Bond yields and bank deposit rates are clearly related to the velocity series. The addition of savings bank deposit rates to form a weighted average of the various bank deposit rates fails, however, to improve the correlations obtained. The fourth and fifth interest rates relate to the return from holding equities, but these are less closely correlated with velocity. Item 6 is included in order to examine whether the demand for money relative to income is related to $(r - r^*)$, where r is the current interest rate and r^* is the interest rate which moneyholders expect to prevail, formed adaptively from past current rates. Friedman (1971) considers this to correspond to the liquidity preference function which Keynes had in mind. Finally, we relate velocity to three measures of

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2 The series on bank clearings, debits, income and money are the same as were used in Chapter 14.

TABLE 16.1

MEASURES OF VELOCITY EMPLOYED IN THE STUDY

Period covered	Numerator	Denominator	Code used
Annual 1900/01-1970/71	Gross domestic product and National Income	Currency plus non-interest bearing deposits (M1)	V_1 GDP or NY
	"	As above, plus interest bearing deposits (M2)	V_2 GDP or NY
	"	As above, plus savings bank deposits	V_3 GDP or NY
Quarterly 1950_3-1971_4	Gross domestic product	Notes plus non-interest bearing deposits (M1A)	V_{1A}
	"	M1A plus interest bearing deposits (M2A)	V_{2A}
	"	M2A plus savings bank deposits	V_{3A}
Quarterly 1902-1968	Bank clearings for Sydney and Melbourne	Non-interest bearing deposits	CDTURN
	"	Total trading bank deposits	TDTURN 1
Monthly 1946-1971	Debits to trading bank accounts excluding government accounts	Current deposits, excluding government deposits	DDTURN
	"	Total deposits, excluding government deposits	TDTURN 2
	"	Total deposits plus advances, excluding government	DATURN
Monthly 1956-1971	Withdrawals from cheque accounts at savings banks	Balances in cheque accounts at savings banks	SCTURN
	Withdrawals from all other accounts at savings banks	Balances in all other accounts at savings banks	SOTURN

TABLE 16.2

SIMPLE AND PARTIAL CORRELATION OF COEFFICIENTS BETWEEN MEASURES OF VELOCITY AND THE COST OF HOLDING MONEY,* 1900-1971

Measure of Cost of holding money	Velocity of M1	Velocity of M2	Velocity of M3	Turnover of Current Deposits	Turnover of Total Deposits
1. Bond yields	.34†	.48†	.38†	.40†	.34†
2. Interest-bearing deposit rate	.73	n.a.	n.a.	.52†	n.a.
3. Interest-bearing and savings deposit rate	.70†	n.a.	n.a.	.34†	n.a.
4. Dividend yield on equities	.20	.16	.15	.01	.03
5. Total yield on equities	.02	.10	.13	.14	.19
6. Current minus 'expected' bond yield	-.04	-.18	.35†	-.17	.09
7. Rate of change of consumer prices	-.38	.04	-.01	-.28	.02
8. Rate of change of wholesale prices	-.41	-.18	-.14	-.38	-.06
9. Bond yield minus dividend yield	.22	.50†	.17	.50†	.54†

Notes to Table 16.2

† Indicates that the correlation is statistically significant and bears the correct sign of association.

* The measures used to represent the cost of holding money are:

1. Bond yields.

Calculated by linking the series of redemption yields for long term securities published by the Reserve Bank in its *Statistical Bulletin* with Lamberton's redemption yield series for New South Wales and Commonwealth government securities in *Security Prices and Yields, 1875-1955*, Sydney Stock Exchange, 1960.

Notes to Table 16.2 *continued*

2. IBD rate.

   This is a weighted average of rates quoted for time deposits of different terms, over the year, according to the formula:

   $$r_T = 0.10 \text{ (3 month rate)} + 0.10 \text{ (6 month rate)} + 0.20 \text{ (12 month rate)} + 0.60 \text{ (24 month rate)}$$

   These weights are based on an average of the distributions by term for the years 1926 to 1936, 1952 and 1960. The interest rates were obtained from *Finance Bulletin* and from Reserve Bank of Australia, *Statistical Bulletin* (various issues).

3. A weighted average of 2 and the savings bank deposit rate. The latter is the average rate actually paid on savings bank deposits, calculated by dividing total interest payments for cash year by average depositors' balances for the year. Data from *Finance Bulletin* and *Banking and Currency Bulletin* (various issues).

4. Dividend yield. Calculated by expressing the paid or indicated dividend as a percentage of price, on all ordinary shares quoted on Sydney Stock Exchange. Source: D. McL. Lamberton, *Share Price Indices in Australia* (Sydney, Law Book Co., 1958) and *Sydney Stock Exchange Gazette* (various issues).

5. The total yield on equities takes account of capital appreciation and depreciation as well as dividend payments. Calculated by adding the first difference of the share prices index to the product of the dividend yield and the index, and then dividing this sum by the index to obtain a total yield. This follows the method of Selden (1956).

6. The difference between bond yields and 'expected' bond yields, where the latter is calculated as a weighted average of current and previous years. The weight for the current year is 0.337 and decline exponentially over eleven years, this weighting pattern being derived from calculation of permanent income.

7. Rate of change of the linked index of retail prices published by Commonwealth Statistician.

8. Rate of change of Melbourne index of wholesale prices.

9. 1 minus 4.

the (expected) rate of change of prices. The measures are defined in the notes to the Table.

As measures of the cost of holding money relative to financial assets we select government bond yields and interest bearing deposit rates. A series of redemption yields on long term bonds is available from 1900 on a monthly basis by linking the official Reserve Bank of Australia series with Lamberton's private estimates (see Appendix to Chapter 15). The only other interest rates available for this period are trading banks' interest bearing deposit rates. These rates were predominant in the Australian interest rate structure in pre-war days, and in post-war years have been adjusted as part of monetary policy in line with competing interest rates. In view of the interdependence between bank and other interest rates, the interest bearing deposit rate is used as an indicator of the behaviour of interest rates in general. These series are supplemented in post-war years by the yields on short dated (2 year) government securities. The return on savings bank deposits is deducted from short term and long term bond yields for the analysis of the turnover of savings deposits.

The measure of the expected rate of change of prices selected is bond yields minus the dividend yield, the rationale for which comes from comparing (16-1) and (16-2). If a *constant* risk premium (ψ) is demanded by wealthholders to render equities and bonds equivalent, then arbitrage will make

$$r_b - \frac{1}{r_b}\frac{d\,r_b}{dt} = r_E - \frac{1}{r_E}\frac{d\,r_E}{dt} + \frac{1}{P}\frac{dP}{dt} - \psi.$$

If we assume

$$\frac{1}{r_b}\frac{d\,r_b}{dt} = \frac{1}{r_E}\frac{d\,r_E}{dt}$$

then

$$r_b - r_E = \frac{1}{P}\frac{dP}{dt} - \psi$$

Changes in the differential between bond yields and the current dividend or earnings yield, $(r_b - r_E)$, are presumed to indicate the market's anticipations about inflation, $\frac{1}{P}\frac{dP}{dt}$. Empirical work for Australia provides support for this presumption.[3] This measure also has the advantage of being derived from market behaviour, and does not rely on some arbitrary weighting of past inflation rates.

U.S. data. Our objective with the data for the U.S. is the more limited one of establishing whether the timing patterns discerned by Friedman in 1959 carry over into the post-war years. Friedman suggested that further research on this point use monthly data and indicators of velocity, and we examine the post-Accord period 1952-1969. The first monthly indicator of velocity uses industrial production as a proxy for income to calculate the velocity of both the M1 ($^{I}/_{M1}$) and M2 ($^{I}/_{M2}$) definitions of money. The second measure calculates these velocities in value terms by employing the product of the index of industrial production and the index of wholesale

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3 It can be adduced from Smith (1974) that the differential between short term bond yields and the dividend yield on equities is functionally related to price movements and the unemployment rate. From the studies by Helliwell, Sparks and Frisch (1973) and Carmichael and Norman (1975) the differential between long term bonds and equities appears to move with various measures of price expectations and foreign equity yields.

prices in the numerator ($^{IP}/M1$, $^{IP}/M2$ respectively). Three measures of deposit turnover are also used for the analysis, these being the turnover of demand deposits (DTURN) in New York, six major financial centres, and in the 226 other reporting areas. As measures of the cost of holding money we use the rates on 3 month and 9-12 month Treasury bills, and the rates on 3-5 year and long term Treasury bonds.[4]

Spectra of Series

Features of the spectra of the Australian series are summarized in Table 16.3. Where the interest rate series (such as government bond yields) have featured in the previous analysis, the information is not recorded. All series for which it was possible to do so[5] were first transformed to natural logarithms to render the variance more stationary, and the moving averages employed in previous chapters to filter trends in mean were used. Data on deposit turnover and velocity in quarterly or monthly form employed the seasonally adjusted data of Chapter 14. As before, in estimating the spectra, the number of lags, m, was varied to ensure an $^{n}/_{m}$ ratio between 4

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4 The sources of the interest rate series were given in Chapter 15. Those for the other series are:

Income Proxies.

The proxy for real income is the index of industrial production (total index grouping), and for prices the index of wholesale prices is used. Both series are adjusted to the base 1967 = 100 and are from Federal Reserve Bulletin.

Deposit Turnover.

Three series of the turnover of demand deposits is used: New York city, 6 other major financial centres and the remaining reporting centres. The latter is calculated by splicing the series for 226 other SMSA's prior to 1964 with the series for 337 other SMSA's. All series from Federal Reserve Bulletin.

5 As the series $r_b - r_E$ has some negative values the logarithmic transform could not be applied (nor to the series crossed with it in later analysis).

TABLE 16.3

SUMMARY OF SPECTRA AND AUTOCORRELATIONS OF MEASURES OF VELOCITY AND INTEREST RATES

Series	Nature of data	Data points	No. of lags	$^n/_m$	Location of Spectrum Peaks	Per cent of variance explained by: Peak band and 2 adjacent frequencies	Per cent of variance explained by: All business cycle frequencies	Autocorrelation diagram
Deposit Turnover, CDTURN	1902-1968 quarterly	243*	48	5.06	(i) 41 months (ii) 18 months	26.51 6.08	75.8	Peak at 39 months
TDTURN 1	"	"	"	"	72 months	30.79	76.4	Peak at 81 months
Interest Bearing Deposit Rate - IBD	"	"	"	"	(i) 48 months (ii) 14.4 months	42.44 2.00	84.87	Peak at 51 months
Bond minus Share Yields - $(R_B - R_E)$	"	"	"	"	(i) 48 months (ii) 18 months (iii) 12.5 months	30.98 4.77 2.76	79.27	48 months
Deposit Turnover, DDTURN	1946-1971 monthly	253*	48	5.27	32 months	20.17	33.33	25, 34 and 48 months
TDTURN 2	"	"	"	"	48 months	28.38	43.39	42 and 48 months
DATURN	"	"	"	"	48 months	34.85	48.74	35 and 37 months
Deposit Turnover, STTURN	1956-1971 monthly	145*	36	4.03	36 months	23.46	37.84	3, 23, 26, 29 and 32 months
SCTURN	"	"	"	"	24 months	33.26	43.96	3, 20, 23, 26 months
SOTURN	"	"	"	"	36 months	21.42	29.84	3, 23, 32 months
Income Velocity,								
V_1^{GDP}	1901-1971 yearly	62*	12	5.2	12 years	52.99	-	-
V_2^{GDP}	"	"	"	"	12 years	54.46	-	12 years
V_3^{GDP}	"	"	"	"	12 years	55.59	-	-
V_1^{NY}	"	"	"	"	12 years	46.80	-	-
V_2^{NY}	"	"	"	"	.12 years	47.01	-	12 years
V_3^{NY}	"	"	"	"	12 years	51.23	-	-
Income Velocity,								
V1A	1951-1971 quarterly	64*	16	4.0	48 months	59.11	79.55	45 months
V2A	"	"	"	"	48 months	61.31	83.81	45 months
V3A	"	"	"	"	48 months	55.99	80.12	42 months

and 6 after filtering, and Parzen II weights were employed.

From an inspection of the spectra it would seem that the cyclical behaviour of velocity is a problem worthy of analysis, for the measures of velocity exhibit considerable power in the vicinity of cycles of reference cycle duration.[6] For example, deposit turnover for the period 1902-1968 has peaks over the frequencies with period ranging from 3.5-6 years. So do interest rates, and the preconditions at least exist for interest rates to 'explain' the cyclical behaviour of velocity. In post-war years, both deposit turnover and income velocity show peaks at frequencies with a period of 4 years, providing some measure of confirmation of the reliability of deposit turnover as a proxy of velocity movements on a monthly basis. Savings bank deposit turnover has considerable power at a cycle of 3 months which may be connected with payment of social welfare cheques, indicating the importance of these deposits as a temporary store of purchasing power.

When annual income velocity is examined, the evidence for reference cycle fluctuations is less clear. The annual series are dominated by long swings of 12 years in duration. An inspection of the relevant time series indicates that secular behaviour of velocity and interest rates in Australia and in the U.S. as well, is dominated by several large movements. Both fell during the 1930's and 1940's and rose in the post-war years. The dominance of these very long term movements reduces the effective degrees of freedom in the data and makes the standard statistical tests employed in regression methods less impressive. Spectral analysis is able to take this into account,

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6 For a contrary view see Gould and Nelson (1974). This has been strongly criticized by Schwartz (1975).

and the advantage of using cross-spectral to examine the inter-relationship of the series is underlined.

Inter-relationships Between the Series

The hypothesis under examination relates cycles in velocity directly to cycles in interest rates. Obviously we expect the series to exhibit a significant coherence. What of the timing relationships between the series? For our purposes, the demand for money functions (16-4a) and (16-5) can be expressed as:

$$[\frac{M}{Y}]^*_t = a_0 + a_1 r_t \qquad (16\text{-}9)$$

On the assumption that transactors in aggregate are always on their demand curve, we can interpret the observations of velocity as movements along such a demand curve (Friedman's first element). This is the assumption usually made when annual data is employed in studies of the demand for money. In this case we should expect the series to be *coincident* in their timing relationships.

When semi-annual or quarterly data is used, transactors are normally assumed to be on a 'short run' demand curve. Either as in Friedman's model the interest rate entering the demand function is an expected one, perhaps formed adaptively from past rates; or alternatively, adjustment costs and transactors' inertia prevent there being a rapid attainment of equilibrium. In the latter case,

$$[\frac{M}{Y}]_t - [\frac{M}{Y}]_{t-1} = \theta \left([\frac{M}{Y}]^*_t - [\frac{M}{Y}]_{t-1} \right) \quad 0<\theta<1 \qquad (16\text{-}10)$$

and,

$$[\frac{M}{Y}]_t = a_0\theta + a_1\theta\, r_t + (1 - \theta)\ [\frac{M}{Y}]_{t-1} \qquad (16\text{-}11)$$

where (16-10) indicates that there is a partial adjustment of (short run) demand and supply to the long run level determined by the interest rate setting in (16-9), and (16-11) is the reduced form. In this limited sense, account is taken of Friedman's third element in demand analysis. It is clear that the hypothesis now embodied in the model is that velocity *lags* movements in interest rates. Depending upon whether model (16-9) or (16-11) is relevant we should expect the phase diagram to provide evidence either that velocity and interest rates are coincident, or that velocity lags interest rates.

Australian results. Altogether 48 series pairs are crossed, and Table 16.4 provides a summary of the results. As compared with the analysis in the previous chapters, considerable interest attaches to the relative amplitude of the series, as revealed by the gain statistic, in view of the continuing debate about the interest rate response of velocity. In constructing the Table, we record those frequencies for which coherence is relatively "high" along with the maximum coherence in that band and the associated gain statistic treating interest rates as the independent variable. When the gain is estimated from logarithmic values of the two processes, as is the case here, there is affinity with the concept of elasticity, computed by lagging the independent variable by the amount estimated in the cross-spectral phase diagram. Particular attention is again given to the nature of the lead-lag relationship by fitting the three models of angle lag, time lag and combined angle and time lag to the phase diagram, and the results are

Table 16.4

Summary of Cross-Spectral and Cross-Correlation Analysis Between Measures of Velocity and the Cost of Holding Money

Velocity or Turnover series	Measure of Cost of Holding Money employed	Nature of data	Period of cycles where coherence relatively high	Maximum Coherence	Gain	Summary of Phase diagram	Cross-Correlation analysis
CDTURN	Bond yields	1902 - 1968 quarterly	4.8 - 6.0 years	.232	.313	Fixed angle *lead* of 30.4° (t = 6.75)	Turnover leads with peak at 3 quarters
			2.7 - 3.0 years	.291	.442		
TDTURN 1	"	"	4.0 - 8.0 years	.400	.482	Fixed angle *lead* of 46.7° (t = 7.06)	Turnover leads by 3 quarters
CDTURN	Interest bearing deposit rate	"	6 years	.244	.298	Fixed angle *lead* of 41.2° (t = 10.56)	Turnover leads by 3 quarters
			2.7 - 3 years	.286	.401		
TDTURN 1	"	"	4.0 - 12.0 years	.524	.428	Fixed angle *lead* of 56.5° (t = 8.16)	Turnover leads by 4 quarters
CDTURN	Bond yields minus dividend yields	"	8.0 - 12.0 years	.216	.618	Complicated: at these frequency bands *lag* of 117.5°	Turnover lags with peaks at 5 and 12 quarters
TDTURN 1	"	"	2.4 - 4.8 years	.251	.311	Mixed model: turnover has a fixed angle *lag* of 75.2° and fixed time *lead* of 1.4 quarters (F = 6.07). At the frequency band indicated there is a *lag* of 46.0°	Turnover lags with peaks at 1 and 3 quarters
DDTURN	Long-term bond yields	1946 - 1971 monthly	4.0 - 8.0 years	.360	.215	Fixed angle *lead* of 68.1° (t = 9.21)	Turnover leads with peaks at 8 and 20 months
TDTURN 2	"	"	2.7 - 8.0 years	.312	.355	Fixed angle *lead* of 93.8° (t = 9.09)	Turnover leads with peaks at 8 and 20 months
DATURN	"	"	2.0 - 8.0 years	.401	.378	Complicated. Average *lead* of 108.3° over these bands	Turnover leads by 16 - 18 months
DDTURN	Short-term bond yields	"	4.0 - 8.0 years	.140	.085	Fixed angle *lead* of 57.6° (t = 5.59)	Turnover leads with peaks at 16 and 21 months
			1.14 - 1.6 years	.185	.098		
TDTURN 2	"	"	1.33 - 8.00 years	.463	.221	Fixed angle *lead* of 84.7° (t = 6.89)	Turnover leads with peaks at 6 and 20 months
DATURN	"	"	little relationship			Fixed angle *lead* of 78.2° (t = 13.77)	Turnover leads by 20 months
DDTURN	Long-term bond yields minus dividend yields	1954 - 1971 monthly	6 years	.150	.661	Turnover *lags* at this frequency band by 22.2°	Turnover lags by 5-6 months
TDTURN 2	"	"	1.5 - 6 years	.322	.992	Fixed angle *lag* of 64.4° (t = 13.75)	Turnover lags by 5 months

Table 16.4 (continued)

Velocity of Turnover Series	Measure of Cost of Holding Money employed	Nature of data	Period of cycles where coherence relatively high	Maximum Coherence	Gain	Summary of Phase diagram	Cross-Correlation analysis
DATURN	Long-term bond yields minus dividend yields	1954 - 1971 monthly	2 - 6 years	.248	.577	Complicated. If anything a fixed time *lag* of 6.1 months (t = 3.50)	Turnover lags by 6 months
DDTURN	Short-term bond yields minus dividend yields	"	3 - 6 years	.240	.713	Fixed angle *lag* of 41.1° (t = 5.95)	Turnover lags by 3 months
TDTURN 2	"	"	1.5 - 6 years	.337	.878	Fixed angle *lag* of 7.3° (t = 1.42)	Coincident
DATURN	"	"	3.0 - 6 years	.280	.566	Turnover *lags* at this frequency by 61.7°	Turnover lags by 5 - 8 months
SCTURN	Long-term bond yields	1956 - 1971 monthly	1.2 - 6.0 years	.358	.674	Fixed angle *lead* of 11.9° (t = 2.47); or fixed time *lead* of .76 months (t = 2.65) fit equally well	Turnover leads by one month at most
SOTURN	"	"	1.5 - 6.0 years	.494	.541	Fixed angle *lead* of 32.8° (t = 12.56)	Turnover leads by 3 months
SCTURN	Short-term bond yields	"	1.2 - 6.0 years	.519	.446	Fixed angle *lag* of 10.1° (t = 4.65)	Coincident
SOTURN	"	"	0.86 - 6.0 years	.761	.421	Mixed model: fixed angle *lead* of 38.0° and a fixed time *lag* of 1.3 months (F = 170.8)	Coincident
SCTURN	Long-term bond yields minus savings deposit rate	"	1.0 - 6.0 years	.206	.239	Mixed model: fixed angle *lag* of 50.1° and fixed time *lead* of 2.6 months (F = 25.8)	Turnover lags by 1 month
SOTURN	"	"	1.2 - 6.0 years	.636	.293	Fixed angle *lead* of 5.8° (t = 8.29)	Coincident
SCTURN	Short-term bond yields minus savings deposit rate	1956 - 1971 monthly	1.0 - 6.0 years	.336	.130	Fixed angle *lag* of 18.7° (t = 9.45)	Coincident
SOTURN	"	"	1.2 - 6.0 years	.836	.128	Mixed model: fixed angle *lead* of 20.2° and fixed time *lag* of 1 month (F = 38.0)	Coincident
SCTURN	Long-term bond yields minus dividend yields	"	1.5 - 3.0 years	.333	.790	Complicated. Over frequency band *lag* of 45.0°	Turnover lags by 9 months
SOTURN	"	"	1.5 - 6.0 years	.532	.084	Over these frequency bands, average *lag* of 114°	Turnover lags by 8-10 months

