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# The Money Multiplier And The Canadian Money Supply, 1955-1965

Alexander Kenneth Kelly

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**THE MONEY MULTIPLIER AND THE CANADIAN MONEY SUPPLY:**

**1955-1965**

by

**Alexander Kenneth Kelly**

**Department of Economics**

Submitted in partial fulfillment  
of the requirements for the degree of  
Doctor of Philosophy

Faculty of Graduate Studies  
The University of Western Ontario  
London, Canada

July 1968

### ABSTRACT

The objective of the thesis is to assess the extent to which, and the processes whereby, the portfolio behavior of the general public and the banking system enhances or inhibits monetary policy in Canada.

The basic analytical tool employed is a money supply multiplier of the form  $m = (1+c+t)/(r+rt+c)$  where  $m$  is the money supply multiplier,  $r$  is the actual reserve ratio, and  $c$  and  $t$  are the ratios of the public's holdings of currency and savings deposits respectively to demand deposits. The multiplier forms the basis of a simultaneous equation model of the Canadian monetary sector which yields solutions for the equilibrium stocks of demand and savings deposits, public currency holdings, the stock of money, the supply of reserves to the banking system, and the short-term and long-term interest rates. The real sector is taken as exogenous. The equations of the model are estimated by Two-Stage Least Squares using quarterly averages of Average-of-Wednesdays monthly data in nominal terms for the period 1955-65.

Changes in the multiplier account for approximately ten percent of the observed change in the money stock over the total period covered; on a quarterly basis, changes in the multiplier account for as much as three-quarters of the observed change in the money stock. The major source of change in the multiplier is changes in the currency ratio ( $c$ ). Changes in the savings deposit ratio ( $t$ ) and the reserve ratio ( $r$ ) make smaller and roughly equal contributions to changes in the multiplier. The reserve ratio is found to be the least systematic contributor to changes in the multiplier.

The regression coefficients of the structural equations and the coefficients of the reduced-form equations of the model are used to calculate elasticities of the multiplier with respect to several exogenous variables. It is found that the multiplier is positively related to Gross National Product and the average term to maturity of the public debt, and negatively related to interest rates. When chartered bank reserves are taken as exogenous, the multiplier is positively related to reserves.

Changes in the money multiplier appear to have made a positive contribution to monetary policy during the

period studied. During the recessions of 1957-58 and 1960, changes in the multiplier compensated, in part, for inadequate action on the part of the Bank of Canada.

Other topics discussed include the relationship between the money multiplier and the income velocity of money, the dichotomization of the demand for money into active and idle balances, and extensions of the multiplier approach to cover different definitions of money and credit.

## Preface

I should like to acknowledge the generous financial assistance I have received during the past three years from the Canada Council, the Government of Ontario, and the University of Western Ontario.

Much of the credit for whatever success this dissertation enjoys must go to the members of the Department of Economics who have, in a spirit of camaraderie, answered questions, made suggestions, and directed me away from pitfalls. In particular, I extend my warmest thanks to my Thesis Advisory Committee: Professors G. L. Reuber (Chairman), T. J. Courchene, and T. R. Robinson. Special thanks are due Dr. T. J. Courchene who supervised the thesis on a day-to-day basis.

A.K.K.

London, Ontario  
July, 1968



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## CHAPTER I

### THE PROBLEM, OBJECTIVES, OTHER STUDIES

Until quite recently, the behavior and determinants of the stock of money received scant attention from economists even though most would admit that this constitutes a serious oversight:

. . . in most discussions of monetary theory the nominal quantity of money supplied is taken as an exogenous variable. But though we continuously shy away from this fact in our theoretical work, we do nevertheless know that in the real world this is not the case: for money is largely the creature of a banking system which responds to such endogenous variables as the rate of interest, the wages of clerks, etc.<sup>1</sup>

If the stock of money is determined largely by the pace and volume of gold and silver discoveries, or the skill of pirates, or if we can assume that the authorities responsible for managing the money stock are perverse and unreliable,<sup>2</sup> then it is not unreasonable to assume

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<sup>1</sup> Don Patinkin, "Financial Intermediaries and the Logical Structure of Monetary Theory," American Economic Review, March, 1961, pp. 111-112.

<sup>2</sup> An assumption of perverse behavior motivates, in part, Friedman's proposal for a statutorily-defined constant rate of increase in the stock of money. See: Milton Friedman, A Program for Monetary Stability, New York, Fordham Press, 1959.

that the stock of money is an exogenous variable. However, if the nominal stock of money is determined in part by forces endogenous to the economic system, and if the monetary authorities behave in a reasonably consistent manner, the supply of money should be considered as legitimate a subject for economic analysis as the demand for money.

While it is generally assumed that the central bank or the monetary authorities controls the nominal stock of money, it is more precise to say that it has direct and complete control only over its stock of assets and that the link between the central bank's portfolio and the nominal stock of money may or may not be direct and precise. More generally, the central bank can alter its assets and liabilities only if financial institutions, primarily banks, alter their holdings of earning assets.<sup>3</sup> And, as Tobin has argued,<sup>4</sup> these institutions can in turn alter their asset holdings only if the public at large alters its portfolios. Thus, at least theoretically, there is not one set of decisions, the central bank's, affecting the nominal stock of money, but three: the central bank's, the banking or financial system's, and the public's. Each group may

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<sup>3</sup>This is not entirely correct; a purchase by the central bank of securities from the government does not involve private institutions but does alter the assets and liabilities of the central bank.

<sup>4</sup>James Tobin, "Commercial Banks as Creators of Money," in: Deane Carson, ed., Banking and Monetary Studies, Homewood, Illinois, Richard D. Irwin, 1963, pp. 408-19.

alter its holdings of financial assets in a manner that can affect the stock of money. Given that not only the central bank, but the public and financial institutions as well, can affect the nominal stock of money, the distinct possibility arises that the public and financial institutions may behave in a manner inconsistent with the policies of the central bank. Portfolio shifts by the public and financial institutions may, therefore, constitute a source of weakness in monetary policy.<sup>5</sup>

It is not necessary, of course, that the central bank be able to predict accurately the behavior of the public and financial institutions since it does possess the power and techniques to make the nominal stock of money whatever it chooses: it can affect the money stock directly through its power to alter bank reserve requirements, or, given its predominant position in the market in government securities, it can force interest rates to any level consistent with a target stock of money. There may be, however, a considerable social opportunity cost associated with a central bank which operates on a trial-and-error basis and which occasionally may find it necessary

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<sup>5</sup>Since the mid-1950's there has been increasing concern that the growth of financial intermediaries and the opportunities for asset shifts arising from their existence might constitute a source of weakness in monetary policy. This fear gets its most radical expression in the report of the Radcliffe Committee. See: Committee on the Working of the Monetary System, Report, London, HMSO, 1959, p. 357.



to resort to "blunderbuss" techniques to achieve its objectives.<sup>6</sup> A knowledge of the response patterns of the public and financial institutions should increase both the efficacy and social efficiency of monetary policy.

### Objectives of the Study

Our basic hypothesis is that the nominal stock of money in Canada is determined simultaneously by the actions of the central bank, the banking system, and the non-bank public. In the light of this hypothesis, our objectives are:

- 1) to construct an analytical framework which will permit us to investigate the economic determinants of the Canadian money stock;
- 2) to investigate the extent to which, and the processes whereby, the behavior of the banking system and the non-bank public contributes to, or weakens, the effectiveness of monetary policy in Canada;
- 3) to comment, in the light of our findings, on the following topics, among others, in monetary economics:

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<sup>6</sup>For example, if the central bank must undertake "larger than necessary" open-market sales of securities, it will impose "unnecessary" or avoidable capital losses on holders of government securities.

- a) the meaning and usefulness of the concept of the income velocity of money;
- b) the usefulness of dichotomizing the demand for money into active and idle balances;
- c) the validity of those studies which attempt to demonstrate the superiority of the neo-quantity theory of money over the Keynesian income-expenditure theory in predicting national income.

#### Method of Approach

The analytical framework we utilize in approaching the above problems is the money supply multiplier. The nominal stock of money can be expressed as the product of a money multiplier whose terms reflect the asset preferences of the banking system and the non-bank public, and a monetary base which consists of all currency outstanding plus chartered bank deposits at the central bank. Our basic monetary equation, therefore, is:

$$M = mB$$

where  $M$  is the nominal money stock,  $m$  is the money multiplier, and  $B$  is the monetary base. The first step, therefore, towards an analysis of the behavior and determinants of the Canadian money stock is the derivation of a money supply multiplier which reflects Canadian institutions

and conventions and which captures the most important features of the Canadian monetary sector. In the next chapter we derive and discuss the particular money supply multiplier around which the remainder of the study is organized.

There are two ways in which we can utilize our money multiplier: first, since changes in the multiplier will, ceteris paribus, generate changes in the stock of money, we can assess the relative contributions of changes in the multiplier and the monetary base to changes in the money stock over time, and determine the relative importance of changes in each of the terms of the multiplier to changes in the multiplier and the money stock. This approach is presented in detail in Chapter III. Second, we can expand the multiplier into a simultaneous equation model of the Canadian monetary sector and analyse the effects and the processes whereby a change in exogenous economic variables alters the terms of the multiplier and the multiplier itself, the monetary base, and the stock of money. This approach is presented in Chapter IV.

A study of the money supply multiplier would be unnecessary if the multiplier were numerically stable over time. This has not been the case, however, in Canada for the period covered by this study: on a quarterly basis, the money multiplier, calculated as the ratio of the

nominal money stock to the nominal monetary bases, has varied considerably, from a low of 4.87 to a high of 5.28. During 1955-65, the marginal money multiplier ( $\partial M/\partial B$ ), rose from 5.02 during 1955-60 to 6.37 during 1961-65. For the same period, there has been a general rise in the multiplier: from 1955-65, the stock of money rose 85.4% while the money multiplier rose 7.9%, accounting for 9.2% of the overall increase in the stock of money.

#### Alternative Approaches to Money Supply Analysis

The major analyses of the behavior and determinants of the money stock in recent years have been those of Brunner and Meltzer,<sup>7</sup> Cagan,<sup>8</sup> Friedman and Schwartz,<sup>9</sup> Teigen,<sup>10</sup> and Leonall Andersen.<sup>11</sup> Andersen is also the

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<sup>7</sup>Karl Brunner, Allan Meltzer, "Some Further Investigations of Demand and Supply Functions for Money," Journal of Finance, May, 1964, pp. 240-83.

<sup>8</sup>Phillip Cagan, Determinants and Effects of Changes in the Stock of Money, 1875-1960, Princeton, Princeton University Press, 1965.

<sup>9</sup>Milton Friedman, Anna J. Schwartz, A Monetary History of the United States, 1867-1960, Princeton, Princeton University Press, 1963, Appendix B.

<sup>10</sup>Ronald Teigen, "Demand and Supply Functions for Money in the United States: Some Structural Estimates," Econometrica, October, 1964, pp. 476-509.

<sup>11</sup>Leonall Andersen, "A Study of Factors Affecting the Money Stock: Phase 1," Staff Economic Studies, Board of Governors of the Federal Reserve System, October, 1965.

author of a useful summary of money supply approaches from which we borrow heavily in the following paragraphs.<sup>12</sup>

The traditional approach to the determination of the nominal stock of money, exemplified by Money and Banking textbooks, has been to assume a direct and mechanical link between the stock of bank reserves and the stock of money. While both the public and the banking system exist in this simple model, it is a dim existence, devoid of any active role: the banks hold no excess reserves and the public has an insatiable demand for bank loans and deposits. In most cases, the public's only monetary asset is bank deposits; if they hold currency as well, it is as some unvarying proportion of their bank deposits. In this model, the only active decision maker is the monetary authority.

In their long-run studies of the American money stock, Friedman and Schwartz and Cagan use identical approaches. Both studies develop what are termed "proximate determinants of the money stock" which represent actions of the central bank, the banking system, and the public. The variable High Powered Money, used in both studies,

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<sup>12</sup>Leonall Andersen, "Three Approaches to Money Stock Determination," Review, Federal Reserve Bank of St. Louis, October, 1967, pp. 6-13.

refers to those Federal Reserve liabilities which can be held by the public as money (currency) or by the banking systems as reserves (commercial bank deposits at the Federal Reserve). The quantity of High Powered Money in the system is controlled by the central bank. The behavior of the banking system is represented by the ratio of bank deposits to reserves in the Friedman-Schwartz model, and by the ratio of reserves to deposits in the Cagan model. Friedman and Schwartz represent the behavior of the public by the ratio of total bank deposits held by the public to currency held by the public while Cagan uses the ratio of currency held by the public to the total money stock. The Friedman-Schwartz approach defines the money stock to be a result of the three proximate determinants as follows:

$$M = \frac{D/R(1+D/C)}{D/R + D/C} H$$

The Cagan approach yields the following identity:

$$M = \frac{H}{C/M + R/D - (C/M)(R/D)}$$

where H is High Powered Money; C is currency held by the public; D is total bank deposits; and R is bank reserves. While the two identities appear to be dissimilar, it can be shown that they are

identical.<sup>13</sup> Both studies attempt to attribute to changes in  $H$  and the two ratios observed changes in  $M$  over a long period of time in the United States, and retain the money supply identities throughout.

<sup>13</sup>It can be shown that the Friedman-Schwartz and Cagan formulas are identical and that they are furthermore identical to a more common formulation  $M = (1+c)/(r+c)$  times a reserve base, where  $c = C/D$  and  $r = R/D$ . This latter formulation is found in most Money and Banking textbooks.

The Friedman formulation:  $M = \frac{(D/R)(1 + D/C)}{(D/R) + (D/C)} H$

Dividing first by  $D/R$  and then by  $C/(C+D)$  yields:

$$M = \frac{1}{C/(C+D) + R/(C+D)} H$$

But  $C+D = M$ , therefore:

$$M = \frac{1}{(C/M) + (R/M)} H$$

Now,  $R = (RM - CR)/D$ , therefore:

$$M = \frac{1}{(C/M) + (R/D) - (CR/MD)} H$$

which is the Cagan formulation.

If we begin with the Friedman formulation and define  $c = C/D$  and  $r = R/D$ , we obtain:

$$M = \frac{(1/r)(1 + 1/c)}{(1/r) + (1/c)} H$$

$$M = \frac{(1+c)(rc)}{(r+c)(rc)} H$$

$$M = \frac{1+c}{r+c} H$$

which is the traditional formulation. Thanks are due T.J. Courchene for this derivation.

The Brunner-Meltzer approach, like the Friedman-Cagan studies, is phrased in terms of a quantity which contains the maximum size of the money stock (the monetary base, which is analytically equivalent to High Powered Money), but goes beyond money supply identities and develops several money supply functions. Originally, Brunner<sup>14</sup> developed a behavioral function for the individual bank in which the bank attempts, by varying its portfolio, to maintain some desired level of reserves. Excess reserves lead to the acquisition of earning assets; deficient reserves lead to the liquidation of earning assets. The individual bank functions are then aggregated to obtain a money supply function for the system as a whole in which the change in the money stock is the product of changes in reserves times a money multiplier which summarizes the leakages of reserves from the banking system.

The Brunner-Meltzer models build upon this foundation. The linear version of their money supply function, where money is defined to exclude time deposits, is:

$$M = m_0 + m_1(B+L) - m_2C_0 - m_3T_0 - m_4ER_0$$

Andersen describes the above money supply equation as follows:

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<sup>14</sup>Karl Brunner, "A Schema for the Supply Theory of Money," International Economic Review, January, 1962, pp. 79-109.



In this function,  $M$  is money narrowly defined and  $m_1$  is a money multiplier. . . . The expression  $B+L$  is called the extended monetary base. This includes the monetary base ( $B$ ) and reserves 'liberated' . . . by reserve requirement changes and shifts in deposits between classes of member banks, between non-member and member banks and between time and demand deposits. These liberated reserves are called  $L$ . The first term in the money supply function ( $m_0$ ) is a constant and the next term,  $m_1 (B+L)$ , may be viewed as the average response of money to a change in the extended base.

The remaining three terms represent the influence of economic factors other than the spillover effects included in the money multiplier . . . The  $m$ 's in these three expressions are also multipliers, but they have values different from  $m_1$ .<sup>15</sup>

The multipliers in the Brunner-Meltzer money supply function are empirical estimates rather than definitional identities and reflect the influence of changes in interest rates, wealth, and policy variables on portfolio preferences.

The "Reserves Available" approach to money stock determination is used by the Federal Reserve system and resembles the approaches outlined above.<sup>16</sup> Given a change in total member-bank reserves, the amount of the change absorbed by float, public currency holdings, Treasury currency holdings, and Treasury deposits at Reserve Banks

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<sup>15</sup>  $C_0$ ,  $T_0$ , and  $ER_0$  are currency, time deposits, and excess reserves respectively. Andersen, "Three Approaches . . .," op. cit., p. 10.

<sup>16</sup> Ibid., p. 10-11.

is estimated and deducted from the original change. Reserves required to support U. S. Government deposits at commercial banks and time deposits are then subtracted to yield reserves available to support private demand deposits. This total, multiplied by the reciprocal of average reserve requirements, yields the change in total member bank demand deposits to which is added public currency holdings and non-member bank demand deposits to get the total change in the money stock. The portfolio preferences of the banking system and the public are assumed to be constant.

In an approach to the money supply similar in some respects to an earlier study by Polak and White,<sup>17</sup> Teigen argues that the ratio of the actual money stock to the potential money stock is a function of the differential between the returns from and the cost of lending to the banks. The potential money stock is that stock that can be supported by unborrowed reserves, given the portfolio preferences of the public.<sup>18</sup> As the returns from lending rise relative to the costs of lending (as measured by the rediscount rate), banks will economize on existing reserves and may borrow additional reserves from the

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<sup>17</sup>J. Polak, W. H. White, "The Effect of Income Expansion on the Quantity of Money," IMF Staff Papers, August, 1955, pp. 398-433.

<sup>18</sup>Teigen, op. cit. The actual money stock is a behavioral relation while the potential money stock is a money supply identity.

central bank. This will result in a rise in the actual money stock relative to the potential money stock.

Teigen uses a money supply identity similar to the Cagan-Friedman identities to generate his money supply hypothesis which has performed well empirically.

Although each of the above models yields a somewhat different hypothesis about the money supply, in the final analysis they all express the money supply, or changes in the money supply, as the product of a money multiplier or multipliers which reflect the asset preferences of the banking system and the non-bank public, and a monetary base determined by the central bank. Theoretical differences relate primarily to the range of portfolio adjustments permitted the public and the banks while empirical differences relate to the role accorded the real sector. These differences are described in more detail in Chapter IV where we compare our model of the money supply process to others.

#### Other Studies of the Canadian Monetary Sector

There have been several studies of the Canadian monetary sector in recent years including those by

Harold Shapiro,<sup>19</sup> H. Shapiro and Peter Miles,<sup>20</sup>, Keith Hay.<sup>21</sup>  
 David Fand and John Tower,<sup>22</sup> Ian Stewart,<sup>23</sup> and George  
 Weber.<sup>24</sup> All these studies have been of considerable  
 assistance during our research. Only the Fand-Tower and  
 Weber studies attempt to fit money supply functions based  
 upon a money supply multiplier to Canadian data although  
 Keith Hay utilizes a Cagan money supply identity to analyse  
 the behavior of the proximate determinants of the money  
 stock in Canada. Weber's money supply function ignores  
 two sources of change in the multiplier which our study  
 indicates are important: the reserve ratio and the ratio  
 of savings deposits to demand deposits. The Fand-Tower  
 study, in an attempt to fit a "free reserves" model to

<sup>19</sup>Harold Shapiro, The Canadian Monetary Sector: An Econometric Analysis, unpublished doctoral dissertation, Princeton, 1964.

<sup>20</sup>Harold Shapiro, Peter Miles, Demand for Money, unpublished paper, 1966.

<sup>21</sup>Keith Hay, "Money and Cycles in Post-Confederation Canada," Journal of Political Economy, June, 1967, pp. 263-73.

<sup>22</sup>David Fand, John Tower, "An Analysis of the Money Supply Process in Canada," Canadian Journal of Economics, May, 1968, pp. 381-400.

<sup>23</sup>Ian Stewart, A Quarterly Econometric Study of the Canadian Economy, 1951-62, unpublished doctoral dissertation, 1966.

<sup>24</sup>G. I. Weber, An Econometric Study of the Money Supply of Canada, unpublished doctoral dissertation, 1964.

Canadian data, ignores the considerable role played by the non-bank public in the determination of the Canadian money stock. The Shapiro, Shapiro-Miles, and Stewart studies are not explicitly concerned with the behavior and determinants of the money supply multiplier.