Table 16.4 (continued)

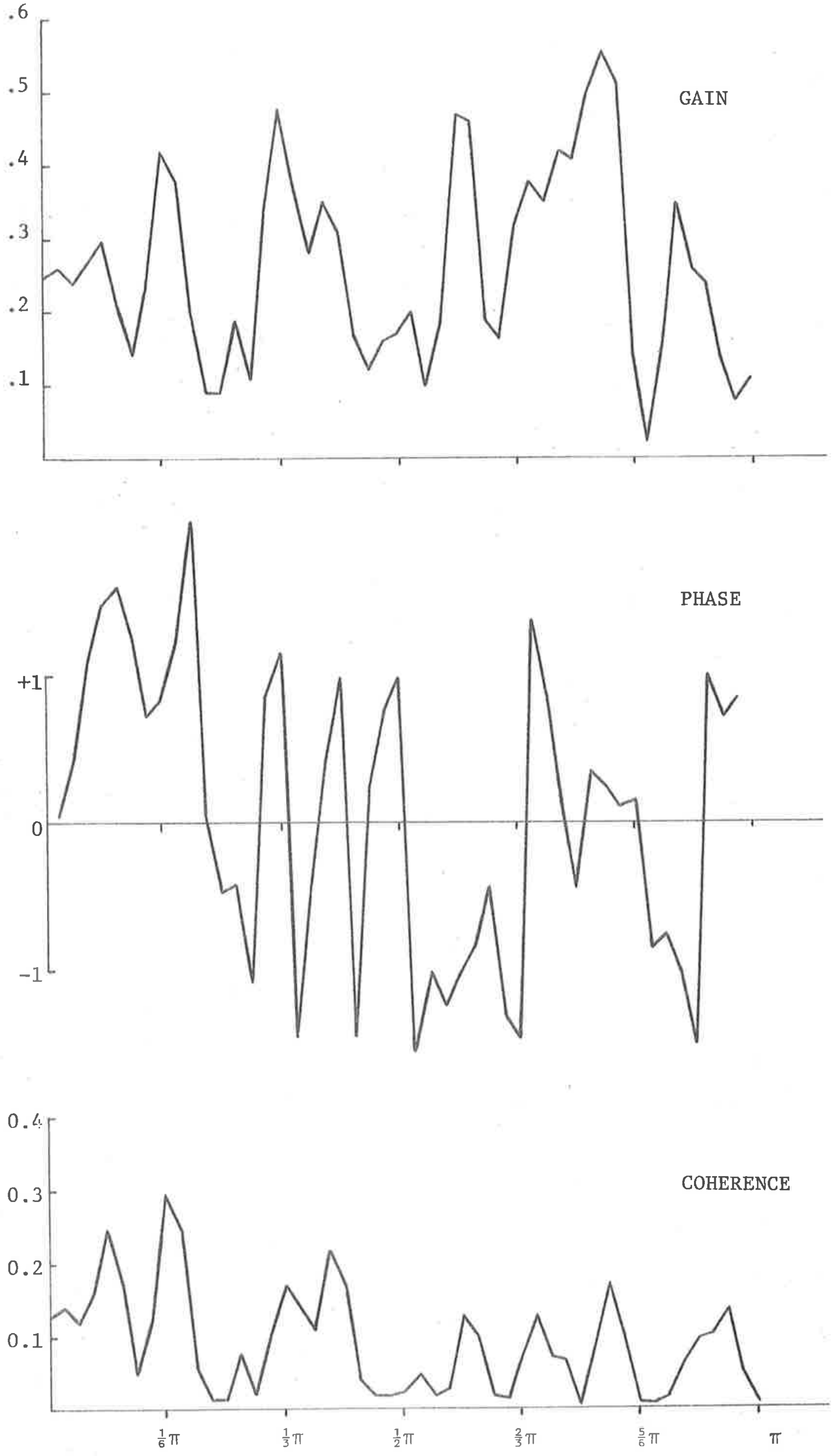
Velocity of Turnover Series	Measure of Cost of Holding Money employed	Nature of data	Period of cycles where coherence relatively high	Maximum Coherence	Gain	Summary of Phase diagram	Cross-Correlation analysis
SCTURN	Short-term bond yields minus dividend yields	1956 - 1971 monthly	6 years	.261	.538	Lag of 48.8° over these frequency bands	Turnover lags by 6 - 9 months
SOTURN	"	"	1.0 - 6.0 years	.416	.080	Fixed angle *lag* of 54.1° (t = 5.40)	Turnover lags by 7 months
V_{1A}	Long-term bond yields	1951 - 1971 quarterly	4.0 - 8 years	.148	.112	Fixed angle *lead* of 11.3° (t = 2.91)	Coincident
V_{2A}	"	"	2.5 - 8 years	.173	.139	Fixed angle *lead* of 76.9° (t = 45.60)	Turnover leads by 3 quarters
V_{3A}	"	"	2.5 - 8 years	.250	.133	Fixed angle *lead* of 53.7° (t = 9.07)	Turnover leads by 3 quarters
V_{1A}	Short-term bond yields	"	2.0 - 8 years	.250	.097	Fixed angle *lag* of 30.6° (t = 17.21)	Turnover lags by 1 quarter
V_{2A}	"	"	2.5 - 8 years	.243	.104	Fixed angle *lead* of 48.6° (t = 6.48)	Turnover leads by 2 quarters
V_{3A}	"	"	2.5 - 8 years	.320	.093	Fixed angle *lead* of 33.8° (t = 3.70)	Turnover leads by 2 quarters
V_{1A}	Interest bearing deposit rate	"	4.0 - 8 years	.319	.098	Fixed angle *lead* of 27.2° (t = 8.06) or a fixed time *lead* of 2 months (t=6.29) fits equally well	Turnover leads by 1 quarter
V_1^{GNP}	Bond yields	1901 - 1971 yearly	2.7 - 3.4 years	.197	.341	Fixed angle *lead* of 10.2° (t = 5.79)	Coincident
V_1^{NY}	"	"	2.7 - 3.0 years	.139	.301	Fixed angle *lead* of 12.9° (t = 7.41)	Coincident
V_1^{GNP}	Interest bearing deposit rate	"	12 - 24 years 3.4 - 4.8 years	.265 .155	.388 .263	Fixed angle *lead* of 16.6° (t = 10.18)	Velocity leads by something less than 1 year
V_1^{NY}	"	"	12 - 24 years 3.0 - 4.8 years	.257 .178	.370 .378	Fixed angle *lead* of 21.8° (t = 6.36)	Velocity leads by something less than 1 year
V_2^{GNP}	Bond yields	"	6 - 8 years	.133	.255	Mixed result: fixed angle *lag* of 79° and a fixed time *lead* of 7.6 months (F = 7.65)	Messy. Interest rates lead by 5 and 2 years, and lag by 2-3 years
V_3^{GNP}	"	"	6 - 8 years	.192	.327	Mixed: fixed angle *lag* of 73° with fixed time *lead* of 6.4 months (F = 7.86)	Messy. Interest rates lead by 5 and 1-2 years, lag by 2-3 years
V_2^{NY}	Bond yields	"	6 - 12 years	.195	.331	Mixed: fixed angle *lag* of 86° with a fixed time *lead* of 7.8 months (F = 11.52)	Messy. Interest rates lead by 5 and 1-2 years lag by 2-3 years
V_3^{NY}	Bond yields	1901 - 1971 yearly	6 - 12 years	.201	.351	Mixed: fixed angle *lag* of 86° with fixed time *lead* of 6 months (F = 27.36)	Messy. Interest rates lead by 5 and 1-2 years lag by 2-3 years
V_1^{GNP}	Bond Yields minus dividend yields	"	8 - 24 years	.481	.469	Complicated. Velocity *lags* by 132° over these frequency bands	Velocity lags by 4-5 years
V_2^{GNP}	"	"	8 - 24 years	.414	.203	Velocity *lags* by 125° over these bands	Velocity lags by 4-5 years
V_3^{GNP}	"	"	8 - 24 years 3 - 3.4 years	.387 .138	.141 .071	Velocity *lags* by 140° over these bands Velocity *lags* by 44° over these bands	Velocity lags by 5 years

recorded. Where it seems clear that none of these models summarizes the phase relationship, we record the phase angle (in degrees) over the relevant frequency band. Finally, in order to assist further in the interpretation of the phase relationships we report the lead or lag as revealed by the maximum value of the sample cross-correlation coefficient between the filtered series.

As an example of the inter-relationships, we illustrate in Figure 16a the coherence, gain and phase diagrams estimated by crossing deposit turnover (CDTURN) with the interest bearing deposit rate, over the period 1902-1968, using quarterly data. The coherence between these series is lower than when the other turnover series is used (then the coherence has a maximum value of .52); nevertheless that maximum coherence of .29 indicates a significant association exists. This is at the frequency band $\frac{1}{6}\pi$ which is adjacent to the band which contains the most spectral density in velocity. Coherence is only relatively high at four frequencies for cycles longer in period than the seasonal ($\frac{1}{2}\pi$ radians) and in each instance deposit turnover leads the interest rate series. At the frequencies around $\frac{1}{6}\pi$ (cycles of 36 months in period), where the coherence is at a maximum, the lead of turnover over interest rates is 61°, which is 5.7 months. At this coherence and an $^{n}/_{m}$ ratio of 5, the 95 per cent level confidence bands for phase can be obtained by adding or subtracting 49° to the estimated phase angle (refer Table 13.2). Thus the 'true' lead could be between 12° and 110°. In this case we can reject the notion that velocity lags interest rates, and that the series are coincident in timing. The gain fluctuates around a mean of .3, increasing when coherence is relatively high. At the frequency band of maximum coherence the gain is .4, which we interpret as an estimate of the elasticity of velocity with respect to the interest rate concerned.

FIGURE 16a

COHERENCE, GAIN AND PHASE DIAGRAMS FOR DEPOSIT TURNOVER (CDTURN) AND INTEREST BEARING DEPOSIT (IBD) RATE, 1902-1968 QUARTERLY DATA



Rather than attempt to examine each series pair crossed in this fashion, it seems preferable to provide an overall summary of the findings. Fortunately this is made easier by an identifiable pattern which emerges in most instances. This pattern has the following features.

First, although the inter-relationships revealed between velocity and the cost of holding money are not very close (in only 7 instances does the maximum coherence exceed .5), they are relatively robust in the sense that they hold up for all the measures of velocity and for all of the time periods examined. The coherencies are generally higher for the turnover series and for the broader definitions of money. The elasticities of velocity with respect to the long term interest rates range from .15 to .60, and, in line with overseas studies, these elasticities are higher than those obtained using short term rates.

Secondly, the question of whether or not inflationary expectations have a role in the demand for money function over and above their impact through nominal interest rates is controversial, and empirical evidence on the point is sparse. While our method of analysis follows Friedman in analyzing the variables in pairs, evidence can be discerned in support of the view of Steindl (1973) that expectations of inflation may have a separate influence upon velocity. With the turnover series, the relationship is centred around the frequency bands containing the conventional business cycle length fluctuations, but with turnover lagging rather than leading as is the case with interest rates. A significant association is found to exist also for long swings of from 8 to 24 years in length using data of annual velocity over the period 1900-1971. Although long swings are notoriously difficult to interpret, this association occurs at a lower frequency than that between velocity and interest rates, and there are long lags indicated in the adjustment of velocity to inflationary expectations.[7]

Thirdly, the timing relationships we have noted between velocity and inflation expectations contrast sharply with those between velocity and interest rates. With interest rates, velocity exhibits *leading* rather than *lagging* association. Three aspects of the timing relationship are worth attention. (a) Velocity consistently *leads* movements in interest rates and this is so whether we use income velocity or turnover to measure velocity or whether we take data for the whole 70 years or for the post-war years separately. Even for some of the relatively low coherences estimated, we can confidently reject the hypothesis that velocity lags interest rates. (b) This lead has a relatively consistent form and the simple model $\phi_w = a$, a fixed angle lag, seems to fit the phase diagrams reasonably well. (c) The lead of velocity over interest rates is shorter for short term than for long term bond yields, and seems to be longer in post-war years than for the full period incorporating both pre- and post-war years.

U.S. results. Twenty-eight series pairs are examined, and the results are summarized in Table 16.5. For the U.S. series we are less interested in examining the form of the lead or lag, and thus we record the coherence-weighted angle lead or lag over the cyclical frequencies. A + indicates that velocity leads interest rates, a - that velocity lags interest rates; similarly with the cross-correlation analysis (in number of months).

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7 This interpretation is contingent upon treating the differential $r_b - r_E$ as a measure of inflation expectations, as has been done by Friedman and Schwartz (1963) and Laidler (1972). As an alternative we might postulate that share prices are written up in anticipation of rising profits, so that the equity rate will fall, and $r_b - r_E$ tend to rise, in advance of the peak in general business. Such behaviour would also be consistent with the timing patterns revealed. I am indebted to M.J. Artis for suggesting this alternative view.

Table 16.5

Summary of Cross-Spectral and Cross-Correlation Analysis Between Measures of Velocity and Interest Rates, United States 1952-1969 Monthly Data

Measure of Velocity	Interest Rate measure	Period of cycles where coherence high	Maximum coherence	Gain at frequency $1/_{36}$ c.p.m.	Phase	Cross-Correlation
$^{I}/_{M1}$	3 months	3 years	.766	.136	+4.4°	+4, 0
"	9-12 months	"	.727	.127	+5.8°	+3, 0
"	3-5 years	"	.632	.154	+3.8°	+3, 0
"	long term	2 years	.532	.534	+4.4°	0
$^{I}/_{M2}$	3 months	3 years	.796	.120	+1.6°	+4, 0
"	9-12 months	"	.764	.112	+2.6°	+3, 0
"	3-5 years	"	.686	.134	+0.8°	+3, 0
"	long term	"	.557	.491	+0.2°	0
$^{IP}/_{M1}$	3 months	"	.794	.137	+1.13°	+4, 0
"	9-12 months	"	.746	.128	+2.00°	+3, 0
"	3-5 years	"	.663	.157	+0.9°	+3, 0
"	long term	"	.552	.560	+3.7°	0
$^{IP}/_{M2}$	3 months	"	.803	.121	-1.2°	0
"	9-12 months	6 years	.768	.113	-0.6°	0
"	3-5 years	"	.705	.136	-2.3°	0
"	long term	3 years	.601	.477	-0.8°	0
DTURN - New York	3 months	2 years	.485	.067	+35.9°	no clear patterm emerges
	9-12 months	"	.551	.072	+40.8°	"
	3-5 years	"	.471	.084	+42.0°	"
	long term	"	.582	.374	+20.6°	"
DTURN - 6 Other Major centres	3 months	3 years	.442	.060	-19.7°	+1, -1
	9-12 months	"	.386	.053	-18.6°	+2
	3-5 years	"	.409	.070	-17.6°	+2
	long term	2 years	.347	.241	-10.6°	+2
DTURN - 226 Other Reporting Centres	3 months	3 years	.666	.049	-12.3°	+1, -1
	9-12 months	6 years	.586	.044	-12.9°	+2
	3-5 years	3 years	.634	.059	-15.8°	+2
	long term	"	.457	.211	- 3.2°	+2

As the data relate solely to the post-war years, we need to interpret the results in the light of earlier research. Friedman in his study of the period 1870-1954 found that the length of the lag of interest rates behind both general business and velocity changed considerably over the period he examined, being much longer prior to World War I than in the period 1921-1954. Subsequent work by Cagan (1971) and Garvy and Blyn (1969) shows that the coincident behaviour of velocity and the shortening lag of interest rates has persisted in post-war reference cycles.

Our own findings are consistent with these studies. Both the cross-spectral and the cross-correlation analysis suggest that velocity has a short *lead* over interest rates at the cyclical components of oscillation. Cagan's study shows that the rates we use are sensitive indicators of market conditions and generally turn ahead of other interest rates. Use of call money rates, commercial paper rates, or corporate bond yields would presumably show that velocity has a longer lead.

Unlike Friedman we find that there is a considerable degree of conformity between the cycles in interest rates and those in the velocity measures, and as much as 80 per cent of the variation in velocity can be 'explained' in this way. The estimates so provided of the interest rate elasticity of velocity using the industrial production proxies at the $^{1}/_{36}$ c.p.m. frequency band range from .12 for short term securities to .56 for long term bonds. On the assumption that these figures indicate the equilibrium relationship and are equivalent to long run elasticities, they appear to be comparable with the elasticities estimated by standard regression methods for the U.S.

Conclusions

Before we can draw firm conclusions about the importance of the evidence, one important question needs to be answered. Friedman noted that the observations of velocity might reflect either (a) movements along a demand for money function; (b) shifts of the function; (c) divergences between the demand and supply of money. The model we have tested, as embodied in equation (16-11), allows for elements (a) and (c), but makes no allowance for the phenomena in (b).

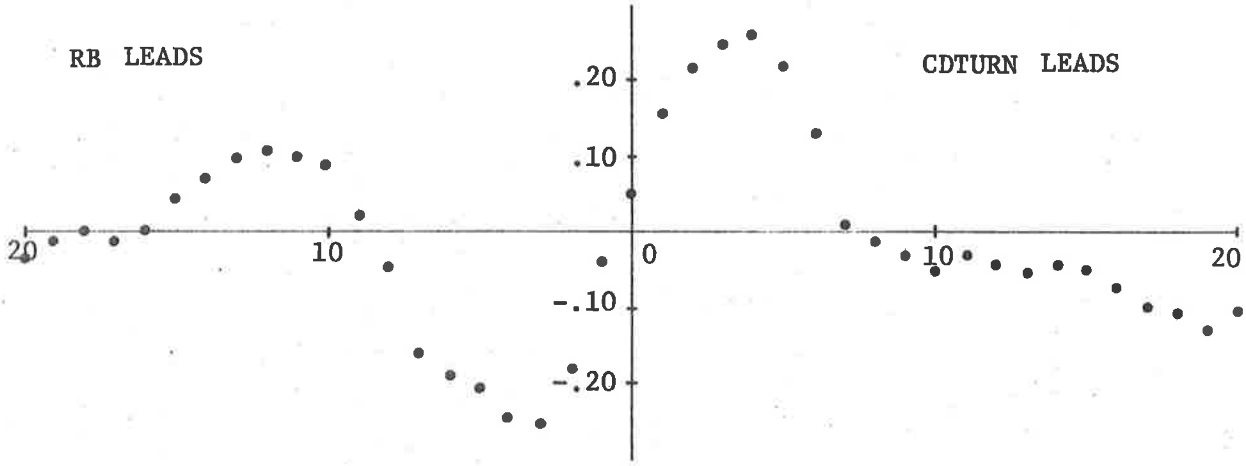
Could shifts of the demand for money function account for the timing evidence? Interest rates generally lag at peaks and troughs of general business. Suppose, for example, that at the onset of recession phases in the economy shifts were to occur out of securities into money (increases in liquidity preference). The shift into money would have the effect of raising the ratio of money to income, lowering the ratio of income to money (velocity), and pushing up the structure of interest rates. Interest rates and velocity would be inversely related. Such an association is possible and may contribute to the lagged behaviour of interest rates at cyclical turning points in the economy; but two pieces of evidence suggest that it is unlikely to be the dominant factor at work.