### Organization of the Study

In the next chapter, we derive and discuss our particular money supply multiplier. In Chapter III, we approach the question of sources of change in the multiplier in a manner similar to the Friedman-Schwartz-Cagan analyses, utilizing the concept of proximate determinants of the money stock. In the fourth chapter we construct a model of the Canadian monetary sector based upon the money multiplier derived in Chapter II and discuss its assumptions, properties, and relationship to other models. Chapter V contains an extended discussion of the theory underlying the structural equations of the model developed in Chapter IV and their estimation. In Chapter VI, we again examine the question of sources of change in the money supply multiplier using information generated by our model. In Chapter VII, we examine the question of changes in the money supply multiplier as a source of weakness in monetary policy. Finally, Chapter VIII summarizes our findings and conclusions, and suggests areas which might profit from further examination and study.

## CHAPTER II

### THE MONEY MULTIPLIER: DERIVATION, PROPERTIES, AND EXTENSIONS

Our fundamental analytical construct is the money supply multiplier, defined as the ratio of the stock of money to the monetary base (or reserve base, or High Powered Money).<sup>1</sup> As we demonstrate in this chapter, the money multiplier is an exceedingly useful and flexible concept whose properties and applications have been largely overlooked by economists in their preoccupation with the demand for money and the concept of the income velocity of money.

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<sup>1</sup> Broadly put, the monetary base consists of all the liabilities of the central bank and the government which can be held by the general public as money or by the banking system as reserves. In Canada, the monetary base thus includes coins (a liability of the Government of Canada), Bank of Canada notes, and chartered bank deposits at the Bank of Canada. In the naive model, since the public is assumed to hold only bank deposits, the entire monetary base is held by the banking system as reserves. When the naive model is expanded to allow for public currency holdings, a portion of the monetary base is held by the public. Later in this chapter, we define the monetary base to consist of all chartered bank reserves plus currency in the hands of the public. About one-third of bank reserves consists of currency held by the banks but we do not distinguish between reserves held as currency and reserves held as deposits at the central bank. We adopt the term "monetary base" from Brunner and Meltzer; the term "High Powered Money", used by Friedman and Schwartz, and Cagan, is identical in meaning.

Although Money and Banking textbooks and courses have long used the money multiplier concept, the multipliers employed have been both naive and devoid of interesting behavioral implications. The best-known multiplier is:

$$M/B = 1/r \quad \text{or}$$
$$m = 1/r$$

where  $M$  is the money stock,  $B$  is the monetary base,  $m$  is the money multiplier, and  $r$  is either the legal or customary reserve ratio (legal if the banks are assumed to be fully loaned up; customary if the banks are assumed to hold excess reserves in some unvarying proportion of their deposit liabilities). The money supply process implied by this naive model is well known and straightforward: an increase in the monetary base accrues to the banking system; if the system contains but one bank, it acquires assets and liabilities until the change in its liabilities equals  $1/r$  times the change in reserves. If the system contains several banks, the bank receiving the initial influx of reserves retains  $r$  of the new reserves and lends the remaining  $(1-r)$  to its customers. They ultimately deposit these funds with other banks which retain  $r$  of the new deposit as reserves and lend the remaining  $(1-r)$  to

other customers. The process of deposit and redeposit continues until the original new reserves are distributed throughout the banking system. In equilibrium, the system will have created new deposits to the extent of  $(1/r)$  times the original reserves. In this model, the non-bank public holds only one kind of monetary asset--bank deposits.

If the naive model is expanded to include public currency holdings, the money supply process is only slightly more complicated. The public is assumed to hold currency (C), in some proportion (c) of its bank deposits (D).<sup>2</sup> Thus,  $C = cD$ . If the stock of money is defined as  $M = C+D$ , then we can rewrite M as  $M = D(1+c)$ . In this model, the public is assumed to first obtain bank deposits and to then withdraw c% of these deposits as currency. In this case, a portion of the increase in the monetary base is held by the public, and the ability of the banks of expand deposits is attenuated. This model yields a money supply multiplier of the form:

$$M/B = (1+c)/(r+c) \quad \text{or}$$

$$m = (1+c)/(r+c)$$

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<sup>2</sup> In both the naive model and the expanded naive model, there is only one type of bank deposit, demand deposits. Thus, the reader can substitute the words "demand deposits" for "bank deposits" in these simple models.



Because the reserve ratio,  $r$ , is assumed to be less than unity, the money multiplier,  $m$ , exceeds unity. Like most multipliers in economics, the above process can be expressed in terms of a geometric series: as  $n \rightarrow \infty$ , the sum of  $a+ax+ax^2+ \dots + ax^n$  approaches  $a/(1-x)$ . In our example,  $a = (1+c)$  and  $x = (1-r-c)$ .

We have thus developed a simple money multiplier for a system in which the public holds only two types of money--bank deposits and currency. We can now proceed to derive multipliers for more complex financial systems.

Our basic monetary equation,  $M = mB$  tells us the total stock of money, however, defined, that a given monetary base can support, given the asset-holding preferences of the public and other financial institutions we may wish to introduce, ~~and the~~ reserve behavior of the banks. While our primary concern in this study is the stock of money as it is customarily defined in Canada (chartered bank deposits in the hands of the public and currency in the hands of the public), later in this chapter we indicate how multipliers can be derived for quantities which include other generally-accepted means of payment such as credit-union shares and deposits at trust and loan companies.

### Derivation of the Multiplier

Many authors have presented derivations of money multipliers. Perhaps the most interesting method is that of Lindbeck.<sup>3</sup> The approach we use is related to those of Lindbeck and Meltzer<sup>4</sup> and is adopted because it permits easy transformation from the more general formulations to particular multipliers consistent with Canadian institutional convention. The multiplier which forms the focal point of this thesis is of the form:

$$m = \frac{1+c+t}{r+rt+c}$$

where:

- m is the money supply multiplier,
- c is the ratio of currency held by the public to chartered bank demand deposits held by the public (denoted as the currency ratio),
- t is the ratio of chartered bank personal savings deposits held by the public to chartered bank demand deposits held by the public (denoted as the savings deposit ratio),
- r is the actual reserve ratio applicable to both demand and personal savings deposits.

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<sup>3</sup> Assar Lindbeck, A Study in Monetary Analysis, Uppsala, Almqvist and Wiksells, 1963, p. 191.

<sup>4</sup> Karl Brunner, Allan Meltzer, "Some Further Investigations of Demand and Supply Functions for Money," Journal of Finance, May, 1964, p. 251.

Our basic monetary equation, therefore, is:

$$M = \frac{1 + c + t}{r + rt + c} B$$

When  $t = 0$ , the multiplier is  $(1+c)/(r+c)$ . For the remainder of this study, the money stock (M) is defined to be sum of currency held by the public (C), chartered bank demand deposits held by the public (D), and chartered bank personal savings deposits held by the public (T). Chartered bank deposits of the Government of Canada are excluded from the money stock<sup>5</sup> while Float is included in M. Our definition of demand deposits held by the public includes Non-Personal Term and Notice deposits and the demand balances of provincial and municipal governments and private institutions, firms, and individuals. Currency (C) includes Bank of Canada notes held by the public plus all coins in circulation. The monetary base (B) is defined to be the sum of all chartered bank reserves (including vault cash and deposits at the Bank of Canada) and all currency in the hands of the public, including coin. All quantities are defined for the current period and we therefore ignore the peculiarities of the legal-reserve calculation method adopted in Canada. The propriety of this last assumption is discussed fully in Chapter IV. Finally, we

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<sup>5</sup> Government of Canada deposits at the chartered banks are excluded from the money stock primarily because they are used by the Bank of Canada as a policy instrument. A movement of the Government account to the chartered banks increases the reserves of the banking system and vice-versa.

stress that the reserve ratio terms in our multiplier are actual, as opposed to legal, ratios. The derivation of  $m$  proceeds as follows:

- 2.1  $M = C + D + T$       the money supply equals the sum of currency in the hands of the public, demand deposits in the hands of the public, and personal savings deposits in the hands of the public;
- 2.2  $T = tD$        $t$  and  $c$  are the ratios of personal savings deposits in the hands of the public and currency in the hands of the public respectively to demand deposits in the hands of the public;
- 2.3  $C = cD$

Using (2.2) and (2.3), we can rewrite (2.1) as:

$$2.4 \quad M = D(1 + c + t)$$

The monetary base ( $B$ ) is the sum of all chartered bank reserves ( $R$ ) and currency in the hands of the public ( $C$ ):

$$2.5 \quad B = R + C$$

Reserves ( $R$ ) are a fraction ( $r$ ) of the sum of ( $D$ ) and ( $T$ ):

$$2.6 \quad R = r(D + T)$$

Using (2.2), (2.3), and (2.6), we can rewrite (2.5) as:

$$2.7 \quad B = D(r + rt + c) \quad \text{or:}$$

$$2.8 \quad D = B/(r + rt + c)$$

Substituting (2.8) into (2.4) yields:

$$2.9 \quad M = B(1 + c + t)/(r + rt + c) \quad \text{or}$$

$$2.10 \quad M = mB$$

The above multiplier incorporates the following assumptions: first, that it is useful to distinguish amongst classes of bank deposits; second, that the currency drain is against demand deposits only; and third, that the same reserve ratio applies to both personal savings deposits and demand deposits.

The assumption that demand and savings deposits can be usefully separated derives from more basic assumptions regarding the motives for holding such deposits. In particular, demand deposits are viewed primarily as transactions balances while savings deposits are viewed primarily as a means of holding wealth.<sup>6</sup> Our assumption that only demand deposits are subject to a currency drain

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<sup>6</sup> Exceptions to these assumptions are evident: many persons use savings accounts as transactions balances while others hold idle demand deposits. Non-Personal Term and Notice deposits, which we classify as demand deposits, are short-term corporate and institutional savings instruments and are not, therefore, properly considered transactions balances. We include Non-Personal Term and Notice deposits in the demand deposits category because we lack data on such deposits on an Average of Wednesdays basis; prior to 1962, this practice was employed by the Bank of Canada.

is the result of both a lack of data on currency drains against the two types of deposits and a desire for as simple a formulation as is warranted. The third assumption, that the same reserve ratio applies to both types of deposits, is consistent with Canadian statutory provisions during the period studied (1955-65) and further reflects a lack of data on reserves held against the two types of deposits.

It is possible to modify our basic monetary equation to account for the effect on bank reserves and the monetary base of Government of Canada deposits at the chartered banks. Following Canadian custom, we have excluded federal government deposits from  $M$ . The banks, however, are required to hold reserves against such deposits and a portion of the monetary base therefore is used to support deposits which are not a part of the money stock. One approach to this problem is to deflate the monetary base by 8% of Government of Canada deposits at the chartered banks (see Appendix A). We have not done this; rather, our definition of the monetary base includes all reserves plus currency in the hands of the public.<sup>7</sup>

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<sup>7</sup> By not deflating the monetary base by 8% of Government of Canada deposits at the chartered banks, we obtain a higher value for the reserve ratio and a lower value for the multiplier than would obtain were we to deflate the base.

### Properties of the Multiplier

The multiplier is negatively related to the currency ratio, ceteris paribus:

$$\frac{\partial m}{\partial c} = \frac{(1+t)(r-1)}{(r+rt+c)^2} < 0 \text{ for } r < 1$$

The elasticity of the multiplier with respect to the currency ratio is:

$$e(m;c) = \frac{(1+t)(r-1)c}{(r+rt+c)(1+c+t)} < 0$$

A rise in the currency ratio, which requires a rise in currency held by the public relative to demand deposits, will reduce the money multiplier. This occurs because a rise the currency ratio reduces the ability of the banks to purchase earning assets and because they must give up more reserves each time they purchase such assets.

The multiplier is positively related to the savings deposit ratio:

$$\frac{\partial m}{\partial t} = \frac{c(1-r)}{(r+rt+c)^2} > 0 \text{ for } r < 1$$

The elasticity of the multiplier with respect to the savings deposit ratio is given by:

$$e(m;t) = \frac{c(1-r)t}{(r+rt+c)(1+c+t)} \quad 0$$

The positive relationship between the multiplier and the savings deposit ratio results from our assumption of no currency drain against savings deposits: a shift from demand deposits to savings deposits frees cash reserves held against the currency drain and increases the multiplier (assuming  $r$  does not change).

The relationship between the actual reserve ratio and the money multiplier is negative:

$$\frac{\partial m}{\partial r} = - \frac{(1 + c + t)(1 + t)}{(r + rt + c)^2} < 0 \text{ for all } r$$

The elasticity of the money multiplier with respect to the reserve ratio is given by:

$$e(m;r) = - \frac{(1 + t)r}{(r + rt + c)} < 0$$

Under the provisions of the Bank Act of 1967, the legal reserve requirements have been altered from 8% against all bank deposits to 12% and 4% against demand and savings deposits respectively. Under this regime, a shift from demand deposits to savings deposits will increase the multiplier by freeing reserves held against demand deposits (assuming the banks are able to find customers for loans).<sup>8</sup> When combined with the positive

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<sup>8</sup> For an analysis of the effects of shifts between various monetary assets whose reserve ratios differ, see: Warren Smith, "Financial Intermediaries and Monetary Controls," Quarterly Journal of Economics, November, 1959, pp. 533-53.



relationship between  $m$  and  $t$  that exists under a single reserve ratio regime, this effect can be particularly powerful and explains in part the observed enthusiasm with which the chartered banks have been trying to persuade their customers to hold savings deposits.

### Possible Extensions of the Multiplier Approach

A topic that has long occupied monetary economists has been the proper definition of money.<sup>9</sup> In the United States, most economists follow established convention and exclude time deposits from the definition of money while others, notably Milton Friedman,<sup>10</sup> argue that money is "a temporary abode of purchasing power" and should include time deposits. Others argue that even the Friedman definition is too restrictive and that the liabilities of some non-bank financial intermediaries should properly be considered money or means of payment.<sup>11</sup> Still others.

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<sup>9</sup> See, for example: Milton Friedman, "The Demand for Money: Some Theoretical and Empirical Results," Journal of Political Economy, August, 1959, pp. 327-51.

<sup>10</sup> In his survey article on monetary economics, Harry Johnson lists the definition of money as one of the three crucial questions in demand for money studies: "Monetary Theory and Policy," American Economic Review, June, 1962, pp. 335-84.

<sup>11</sup> This is the tenor of the Report of the Radcliffe Committee on the Working of the Monetary System, HMSO, 1959, p. 357.

suggest that the components of the money stock, however defined, should be weighted by the degree to which they are utilized in exchange. One of the advantages of the multiplier approach to money supply analysis is that it is not difficult to modify our multiplier (or multipliers) to reflect these various opinions.

If time or savings deposits at banks are excluded from the money stock, it can be shown (Appendix B) that the money multiplier becomes:

$$m_1 = \frac{1 + c}{r_d + r_t t + c}$$

where  $r_d$  and  $r_t$  are the actual reserve ratios applicable to demand and savings deposits respectively,  $c$  is the ratio of currency held by the public to demand deposits, and  $t$  is the ratio of time or savings deposits to demand deposits. Including savings deposits in the money stock of course yields our multiplier:

$$m_2 = \frac{1 + c + t}{r_d + r_t t + c} \quad \text{where } r_d = r_t = r$$

If we expand our definition of money to include the liabilities of, say, credit unions, then one possible multiplier is given by (See Appendix C for the derivation):

$$m_3 = \frac{1 + c + t + s}{r_d + r_t t + r_d r_s s + c}$$

where  $s$  is the ratio of credit union shares held by the public to demand deposits and  $r_s$  is the actual credit union reserve ratio. Credit unions are assumed, in this case, to hold their reserves as demand deposits at chartered banks.

Regardless of which definition is chosen, it is possible to further modify our multipliers to account for varying degrees of utilization of the various monetary assets. Kane,<sup>12</sup> for example, has suggested that we view the total money stock as a weighted aggregate of its components where the weights reflect intensities of utilization. One possible weighting scheme would be the use of deposit velocities: one dollar of demand deposits would weigh heavier in the final money stock total than one dollar of savings deposits if the former exhibited a higher turnover velocity than the latter. This approach is very compelling: in Canada, the turnover velocity of demand deposits greatly exceeds that of savings deposits, and the differential has been growing rapidly. The Kane proposal could be incorporated in multiplier  $m_2$  in the following fashion:

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<sup>12</sup> E. J. Kane, "Money as a Weighted Aggregate," Zeitschrift fur Nationalokonomie, Spring, 1964, pp. 221-43. The turnover velocity interpretation of the Kane proposal is presented in: T.J. Courchene, A.K. Kelly, The Stability of the Money Multiplier, unpublished paper, 1967.

$$m_4 = \frac{1 + c + (Vt/Vd)t}{r_d + r_t t + c}$$

where  $Vt$  is the turnover velocity of savings deposits and  $Vd$  is the turnover velocity of demand deposits. The differential velocity approach was utilized by Tobin in an early study of the demand for money.<sup>13</sup> A recent version of the weighted aggregate approach is that of Pesek and Saving who suggest that we deduct from the stock of money that portion of savings deposits which is truly idle and does not constitute a medium of exchange. A multiplier version of the Pesek-Saving hypothesis is given by:

$$m_5 = \frac{1 + c + pt}{r_d + r_t t + c}$$

where  $p = (1 - i^T/i^M)$ , and  $i^M$  and  $i^T$  are the market rate of interest and the rate of interest paid on savings deposits respectively.<sup>14</sup>

Because each of these multipliers contains terms which are both amenable to measurement and which reflect patterns of asset choice and economic behavior, the multiplier constitutes a powerful tool for analysis of problems

<sup>13</sup> James Tobin, "Liquidity Preference and Monetary Policy," Review of Economics and Statistics, February, 1947, pp. 124-31.

<sup>14</sup> Boris Pesek, Thomas Saving, Money, Wealth and Economic Theory, New York, MacMillan, 1967, pp. 120-24. When  $i^T = i^M$ , a savings deposit is considered a "pure" bond and no longer functions as a medium of exchange.

in monetary economics. Less flattering adjectives must be applied to another concept in monetary economics that has displayed amazing longevity: the income velocity of money.

Several studies of the demand for money have detected a positive relationship between the income velocity of money and interest rates thus supporting the hypothesis of a negative interest-elasticity in the demand for money.<sup>15</sup> The particular interest rate chosen does not appear to affect significantly the results, nor does the choice of definition of money.<sup>16</sup> A positive relationship between velocity and interest rates implies that, for a given level of income, a rise in interest rates reduces  $M$  and raises velocity. Those studies which stress the concept of velocity fail to explain the process whereby velocity changes in terms more complex than economizing on cash balances. It can be demonstrated that, at a given level of income, a positive relationship between velocity and the rate of interest requires a negative relationship between the money multiplier and the rate of interest:

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<sup>15</sup> H. Latané, "Income Velocity and Interest Rates: A Pragmatic Approach," Review of Economics and Statistics, November, 1960, pp. 445-49.

<sup>16</sup> Allan Meltzer, "The Demand for Money: The Evidence from the Time Series," Journal of Political Economy, June, 1963.

$$\text{Let} \quad M = mB$$

$$\text{then} \quad dM = mdB + Bdm$$

$$\text{Let} \quad V = Y/M$$

$$\text{then} \quad dV = \frac{MdY - YdM}{M^2}$$

$$\text{or} \quad dV = \frac{MdY - Y(mdB + Bdm)}{M^2}$$

$$\text{or} \quad dV/di = \frac{MdY - Y(mdB + Bdm)}{M^2 di}$$

$$\text{For} \quad dB = dY = 0$$

$$\frac{dV}{di} = \frac{-YB dm}{M^2 di}$$

For a given level of income and the monetary base, velocity can change only if the multiplier changes. This in turn requires a change in the relative demands for the components of the stock of money. Velocity, which is a measure of the utilization of the nominal stock of money, does not yield any explicit information on the process whereby the degree of utilization is altered. The money multiplier, a measure of the utilization of the monetary base, does yield explicit information on the process whereby a given monetary base generates different stocks of money. We suggest, therefore, that the money multiplier is at least as interesting and useful a concept as the income velocity of money.

An interesting implication of the foregoing is that the dichotomy between active and idle balances, which fell into disrepute as work on the demand for money increased, proves to be less artificial and more meaningful than has recently been thought, since it is precisely as a result of shifts amongst classes of money balances that the multiplier and velocity change.

In the next chapter, we begin our analysis of the sources of change in the money multiplier developed in this chapter.

APPENDIX ACORRECTION OF THE MONETARY BASE FOR GOVERNMENT  
OF CANADA DEPOSITS AT THE CHARTERED BANKS.

Let  $B = R + C$                       monetary base, reserves,  
currency in the hands of  
the public.

$R = r(D_p + D_g + T)$             reserves, the reserve ratio,  
public demand deposits,  
government demand deposits,  
savings deposits.