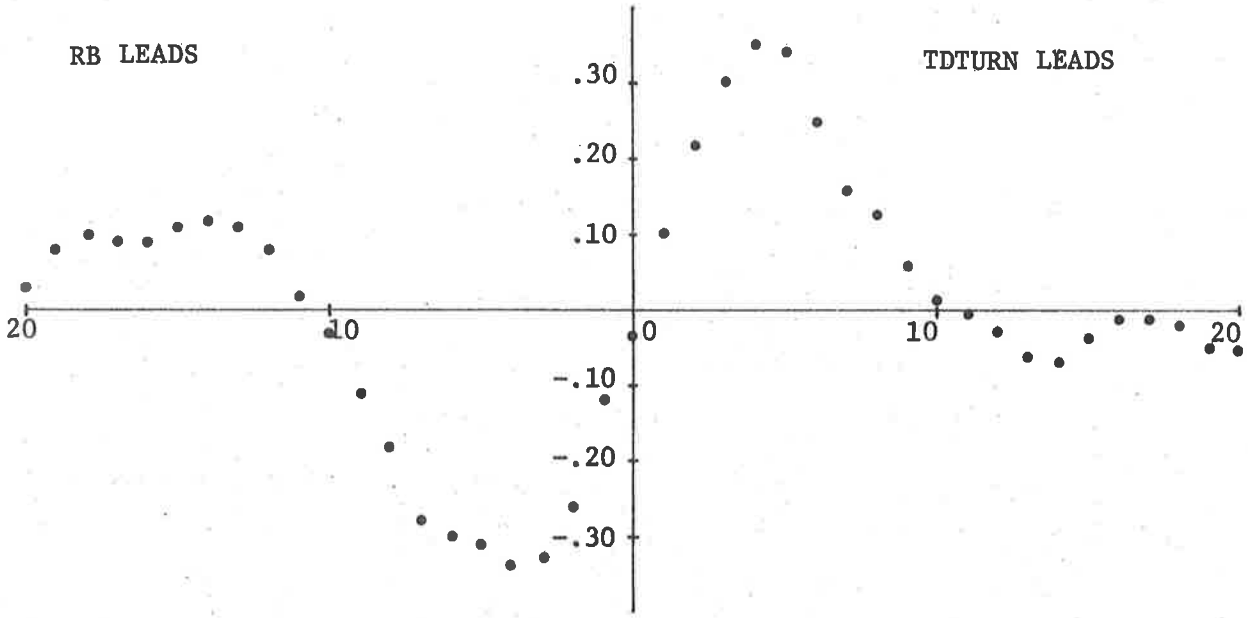
First, on a positive signed association we have seen that velocity leads interest rates. Roughly speaking, the lead varies between 30° and 90°. To obtain timing evidence on an inverted basis we need to adjust the phase angle estimates by π or 180°. This implies that interest rates will lead velocity by a margin of between 90° and 150°. Confirmation comes from Figure 16b which shows the cross-correlograms of bond yields with the two measures of deposit turnover, quarterly 1902-1968. On an inverted association, interest rates lead deposit turnover by 4 quarters. With the U.S. data, the lead of interest rates over velocity is 11-14 months.

Secondly, the correlation is highest when the series are directly correlated. With the series shown in the upper panel of Figure 16b the

FIGURE 16b

CROSS-CORRELOGRAMS OF BOND YIELDS AND TWO MEASURES OF DEPOSIT TURNOVER, USING QUARTERLY FILTERED DATA, 1902-1968





correlation on a direct association is +.257; on an inverse association, the maximum correlation is -.246. For the series in the lower panel the relevant correlation statistics are +.350 and -.347. In the case of the U.S. series, the difference is more striking. Considering the correlation between the velocity measure, $^{IP}/_{M1}$, and the long term Treasury bond rate, the maximum inverse correlation is -.169 compared with a positive correlation coefficient of +.290. These figures lend support to our interpretation of the relationship between velocity and interest rates being a direct one.

We thus conclude that interest rates lag movements in velocity. Clearest evidence comes from the Australian series, while our examination of the U.S. time series provides confirmation that Friedman's findings in 1959 were not an aberration. The Australian results, which cover a time period comparable to that which Friedman studied, show that the lag cannot be attributed to sampling variations or to the use of annual data, and indicate further that the form of the lag is relatively constant over time. Any explanation for these findings cannot resort to Friedman's argument that velocity and interest rates are largely unrelated, for the relationship is persistent enough over different time periods and for different interest rate and velocity measures to establish its existence. Nor can it be argued that the timing relationships merely reflect the choice of interest rates employed, for less market oriented rates would undoubtedly exhibit longer lags relative to the velocity cycles.

This lag appears to be inconsistent with the demand for money function postulated by Friedman (see (16-4b) and (16-5) above), which implies that interest rates and velocity move together over the cycle. It is certainly inconsistent with the demand for money function (16-11) which is the one most commonly employed in empirical investigation of the monetary sector.

As we have seen the hypothesis embodied in this analysis is that velocity *lags* movements in interest rates. Our finding that velocity *leads* interest rates is a disturbing one, and calls into question the assumptions underlying this model. This is taken up in the next chapter.

Chapter 17

An Alternative View of Adjustments in the Monetary Sector*

The principal objective of this chapter[1] is to seek an explanation of the puzzling economic relationships we have discovered in the two previous chapters: in particular, the lag of interest rates relative to velocity and the money supply. In doing so, we also take up two issues which were put to one side in earlier analysis.

In Chapter 12 we argued that the demand for money function provides an indirect estimate of the length of the outside lag of monetary policy. Much of the support for the long lags estimated by Friedman (16 to 20 months for output, 2 years or more for prices) comes from work on the demand for money which allow for balances to be in the process of adjusting to equilibrium as in equation (16-11). Almost invariably the speeds of adjustment which are estimated indicate that less than fifty per cent, and sometimes as little as fifteen per cent, of the difference between actual and desired money balances is eliminated in one year, and that in consequence many *years* elapse before the adjustment of balances is, say, 90 per cent completed.[2] By these standards we find relatively short lags (6-10 months for output, 12-15 months for prices). But how can lags of this length tally with the Australian studies of the demand for money, which imply that 31 to 36 months elapse

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* See note at beginning of chapter 16.

1 Many of the ideas worked out here had origins in research conducted jointly with Professor M.J. Artis of University College, Swansea, now of University of Manchester, during my study leave of 1973/74. That research, largely specific to the U.K., is reported in Artis and Lewis (1974 and 1976).

2 Under the distributed lag models used in most of the studies the lag is never completed but each movement of the adjustment becomes infinitely small. Consequently it is usual to use a cut off such as 90 or 95 per cent of the effect to measure the full adjustment.

before the desired change in the money market is 90 per cent complete? How can output have adjusted to the monetary disturbance if the money market is still in disequilibrium and years are still to elapse before equilibrium is attained?

Implicit in the last question is a presumption that lags in the money market imply long lags to output. Tucker (1966) has argued that such a conclusion may be invalid if there are *long* lags in the money demand function, for these will tend to act as a counter-balancing force and will, in effect, speed up the adjustment of demand and income to monetary policy (money supply) changes. The longer is the lag in the demand for money function, the more is the adjustment speeded up. In Tucker's exposition, the basis for the presence of lags in the money demand function is not made explicit, but Laidler (1972), subsequently, has sought to demonstrate that, whether the lags arise from an adaptive expectations mechanism or from partial adjustment (or both combined), Tucker's main conclusions still hold. Their analysis has similarity with mechanisms suggested earlier by Friedman and Schwartz (1963) and Walters (1966) in the case of income.

In essence, the mechanism envisaged in the models turns on the argument that the value of the short run income or interest rate elasticity is less than its long run value. Combined with the assumption of instantaneous equilibrium in the money market, this ensures that there is a larger response of the arguments of the demand for money function in the short run than is required in the long run to clear the money market in the face of an exogenously determined change in the money supply; there is 'overshooting'.

Partial Adjustment of Money Demand

Our starting point is the demand for money function of the form commonly employed in the analysis of quarterly data. This is the model (16-9), (16-10), (16-11) which was found to be inconsistent with the time series evidence of velocity and interest rates. It incorporates the hypothesis of the partial adjustment of supply to demand, by analogy with studies of fixed investment where the principle seems to have originated. An important difference between the investment application and the money demand application of the partial adjustment hypothesis is that in the former case the determinants of long run demand are typically capable of being regarded as independent of the level of the dependent variable, investment; but this is not obviously true of the monetary sector: one of the determinants of the demand for money, the rate of interest, is typically also regarded as providing the market clearing 'price'.

This suggests that while the partial adjustment model may carry over straightforwardly to situations in which the determinants of money demand can be taken as given, the same may not be true in a regime where this does not hold. It is appropriate, therefore, to examine the properties of the model separately in the two cases.

A demand-determined money supply. A stylized view of a demand-determined money supply regime may be characterized as one in which the determinants of demand are exogenously given, with supply passively adjusting. In such a regime, the intervention of forces of inertia or costs of adjustment may be appealed to as leading to a partial adjustment of effective (short run) demand (and supply) to changes in the determinants of long run demand. Algebraically, this is usually represented, in obvious notation, as:

$$M^* = mY - jr \qquad (17\text{-}1)$$

$$M^{DS} - M^{DS}_{-1} = d(M^* - M^{DS}_{-1}) \qquad (17\text{-}2)$$

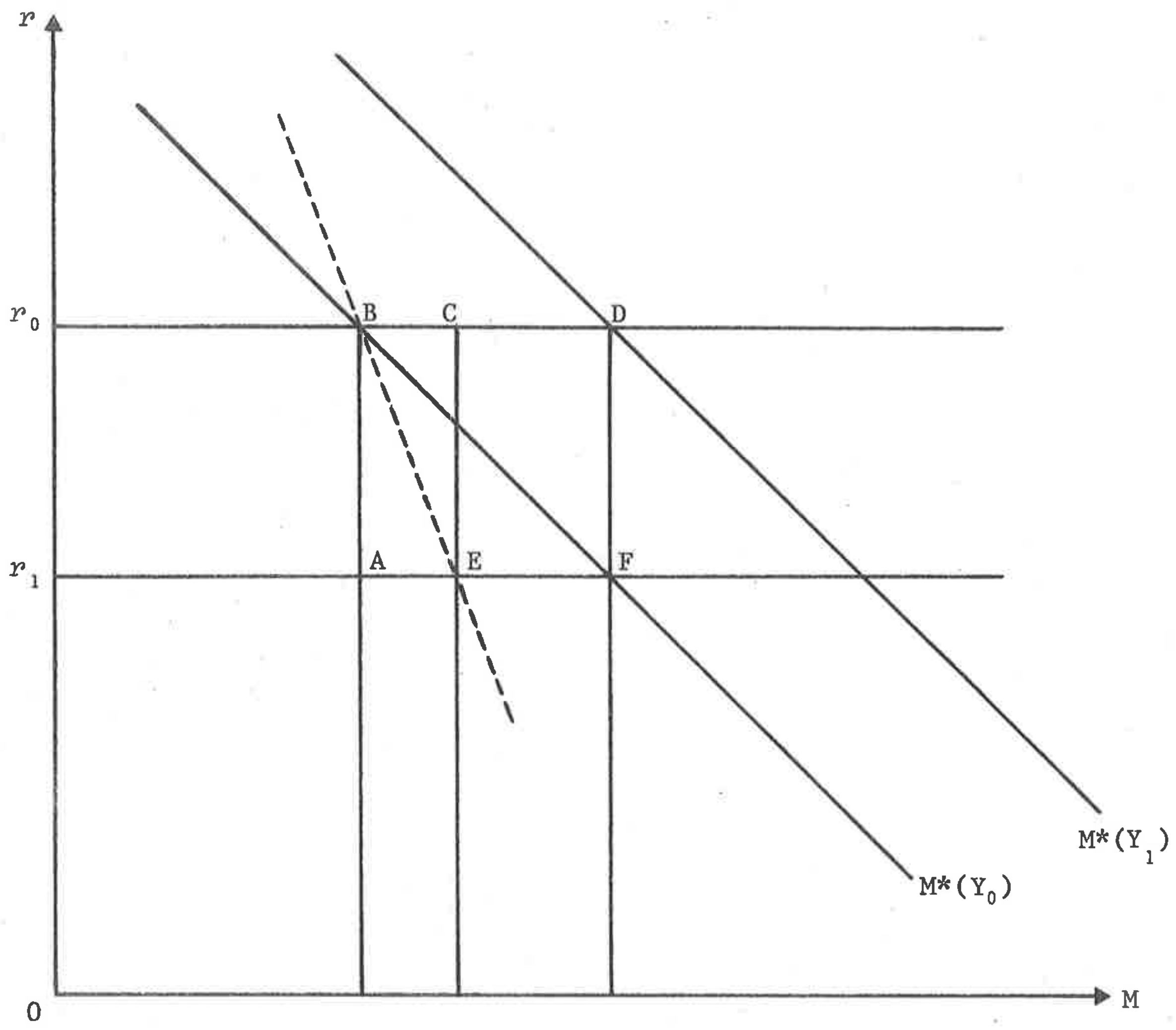
$$M = M^{DS} \qquad (17\text{-}3)$$

$$M = dmY - djr + (1 - d)M_{-1} \qquad (17\text{-}4)$$

where (17-1) is the demand function, (17-2) indicates that portfolio imbalances are eliminated gradually and (17-3) asserts a passive supply function facilitating this. Alternatively, (17-1) and (17-2) might be called respectively the long run and short run demand functions with (17-3) indicating how they are reconciled; as the reconciliation is effected by money supply changes, this is a terminological not a substantive difference. Equation (17-4) is, in either case, the reduced form of the system. Both r and Y are here taken to be strictly exogenous, so that r should be thought of for the moment as an administered rate of interest which is set by the fiat of the Central Bank. Where r is a market rate the appropriate analysis, as argued below, is different.

Figure 17a is drawn to illustrate this system and the response of money demand and supply to changes in r and Y (in this example and later ones, a change in Y which shifts the demand schedule may be regarded as similar to an autonomous change in liquidity preference with similar effects). Taking first the case of a rise in income, this is pictured as a shift of the demand schedule from $M^*(Y_0)$ to $M^*(Y_1)$, creating an excess demand of BD. Given the partial adjustment assumption, however, the effective attempt at portfolio adjustment is a fraction d of BD, say the distance BC; at the existing interest rate r_0, sales of bonds of BC and a corresponding increase in the supply of money satisfy equation (17-4) and constitute the initial response to the rise in income. In succeeding periods, the remaining excess demand CD is gradually closed until the new equilibrium at D is reached. A fall in the fiat rate of interest from its initial position at r_0 and equilibrium at B gives rise to an excess demand for money, income remaining unchanged, of AF

FIGURE 17a



drawn equal to BD. The partial adjustment hypothesis implies that only a fraction of this excess demand (AE/AF = BC/BD) is cleared in the initial period. The movement from B to E might therefore be described as a movement down the short run demand schedule described by the dashed line.

Thus the response of the money supply to an identical excess demand created by a change in either one of the exogenous variables r and Y is, reasonably enough, the same. We take it as read that the response of the money market to an excess demand for money produced either by a reduction in money supply or by an increase in income should be identical.

This account of a demand-determined regime is, however, severely caricatured by our insistence so far on regarding r as a fiat rate of interest, which is simply declared, rather than as a rate which is determined in the market. A more persuasive and popular picture of a demand-determined regime would settle for the Central Bank pursuing a policy of pegging 'the' bond rate. Alternatively, the rate may be thought to be pegged by flows of international capital responsive to interest rate differentials in a world where exchange rates are fixed and no exchange risks exist. In such systems the response of 'effective' demand and supply to a change in income would still be as described above, but as the rate of interest is no longer a fiat rate, the question arises of what happens when the 'peg' is changed, for example, by monetary policy. In order to enforce the new peg, the Central Bank must alter the money supply; in this instance, the money supply is instigating the change rather than adapting passively to prior events. That is, the occasion of the change in peg is one on which the money supply should be regarded as exogenous. This is the case covered by the next sub-section.

Exogenously determined money supply. The consistency of response of the endogenous variable to excess demand which we observe in the demand-determined case turns out *not* to hold when the money supply is regarded as exogenously determined and the framework provided by equations (17-1) - (17-4) is 'turned round'. The system may now be rewritten in the manner proposed by Tucker and Laidler[3] as

$$M^* = mY - jr \qquad (17\text{-}1)'$$

$$M^{DS} = dM^* + (1 - d)M^{DS}_{-1} \qquad (17\text{-}2)'$$

$$M = \bar{M} \qquad (17\text{-}3)'$$

$$\bar{M} = M^{DS} \qquad (17\text{-}4)'$$

where (17-1)' and (17-2)' represent long run and short run demand functions, (17-3)' is a supply function which specifies exogeneity and (17-4)' is a market-clearing condition. The reduced form in the endogenous variable, r, may be derived as

$$r = \frac{m}{j} Y - \frac{\bar{M}}{dj} + \frac{(1 - d)M}{dj} - 1 \qquad (17\text{-}5)'$$

This yields a prediction that the short run response of r to a change in the money supply will involve an 'overshooting' of the 'full' equilibrium rate since the impact 'multiplier' is (-) $\frac{1}{dj}$ and the long run multiplier (obtained by setting $\bar{M} = \bar{M}_{-1}$) is (-) $\frac{1}{j}$.

A similar looking expression can be derived for income:

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[3] As presented in (17-1)' - (17-4)', the system resembles that proposed by Tucker; Laidler presents his system in such a way that it might be read as implying two different supply functions, one stating that the money is exogenously determined, the other that supply is a distributed lag function of demand (see footnote 1). The reduced form is the same, however, and minor quibbles over presentation can be ignored for the substantive equivalence.

$$Y = \frac{j}{m} r + \frac{\bar{M}}{dm} - \frac{(1 - d)M}{dm} - 1 \qquad (17\text{-}6)'$$

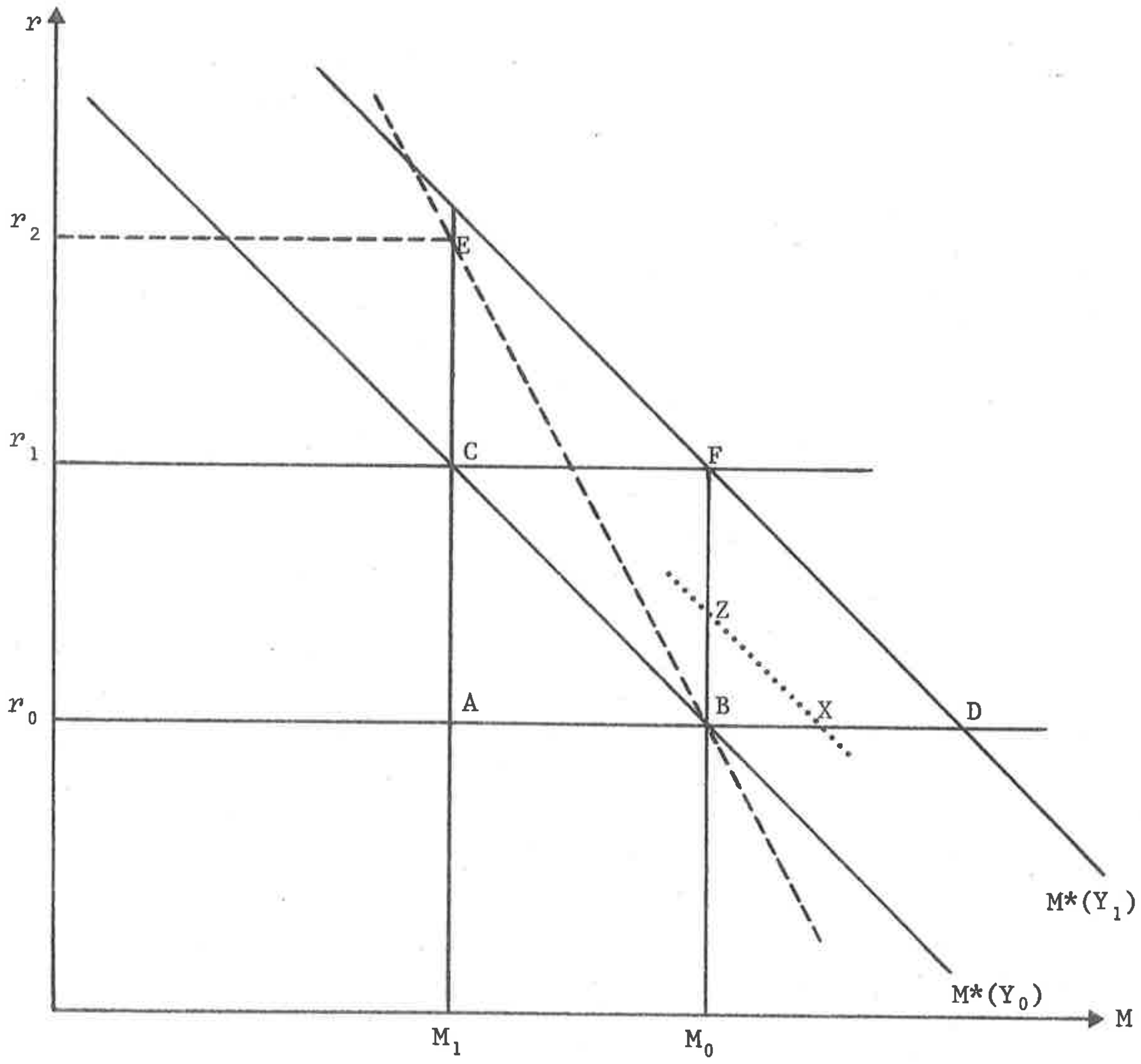
Where the lags in the demand function arise because of adaptive expectations, then (17-6)' is the basis of Friedman-Schwartz's and Walter's suggestion of an overshooting (or cyclical) response of income to money supply changes. Comparing (17-5)' and (17-6)' it may be noted that income and the rate of interest both over-adjust at the same rate.