$C = cD_p$                               currency, the currency  
ratio, public demand  
deposits.

$T = tD_p$                               savings deposits, the  
savings deposit ratio, public  
demand deposits.

$$B = r(D_p + D_g + T) + cD_p$$

$$B = D_p(r + rt + c) + rD_g$$

$$D_p = \frac{(B - rD_g)}{r + rt + c}$$

$$M^* = \frac{(1 + c + t)}{(r + rt + c)} (B - rD_g) + D_g$$

$M^*$  is the stock of money including Government of Canada deposits at the chartered banks. If  $D_g$  is subtracted from both sides, the monetary base is:  $R + C - rD_g$ .



APPENDIX BDERIVATION OF MULTIPLIER  $m_1$ 

$$B = R + C$$

as before.

$$R = r_d D + r_t T$$

reserves, demand deposit reserve ratio, demand deposits, savings deposit reserve ratio, savings deposits.

$$R = r_d D + r_t tD$$

$$B = D(r_d + r_t t + c)$$

$$D = B / (r_d + r_t t + c)$$

$$M = C + D$$

$$M = D(1 + c)$$

$$M = \frac{1 + c}{r_d + r_t t + c} B$$

APPENDIX CDERIVATION OF MULTIPLIER  $m_3$ 

$$B = R + C \quad \text{as before.}$$

$$R = r_d D + r_t T$$

$$D = D_p + D_s \quad \text{total demand deposits, demand deposits held by the general public, demand deposits held in chartered banks by credit unions.}$$

$$D_s = r_s S \quad \text{demand deposits held by credit unions, credit union reserve ratio, credit union shares held by the public.}$$

$$S = s D_p \quad \text{credit union shares, shares ratio, demand deposits held by the public.}$$

$$D_s = r_s s D_p$$

$$R = r_d D_p + r_d r_s s D_p + r_t t D_p$$

$$R = D_p (r_d + r_d r_s s + r_t t)$$

$$B = R + c D_p$$

$$B = D_p (r_d + r_d r_s s + r_t t + c)$$

$$M + S = C + D_p + T + S = D_p (1 + c + t + s)$$

$$(M+S)/B = (1 + c + t + s) / (r_d + r_d r_s s + r_t t + c)$$

### CHAPTER III

#### SOURCES OF CHANGE IN THE MULTIPLIER: I

In the previous chapter, we derived the version of the money multiplier which forms the focal point of this study, investigated its properties, and suggested possible extensions of the money multiplier approach. In this chapter, we commence the empirical investigation of the sources of change in the money multiplier. Before doing so, however, we document in detail the contributions of changes in the multiplier and the monetary base to changes in the stock of money.

A glance at Chart 1 reveals that, for 1955 to 1965, the major source of the substantial increase in the stock of money was a concomitant increase in the monetary base. During the same period, however, the impact of the rise in the monetary base on the money stock was reinforced by a slight secular increase in the money supply multiplier. Chart 1 further suggests that, for a number of years, similar changes in the monetary base have had associated with them dissimilar changes in the stock of money due, of course, to changes in the money multiplier. Chart 1

millions of \$

13000  
12000  
11000  
2400  
2200  
5.00  
4.90  
4.80

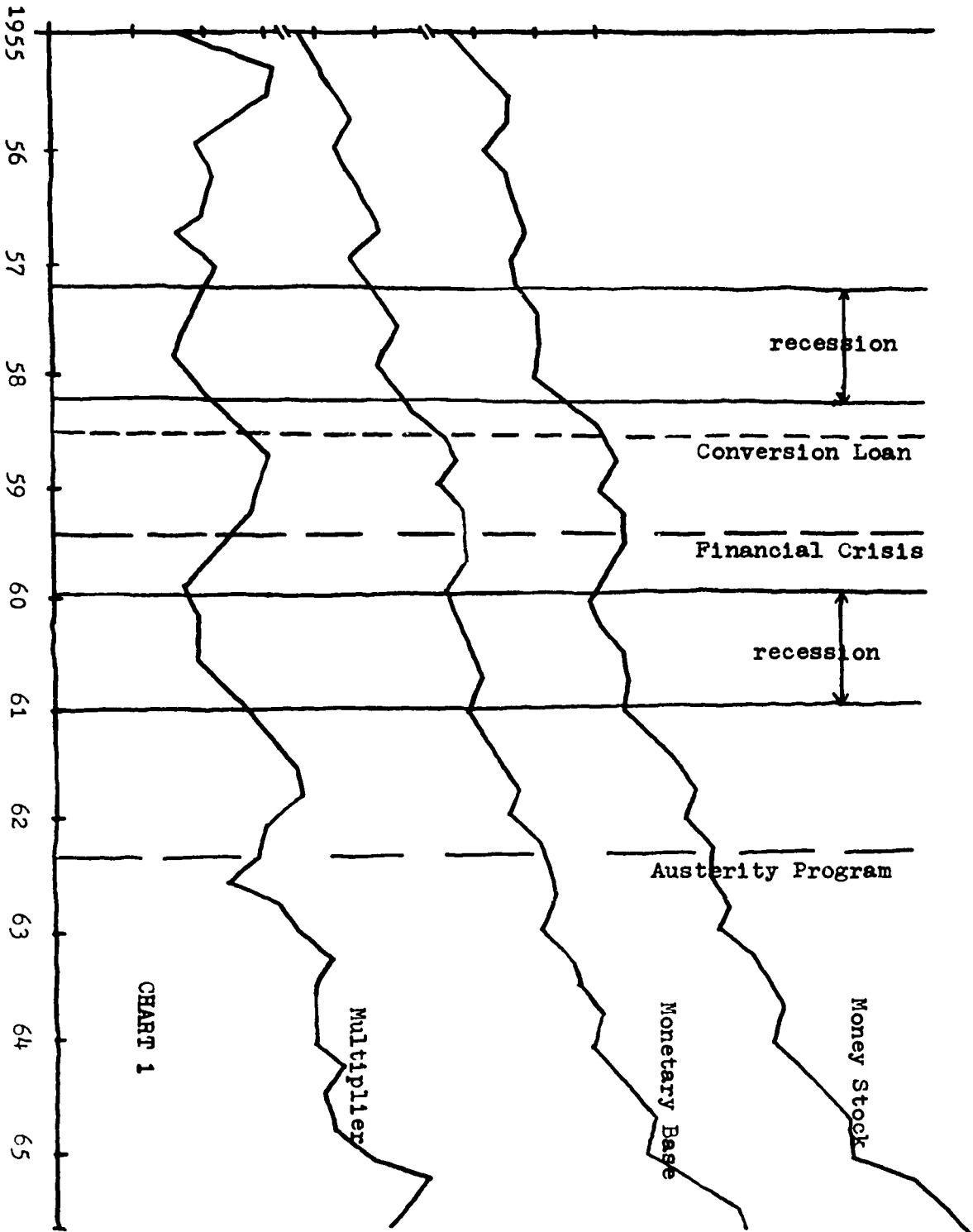


CHART 1

Multiplier

Monetary Base

Money Stock

recession

Conversion Loan

Financial Crisis

recession

Austerity Program

is based upon "raw" data (not seasonally adjusted) and a strong seasonal pattern is evident in both the monetary base and the money stock but is not so evident in the behavior of the multiplier. Because a graphical exposition is rather imprecise and unwieldy, we turn to numerical analysis for more information.

Table I contains percentage changes in the money stock, the money multiplier, and the monetary base for the years 1955-64, the relative contributions of changes in the base and the multiplier to changes in the money stock for those years, and the percentage contributions of the multiplier and the base to changes in the money stock for the period 1955.I to 1965.IV.

TABLE I

CONTRIBUTIONS OF THE MULTIPLIER AND THE  
MONETARY BASE TO CHANGES IN THE MONEY STOCK.

Year	Change in M %	Change in B %	Change in m %	(2÷1) %	(3÷1) %
	<u>(1)</u>	<u>(2)</u>	<u>(3)</u>	<u></u>	<u></u>
1955	5.86	5.71	0.14	97.4	2.6
1956	3.04	2.44	0.58	80.2	19.8
1957	3.42	4.27	-0.83	124.8	-24.8
1958	10.08	7.88	2.20	78.1	21.9
1959	-1.94	0.52	-2.47	-26.8	126.8
1960	5.55	3.16	2.39	56.9	43.1
1961	6.25	5.62	0.61	89.9	10.1
1962	4.56	3.42	1.14	75.0	25.0
1963	5.92	5.68	0.23	95.9	4.1
1964	8.02	6.46	1.55	80.5	19.5
Total Period	85.40	77.50	7.90	90.8	9.2

Over the total period, it is evident that, while the multiplier made a positive contribution to the increase in the stock of money, by far the largest role was played by the rise in the monetary base. The annual figures reveal that the role of the multiplier is enlarged for the shorter period: with the exceptions of 1955 and 1963, the annual contribution of changes in the multiplier to changes in the money stock far exceeds the contribution over the total period. In 1957, the decline in the multiplier reduced the impact of an increase in the monetary base while, for 1959, despite an increase in the base, a decline in the multiplier caused a decline in the stock of money. Finally, the reader is referred to Table I(A) (Appendix A) for data on the quarter-to-quarter contributions of changes in  $m$  and  $B$  to changes in the money stock: Table I(A) indicates that, on a quarterly basis, the multiplier has accounted for as much as three-quarters of the observed change in the money stock. The inference to be drawn from the data is clear: while movements in the monetary base are predominant over long periods of time, over short periods, the impact of changes in the monetary base engineered by the monetary authorities on the money stock is apt to be less certain. A glance at Table I(A) reveals that for five quarters in which the percentage

increase in the monetary base was between 1.81% and 1.88%, the percentage increase in the stock of money varied from 0.24% to 4.65%.

### Sources of Change in the Multiplier

We have established that, for short periods of time, changes in the money multiplier constitute an important source of change in the stock of money. The source of changes in the multiplier is, of course, changes in the constituent ratios of the multiplier. As a first step towards a fuller understanding of the sources of change in the multiplier, we can attribute to changes in the constituent ratios observed changes in the multiplier and relate such information to our knowledge of the important financial and economic events of the period under study.

Given the form of our money supply multiplier, we can express it in functional terms as:

$$3.1 \quad m = m(c, t, r)$$

Differentiating this expression totally yields:

$$3.2 \quad dm = \frac{\partial m}{\partial c} dc + \frac{\partial m}{\partial t} dt + \frac{\partial m}{\partial r} dr$$

Dividing through by (dm) yields:

$$3.3 \quad 1 = \frac{\partial m}{\partial c} \frac{dc}{dm} + \frac{\partial m}{\partial t} \frac{dt}{dm} + \frac{\partial m}{\partial r} \frac{dr}{dm}$$

which gives us the proportion of the change in the multiplier

attributable to changes in the currency, savings deposit, and reserve ratios (c, t, and r) respectively. While equations 3.2 and 3.3 are in continuous terms, our data consist of discrete observations. We can rewrite equations 3.2 and 3.3 to account for this as follows:

$$3.4 \quad \Delta m = \frac{\partial m}{\partial c} \Delta c + \frac{\partial m}{\partial t} \Delta t + \frac{\partial m}{\partial r} \Delta r$$

$$3.5 \quad 1 = \frac{\partial m}{\partial c} \frac{\Delta c}{\Delta m} + \frac{\partial m}{\partial t} \frac{\Delta t}{\Delta m} + \frac{\partial m}{\partial r} \frac{\Delta r}{\Delta m}$$

These latter equations are, of course, approximations to equations 3.2 and 3.3.<sup>1</sup> We can give these expressions empirical content by substituting for the partial derivatives in equations 3.4 and 3.5 the expressions derived in Chapter II. For equation 3.4, this yields the following:

$$3.6 \quad \Delta m = \left[ \frac{(1+t)(r-1)}{(r+rt+c)^2} \right] \Delta c + \left[ \frac{c(1-r)}{(r+rt+c)^2} \right] \Delta t - \left[ \frac{(1+c+t)(1+t)}{(r+rt+c)^2} \right] \Delta r$$

This approach has been used by Friedman and Schwartz,<sup>2</sup> and Ahrens Dorf and Kanesathasan,<sup>3</sup> but both the

<sup>1</sup> See: R.G.D. Allen, Mathematical Analysis for Economists, London, MacMillan, 1964, pp. 328-9.

<sup>2</sup> Milton Friedman, Anna J. Schwartz, A Monetary History of the United States, Princeton, Princeton University Press, 1963, Appendix B.

<sup>3</sup> J. Ahrens Dorf, S. Kanesathasan, "Variations in the Money Multiplier and Their Implications for Central Banking," IMF Staff Papers, November, 1960, p. 134.



details of the method and the multipliers investigated differ from ours.

We have calculated the terms of equation 3.6 for quarterly data (both seasonally adjusted and unadjusted), annual data, and for the total period. The quarterly unadjusted figures are found in Table II while the annual and total period figures are contained in Table III. The quarterly seasonally adjusted figures are found in Appendix B. To assist the reader in assessing the contributions of the constituent ratios to changes in the multiplier, the ratios and the multiplier (for unadjusted data) are charted in Chart 2.

On both a quarterly and an annual basis, Tables II and III indicate that the predominant source of change in the money multiplier is changes in the currency ratio (c). The savings deposit and reserve ratios, on the basis of Tables II and III, appear to make roughly equal contributions to changes in the multiplier but neither is as powerful as the currency ratio. The average annual absolute values (1955-65) of the ratios  $\frac{\partial m}{\partial c} \Delta c$ ,  $\frac{\partial m}{\partial r} \Delta r$ , and  $\frac{\partial m}{\partial t} \Delta t$  to  $\Delta m$  are 2.392, 0.996, and 1.312 respectively, indicating a somewhat greater role for the savings deposit ratio than for the reserve ratio, although the figures for the total period suggest a slightly greater role for the reserve ratio vis-à-vis the savings deposit ratio.

TABLE II

SOURCES OF CHANGE IN THE MULTIPLIER  
(quarterly data, not seasonally adjusted)

	$\Delta m$	$\Delta m$	$\frac{\partial m \Delta c}{\partial c}$	$\frac{\partial m \Delta r}{\partial r}$	$\frac{\partial m \Delta t}{\partial t}$	(2) ÷ (1)	(3) ÷ (1)	(4) ÷ (1)
	Actual	Estimated	(2)	(3)	(4)	(2) ÷ (1)	(3) ÷ (1)	(4) ÷ (1)
1955	1	---	---	---	---	---	---	---
	2	.140	.146	.114	.088	0.78	0.60	-0.38
	3	-.012	-.011	.022	-.019	-1.94	1.65	1.28
	4	-.078	-.076	-.058	-.025	0.76	0.33	-0.09
1956	1	-.043	-.042	-.114	-.024	2.71	0.56	-2.27
	2	.027	.027	.027	.006	1.01	0.24	-0.25
	3	-.018	-.017	-.026	.021	1.50	-1.25	0.74
	4	-.047	-.046	-.058	-.008	1.24	0.19	-0.43
1957	1	.067	.067	-.083	.040	-1.23	0.60	1.63
	2	-.023	-.023	.009	-.024	-0.38	1.03	0.35
	3	-.039	-.038	-.064	.014	1.69	-0.37	-0.32
	4	-.007	-.008	.084	.018	-10.26	-2.22	1.34
1958	1	.028	.027	-.025	-.016	-0.94	-0.62	2.56
	2	.051	.052	.058	.010	1.11	0.20	-0.31
	3	.041	.042	.103	-.020	2.45	-0.47	-0.97
	4	.043	.044	.084	.016	1.92	0.36	-1.28

TABLE II (continued)

	$\Delta m$	$\Delta m$	$\frac{\partial m}{\partial c}$	$\frac{\partial m}{\partial r}$	$\frac{\partial m}{\partial t}$	(2)÷(1)	(3)÷(1)	(4)÷(1)
	Actual	Estimated	(2)	(3)	(4)			
		(1)						
1959	1	--.026	--.126	--.029	.129	4.77	1.10	-4.87
	2	--.012	--.044	.002	.031	3.98	-0.19	-2.78
	3	--.043	--.084	.017	.024	2.01	-0.41	-0.59
	4	--.054	.000*	--.015	--.039	--.002	0.29	0.71
1960	1	--.013	--.066	--.024	.077	4.92	1.85	-5.78
	2	.012	--.014	.032	--.005	-1.12	2.53	-0.41
	3	.005	.004	.015	--.015	0.96	3.42	-3.39
	4	.045	.086	.017	--.057	1.86	0.36	-1.22
1961	1	.056	.011	--.007	.051	0.21	-0.14	0.93
	2	.043	.056	.006	--.018	1.27	0.15	-0.42
	3	.027	.079	.024	--.077	2.97	0.90	-2.88
	4	.010	.082	--.009	--.062	7.83	-0.86	-5.96
1962	1	--.049	--.090	--.061	.103	1.85	1.26	-2.12
	2	--.024	.001	--.027	.001	-0.05	1.12	-0.06
	3	--.072	--.095	--.001	.028	1.38	0.02	-0.40
	4	.105	.122	.086	--.101	1.13	0.80	-0.93
1963	1	.049	.026	--.022	.043	0.56	-0.47	0.90
	2	.051	.069	.015	--.033	1.33	0.29	-0.63
	3	--.037	--.035	--.012	.012	0.98	0.35	-0.34
	4	.000	.047	--.003	--.044	-94.59	0.64	89.13

\*This entry is the result of truncating at three decimal places.

TABLE II (continued)

	$\Delta m$	$\Delta m$	$\frac{\partial m}{\partial c} \Delta c$	$\frac{\partial m}{\partial r} \Delta r$	$\frac{\partial m}{\partial t} \Delta t$	(2) ÷ (1)	(3) ÷ (1)	(4) ÷ (1)
	Actual	Estimated (1)	(2)	(3)	(4)			
1964	1	--.002	--.006	--.048	.005	2.14	16.12	-17.26
	2	.050	.049	.029	--.028	0.98	0.58	-0.56
	3	--.044	--.029	--.004	--.008	0.68	0.11	0.20
	4	.034	.070	.021	--.058	2.10	0.65	-1.76
1965	1	.040	.052	--.025	.013	1.30	-0.63	0.33
	2	.111	.167	.047	--.098	1.43	0.40	-0.84
	3	--.031	.037	--.022	--.046	-1.16	0.71	1.45
	4	--.019	--.010	--.003	--.004	0.57	0.18	0.24

TABLE III  
 SOURCES OF CHANGE IN THE MULTIPLIER  
 (annual data)

Year	$\Delta m$ (1)	$\frac{\partial m \Delta c}{\partial c}$ (2)	$\frac{\partial m \Delta r}{\partial r}$ (3)	$\frac{\partial m \Delta t}{\partial t}$ (4)	(2:1)	(3:1)	(4:1)
1955	0.007	-0.045	0.016	0.036	-6.260	2.209	5.051
1956	0.031	-0.139	0.060	0.110	-4.512	1.953	3.560
1957	-0.041	0.000	-0.007	-0.033	0.003	0.190	0.806
1958	0.110	0.113	-0.022	0.020	1.023	-0.206	0.183
1959	-0.114	-0.186	-0.021	0.093	1.627	0.191	-0.818
1960	0.122	0.088	0.059	-0.026	0.724	0.490	-0.214
1961	0.033	0.120	-0.040	-0.047	3.619	-1.200	-1.419
1962	0.058	0.046	0.035	-0.024	0.804	0.618	-0.422
1963	0.012	0.072	-0.048	-0.011	5.811	-3.897	-0.914
1964	0.083	0.144	0.022	-0.082	1.728	0.263	-0.991
1965	-0.841	-0.169	-0.622	-0.048	0.202	0.740	0.057
Total Period	0.296	0.191	0.057	.047	0.645	0.195	0.159

Further evidence on the relative importance of the individual constituent ratios to changes in the multiplier is obtained from the elasticities and weighted regression coefficients derived from the following regression equation:

$$3.7 \quad m_t = -7.41c_t + 1.05t_t - 22.4r_t + 7.99 \quad R^2 = 0.9940$$

(84.7) (45.8) (23.4) (99.4) D.W. = 0.40

Equation 3.7 was estimated with quarterly, unadjusted data. Re-estimation of equation 3.7 after the application of a Durbin procedure to the time series lowered the t-values but did not materially alter the regression coefficients. The ranking of the t-values was retained. The elasticities calculated from equation 3.7 are as follows:

Elasticity of m with respect to:

Currency Ratio	-.5187
Savings Deposit Ratio	.2940
Reserve Ratio	-.3584

Weighting the regression coefficients of equation 3.7 by the correlation between the dependent and relevant independent variable yields values of 1.29, -0.37, and -0.08 for the currency, savings deposit, and reserve ratios respectively (the weighted coefficients sum to unity when the weighted coefficient for the constant is included).<sup>4</sup>

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<sup>4</sup> This technique is presented in: A. Goldberger, Econometric Theory, New York, John Wiley, 1963.