The overshooting of the interest rate in (17-5)' provides the trigger for Tucker's mechanism, whereby the larger short term response of interest rates speeds up the transmission of monetary policy. It is illustrated in Figure 17b as a movement along BE in response to a fall in the money stock from M_0 to M_1, r rising from r_0 to r_2 in the short run, overshooting the new equilibrium rate r_1.

There are two problems with the overshooting idea: one empirical, the other theoretical. At an empirical level, it does not help us with the timing issue. In (17-5)', interest rates respond immediately and significantly to a reduction in the money supply which, with income constant, raises the income velocity of circulation. As we have discovered in the previous chapter, such a response does not accord with the facts, for velocity and interest rates are not coincident in timing. Moreover, as Goodhart (1975) has noted, the real world does not seem to exhibit signs of considerable overshooting and instability that the model predicts should follow from variations in monetary growth rates.

From a theoretical viewpoint one is led to ask whether it is legitimate to take a model embodying a particular set of behavioural assumptions and apply it to analyze an environment which is marked by exactly opposite conditions. Putting this question aside for a moment, we should at least

FIGURE 17b



expect to observe a similar response of the interest rate for a comparable excess demand for money caused by a rise in income. But, as the figure shows, an excess demand of BD (drawn = AB), as a result of a rise in income from Y_0 to Y_1 does not cause an overshooting of the rate of interest. There is no mechanism for bringing this about. The rate should either move immediately to the new equilibrium r_1 or, possibly, to a point like Z: if an increase in money supply of BX would suffice in the short run to stabilize the rate at r_0 (as in our discussion of diagram A) it would seem that a proportional adjustment of the rate of interest in the same ratio (BZ/BF = BX/BD) would provide a short run equilibrium. This is not, however, obtainable from the system (17-1)' - (17-5)' as it stands.

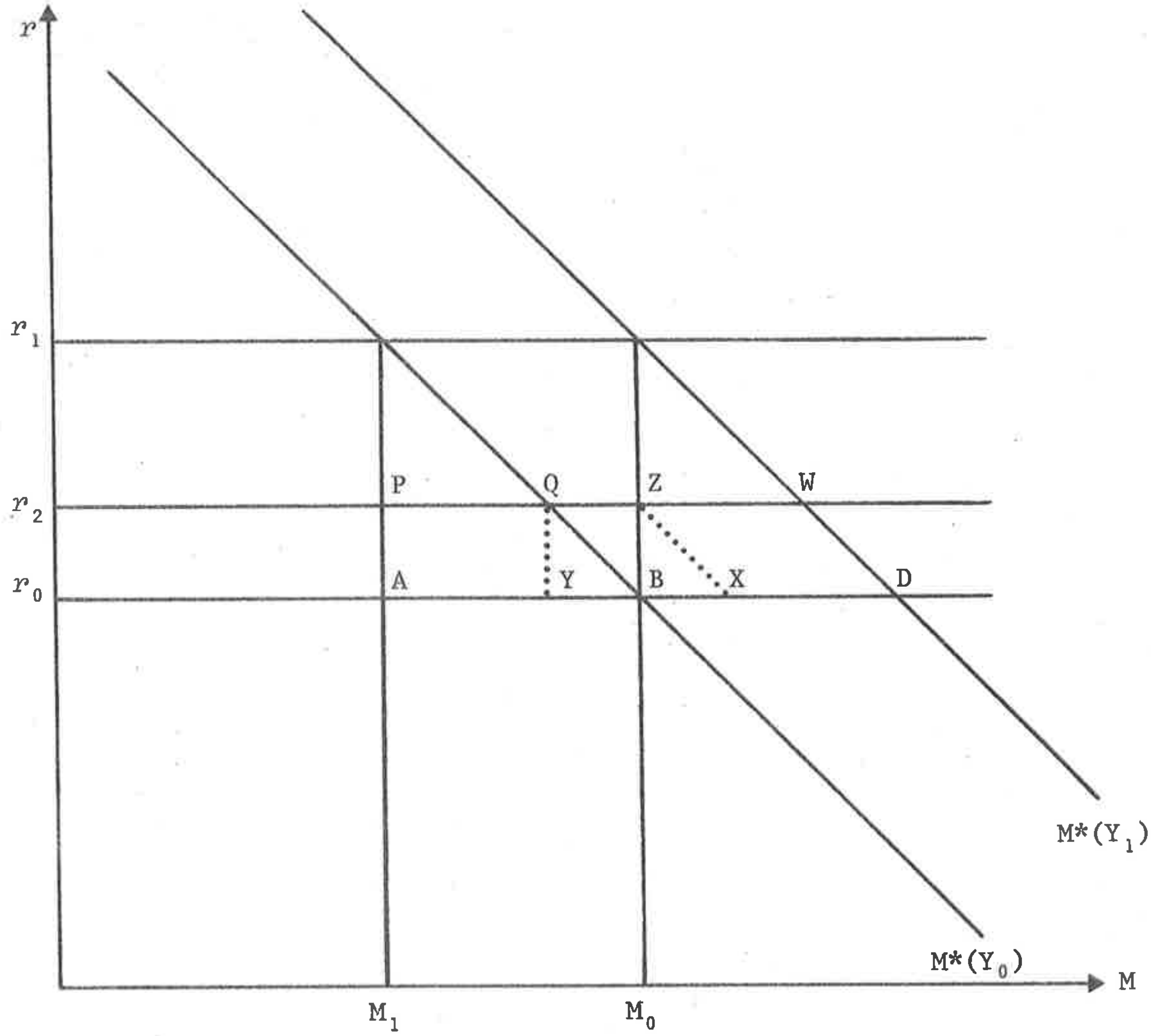
The immediate issue is that the partial adjustment framework, when adapted from a demand-determined regime to an exogenous money supply framework is no longer capable of producing consistent results: an increase in income has a different implication for interest rates than does a reduction in the money supply.

An Alternative View

A consistent analogue to the partial adjustment hypothesis in a regime where the money supply fails to adapt passively to demand may be sought along the lines sketched immediately above. The assumption is that wealthholders seek to extinguish a portion of any excess demand/supply of money by translating their disequilibrium into bond sales; as a result, the rate of interest is hypothesized to adjust in a partial manner to a disturbance.

Figure 17c depicts the case in question. From an initial equilibrium at $B(r_0, M_0)$, an excess demand for money may be brought about by a shift of the demand curve as income, say, increases (giving BD excess demand, as

FIGURE 17c



before) or as money supply falls from M_0 to M_1, yielding an excess demand of AB, drawn so that AB = BD. The rate of interest in each case eventually rises to r_1. In the short run, however, transactors partially adjust to their excess demand for money (partially extinguish their excess supply of bonds) by sales of BX (=YB) of bonds. This transaction reduces the excess demand to XD (= ZW) = AY (= PQ), and leads to further partial adjustments in ensuing periods. In this event, as can be seen, the rate of interest, far from overshooting, consistently 'undershoots'. This is equally the case whether the excess demand for money originates from the demand side or the supply side.

The partial extinction of excess demands (supplies) allows us to rewrite the system as

$$M = mY - jr \quad (17\text{-}1)''$$

$$M = \bar{M} \quad (17\text{-}2)''$$

$$r - r_{-1} = a(r^* - r_{-1}) \quad (17\text{-}3)''$$

where (17-1)" is the demand for money, (17-2)" asserts exogeneity of the money supply, and (17-3)" specifies that the actual change of the interest rate corresponds to a proportional adjustment of the gap between the full equilibrium rate (r^*) and the initial rate (r_{-1}). Thus the reduced form in r becomes:

$$r = \frac{a(mY - \bar{M})}{j} + (1 - a)r_{-1} \quad (17\text{-}4)''$$

and the short run 'multipliers' $\Delta r/\Delta Y$ and $\Delta r/\Delta\bar{M}$ are $\frac{am}{j}$ and (-) $\frac{a}{j}$ respectively, as compared with corresponding long run multipliers of $\frac{m}{j}$ and (-) $\frac{1}{j}$. The interest rate now 'undershoots'.

Adaptive Expectations

The overshooting possibility, and the mechanism on which Tucker's and Laidler's conclusions rely may be retained, but elucidation of the basis for writing lags into the demand for money function is vital. While the partial adjustment hypothesis, properly interpreted, is not capable of sustaining overshooting (indeed it implies undershooting), it can be combined with adaptive expectations assumptions, where the relevant rate of interest in the demand for money is an expected or 'permanent' one, r^P. In this event the system may be respecified as:

$$M = mY - jr^P \qquad (17\text{-}1)'''$$

$$r^P = \lambda r + (1 - \lambda)r^P_{-1} \qquad (17\text{-}2)'''$$

$$M = \bar{M} \qquad (17\text{-}3)'''$$

$$r - r_{-1} = a(r^{**} - r_{-1}) \qquad (17\text{-}4)'''$$

where (17-2)''' defines r^P in the adaptive expectations framework and (17-4)''' specifies a partial adjustment of the current rate in terms of the gap between the equilibrium current rate (r^{**}) and the initial rate. The reduced form then becomes

$$r = a\left[\frac{mY' - \bar{M}'}{\lambda j}\right] + (1 - a)r_{-1} \qquad (17\text{-}5)'''$$

where Y', $\bar{M}'$ refer to the first differenced expressions $\bar{M}' = \bar{M} - (1 - \lambda)\bar{M}_{-1}$, $Y' = Y - (1 - \lambda)Y_{-1}$.

Short run interest rate multipliers are therefore $\Delta r/\Delta Y = \frac{am}{\lambda j}$; $\Delta r/\Delta M = (-)\ \frac{a}{\lambda j}$ and whether or not the interest rate 'overshoots' depends on the ratio $^{a}/_{\lambda}$ since the respective long run multipliers remain $\frac{m}{j}$ and $(-)\ \frac{1}{j}$.

A value of $^{a}/_{\lambda}$ which is greater than unity will bring about an overshooting. This model is capable of sustaining the qualitative conclusions of the Tucker-Laidler mechanism only for critical levels of the ratio of two parameters, which must be determined empirically.

The Theoretical Issue

Thus the essential point remains. Sluggish reactions on the part of transactors in ridding themselves of exogenous changes in the money supply do not cause an impact effect upon interest rates which exceeds the long run effect. Rather the appropriate response would seem to be a *partial* adjustment of the rate of interest, although such a generalisation needs to be qualified to take account of the source of the money supply change and the reactions which ensue as balances spread beyond initial recipients. The overshooting implication can be derived from incorporating expected variables in the demand relationship, but when the adaptive expectations hypothesis is coupled with partial adjustment, overshooting is only a possibility which depends on the actual magnitudes of the respective coefficients.

What accounts for the different conclusions? The model employed by Tucker and Laidler arises naturally from a system in which the money supply adapts itself passively to demand through a series of short run responses. When the money supply is exogenous this causation is reversed and demand adjusts to supply. There would seem to be obvious dangers in taking a set of behavioural equations embodying *endogeneity* of the money supply, and then turning these around to be used in an exercise which has interest rates (and could in principle have income, too) dancing to the tune called by *exogenous* changes in the money supply.

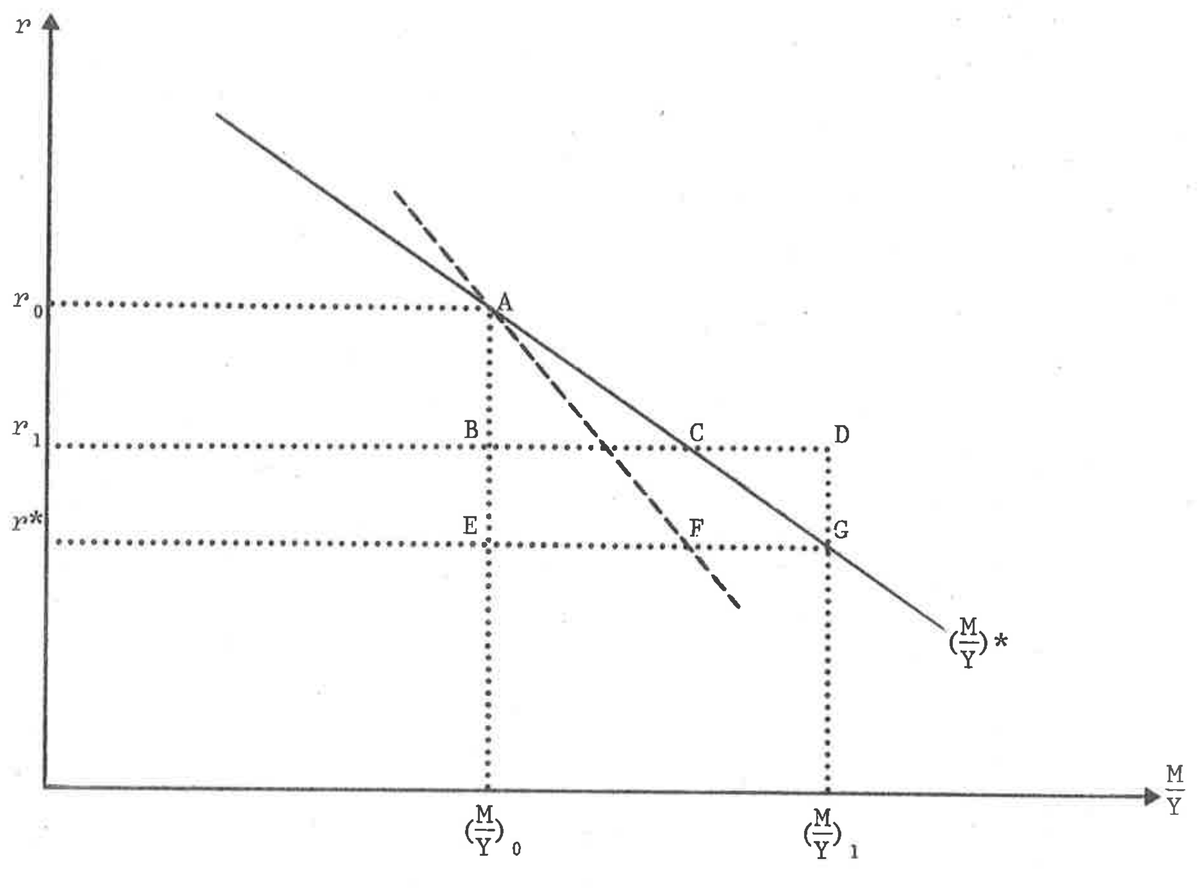
The Empirical Issue

So much for the theoretical issues raised by our examination of the demand for money function. Does the alternative mechanism which we have hypothesized help us with the timing differences between velocity and interest rates which we set out to explain? The answer is yes, but in order to show why it is helpful to return to the terminology which was employed in chapter 16.

It was shown there that models of the type (17-1) - (17-4) embody the implication that velocity lags interest rates, whereas empirically the reverse is found to be the case. This model assumes that the nominal supply of money is determined by demand. When the money supply does *not* passively adapt itself to the ongoing demand, the adjustment occurs in the arguments of the demand function, namely income and interest rates. Many analyses assume interest rates bear the brunt of the adjustment in the short run, all that is necessary is that interest rates share in the adjustments occasioned by monetary disturbances. Nevertheless, in order to simplify the argument we concentrate our attention upon the case in which interest rates provide the market clearing mechanism for the money market.

In response to a monetary expansion, $M_1 - M_0$, in Figure 17d, assumed to be independent of demand, the attempt by wealthholders to dispose of their unexpectedly larger holdings will eventually drive down interest rates from r_0 to the new equilibrium rate r^*, eliminating the excess money supply. However, interest rates may not fall immediately to r^*, and three reasons can be advanced for this. First, financial markets are frequently far from perfect, and interest rates may be dominated by new issues or set by convention. Where such market frictions exist, interest rates may react sluggishly to exogenous shocks. Secondly, depending upon the source of the monetary

FIGURE 17d



injection, the extent and permanency of the unexpected portfolio disturbance may be initially misjudged. Transactors may allow actual balances to temporarily exceed desired balances at the ruling interest rate r_0 before they begin responding to the changed circumstances. Thirdly, and more generally, we can invoke our hypothesis about the correct interpretation of the partial adjustment model, to provide for a partial adjustment of the interest rate (r) which has the market clearing function.

Referring to Figure 17d, in the 'old' partial adjustment system the money supply responds with a lag to interest rates. A fall in the rate of interest from its initial position at r_0 and equilibrium at A to r^* gives rise to an excess demand for money of EG. Inertia and transactions costs imply that only a fraction of the excess demand (EF/EG) is cleared in the initial period and, income remaining unchanged, sales of bonds of EF and a corresponding increase in the supply of money satisfy the partial adjustment hypothesis. When this idea is correctly applied to an environment in which the money supply no longer adapts in such a passive way to variation in demand, a quite different conclusion emerges. Referring to the figure, the existence of transaction costs or inertia means, as in the previously discussed partial adjustment model, that wealthholders seek to translate only a fraction $^{BC}/BD$ (= $^{EF}/EG$) of the disequilibrium arising from the monetary expansion into purchases of bonds. The difference in this case is that the *attempted* purchases cause the interest rate to fall to r_1, and the adjustment occurs in desired balances not in actual balances. The excess supply of money is thereby reduced, but as CD (=FG) remains, further adjustments occur in ensuing periods.

Using a demand for money function of the form (16-9)

$$\left[\frac{M}{Y}\right]^*_t = a_0 + a_1 r_t \qquad (17\text{-}1)''''$$

we postulate the reaction function

$$r_t - r_{t-1} = \delta(r_t^* - r_{t-1}) \qquad 0<\delta<1 \qquad (17\text{-}2)''''$$

with δ the coefficient of adjustment, and define the interest rate r_t^* by setting desired balances equal to actual balances, *viz.*

$$r_t^* = \frac{1}{\alpha_1}\left[\frac{M}{Y}\right]_t - \frac{\alpha_0}{\alpha_1} \qquad (17\text{-}3)''''$$

Substituting (17-3)'''' into (17-2)'''' we obtain

$$r_t = \frac{\delta}{\alpha_1}\left[\frac{M}{Y}\right]_t - \frac{\alpha_0\delta}{\alpha_1} + (1-\delta)\, r_{t-1} \qquad (17\text{-}4)''''$$

and by successive substitution we have

$$r_t = \frac{\delta}{\alpha_1}\sum_{\tau=0}^{\infty}(1-\delta)^{\tau}\left[\frac{M}{Y}\right]_{t-\tau} - \frac{\alpha_0}{\alpha_1} \qquad (17\text{-}4a)''''$$

Thus the partial adjustment hypothesis, when adapted from a demand-determined to an exogenously-determined money supply regime, implies interest rates *lag* movements in velocity. Our empirical findings are *not* inconsistent with cycles in velocity being associated with cycles in interest rates, as Friedman in 1959 argued they were.

If the answer to the timing puzzle is as simple as this, an obvious question is why Friedman didn't see it. Like us, Friedman treats the money supply as the independent variable, but his quantity theory framework leads him to visualize there being a closer link between money and income (the 'direct' mechanism) than between money and a particular set of interest rates, connected to expenditures (the 'indirect' mechanism). Clearance of the money market, according to Friedman's analysis, involves income adjustments but not interest rate adjustments. As in the standard analysis, the ratio of money to income ($^M/_Y$) adjusts partially to the desired level ($^M/_Y$)*, but the variation in his system would occur in the denominator (Y) and not in the numerator (M).

What is at issue is not the strength of the direct versus indirect transmission mechanism, but whether interest rates have *some* market clearing function. Friedman doesn't allow for interest rates to vary *desired* balances and absorb part of the monetary disturbance.[4] In our explanation, the distinction between actual and desired velocity is crucial. To state the point more fully, conventional work on the demand for money specifies that movements in desired velocity, in response to interest rates, elicit responses in the nominal supply of money or income or both until actual velocity adjusts. Our schema reverses this and visualizes desired velocity adjusting with a lag to actual velocity. During the upswing of a cycle, for example, actual velocity increases as economic activity quickens and the growth rate of the money supply begins to slow: elements of both the demand for balances (via income) and the supply of balances contribute to the procyclical behaviour of velocity. Transactors partially adjust to the excess demand for money (partially extinguish the excess supply of bonds), and the response of interest rates and desired velocity is delayed. But actual velocity and not desired velocity is the magnitude observed, and it *leads* the movement in interest rates.

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4 Allowance for this does not negate the 'direct' mechanism, provided that all of the excess money is not so absorbed. The reader may recall that in chapter 11 we described a transmission mechanism of monetary policy which incorporated 'direct' and 'indirect' effects, and wealth effects, while allowing for interest rates to absorb part of the monetary injections.