While the above elasticities suggest that changes in the reserve ratio are more powerful than changes in the savings deposit ratio, the weighted coefficients, coupled with the t-values of equation 3.7, indicate that the reserve ratio is the least systematic contributor to changes in the money multiplier on a quarterly basis. We now examine the behavior of the individual constituent ratios in more detail.

### The Currency Ratio

On an annual basis, increases in the currency ratio made a negative contribution to changes in the multiplier in 1955, 1956, 1959, and 1965, although Chart 2 and Table II indicate that the currency ratio declined in all but the fourth quarters of 1955 and 1965. In 1959, the sharp rise in the currency ratio was the major cause of an actual decline in the money stock. Both 1956 and 1959 are characterized, by Johnson and Winder,<sup>5</sup> as periods of contractionary monetary policy. They designate September, 1955, and October, 1958, as the point of change from expansionary to contractionary policy. In the third quarter of 1955, the currency ratio declined, contributing

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<sup>5</sup> H. G. Johnson, J.W.L. Winder, "Lags in the Effects of Monetary Policy in Canada," a study for the Royal Commission on Banking and Finance, November, 1962, p. 8.

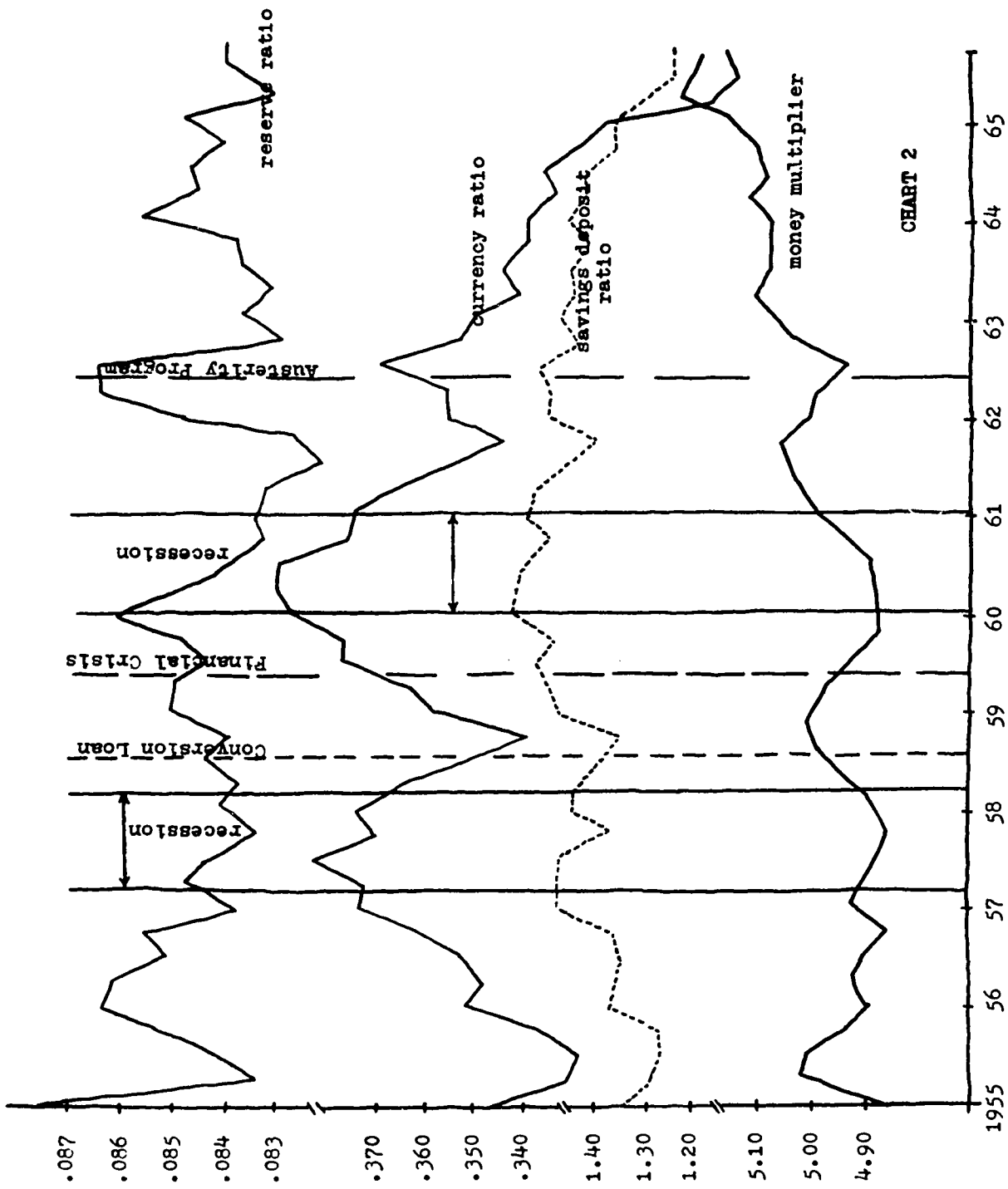


CHART 2



to a rise in the multiplier; during the fourth quarter of 1958, the currency ratio again declined and the multiplier rose. During both 1958 and 1960, years of recession, the currency ratio declined, thus contributing to an increase in the money multiplier. During the years following the recession of 1960, the currency ratio has declined markedly, contributing to a general upward movement of the multiplier. The most obvious source of this decline in the currency ratio is the rapid growth of Non-Personal Term and Notice deposits since 1960 which has raised the denominator of ( $c = C/D$ ). Neither the Conversion Loan of July, 1958, nor the devaluation of the Canadian dollar in June, 1962 appear to have had a distinct influence on the currency ratio. While we might expect the currency ratio to rise sharply during the fourth quarter of each year (as bank deposits are converted to cash for Christmas spending), this pattern occurs in only seven of the eleven years of the period. For five of the eight non-recession years, the currency ratio made a negative contribution to changes in the multiplier during the third quarter of the year (as family vacations are taken).

#### The Savings Deposit Ratio

During 1956, the savings deposit ratio rose slightly, contributing to a rise in the money multiplier; during 1959,

the savings deposit ratio again rose but its positive effect on the multiplier was overshadowed by the concomitant rise in both the currency and reserve ratios. The savings deposit ratio fell during 1957, rose and then fell during 1958, and declined during 1960. Thus, in two recession years (1957 and 1960), the savings deposit ratio contributed to a decline in the multiplier. A decline in the savings deposit ratio during recession years suggests that many individuals draw upon savings balances during such times in order to protect previously established consumption levels. The savings deposit ratio exhibits a strong seasonal pattern, declining in the fourth quarter of most years; this may well reflect the conversion of savings deposits to cash for Christmas spending. The frequent decline of the ratio during the second quarter of the year is possibly due to the payment of income taxes in April. Finally, we note that the savings deposit ratio has declined steadily since 1960. This is due in part to the rapid growth of Non-Personal Term and Notice deposits (raising  $D$ ), and to the growth of non-bank financial intermediaries (lowering  $T$ ).

#### The Reserve Ratio

During 1956, the reserve ratio declined and then rose making, on balance, a positive contribution to the

the savings deposit ratio again rose but its positive effect on the multiplier was overshadowed by the concomitant rise in both the currency and reserve ratios. The savings deposit ratio fell during 1957, rose and then fell during 1958, and declined during 1960. Thus, in two recession years (1957 and 1960), the savings deposit ratio contributed to a decline in the multiplier. A decline in the savings deposit ratio during recession years suggests that many individuals draw upon savings balances during such times in order to protect previously established consumption levels. The savings deposit ratio exhibits a strong seasonal pattern, declining in the fourth quarter of most years; this may well reflect the conversion of savings deposits to cash for Christmas spending. The frequent decline of the ratio during the second quarter of the year is possibly due to the payment of income taxes in April. Finally, we note that the savings deposit ratio has declined steadily since 1960. This is due in part to the rapid growth of Non-Personal Term and Notice deposits (raising  $D$ ), and to the growth of non-bank financial intermediaries (lowering  $T$ ).

#### The Reserve Ratio

During 1956, the reserve ratio declined and then rose making, on balance, a positive contribution to the

multiplier (which rose). During 1959, the ratio declined but then rose sharply and contributed to a decline in the money multiplier and the money stock. During both 1957 and 1958, the reserve ratio behaved erratically but, on balance, made a negative contribution to the multiplier which declined in 1957 and rose in 1958. During 1960, the ratio declined, contributing to a rise in the multiplier. The very sharp rise in the reserve ratio between mid-1961 and mid-1962 is explained partly by the uncertainties associated with Canada's exchange rate problems at that time and partly by the relatively large increase in the monetary base during 1961 (although a much larger increase in the base during 1958 did not lead to so spectacular a rise in the reserve ratio).<sup>6</sup> Finally, we note the existence of a strong, negative first-quarter seasonal pattern in the contribution of the reserve ratio to changes in the multiplier. The lack of a strong loan demand during these winter months is probably the cause of this occurrence.

### Conclusions

Several conclusions can be drawn from the graphical and tabular data presented in this chapter. First, it

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<sup>6</sup> The major cause of the very large rise in the monetary base and bank reserves during 1958 was the Conversion Loan. Because the chartered banks absorbed large quantities of Government of Canada bonds at that time, the reserve ratio did not exhibit a marked increase.

appears that, over periods as long as several years, changes in the monetary base are the predominant source of change in the money stock; for such extended periods, the contribution of changes in the multiplier to changes in the money stock is of minor importance. Second, the relative importance of changes in the multiplier as a source of change in the money stock increases the shorter is the time period examined.<sup>7</sup> While changes in the multiplier accounted for 9.2% of the increase in the money stock between 1955 and 1965, on an annual basis, the multiplier has accounted for as much as 43% of the observed change in the money stock and, on a quarterly basis, its contribution has been as high as 72%. Third, the most important source of change in the multiplier has been movements of the currency ratio; changes in the savings deposit and reserve ratios have made roughly equal contributions to changes in the multiplier but neither is as powerful as the currency ratio.