Consistency with the Evidence

Once this argument is accepted, the timing relationships we have detected for Australia and the United States can be seen in a new light. We recall the following features:

- inflation expectations have a long lead over velocity (Australia);
- interest rates lag velocity;
- the lag of interest rates is shorter in the U.S. than in Australia;
- short term interest rates lag by less than long term rates;
- in Australia, the lag seems to be longer in post-war years than earlier: the reverse is the case in the U.S.;
- a fixed angle lag relationship is observed.

Considering the Australian evidence, an explanation can now be offered as to why inflationary expectations lead velocity, whereas interest rates lag. While the latter can be thought of as adjusting to monetary imbalances, price expectations are better seen as a largely independent force upon money demand. As we are visualizing effects running from money to interest rates, rather than the reverse, it makes sense that short term rates respond before long term rates, which accords with our findings. Next, if the adjustment of government and bank interest rates in early post-war years was delayed by government controls as well as by wealthholders' inertia, the lag of these rates behind velocity is likely to be longer, as we observed. Now that the authorities are pursuing a more flexible interest rate policy we would expect the length of the lag to be shortening. An examination of the turning points in cycles of velocity and interest rates which have occurred after our data sample was collected indicates this to be the case.[5] Finally, while we have couched the model (17-4)'''' in terms of a distributed lag, a fixed angle lag offers a plausible description of the relationship between velocity and interest rates. This particular lag structure implies that the stronger is the disturbance, the longer is the lag, which seems reasonable.

Some of the differences between the U.S. and Australian results can also be explained. The speed with which interest rates respond to monetary imbalances will depend on the source of the monetary disturbance. In the case of open market operations, interest rates need to change for the transaction to be effected and although further changes will occur in the same direction as wealthholders subsequently rearrange their portfolios towards longer run preferences, it is difficult to visualize a long lag occurring. Where the money supply derives from budget deficits or through the balance of payments, interest rates are likely to respond only when recipients move to rebalance their portfolios. In the U.S., cyclical movements in the money supply are dominated by Federal Reserve security transactions.[6] This is much less true of Australia where movements in the monetary base due to the balance of payments and the government budget have been of greater significance (this is taken up in the next chapter). These different supply

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5 Our data period excludes most available evidence for the 1970's. Two complete cycles are evident in interest rates and velocity measures during the years 1971-1975, with turning points in short term interest rates occurring in the September quarter 1971, March quarter 1973, September quarter 1974 and March quarter 1975. Comparing the turning points in our three measures of trading bank deposit turnover, turnover leads by 6-9 months. Turning points in the income velocity of M1 and M2 are virtually coincident with interest rates, the lead varying from 0 to 3 months.

6 See Brunner (1968). This was not so in earlier times, which helps to explain why the lead of velocity over interest rates has tended to shorten in the U.S., as we noted earlier.

characteristics, and institutional differences in securities markets, probably account for the considerably shorter interest rate lag in the U.S.

Implications of the Argument

Our analysis bears directly upon the two issues raised at the beginning of this paper: the overshooting mechanism of Laidler-Tucker and the length of the lags in the monetary sector.

Overshooting. The customary way of modelling the demand for money function, with the supply of money as the dependent and interest rates and income as the independent variables, is appropriate for a world in which the money supply adapts passively to demand. We have shown that this model, when combined with the partial adjustment hypothesis and used in a situation where the money supply varies independently of demand, implies an *overadjustment* of income and interest rates to changes in the money supply. It is this feature, at least insofar as interest rates are concerned, which forms the basis of Tucker's and Laidler's paradoxical contention that lags in the demand for money function speed up the transmission of monetary impulses. In our view the correct analogue of the partial adjustment hypothesis, in conditions where the supply of money is exogenously determined, is one of a partial adjustment of interest rates. At a theoretical level the idea of overshooting can be sustained if expected levels of interest rates enter the demand for money function, but our results do not suggest that this possibility eventuates.

Models which assume the supply of money to be demand-determined are almost invariably used in studies of the demand for money.[7] Whatever sense

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7 Other than the author's own study with M.J. Artis, the only exceptions are those of Teigen (1964) and Gibson (1972), which take into account interactions been money supply and money demand.

the assumption of a demand-determined money supply made of the 1950's and early 1960's (in our view very little), it applies with less force for the late 1960's and early 1970's with exchange rates more flexible and interest rates featuring less prominently in central banks' operating strategies. If a model which implies an overshooting of interest rates is applied to data in which interest rates undershoot, it is mis-specified and will exhibit instability, which is what happens.[8] Such 'instability' tells us nothing about the true instability of the underlying demand function. We have already argued that the relationship between interest rates and velocity could be the result of shifts in demand, but on the available evidence it provides a less plausible explanation than the one we have offered, which interprets the observations of velocity as movements along a stable demand for money function with allowance made for lagged market clearance.

Long lags. The long lags (of three years or more) found in quarterly studies of the demand for money[9] are not only inconsistent with the relatively short

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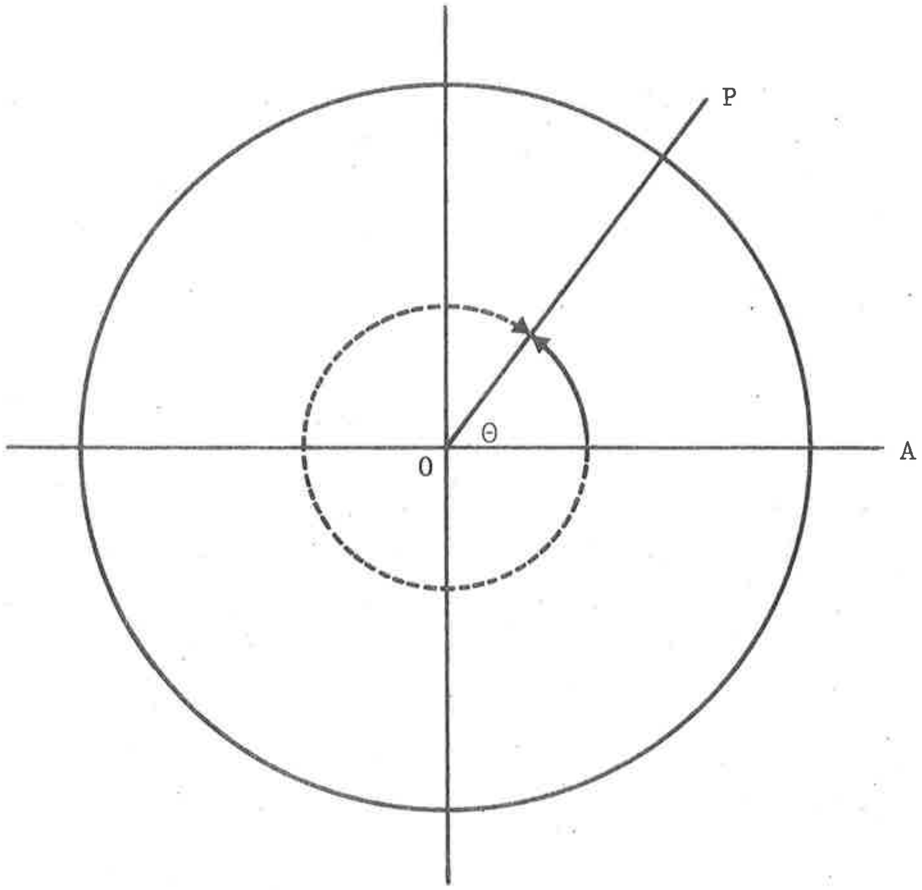
8 Clearest documentation of instability comes from the U.K. where Artis and Lewis (1974) and Hacche (1975) show that the Bank of England's demand for money functions seriously underpredict monetary growth in the 1971-73 period. In the U.S., instability is evident for 1974 and 1975 in studies by Pierce (1975), Enzler, Johnson and Paulus (1976) and Meyer (1976). For Australia, Norman and Purvis (1975) report that functions estimated by Norton, Cohen and Sweeny (1970) and Valentine (1974) exhibit instability when extended from 1969 to 1973, and in their own work with data adjusted for seasonality found that the coefficient on the lagged dependent variable consistently exceeded unity. Similarly explosive adjustment systems are reported by Cagan and Schwartz (1975) for the U.S.

9 These studies employ variations of equation (17-4), and we refer to the lags implied by the parameter d. For the U.S., De Leeuw (1965), Modigliani, Rasche and Cooper (1970) and Cagan and Schwartz (1975) find that only .04 to .10 of the difference is eliminated within the first quarter; for the U.K., Goodhart and Crockett (1970) report adjustment coefficients ranging from .04 to .15; and for Australia, Norton, Cohen and Sweeny (1970) and Jüttner and Tuckwell (1974) both estimate an adjustment coefficient of .18, while Valentine (1975) estimates lags of similar length. For a recent discussion of lags in the demand for money see Thomas (1975).

lags we have measured between money and output, they are also inconsistent with demand for money studies which employ annual data. The annual studies assume implicitly that any adjustments in the monetary sector are completed within the year, and generally obtain satisfactory results. This inconsistency between the annual and quarterly studies has never been rationalized satisfactorily in the literature, but a simple explanation can be offered. The lag of interest rates relative to monetary velocity appears in general to be 12 months or less. When annual data is used the adjustment of interest rates is completed within the unit of observation and it doesn't matter much whether money or interest rates appear on the L.H.S. of the estimating equation, as Kavanagh and Walters (1966) found. But with quarterly data the adjustment is *not* completed and the precise specification *is* important. There is always a $2\pi k (k = 1 \ldots m)$ indeterminancy in phase relationships and thus difficulties in establishing the lead-lag behaviour when regular cycles are present in the time series. Considering Figure 17e, we argue for there being a short lead of velocity over interest rates, as indicated by the angle AOP of θ = say 60° or $\pi/3$ radians. This can always be seen alternatively as a lag of velocity behind interest rates of $5\pi/3$ radians or 300°. For a cycle of 48 months in period, this is the difference between a lead of 8 months and a lag of 40 months, and the shorter is the lead, the longer the lag will appear to be when the alternative specification is made. Our point is that the existing studies have ignored the possibility that a short lead of velocity relative to interest rates is a viable, and sensible, alternative to a long lag from interest rates to velocity. Relatively short lags can be seen to exist from money to *both* output and interest rates, and no necessary inconsistency exists.

Friedman's analysis. As a final matter we return to the issues raised by

FIGURE 17e



Friedman about the procyclical behaviour of velocity. Friedman was led to his conclusion about the unimportance of interest rates for velocity when he observed that the *timing* pattern of interest rates could not account for the cyclical behaviour of velocity, and developed his alternative of the permanent income hypothesis. When permanent (or expected) income is formed adaptively from past values, and it is assumed that the money market always clears, this formulation can produce overshooting of the arguments of the function. We challenge his analysis on two levels. First, we dispute the idea that the money market must always be thought of as cleared, arguing for the possibility of partial clearance. Secondly, we argue that the premise upon which the permanent income notion was introduced is invalid, for the cycles in velocity and interest rates show significant coherence and the lag of interest rates relative to velocity may follow from our hypothesis of partial adjustment to disturbances in the money market. The introduction of the permanent income model of the demand for money was unwarranted.

In his later analysis, Friedman has sought to explain the procyclical behaviour in terms of expectations of inflation induced by prior monetary expansion raising both velocity and interest rates. Given that we have found an association between velocity and both interest rates and inflation expectations, his argument is a possibility but the precise dynamics of the adjustments remain unclear. Using a measure of price expectations based on market behaviour we find the relationship with velocity in Australia to be marked by lags of considerable length relative to the cycle, which led us to the view that, as compared with interest rates, inflation expectations might be best seen as a largely independent influence upon velocity. In the U.S. the lag between increases in money and increases in interest rates is 5-7 months, which on the basis of other evidence pointing to lags in the formation of price expectations, would seem to be too short for an effect to run from money to inflation expectations to nominal interest rates.

As an alternative to Friedman's explanation, we would look in the first instance to the behaviour of expenditures, for while our explanation of the relationship between interest rates and velocity can allow for both supply and demand factors, the procyclical behaviour suggests that movements in income dominate the cyclical swings in interest rates. In chapter 11 we found that part of movements in income in Australia must be attributed to shifts in autonomous expenditures, which raise both income velocity and interest rates; and the income multiplier is estimated to lie in the range 1-2.

This leads naturally to the question of the relative importance of monetary and velocity financed increases in expenditures, for which knowledge of the interest elasticity of the demand for money is relevant. The cross-spectral analysis enables us to make some inferences about the parameters of the underlying demand for money function. The velocity formulation constrains the elasticity of the money stock with respect to money income to unity, but we can estimate the interest rate elasticity directly from the cross-spectral frequency components, and our estimates range from .15 to .60 for Australia and from .12 to .56 for the U.S. These elasticities seem to be small enough to put fairly narrow limits upon the variations in velocity that could be induced by changes in autonomous spending. This indirect evidence tallies with the direct evidence obtained in Chapter 11 by regressing aggregate expenditures with money and autonomous expenditures, where it was found that changes in money exerted both a larger and more consistent impact than did changes in autonomous expenditures. This being so, it is pertinent to examine the sources of cyclical changes in the money supply.

Section VI

Sources of Monetary Changes

Chapter 18

Money and the Balance of Payments

Two overlapping reasons prompt an examination of the sources of cycles in the money supply. First, as cycles in money appear to play an important role in the Australian business cycle it is natural to ask what has caused the fluctuations in money; in this way information might be obtained about the sources of unemployment and inflation in Australia. Second, as we have followed the literature in describing the lag between cycles in money and cycles in output and prices as the 'lag in the effect of *monetary policy*', a criticism would seem to be implied about the role of monetary policy as a cause of economic instability. Monetarists certainly argue in this way. For example, Sharpe (1975) has argued that the Australian evidence is "consistent with" inflation and "excessive" growth of the money supply being attributable to government actions. We shall see that this is an overly-simple interpretation of events.

Pursuant to the first question, we look to the impact of the balance of payments upon the money supply. Australia meets most of the requirements of the 'small open economy' assumption of international trade theory, and its exchange rate has been pegged for most of the post-war period. It seems likely to be subject to economic disturbances originating from overseas, and transmitted to the domestic economy through the banking system and the foreign trade multiplier. In the latter context, four measures of autonomous expenditures were used in our study of the determination of aggregate expenditures in chapter 11, and all treated items of foreign trade as autonomous (two used the trade balance, and the others, exports). Thus the expenditure effects of the balance of payments have already been documented and here we focus upon the responses via the banking system.

The second question leads us to examine the actions of the central bank. Governor Coombs (1958) emphasized that action was needed:

> "The dependence of the Australian economy on export income and the violent fluctuations in the prices of the principal exports have high-lighted the need for ... neutralising or at least modifying the impact of changes in the balance of payments on the liquidity of the banks and the public."

Whereas in section I we were concerned with the 'offensive' policies of the Reserve Bank, here we are concerned with the 'defensive' dimension of policy.

Although this chapter was not primarily designed as such, it serves to draw together our investigation of money and cyclical fluctuations with many of the elements contained in earlier chapters. In particular, we utilize knowledge of the authorities' reaction function, which indicates the desired response of policy to employment, inflation and the balance of payments (chapter 6). We also draw upon our earlier analysis of the determinants of the money supply (chapter 10).

The analysis here may also help us to understand more fully the relationship of money to income. In chapter 14 it was found that the inter-relationship between money and income and prices (wholesale prices) varies markedly with the frequency of oscillation. For long run movements in the economy, money is in a subsidiary position and money income and prices lead the money supply. During cycles which correspond in duration with the conventional business cycle, money appears to have a more active role; money leads output and prices and the pattern of the timing relationships involving equity markets, expenditures, output, income and prices is suggestive of, or at least not inconsistent with, effects running from money to the economy. The consistency of this finding poses a challenge to analysis.

A distinction between short run and long run behaviour lies at the basis of the role of money in external relationships. In a world of fixed exchange rates, each individual country has little leeway with respect to its monetary policy in the long run. Its price level is largely determined by supply and demand conditions in world markets, and if external equilibrium is to be maintained the stock of money must be whatever is required to validate the price level. That is, in the long run the price level determines the quantity of money in circulation, so that the money supply is endogenous. Such a mechanism is explicit in the monetary theory of the balance of payments (see, e.g., Johnson (1972)). The nature of the shorter run dynamics remains relatively unclear, for judgments are involved about the responsiveness of capital flows and trade flows to monetary disequilibria. Room exists for domestic events and domestic economic policies to reinforce or offset the external impulses; there is also an expanded role for the monetary sector. Monetary movements may be passively accommodating the cycles in income, if the long run relationships apply in the short run, or determining them, as in Hume's specie-flow mechanism. In this latter mechanism, domestic incomes and prices are determined solely by the money in domestic circulation, and it is flows of money that are the central factor in the transmission of price changes between countries.

If we find that monetary and thus economic cycles in Australia have a significant external component, it may point to one possible explanation for the role of money differing so much between long run and shorter run oscillations. It would also help us to clarify the nature of the transmission of external impulses and in particular the role of the money supply in them.

Australian Discussion

Australian views about the role of money and external fluctuations have gone through three distinct phases. Studies of the early postwar years by

Hirst (1953) and, more particularly, Rowan (1954) gave considerable emphasis to the dependence of the Australian economy and the need for the banking system to be insulated from the liquidity consequences of fluctuations in the external position. The banking system was seen as a transmitter of external impulses.

During the 1950's and 1960's the conviction that Australian cycles were 'home-grown' grew in strength. In 1957, Arndt wrote of the "Emerging Independence of the Australian Economy" and while he did not exactly conclude that independent status had been attained, it is fair to say that his article was widely interpreted as such. Earlier Downing (1956) had recorded the view that 1956 was "a domestic inflation" and the policymakers concurred: the first of the Treasury's Economic Surveys (in 1956) stated "our troubles arise largely within Australia from which it follows that they lie within the ambit of our own control". This became the dominant view in the 1960's. While the 1959/60 boom ended in a balance of payments crisis, it was seen to be "the result of internal inflation" (Corden, 1968), and the external crisis was widely attributed to the government's ineptness at releasing import controls, a policy described by Lydall (1962) as "comparable with one of trying to put out a fire in Cairo by blowing up the Aswan dam". In a study published in 1969, and to which reference has already been made[1], Burley concluded that "the four to five year post-war growth cycle is more or less endogenous to the Australian economy". This is indicative of Australian economic thinking at that time. It has been challenged by the detailed study of Waterman (1972) of the period 1948 to 1964, which sees the apparent independence as an illusion produced by the relative stability of the world economy and thus export prices, and by more recent analyses of the late 1960's and early 1970's

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[1] See chapter 14.

by Jonson, Mahar and Thompson (1974), Jonson (1973), Porter (1974), and Zecher (1974).

These latter studies present the case for Australia having imported its inflation from overseas. Their analyses commence in 1960, but this seems to be conditioned more by the availability of data than the inapplicability of the models to earlier years. It is beyond the scope of the present study to summarize these models in detail, but the essential point they make can be stated succinctly in terms of our earlier comments about the long run and short run position of the money supply in balance of payments theory. In essence, the authors advance the view, common in much modern thinking about international inflation[2], that it may be a better approximation to reality to treat economies as if they were in long run equilibrium than to see a specie-flow mechanism in operation. This follows in the tradition of the Banking School, which insisted that, even in short run, it made more sense to think of the price level determining the quantity of money than vice versa.[3]

Basic to the transmission mechanism envisaged in the papers authored or co-authored by Jonson is the distinction between tradeables and non-tradeables. Tradeables are goods for which a world market exists, whilst non-tradeables are those which are confined to the domestic economy. The transmission of inflation goes directly from world prices into the domestic prices of tradeables and thence, through the labour market and switches in demand and in combination with the direct importation of inflation expectations, to the prices of non-tradeables. Discrepancies between world prices

2 Rather than attempting to provide detailed documentation, the reader is referred to Laidler and Parkin (1975), section 5.

3 See Laidler (1972)

and domestic prices arise only from the lags involved in the mechanism (Almon lags, lasting 5 quarters).

Surprisingly for a monetarist-inspired study, albeit a Manchester-styled one, the role of the money supply is ignored in this scenario. This is where the studies of Porter and Zecher come in, for they argue that flows of international trade and capital provide, within the quarter, the monetary flows needed to adjust the domestic supply of money to the demand for money and maintain continuous equilibrium in the money market. Thus by linking the studies together, it can be presumed that the balance of payments provides whatever change in reserves is needed to generate the rate of monetary expansion required to validate the rate of inflation determined through the mechanisms outlined above. Flows of money are looked upon not as the vital link that transmits world prices to the domestic economy, but simply as a means of adjusting the consequences of domestic monetary policy to the demand for money, the determinants of which are independent of domestic (monetary) policy.

The notion that conditions of long run equilibrium can be applied to the analysis of short run situations is a bold one, and in order to discuss further the transmission mechanism of external disturbances, the role of the money supply, and the likely responses of domestic monetary policy, it is helpful to translate the ideas into a simple framework based on Mundell (1968) and Johnson (1972).

Balance of Payments and Monetary Policy

Let G represent the Reserve Bank's holdings of gold and foreign exchange, and ${}^{dG}/_{dt}$ their growth over time. With exchange rates fixed,

$$\frac{dG}{dt} = F = X - Im + K \tag{18-1}$$

where F is the sum of the trade balance and capital movements. The domestic money supply is presumed to be functionally related to policy and non-policy forces in the manner hypothesized in chapter 10, such that

$$Ms = m_0 B + m_1 L - m_2 C_0 - m_0 W_0 \quad (18\text{-}2)$$

in which B is the quantity of central bank liabilities held by banks and the public, L is the cumulated sum of bank reserves liberated or impounded by changes in required reserves, and m_0 and m_1 the 'money multipliers' reflecting banks' deposit expansion engendered by B and L. The last terms, C_0 and W_0, allow for public and bank preferences for base money to affect the money supply, as shown in chapter 10. This model postulates that banks' intermediation is governed solely by the supply of cash reserves available to the banking system. The linkage between (18-1) and (18-2) is the balance sheet of the Reserve Bank,

$$B + O = G + T + S + Q$$

where as above G stands for gold and foreign exchange holdings, O stands for the liabilities to government, T for holdings of Treasury bills, S for other government securities holdings, and Q for credit extended to the banks and the public. This can be simplified to

$$B = G + A \quad (18\text{-}3)$$

where A represents net domestic creation of high-powered money by the Reserve Bank (termed domestic base money). Finally, we can relate the demand for money to money income,

$$Md = {}^{Y}/_{V} \qquad (18\text{-}4)$$

where Y is $(P_AQ_A + P_BQ_B)$, that is the value of production of internationally traded and non-traded goods, both treated as single commodities, and V has dimensions such as those defined in chapter 16.

The properties of the system depend upon the precise specification of the determinants of the items in F, of V, and of the division of Y into its components.[4] Ignoring these for the present, and taking for illustrative purposes the simple case in which V is constant over time, by substituting (18-3) into (18-2) and differentiating we obtain

$$\frac{dM_s}{dt} = m_0 \frac{dG}{dt} + m_0 \frac{dA}{dt} + m_1 \frac{dL}{dt} - m_2 \frac{dC_0}{dt} - m_0 \frac{dW_0}{dt} \qquad (18\text{-}5)$$

By differentiating (18-4) and setting $Ms = Md$, we obtain

$$\frac{1}{Y}\frac{dY}{dt} = \frac{m_0 V}{Y}\left(F + \frac{dA}{dt} + \frac{m_1}{m_0}\frac{dL}{dt} - \frac{m_2}{m_0}\frac{dC_0}{dt} - \frac{dW_0}{dt}\right) \qquad (18\text{-}6)$$

This simple model provides the broad framework of our discussion and empirical evaluation of the external influences upon Australian monetary policy.

Let us return to the Australian discussion about the ways in which Australia has 'imported inflation'. The mechanisms linking world inflationary disturbances to domestic money income can be grouped under four headings.

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4 In particular in an open economy imports will be significantly affected by current and prior values of domestic expenditures, so that increases in exports will lead to rising imports. Depending on the precise lag structure, such responses may dampen, truncate or reinforce export swings in the dependent economy. But once monetary mechanisms are considered the total impact on the cycle depends also on the behaviour of capital movements. See Matthews (1959, chapter XI).

First, there are the conventional foreign trade multiplier effects by which improvements in the current account increase domestic expenditures. (These effects are given representation in the econometric models of the Australian economy. One of the five models treats the trade balance as the autonomous item, the others make exports exogenous and relate imports to lagged income and exports.) Secondly, the price of internationally traded goods and their close substitutes will increase, given the condition $P_A = \pi \bar{P}$ where $\bar{P}$ is the U.S. dollar price of trade goods and π is the exchange rate between Australia and the U.S., the number of units of home currency which must be given up to acquire one unit of U.S. currency. Thirdly, the increase in import costs and the price of exportable goods will foster inflationary expectations and generate cost-push and wage-push pressures upon the price of domestic goods, P_B. Under Australian institutional arrangements the responses of the national wages tribunal to the balance of payments are crucial. This particular linkage was emphasized by Meade and Russell (1957), but was given little consideration by model-builders until the recent empirical work of Jonson *et al* which supports their emphasis. Fourthly, improvements in the balance of payments will add to domestic liquidity generating effects upon domestic expenditures, unless velocity moves inversely. This channel is particularly important where movements of capital reinforce export swings. These were the conditions analyzed by Rowan, and research by Barry and Guile (1976) and Kasper (1975) shows that the typical pattern of capital flows into Australia has been to reinforce the tendency towards external surpluses during cyclical upswings. (Like many other countries, Australia's balance of trade has typically moved from deficit towards surplus during downswings, and the surplus continues into the upswing phase.)

This last mechanism has clear implications for monetary policy, discernible from (18-5) and (18-6). In the absence of explicit policy action, it causes a 'primary' expansion of the money supply as foreign exchange is deposited, and a 'secondary' impact through the expansion of bank credit (providing m_0 in equation (18-2) exceeds unity).[5] But the other mechanism by which inflation is imported also have implications for monetary policy. If the liquidity effects are removed by a policy of automatically 'sterilizing' reserve flows, such action involves trying to hold domestic money income below the level implied for international adjustment. Unless the increases in $\frac{1}{Y}\frac{dY}{dt}$ arising from the other mechanisms are 'financed' by an elastic velocity, an excess demand for money and associated excess supplies of securities and goods seem likely to result. The authorities may tacitly permit an expansion of the money supply to be induced via the balance of payments, because to neutralize it will cause deterioration of the employment position. In an open economy, movements in external reserves and the money supply can *accommodate* as well as *transmit* cyclical disturbances emanating from overseas. These dual functions are intertwined, but it may be that one has been more important than the other.

In the light of the foregoing, we can usefully distinguish four kinds of policy response which a Central Bank may initiate in the face of disturbances of an overseas provenance. One possibility is that it will do nothing, and by refraining from action, allow the liquidity and other effects of the disturbance to work through the system in a quasi-automatic manner.

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5 While these reactions would seem to be straightforward, there is little similarity in the way the builders of Australian econometric models have specified the monetary implications of international payments. Only the Reserve Bank model (RBA1) traces a clear effect from the balance of payments to the money supply. There is no monetary sector in either the Nevile (1962) or the Kmenta (1966) models, and in the Treasury model (Higgins and Fitzgerald, 1972) it consists of only one equation. In the Zerby model (1969), changes in international reserves affect the monetary base and the money supply, eventually changing short and long term interest rates: however the impact of the monetary base upon the money supply is poorly determined.

Alternatively, it might choose to follow the gold standard rules, *reinforcing* by appropriate action the quasi-automatic forces in order to rapidly stabilize the balance of payments. In both instances, a policy consistent with maintenance of external equilibrium is pursued. On the other hand, the central bank might seek to sterilize the money supply effect of swings in the external position; or, more ambitiously, it could seek to offset *all* the effects of the external disturbance, aiming to fully insulate prices and incomes from any overseas influence. In the latter cases, the balance of payments disequilibrium has an automatic impact on the supply of money because of the fixity of the exchange rate, but this effect is cancelled because the changed liquidity situation implied by the balance of payments conflicts with the policy desired for internal balance. External disequilibria affect the money supply in a significant way where this coincides with the authorities' internal balance policy. This is the basis of Mundell's (1968, chapter 15) "international disequilibrium system". The ability of a central bank to conduct sterilization policies depends on several factors: the size and duration of the external disturbance, the pervasiveness of the effects, the amount of international reserves held, and the instruments of monetary policy. These are at the basis of the 'old' distinction between the short run and long run impact of the balance of payments.

With these four possibilities in view, we can now turn to the evidence with the object of ascertaining which of them most clearly approximates the characteristic response of the Australian policymakers to overseas disturbances. Our analysis is based on a cross-spectral study of the relevant time series, which enables us to relate the results directly to earlier chapters.

Results of Cross-Spectral Analysis

Our first objective is to examine whether, and to what extent, the monetary base and the money supply reproduce swings in the balance of payments. Since there is no market for foreign exchange and transactors must purchase from or sell to the trading banks who in turn clear all except working balances in London and New York on a monthly basis to the Reserve Bank, we use the Reserve Bank's holdings of gold and foreign exchange (G.F.E.) to indicate the balance of payments position. Other series used are the monetary base, exclusive (Base A) and inclusive (Base B) of savings banks' holdings of central bank liabilities, trading bank deposits (Dep), and the money supply (M1, M2 and M3).

The basic time series are sampled for the period 1946-1970 in monthly form, but two other periods are examined. Analysis of savings bank deposits and the M3 definition of money uses the base definition Base B. As this series is not available prior to 1956, a second period considered is 1956-1971, also sampled monthly. Giblin (1951) provides estimates of the Commonwealth Bank's holdings of international reserves from 1928-1945 in quarterly form and these are combined with post-war series to obtain a quarterly series of G.F.E. from 1928-1970. All three data periods exclude the period of (more) flexible exchange rates which commenced in 1972.

Relevant cross-spectral statistics are shown in Table 18.1. The post-war business cycles identified in chapter 12 have varied in period (peak-to-peak) from 26 months to 59 months, averaging 45 months. We focus upon these frequency bands, and the statistics for coherence, gain and phase (Tau) are simple arithmetic means over the frequency components comprising the bands $^1/_{72}$ - $^1/_{24}$ c.p.m. for 1928-1970, and 1956-1971, and $^1/_{96}$ - $^1/_{24}$ c.p.m. for 1946-1970. As before, we fit models for angle lag, time lag, and combined angle and time lag to all frequencies higher than $^1/_{96}$ c.p.m. and lower than $^1/_{12}$ c.p.m., and the best fitting models are reported.[6] The location of the

[6] A n.a. means that the particular model is not appropriate.

Table 18.1

Cross-Spectral Analysis of Various Monetary Series

Time period	Series 1	Series 2	Coherence	Gain	Phase (months)	Angle lag (degrees)	Time lag (months)	Cross-Correlation
1928-1970 quarterly	G.F.E.	M1	.52	.13	+1.05	+ 8.82° (1.08)	n.a.	0
	G.F.E.	M2	.56	.15	+1.87	+14.60° (2.03)	n.a.	0
1946-1970 monthly	G.F.E.	Base A	.64	.37	+3.01	n.a.	+2.25 (21.31)	+2
	G.F.E.	Dep	.76	.19	+2.55	+ 8.17° (1.79)	n.a.	0
	G.F.E.	M1	.61	.15	+2.87	+13.82° (5.93)	n.a.	0
	G.F.E.	M2	.75	.15	+2.64	+10.26° (2.88)	n.a.	0
	Base A	Dep	.83	.42	-0.88	+ 3.02 (0.40)	-1.67 (3.20)	-1
	Base A	M1	.80	.39	-1.55	n.a.	-1.34 (2.88)	-1
	Base A	M2	.83	.36	-0.93	+2.61 (0.39)	-1.68 (3.66)	-1
1956-1971 monthly	G.F.E.	Base B	.35	.24	+2.86	n.a.	3.46 (1.55)	+5
	G.F.E.	M3	.52	.10	+2.58	n.a.	2.55 (4.23)	+4
	Base B	M3	.80	.29	-1.74	n.a.	-1.53 (2.87)	-1

maximum value of the cross-correlogram is also recorded. With the phase, lag and correlation columns, a + indicates that series 1 leads series 2, and vice versa for a - sign. As all the series crossed are monetary ones, and we give attention to a relatively narrow band of frequencies, the data are not adjusted for seasonality. The data are filtered for trend by applying the moving averages employed in sections IV and V.

All of the monetary series contain considerable power in the business cycle frequencies. The money supply is closely related to both foreign reserves and to the monetary base. In the former case, cycles in foreign reserves 'explain' between 50 and 75 per cent of cyclical variations in the money supply, and this is so for all definitions and all time periods considered. In particular, a significant coherence is found between G.F.E. and M3 over the period 1956-1971, contradicting the evidence presented in Zecher (1973) to the effect that in the 1960's there is zero correlation (R^2 = .02) between reserves and money. His data is quarter-to-quarter changes over the period 1959-1970. Since the time periods covered are so similar, we are at a loss to explain the difference, unless it illustrates the advantages of spectral methods for analyzing cyclical components by its ability to eliminate short run 'noise'.

As would be expected, the coherence between the money supply and the base is higher than that between money and foreign reserves because of the inclusion of domestic credit creation. For all three definitions of money, variations in base money 'explain' over 80 per cent of cyclical variations in the money supply. Recalling the discussion of chapter 10, this would seem to put to rest the Reserve Bank's argument about its inability to control the money supply because of slippages between the monetary base and the money supply. However, some basis for understanding what might have prompted the views expressed comes from the manner in which the association varies with the frequency of oscillation. Coherence is as high as .87 for the frequency $^1/_{48}$ c.p.m., but drops sharply for frequencies higher than $^1/_{20}$ c.p.m. and there is little coherence between the series other than at the seasonal frequency ($^1/_{12}$ c.p.m.) and its harmonics. Short run movements in the money supply presumably derive from changes in banks' and public demands for base money, but for long run movements the supply of base money acts as a constraint upon banks' intermediation.

Foreign reserves appear to have a slight lead over both base money and the money supply. Once allowance is made for the clearance mechanism for London funds which may delay clearance of banks' acquisitions of foreign exchange to the Reserve Bank by up to a month, the base measures and the money supply appear to be coincident. These timing relationships make sense if one thinks of strong effects running from G.F.E. to both the base and the money supply. The length of the lags confirm our earlier suggestion that the intermediate lag of monetary policy is short, for the longest lag recorded is 3 months.

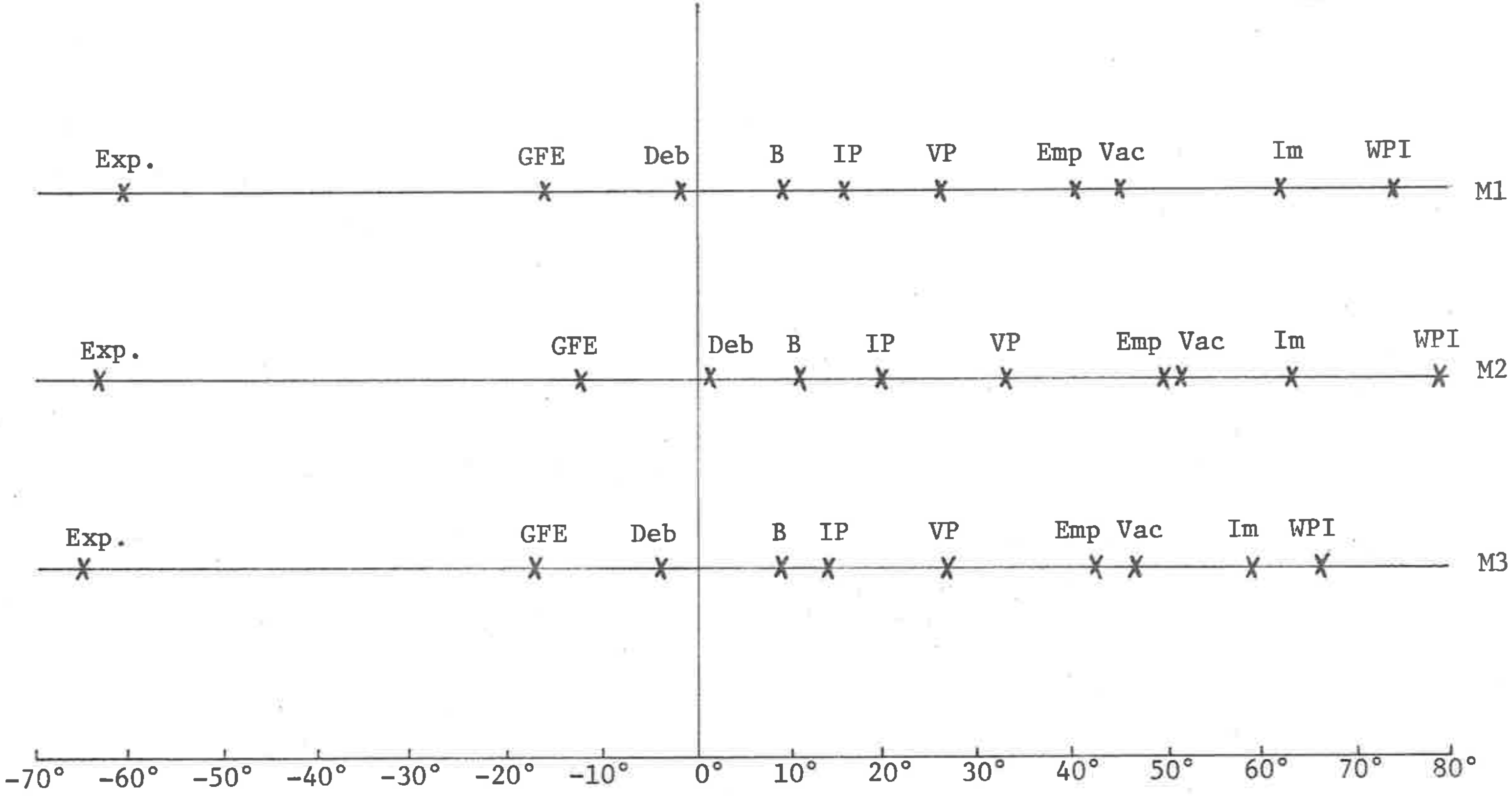
While the base and the money supply thus clearly reproduce swings in gold and foreign exchange holdings their amplitude is considerably less. This is indicated by the gain coefficients, which are essentially unsigned regression coefficients between the various processes at particular frequencies. In the case of the base, the impact of foreign reserves has presumably been modified by inverse movements of domestic base money. The components of the money supply, in turn, are about .40 of the base at the business cycle frequencies. This would seem to indicate that reserve ratio changes have played an important role in modifying the impact of swings in reserves upon the banking system. Those aspects are examined in more detail shortly.

Our second area of examination concerns the timing of balance of payments cycles in relation to measures of domestic activity. Here we wish to superimpose the timing patterns just identified upon the timing relationships discovered between money and economic activity in chapter 14. As well we wish to include the two components of the balance of payments available for the full post-war period, namely the value of exports (Exp) and the value of imports (Im). These two series have not previously been examined relative to the money supply in this study, but the phase differences (soon to be summarized) are clearly delineated, and their coherence with the money supply is high. At the frequency $^1/_{48}$ c.p.m., the coherence of M2 with exports is .63 and with imports is .81.

Figure 18a puts the pieces together. If the cross-spectra of series i and j with a third series, k, are available, $\phi_{ik} - \phi_{jk}$ provides an estimate of the phase difference between that part of the variations of i and j which is coherent with k. The figure shows the relative phases of the series as obtained from their cross-spectra with M1, M2 and M3 at the frequency band centred on $^1/_{48}$ c.p.m., which corresponds to the average duration of the post-war business cycle. A virtually identical pattern emerges from all three definitions of money, in which exports (Exp) and gold and foreign exchange holdings (GFE) lead money, debits (Deb) are coincident with money, and production (IP,VP), employment (Emp,Vac), imports (Im) and prices (WPI) lag money in that order. The close coherency we have found between the money supply and both foreign reserves and the measures of economic activity indicate that money has played a part in Australian economic cycles. Variations in the money supply are admittedly only one of four channels that we have identified through which the balance of payments impinges on domestic economic activity, but the sequence of events in Figure 18a is not inconsistent

FIGURE 18a

PHASE DIFFERENCES OF AUSTRALIAN SERIES WITH M1, M2, M3, 1946-1970



with the money supply having had a role in transmitting as well as accommodating cyclical impulses.

To summarize, the cross-spectral analysis provides us with a broad view of the behaviour of the money supply relative to business cycles and to movements in the balance of payments. This is:

1. A significant association exists between business cycle movements in the money supply and measures of economic activity. At the same time, the cycles in money supply are closely related to the monetary base, which in turn is related to swings in foreign reserves.
2. This link between foreign reserves, the money supply and economic activity suggests that the notion that Australian post-war business cycles have been independent of external impulses warrants reconsideration.
3. The relative phase patterns indicate that it is possible for the money supply to have been one of the channels through which external disturbances were transmitted to the economy.
4. The low amplitude of cycles in the money supply compared with cycles in foreign reserves suggests that the impact of the balance of payments on domestic liquidity has been substantially modified. If the money supply is accorded a role in generating economic cycles, it follows that the amplitude of Australian business cycles has probably been reduced.

Defensive Policies

From the analysis of chapter 10, we are entitled to assume that the responses of the money supply to balance of payments cycles reflects the activities of the central bank. Considering equation (18-2), it was found that changes in B and L dominated changes in M, and when proxies for C_0 and W_0

were included in the regression analysis they exerted a trivial impact upon the money supply. In Table 18.1 the gain statistic of the money supply when crossed with G.F.E. is .15. Thus it would seem that as much as 85 per cent of foreign reserve swings have been sterilized!

This conclusion needs to be viewed in the context of the four benchmarks for monetary policy (defined earlier), according to whether the central bank reinforces, ignores, sterilizes or over-compensates for the effects of the balance of payments upon the banking system and the credit market. In these terms, our cross-spectral study indicates that the Reserve Bank has followed a policy intermediate between the second and the third benchmarks; that is, it has modified, but not fully sterilized, the impact upon money supply of swings in reserves. This accords with our earlier conclusion based on a study of policy objectives and a constructed index of policy intentions that monetary policy has been consistently framed to take account of employment as well as the external position.[7] A more complete picture can be gained by examining these policy responses in detail.

Defensive policies have modified both the primary impact of reserve swings (upon the monetary base) and secondary repercussions on the banking system. Only some of the components of domestic base money are controlled by the Reserve Bank, for the finance provided to cover the government deficit and extended to rural marketing organizations is largely exogenous to the Bank. There have also been constraints upon full use of open market operations: the Bank's portfolio of government securities has frequently

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7 This judgment needs qualification. A policy of partial sterilization may be quite consistent with pursuit of external balance alone, if requisite changes in the quantity of money to achieve balance of payments adjustment are smaller than those magnitudes which would occur in the absence of policy. See Michaely (1971, chapter 2) and also Scitovsky (1969).

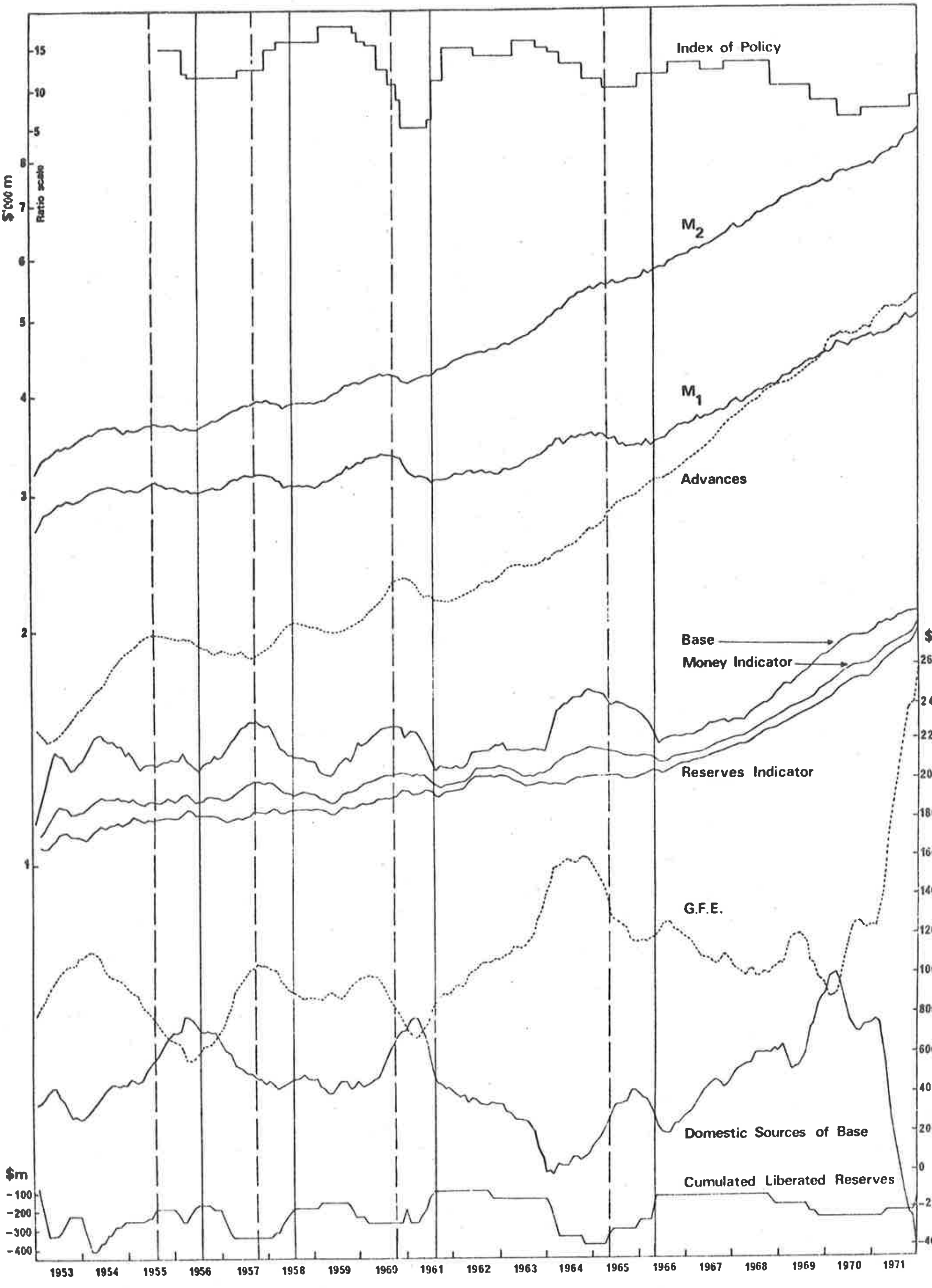
been thin; and the Bank's obligation to maintain an interest rate structure has hindered vigorous sales. But additional sterilization of foreign reserve flows has come from the sale of Treasury notes to the banks, and from the Reserve Bank's practice of meeting the bank's security requirements directly from its own portfolio. Some of the series relevant to our discussion are graphed in Figure 18b. In some instances such as in 1959/60, the domestic sources reinforced the relatively mild upswing in foreign reserves and continued the fluctuation in base money after foreign reserves declined. But in general an inverse relationship between G.F.E. and the domestic sources of base money is apparent. Using quarterly first differences of seasonally adjusted data over the period 1946-1970, we find that

$$\Delta A = 7.65 - .680\ \Delta G \qquad r^2 = .62$$

Changes in the domestic items of the base (A) have on average neutralised about 68 cents of every one dollar change in foreign reserve holdings (G).

An analysis of these defensive actions using cross-spectral analysis is revealing. Figure 18c shows coherence, gain and phase statistics for foreign reserves and the Reserve Bank's securities portfolio, and Figure 18d statistics for foreign reserves and domestic base money. In both cases the coherence is highest for the cyclical frequencies, although it remains high for higher frequencies in the second figure. The phase diagrams are relatively uninformative, showing that the series are approximately coincident in timing, with a suggestion that foreign reserves has a fixed time lead over the securities series. (In both cases, the series are inversely related.) What is of most interest is the gain diagram. The regression coefficient of -.68 estimated in the time domain is an average over all frequencies

FIGURE 18b


Index of Policy
$'000 m
Ratio scale
M_2
M_1
Advances
Base
Money Indicator
Reserves Indicator
$m
G.F.E.
Domestic Sources of Base
Cumulated Liberated Reserves
$m
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971

(excluding the seasonal). In Figure 18d it can be seen that at the frequency $^1/_{48}$ c.p.m. ($^{\pi}/_{24}$ radians), the components of domestic base money are .50 of foreign reserves but the gain rises to about 1.00 around the $^1/_{12}$ c.p.m. frequency bank ($^{\pi}/_6$ radians). This pattern is evidenced also in Figure 18c. The extent of the sterilization falls as the periodicity of cycles in foreign reserves increases. It would seem that the longer the external disturbance persists, the harder it is to neutralize. This accords with our *a priori* expectations. But the consequence has been the large cyclical fluctuations in the monetary base, evident in Figure 18b. Toward the latter part of the 1960's, the Bank seems to have been less constrained in its open-market operations and has been able to make greater use of them to absorb swings in foreign reserves. In Figure 18b this is shown by the pronounced inverse relationship of G.F.E. and the domestic sources of the base, particularly in 1970 and 1971.

Turning now to the impact of movements in foreign reserves upon bank liquidity, we find that S.R.D.'s (and Special Accounts) have been used frequently and vigorously to offset the residual. The devices were designed specifically for this purpose. Completing the earlier quotation from Governor Coombs:

> "The dependence of the Australian economy on export income and the violent fluctuations in the prices of the principal exports have high-lighted the need for neutralising or at least modifying the impact of changes in the balance of payments on the liquidity of the banks and the public. The Special Accounts system ... was adopted specially to meet such a need so far as the liquidity of the banking system is concerned, *though of course its operation has no direct effect on the liquidity of the public.*"

The importance of the words we have italicized will be made clear below. Judged in these terms the S.R.D.-Special Account devices have succeeded admirably. The absorption into and release of required reserves is shown

FIGURE 18c

ESTIMATED COHERENCE, GAIN AND PHASE STATISTICS FOR FOREIGN RESERVES (GFE) AND RESERVE BANK'S PORTFOLIO OF GOVERNMENT SECURITIES, 1946-1970 MONTHLY DATA

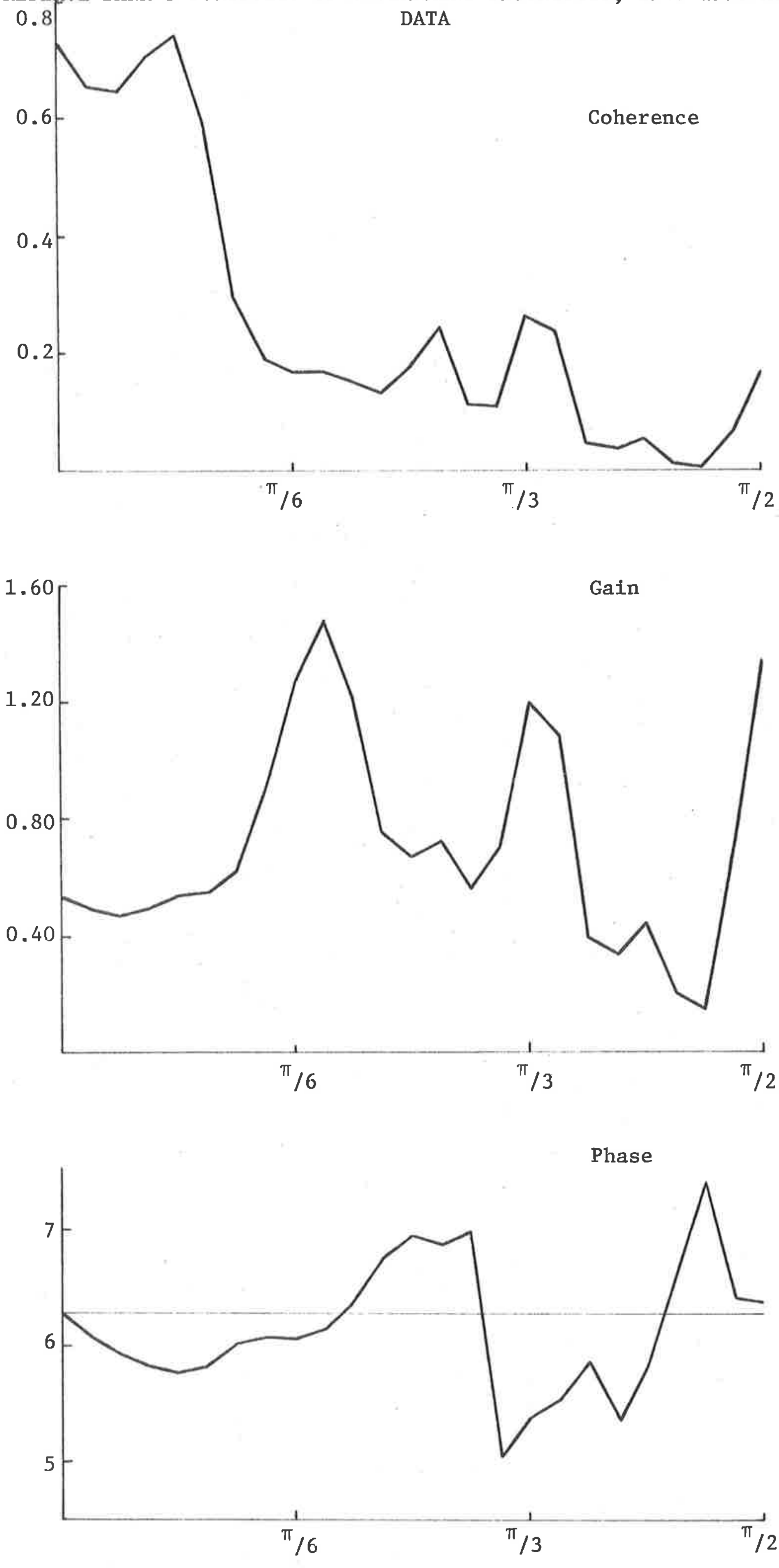
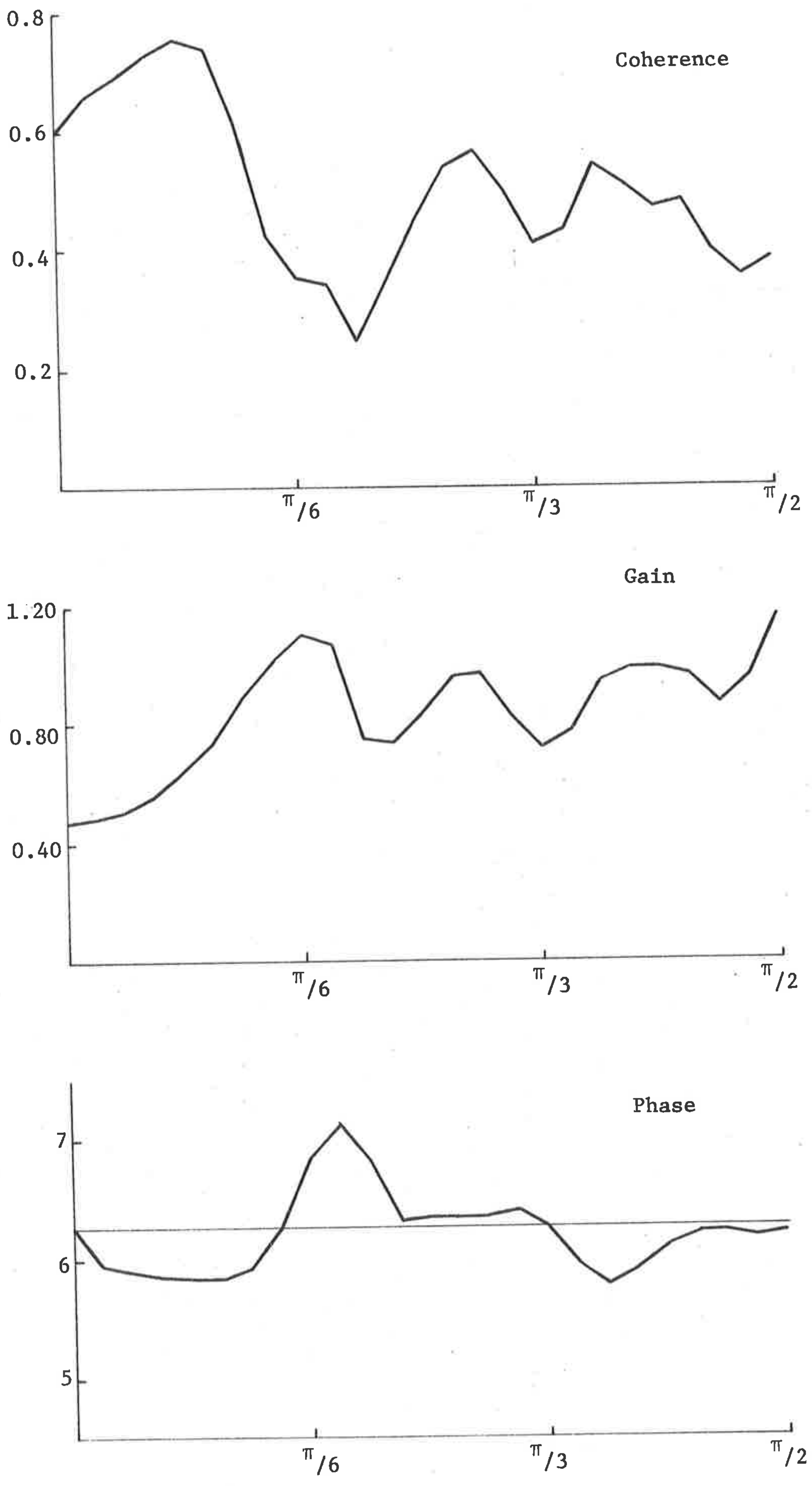


FIGURE 18d

ESTIMATED COHERENCE, GAIN AND PHASE STATISTICS FOR FOREIGN RESERVES (GFE) AND DOMESTIC BASE MONEY (A), 1946-1970 MONTHLY DATA



in Figure 18b by changes in cumulated liberated reserves (L). The inverse relationship between this series and the monetary base, B, is evident. From quarterly first differences of both variables over the period 1946-1970, the relationship is

$$\Delta L = 9.87 - .95\ \Delta B \qquad r^2 = .91$$

suggesting that the *major* role of changes in frozen reserves has been defensive.[8] In combination with changes in domestic base money, variations in the reserve ratio over the period 1946-1970 have neutralised the effects upon bank liquidity of swings in foreign reserves:

$$\Delta(A + L) = 10.50 - 1.01\ \Delta G \qquad r^2 = .97$$

These actions have stabilized the reserve position of the banks, thus preventing any secondary responses to the movements in foreign exchange. It would seem that the cycle in advances is markedly out of phase with cycles in foreign reserves, and during the 1963/65 cycle advances vary little from their upward trend.

Despite these defensive operations the money supply has exhibited much the same cyclical pattern as foreign reserves, although the amplitude of cycles in the money supply is significantly smaller. This raises once again the question of the inherent controllability of the Australian money supply. The issue is complex, and to resolve it we must return to our discussion in chapter 10 of the role of reserve ratio changes in the Australian money supply determination. A consistent feature of the results presented in that

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8 In constructing cumulated liberated reserves, releases to replenish term loan funds were excluded.

chapter is the *smaller* 'multiplier' impact that S.R.D. changes have had upon the money supply compared with changes in foreign exchange holdings and domestic base money. As an example, we reproduce two equations from Table 10.2, estimated from quarterly differences over the period 1946-1969.

$$\Delta M1 = \underset{}{11.45} + \underset{(7.63)}{2.23}\,\Delta G + \underset{(7.08)}{1.96}\,\Delta(B-G) + \underset{(5.41)}{1.60}\,\Delta L \qquad R^2 = .65,\ DW = .93$$

$$\Delta M2 = \underset{}{38.82} + \underset{(6.12)}{2.39}\,\Delta G + \underset{(5.67)}{2.12}\,\Delta(B-G) + \underset{(4.22)}{1.66}\,\Delta L \qquad R^2 = .56,\ DW = .87$$

The differences between the regression coefficients on ΔG and Δ(B-G) can be attributed to sampling variations, those differences between these coefficients and those on ΔL cannot. In order to illustrate the importance of this difference for the behaviour of the money supply we have constructed two measures: one which weights the base and liberated reserves equally (Reserves Indicator); the other which weights them according to the calculated 'multipliers' (Money Indicator). These are shown in Figure 18b. The first shows the way in which banks' liquid reserves have been largely insulated from overseas liquidity disturbances; by contrast, the money indicator has a cyclical pattern which matches that of the money supply.

In explaining the responses of the money supply to changes in the S.R.D. ratio in the earlier chapter, a distinction was drawn between the device's potential and actual role. The frozen account devices were designed in the era when bank lending was the prime target of monetary policy. They were seen as a highly flexible means of impounding or releasing bank reserves, and thus preventing *secondary* responses to external liquidity movements. In this they appear to have succeeded, but as Governor Coombs pointed out, there is no direct impact upon bank deposits. The *primary* effects are not removed unless a call to S.R.D. gives rise to a net reduction in banks' earning assets, and for the most part this has not occurred. Various technical aspects of the application and timing of S.R.D. changes have been discussed: these have had the effect of negating what we have termed the 'cash' aspect, leaving only the 'liquidity' aspect. That discussion can now be placed in a more general context.

While secondary deposit creation on the base of increases in overseas liquidity can be easily prevented by variations in the S.R.D. ratio, the stronger action of removing primary deposit creation, either by bond sales or restricting bank advances, involves pushing up, or at least resisting the pressures operating (with a lag) to lower, the structure of interest rates. Such action would have had to be undertaken when the stance of policy was expansionary. At the top of Figure 18b is shown the index of policy intentions constructed in chapter 5, where high values imply easy policy, low values restrictive policy. In chapter 6 this index was found to be reliably related to proxies of the policy objectives. Upswings of foreign reserves in 1957 and 1962/64 occurred during periods when monetary policy was pointed firmly in an expansionary direction. The relative phase differences between foreign reserves and employment are, on average, 60°-65°. Stronger action would involve increasing interest rates 8-9 months *before* the upswing in employment.

As cycles in the money supply over the whole period 1928-1970 are damped versions of the cycles in foreign reserves, the nature of the factors leading to such responses prior to 1945 need to be ascertained; while the Commonwealth Bank was established in 1911, it did not function effectively as a central bank until the war years. Guiney (1971) argues that much the same sort of behaviour that we have attributed to the central bank in post-war years was performed earlier by the trading banks, who dominated the capital market. After a careful study of the responses of the banking system to "disturbances emanating from abroad" during 1927-1939, Guiney concludes:

> "The trading banks were willing to absorb seasonal fluctuations in London funds and were not immediately susceptible to even sharp cyclical fluctuations. But if the latter persisted and the level of their London funds reached unusually high or low levels, they tended to adjust their credit policy."

Our conclusion in the post-war years is remarkably similar.

Defensive or Offsetting Responses?

So far we have assumed that the swings in foreign reserves have derived from movements in the balance of payments largely *autonomous* of domestic monetary conditions, followed by defensive operations. These results are capable of the opposite interpretation: namely that the swings in foreign reserves are *induced* by attempts at internal monetary policy. Consider again our simple model and suppose that $^{dY}/_{dt}$ is fully set by world conditions even in the short run and that the adjustment is completed. Solving the equations for $^{dG}/_{dt}$ we have

$$\frac{dG}{dt} = \frac{1}{m_0 V}\frac{dY}{dt} - \frac{dA}{dt} - \frac{m_1}{m_0}\frac{dL}{dr} + \frac{m_2}{m_0}\frac{dC_0}{dt} + \frac{dW_0}{dt} \qquad (18\text{-}7)$$

With $^{dY}/_{dt}$ given, any divergence between money supply and money demand produced by liquidity preferences ($^1/_V$), central bank policy (A and L), or by changing preferences of the banks and public for base money (C_0 and W_0), will induce offsetting responses in the balance of payments, trade and capital flows providing the required credit or restoring interest rates to world levels. This is the extreme case. The extent of the offset will be determined by the openness of the domestic capital market, the substitutability of domestic bonds for overseas securities, and the processes through which monetary actions are transmitted to the real sector (that is, the extent that monetary policy works through what Friedman calls 'implicit' interest rates rather than market rates).

On this alternative interpretation what we have viewed as being sterilization would be seen as the extent to which movements in foreign reserves had offset domestic monetary policy. Thus Porter (1974) estimates an equation in which the capital inflow is the dependent variable and his indicator of domestic policy ΔNDA ($=\Delta A + \Delta L$ in our terminology) appears with the right hand side variables. He argues that over the period 1961 to 1972 between 46 and 82 per cent of domestic monetary policy in Australia has been offset by induced capital flows - the difference in the extent of offset arising from the role which is accorded to 'speculative' capital flows. Similarly, Zecher (1974) estimates equations in which the dependent variable is the foreign component of base money($^{\Delta G}/_{B}$ in our terms) and among the independent variables is the domestic component of base money($^{\Delta A}-_{B}$). He argues:

> "If domestic supply of money exceeds demand, outlays rise above receipts, and part of the increased outlays are directed at foreign goods, services, and assets. Residents may acquire the reserve currencies to pay for the increased purchases from foreigners by buying reserves from the central bank in exchange for domestic money, thus generating a decline in the domestic money stock."

Both of these studies find that the hypothesized adjustments occur *within* the quarterly unit of observation, despite our finding that the foreign trade part of the mechanism, i.e. imports, lags the money supply by at least 60°, or 8 months, at the frequency $^{1}/_{48}$ c.p.m. A close relationship is also found to exist between reserve flows and their 'determinants'. This is not surprising. Re-estimating the earlier equation in reverse gives:

$$\Delta G = 10.29 - .95\ \Delta\ (A + L) \qquad r^2 = .97$$

It would thus be argued that variations in domestic policy have been fully offset by movements in the balance of payments.

These interpretations of the evidence would appear to be in direct conflict. This is evidenced by the diametrically opposite interpretations of German experience by Willms (1971) and Porter (1972), where the same facts are viewed as sterilization actions of the authorities by one and as offsets to policy by the other. As far as Australia is concerned, Zecher (1974) recognizes the possible presence of defensive actions by the authorities.

> "To the extent that policy actions are aimed at ... sterilizing reserve flows, these two variables [the money multiplier and the domestically determined portion of high powered money] will be functionally dependent on reserve flows, thus partly reversing the direction of causation implied by the hypothesis. This objection remains an open question, although I find it unconvincing, particularly during the 1950's when policy actions were carried out by the Commonwealth Bank. After the formation of the Reserve Bank, policy actions were more aggressive, and reserve flows may have become a more important factor in policy decisions."

Unlike Zecher our intuitive view is that cyclical disturbances in the balance of payments and responses in the monetary system - which contain much of the spectral density - reflect movements in foreign reserves which contain many elements largely autonomous to the local monetary system, followed by defensive strategies; the principal qualification coming from the possible responses of imports, but these would appear to be to *prior* monetary movements. If, for example, increases in the money supply are merely relieving an excess demand for money arising domestically, or accommodating an imported inflation written directly into wage and price setting mechanisms, the lead of foreign reserves and the money supply relative to income cannot be readily explained.

But let us consider the argument offered by Zecher about the differences between the 1950's and 1960's. From our survey of the modus operandi of monetary policy in chapter 3, we reject the naive view that the 1959 banking legislation altered the conduct of central banking in Australia in any substantive way. The Reserve Bank had the same Governor, the same officers and inherited the same basic central banking powers of its predecessor, the Commonwealth Bank of Australia. However, there were important differences between the two decades in the extent of openness of the Australian capital market. In the 1950's exchange controls and import restrictions were strictly enforced, and the capital market was inward looking. We doubt that offsetting capital flows would have been important. Exchange controls over current transactions were removed during 1960 and those over capital transactions were progressively relaxed during the 1960's making offsetting responses to domestic policy more likely. Yet the relationship between changes in foreign reserves and domestic policy (domestic base money and liberated reserves) has been *remarkably consistent* over time. Table 18.2 shows regressions between ΔG and $\Delta(A + L)$, estimated in both directions, for three 'decades' and for consecutive four yearly periods. Two aspects are remarkable: one is the closeness of the relationship, with the r^2 ranging from .91 to .99; the other is the stability of the magnitude of the regression coefficients. Considering the regression of $\Delta(A + L)$ on ΔG, the coefficient for 1950-1959 is -1.03, for 1960-1969 it is -1.03. Given the changes in the structure of the capital market, such a consistent result seems unlikely if offsetting responses (within the same quarter) are the dominant influence at work.

Support for our view of the importance of sterilization policies comes from examining the relationship with respect to frequency. The gain

Table 18.2

Regressions between quarterly first differences of Gold and Foreign Exchange Holdings (G) and Net Domestic Assets (A+L), 1946 - 1976.

Time period	R^2	D.W.	ΔG on Δ(A+L)		Δ(A+L) on ΔG	
			Constant	Coeff	Constant	Coeff
Full period						
1946 - 1976	.938	1.10, 1.04	23.603	-.905	25.138	-1.036
Decades						
1950 - 1959	.970	2.14, 2.24	9.580	-.940	10.126	-1.031
1960 - 1969	.970	1.74, 1.71	10.067	-.936	10.755	-1.036
1970 - 1976	.969	2.32, 2.21	73.584	-.915	79.142	-1.059
Four Yearly Periods						
1949 - 1952	.985	2.42, 2.49	17.405	-.946	18.336	-1.041
1953 - 1956	.937	2.51, 2.70	7.610	-.952	8.144	-0.984
1957 - 1960	.963	2.23, 2.24	5.835	-.924	6.058	-1.042
1961 - 1964	.964	2.09, 2.04	5.937	-.935	4.422	-1.031
1965 - 1968	.965	1.62, 1.86	14.454	-1.051	14.879	-0.918
1969 - 1972	.994	2.12, 2.09	32.976	-1.055	30.153	-0.942
1973 - 1976	.914	2.63, 2.54	78.909	-0.907	99.692	-1.007

coefficient between domestic base money and foreign reserves, is shown in Figure 18d. This is essentially an unsigned regression coefficient between the two processes at different frequencies, treating foreign reserves as the independent variable. We find that the gain declines as the periodicity of the cycle increases, which we interpret as consistent with the constraints upon defensive policies, and the difficulties of resisting large and persistent disturbances from overseas. If the relationship is inverted, then the 'offset' response via the balance of payments exceeds the domestic disturbance at the cyclical frequencies, which is less plausible. Further, since the offsetting responses envisaged by Porter and Zecher incorporate trade flows as well as capital flows (refer the first quotation from Zecher above), and even in the latter case seem likely to involve lags, the coincident timing of foreign reserves and domestic base money indicated by the phase diagram is also suggestive of defensive policies, which can be conducted concurrently with the flows.

This is not to deny that there are instances when capital movements have clearly responded to domestic monetary policy. One occasion was during the credit stringency of 1961; another was in response to interest rate increases in March 1970. Nor would we deny that the money supply has accommodated income effects produced by other mechanisms. Our framework allows for this, and we have argued that the two functions of the money supply are intertwined. If so, it may be argued that an attempt to distinguish the two roles, or at least to ascertain which has been dominant, is pointless. Both imply the existence of a stable demand for money function, which is the cornerstone of monetarist literature. Kaldor (1970) argues that the apparent empirical stability of monetary relationships and the relative unimportance of velocity movements is a result of the supply of money being a passive variable in the system that simply adjusts to demand. If the authorities were to actively attempt to control the money supply, he argues that instability in monetary relationships and in velocity would be manifested. By presenting evidence which is suggestive that the money supply has served to transmit economic fluctuations, the analysis of the previous chapters and the lags which have been measured bear directly on the issues raised by Kaldor, and provides direct estimates of the lags in conducting monetary policy.

Conclusion

In conclusion, we return to the two questions which prompted the preceding analysis. Cycles in the money supply have been much influenced by the balance of payments, but not exclusively so, for the coherence of the money supply with the monetary base exceeds that with foreign reserves. When viewed in the context of the behaviour of the money supply relative to other economic variables, the inter-relationships between the series leads us to suggest that during fluctuations of business cycle length, the money supply has had an active role in transmitting foreign-generated cycles. This is not to say that the authorities have passively accepted the liquidity flows, or have subjugated employment objectives for the requirements of external balance. We have found that the Bank's defensive actions have substantially modified the liquidity effects of swings in the balance of payments, and only a residual element has contributed to cycles in the money supply. This is for post-war cycles. Our earlier finding in chapter 14, based on a longer time period, which suggests that the money supply is in a subservient position for major swings in prices and incomes, may be explicable in terms of the difficulties of resisting major disturbances in the world economy and the role that the money supply plays in accommodating such pervasive forces.

Chapter 19

A Final Summing Up

As a way of concluding this study, we return to the two major themes of the effectiveness and the time lags of monetary policy and attempt to summarize briefly how the principal findings reflect on them.

Throughout the study we have used Friedman's findings as a benchmark, and we begin by setting out his principal conclusions about the influence of money on the economy.

> "1. Changes in the behaviour of the money stock have been closely associated with changes in economic activity, money income, and prices.
>
> 2. The interrelation between monetary and economic changes has been highly stable.
>
> 3. Monetary changes have often had an independent origin; they have not been simply a reflection of changes in economic activity." (Friedman and Schwartz, 1963, p.676)

Considering the first two, three pieces of evidence we have presented bear on them: (a) the correlations and regressions between consumption expenditures and money in chapter 11; (b) the comparison of turning points in the money supply with turning points in post-war reference cycles in chapter 12; and (c) the cross-spectral study of money and other economic variables in chapter 14. All three are favourable to the two initial propositions, but the clearest evidence comes from the cross-spectral study, for which the time period covered compares favourably with Friedman's and in terms of data employed the two propositions are confronted with a richer and more diverse data sample. A statistically significant coherence is found to exist between money and measures of business activity over the frequency bands which encompass fluctuations of business cycle duration. On average, about half of the variability of income can be accounted for by the hypothesized connection, which is all that Friedman has ever claimed (see Friedman, 1970). While the inter-relationship does vary markedly with the frequency of the oscillation, this particular pattern is found to be basically unchanged when different time periods are studied. Whether these relationships are 'close' or 'stable' depends on the meaning that one cares to attach to such words. One objective comparison that can be made is between our cross-spectral analysis of the Australian data and the four studies which have employed this statistical tool to analyze the money-business relationship in the U.S. Much higher coherencies and a more clearly discernible lead-lag relationship are reported here. This assumes importance in view of the comments which follow.

A close correlation between money and business does not reveal the direction of causation; monetary changes might be responding to business, business might be responding to money, or the two might be mutually inter-acting. Some basis for distinguishing between these is aided by setting up two extreme paradigms. Consider first the ultra 'Keynesian' argument (of, for example, Kaldor) that causation runs from income to money. Any simple notion that banks adjust the supply of money to meet the 'needs of trade' is contradicted by our findings in chapters 10 and 18 about the money supply function. Specifically, bank advances move markedly out-of-phase with the money supply, which is dominated by changes in base money and calls to and releases from the Special Accounts/S.R.D. mechanism. But the monetary base may contain endogenous elements, and there are two other hypotheses which place money in a subsidiary position and which are consistent with our findings about the money supply function. Both have been examined in this study.

One is the common assumption that the central bank pegs the rate of interest and adjusts the money supply to the demand for money. The inverse association between interest rates and the stock of money which would be expected from such behaviour could not be discerned in chapter 15. Further, in chapter 16 it was shown that the timing of velocity cycles relative to interest rate cycles is inconsistent with this hypothesis. This suggested the interpretation that adjustments in interest rates follow variations in the supply of money, rather than the reverse. Because a rate is seen to be administered it does not follow that movements in that rate are independent of market forces, and the effect of government intervention may result in a more sluggish response than would otherwise be the case. This interpretation provides an explanation for the instability and the long lags exhibited by demand for money functions predicated on the interest rate peg assumption.

The other argument supposes the money supply is rendered endogenous by the openness of the economy. Given the exchange rate, domestic wages and prices adjust to world levels independently of the domestic monetary system and the supply of money which is needed to sustain these levels is provided through the balance of payments. Some evidence in support of this hypothesis can be discerned, for we find that the balance of payments has exerted an important influence on the money supply and during long-run movements in the economy (more than 8 years in period) the money supply appears to lag cycles in income and prices. But the inter-relationship during business cycles is *not* suggestive of such passive, accommodating behaviour. Instead, it seems that the money supply has helped to transmit foreign (and domestically) generated impulses. Moreover, the models of the monetary sector which 'demonstrate' the endogeneity of the Australian money supply are capable of being interpreted in a way which effectively reverses the direction of causation (see chapter 18). The monetary theory of the balance of payments which sustains these ideas is a long-run full employment model and the finding either that conditions of long-run equilibrium apply in the short-run or that the adjustment to equilibrium excludes the monetary sector would be surprising.

Conversely, the extreme monetarist view that the business cycle 'dances to the dollar' (Irving Fisher's expression) cannot readily be sustained. Our study of the nature of the demand and supply functions for money in section II establishes the possibility that money exerts an independent influence upon the course of the cycle, and historically such an impact seems to have occurred. But changes in money are not the only factor at work. The behaviour of velocity is crucial. We find velocity to have exhibited a regular cyclical pattern, a significant part of which can be attributed to movements along a downward-sloping liquidity preference schedule involving mutual interactions with variations in the cost of holding money. Friedman's earlier attempt to explain velocity without recourse to interest rates is shown to be inconsistent with the evidence (for Australia and the U.S.), and his introduction of the permanent income explanation is simply unwarranted. Whether the variations in the cost of holding money can themselves be attributed fully to associated monetary impulses, so that the business cycle is a purely monetary phenomenon, as Friedman hypothesizes in his Monetary Theory of Nominal Income, must remain an open question. However, we would venture the opinion that on the timing relationships we have found between money and interest rates, and on the basis of the long lags we have discerned to exist between inflationary expectations and velocity, such an explanation of velocity movements seems implausible.

Rather we would look to the behaviour of expenditures and see independent effects running both from money *and* autonomous expenditures to income, including some monetary changes with wealth effects upon aggregate demand, so that in terms of the Hicks-Hansen model shifts in both the I.S. and L.M. curves contribute to the outcome. In chapter 11 we showed how the 'direct' monetary mechanism sketched out by Friedman-Meiselman could be extended to allow for expanded wealth effects, when the monetary changes include increases in 'outside' money. It was also shown in that chapter that the autonomous expenditures multiplier in Australia, holding the quantity of money constant, probably lies in the range 1 to 2. All definitions of autonomous spending employed in that statistical examination treated either exports or the foreign trade balance as autonomous items, and in an open economy this is an important medium by which foreign impulses are transmitted to domestic economic activity.

While the contribution of non-monetary factors in the Australian business cycle is recognized, our evidence does suggest that the monetary factors play a dominant role. This evidence comes from both reduced form and structural models. In our examination of the determination of consumption and 'induced' expenditures over the period 1880-1967, it was found that changes in money exerted both a larger and a more consistent influence than any of five alternative definitions of autonomous spending. Using cross-spectral analysis we found that money consistently leads measures of business activity during cycles with periods of between 2½ to 6 years and the pattern of the relative phase shifts is such as to be highly suggestive of an influence running from money to business involving consecutively share prices, expenditures, output and employment, nominal income and prices.

The structural evidence comes from the two chapters which deal with the demand for money, one investigating the substitutability between bank and non-bank liabilities, the other studying the inverse, the velocity of money. In both instances evidence of a relatively stable relationship between monetary claims, income and interest rates seems to exist, suggesting that variations in the supply of money would have relatively predictable consequences for income and prices, depending on the 'slippage' induced by the elasticity of the demand for money with respect to interest rates. This seems to be inelastic: the long-run elasticity of narrow money with respect to bank interest rates ranges from -.16 to -.49; the elasticity of narrow money with respect to non-bank interest rates ranges from -.27 to -.84; while the most direct evidence is the elasticity of the income velocity of money at business cycle frequencies estimated from the cross-spectrum, which ranges from .09 to .39. What does this mean for the variability of velocity? For illustration we use the estimate of the elasticity of the income velocity of M3 with respect to bond yields over the period 1900-1971 (.33). An increase in long term bond yields in one year of 2 percentage points (a large increase by past standards) from the current level of 10 per cent implies a once for all increase in velocity of 6.6 per cent. Not a small increase, but less than half of the increase in M3 in 1975/76 (14 per cent).

Given acceptance of the effectiveness of monetary policy, the length of the lags assume importance. Separate estimates have been made of inside, intermediate, and outside lags of monetary policy and these are now combined to estimate the total lag. Estimates of the inside lag are drawn from chapter 6 using the constructed index of formulated policy and a combination of employment, prices and balance of payments objectives as defined by the fitted policy reaction function to measure the need for policy action. For the intermediate lag, we use the money supply as the intermediate target variable and the monetary base and Special Accounts/S.R.D. ratio to measure the actions of the monetary authorities. As is the case with the inside lag,

Table 19

Estimates of the Average Lags of Monetary Policy

Nature of lag	Average length
Inside lag	3 - 6 months
Intermediate lag	0 - 3 months
Outside lag	
(a) Employment	4 - 7 months
(b) Nominal Income	8 - 11 months
(c) Consumer Prices	11 - 14 months
Total lag	
(a) Employment	7 - 16 months
(b) Nominal Income	11 - 20 months
(c) Consumer Prices	14 - 23 months

this lag is of a constant delay form, and the estimate is based on the multiple regression analysis of chapter 10 and the cross-spectral analysis of chapter 18. The estimates of the outside lag are based on the cross-spectral analysis, and in order to translate the phase angle into time units a cyclical disturbance of 48 months in length is assumed. Separate estimates of the lags to employment, nominal income and prices are provided in Table 19.

Post-war reference cycles in Australia have averaged 45 months in duration. Assuming a symmetrical cycle in detrended form, it follows that the total lag must be less than 23 months if any stabilizing influence at all is to occur. Those lags which relate to the employment objective range from 7-16 months. In terms of the 'rules versus authorities' debate they would seem to fall into an intermediate position. They are not so short as to remove the doubts which have arisen about the stabilizing potential of monetary policy, nor so long as to suggest that the authorities should withdraw completely from an activist role. A note of caution is warranted, for these are average lags and allowance must be made for the variability of the lag in individual episodes. And, recalling our discussion of chapter 12, estimates of the outside lag might be denoting the most significant effect on economic activity, not the total impact.

On a more positive note, our study has shown that monetary policy has an important role to play, even if discretionary policy is limited in scope. An open economy like Australia is subject to shocks from overseas, transmitted through the balance of payments and the monetary system to the domestic economy. The central bank's defensive actions have substantially modified the liquidity effects on swings in the balance of payments, and only a residual impact has contributed to cycles in the money supply. These actions have probably reduced the amplitude of Australian business cycles, and should not be seen as a failure of stabilization policy to which blame attaches to the monetary authorities. We concur with Lindbeck (1972):

> "If stabilization policy succeeds in eliminating the 'big waves' in business fluctuations, the 'small ripples' that remain may be identified with specific policy measures undertaken. Somewhat surprisingly, such an identification between policy actions and remaining 'ripples' is sometimes regarded in the international literature on stabilization policy as an expression for a *failure* of stabilization policy".

In this sense we have shown the important role that monetary policy has in economic stabilization.

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