The limitations of the method of analysis employed in this chapter are manifest. Although we are able to quantify with some precision the relative importance of changes in the monetary base and the multiplier to changes in the money stock and, further, to determine the

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<sup>7</sup> This result is also reported by Ahrens Dorf and Kanesathasan in op. cit., p. 134.

relative contributions of changes in the constituent ratios to changes in the multiplier, it is difficult to extract from the data more than rudimentary hypotheses about the sources of change in the ratios themselves. Over long periods of time characterized by dramatic changes in either the structure or performance of the economy, it is, as Friedman and Schwartz have shown,<sup>8</sup> a useful method. For shorter, more stable periods, its analytical power is limited. What is required, instead, is a simultaneous equation model which relates the various asset demands which affect the constituent ratios and the multiplier to asset prices, income, and other economic variables. In the next chapter, we present such a model, and discuss its assumptions and properties.

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<sup>8</sup> Friedman and Schwartz, op. cit.

APPENDIX ATABLE I(A)

CONTRIBUTIONS OF THE MULTIPLIER AND THE  
BASE TO CHANGES IN THE MONEY STOCK  
(quarterly data, unadjusted)

		$\frac{\ln M}{\%}$	$\frac{\ln B}{\%}$	$\frac{\ln m}{\%}$	$\frac{\ln m}{\ln M}$ %	$\frac{\ln B}{\ln M}$ %
1955	1	--	--	--	--	--
	2	4.65	1.82	2.81	60.6	39.1
	3	3.48	3.72	-0.23	-68.3	106.7
	4	0.24	1.81	-1.56	-646.3	747.7
1956	1	-2.51	-1.63	-0.87	34.6	64.9
	2	2.70	2.14	0.54	20.3	79.5
	3	1.99	2.35	-0.36	-18.3	117.8
	4	0.71	1.68	-0.96	-134.3	235.8
1957	1	-2.36	-3.74	1.36	-57.7	158.0
	2	1.99	2.46	-0.46	-23.4	124.1
	3	1.33	2.12	-0.79	-59.6	159.9
	4	0.86	1.00	-0.14	-16.7	117.0
1958	1	-0.75	-1.33	0.57	-76.2	176.8
	2	4.28	3.23	1.03	24.2	75.5
	3	5.24	4.42	0.82	15.7	84.3
	4	3.16	2.30	0.85	27.1	72.8
1959	1	-2.60	-2.08	-0.51	19.8	79.7
	2	1.88	2.11	-0.24	-12.7	112.1
	3	0.66	1.53	-0.86	-129.6	229.2
	4	-1.51	-0.39	-1.09	72.6	26.3
1960	1	-2.99	-2.72	-0.26	8.8	91.0
	2	2.15	1.88	0.24	11.4	87.8
	3	1.94	1.85	0.10	52.5	49.1
	4	1.82	0.89	0.91	50.2	49.1
1961	1	-0.36	-1.47	1.12	-312.0	407.4
	2	2.73	1.86	0.85	31.3	68.1
	3	3.22	2.69	0.53	16.5	83.6
	4	2.04	1.84	0.19	9.6	90.4

## APPENDIX A -- TABLE I(A) continued

		$\ln M$ %	$\ln B$ %	$\ln m$ %	$\frac{\ln m}{\ln M}$ %	$\frac{\ln B}{\ln M}$ %
1962	1	-1.74	-0.78	-0.97	55.5	44.8
	2	2.80	3.29	-0.47	-17.0	117.6
	3	0.43	1.86	-1.45	-332.9	429.0
	4	1.78	-0.32	2.10	118.3	-18.2
1963	1	-0.46	-1.41	0.96	-210.4	306.5
	2	3.62	2.60	0.99	27.6	72.2
	3	1.64	2.35	-0.72	-44.0	143.4
	4	1.48	1.49	-0.01	--	100.0
1964	1	-0.81	-0.77	-0.04	4.8	95.1
	2	3.01	2.03	0.97	32.3	67.6
	3	2.13	2.98	-0.85	-40.2	139.8
	4	2.24	1.59	0.66	29.5	70.7
1965	1	0.62	-0.14	0.77	123.3	-23.2
	2	5.35	3.22	2.12	39.6	60.2
	3	3.55	4.16	-0.58	-16.5	117.0
	4	2.04	2.39	-0.36	-17.7	117.0



APPENDIX B

TABLE II(A)

SOURCES OF CHANGE IN THE MULTIPLIER  
(quarterly data, seasonally adjusted)

	$\Delta m$	$\Delta m$	$\frac{\partial m}{\partial c} \Delta c$	$\frac{\partial m}{\partial r} \Delta r$	$\frac{\partial m}{\partial t} \Delta t$	(2)÷(1)	(3)÷(1)	(4)÷(1)
	Actual	Estimated	(2)	(3)	(4)	(2)÷(1)	(3)÷(1)	(4)÷(1)
		(1)						
1955	1	---	---	---	---	---	---	---
	2	0.111	0.092	0.050	-0.020	0.549	0.677	-0.226
	3	0.014	0.028	0.030	0.007	1.076	-0.325	0.249
	4	-0.042	-0.055	-0.072	0.033	1.313	0.287	-0.599
1956	1	-0.074	-0.079	-0.068	0.023	0.855	0.455	-0.300
	2	0.000	0.017	-0.008	0.017	-0.494	0.518	0.976
	3	0.005	0.009	-0.018	0.004	-1.871	2.448	0.423
	4	-0.017	-0.029	-0.083	0.061	2.881	0.228	-2.110
1957	1	0.043	0.007	-0.042	0.030	-5.929	2.644	4.285
	2	-0.049	0.004	-0.009	0.009	-2.161	1.008	2.153
	3	-0.018	-0.023	-0.057	0.007	2.413	-0.321	-1.092
	4	0.017	0.006	0.048	0.011	7.807	1.923	-8.730
1958	1	0.004	0.017	0.033	-0.007	1.869	-0.462	-0.406
	2	0.046	0.021	0.028	-0.013	1.309	0.336	-0.644
	3	0.051	0.058	0.108	-0.023	1.859	-0.409	-0.449
	4	0.025	0.046	0.017	0.005	0.377	0.109	0.512

APPENDIX B -- TABLE II(A) continued

	$\Delta m$	$\Delta m$	$\frac{\partial m \Delta c}{\partial c}$	$\frac{\partial m \Delta r}{\partial r}$	$\frac{\partial m \Delta t}{\partial t}$	(2)÷(1)	(3)÷(1)	(4)÷(1)
	Actual	Estimated	(2)	(3)	(4)			
		(1)						
1959	1	-0.007	-0.007	-0.002	0.016	2.684	0.322	-2.000
	2	-0.010	-0.036	-0.007	0.055	2.322	0.198	-1.520
	3	-0.049	-0.044	0.001	0.045	2.082	-0.043	-1.038
	4	-0.040	-0.024	-0.013	0.009	0.823	0.547	-0.371
1960	1	-0.028	-0.025	0.001	0.007	1.362	-0.043	-0.317
	2	0.004	-0.008	0.016	---	3.040	-2.020	-0.019
	3	0.014	0.019	0.004	0.002	0.647	0.238	0.113
	4	0.052	0.054	0.018	-0.011	0.868	0.347	-0.215
1961	1	0.051	0.045	0.009	-0.017	1.187	0.197	-0.384
	2	0.032	0.038	0.000	-0.011	1.296	0.000	-0.295
	3	0.037	0.043	0.018	-0.063	2.031	0.432	-1.463
	4	0.008	-0.006	-0.021	0.005	-1.354	3.187	-0.833
1962	1	-0.040	-0.036	-0.037	0.009	0.243	1.029	-0.272
	2	-0.055	-0.032	-0.030	0.013	0.468	0.933	-0.402
	3	-0.015	-0.059	-0.012	0.047	1.592	0.208	-0.800
	4	0.067	0.114	0.082	-0.051	0.729	0.712	-0.442
1963	1	0.049	0.029	-0.004	-0.018	1.811	-0.157	-0.654
	2	0.042	0.042	0.008	-0.033	1.569	0.209	-0.778
	3	-0.007	-0.002	-0.013	0.019	3.676	6.085	-8.76
	4	-0.021	-0.015	-0.020	0.008	0.244	1.334	-0.578

APPENDIX B -- TABLE II(A) continued

	$\Delta m$	$\Delta m$	$\frac{\partial m \Delta c}{\partial c}$	$\frac{\partial m \Delta r}{\partial r}$	$\frac{\partial m \Delta t}{\partial t}$	(2)+(1)	(3)+(1)	(4)+(1)	
	Actual	Estimated (1)	(2)	(3)	(4)	(2)+(1)	(3)+(1)	(4)+(1)	
1964	1	0.003	-0.009	0.019	-0.010	-2.026	1.968	1.058	
	2	0.037	0.040	0.042	0.018	1.045	0.462	-0.508	
	3	-0.027	-0.008	-0.002	-0.007	0.002	0.337	0.854	-0.191
	4	0.027	0.006	0.025	0.003	-0.022	3.912	0.517	-3.430
1965	1	0.060	0.047	0.085	---	1.815	-0.019	-0.795	
	2	0.126	0.131	0.137	0.072	1.047	0.553	-0.601	
	3	0.000	-0.003	0.189	-0.042	-54.12	12.23	42.89	
	4	---	---	---	---	---	---	---	

## CHAPTER IV

### THE MODEL AND ITS PROPERTIES

In the previous chapter, we suggested the need for a model of the Canadian monetary sector. In this chapter we present and discuss such a model.<sup>1</sup>

#### The Model and Empirical Estimates

Our model, and the regression estimates of the structural equation is as follows:

$$4.1 \quad C_t^D = 0.0041Y_t + 0.88C_{t-1} + 15.4S_1 + 82.0S_2 \\ (3.62) \quad (22.12) \quad (0.5) \quad (3.2) \\ 76.5S_3 + 70.1S_4 \\ (3.5) \quad (2.6)$$

$$R^2 = 0.9980$$

$$D.W. = 1.55$$

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<sup>1</sup> A more detailed model of the Canadian monetary sector, which incorporates the real sector as well, is found in: T. J. Courchene, "The Canadian Money Supply: An Econometric Analysis with Special Emphasis on the Money Supply Multiplier," a paper presented to the meetings of the Canadian Economics Association, Calgary, 1968. Professor Courchene's model enlarges, in part, on the model presented in this thesis.

$$\begin{aligned}
 4.2 \quad D_t^D &= -89.631_t^S + 0.0246Y_t + 0.91D_{t-1} - 290.8S_1 \\
 &\quad (4.15) \quad (2.43) \quad (11.2) \quad (2.13) \\
 &\quad + 2.66S_2 - 160.2S_3 - 23.4S_4 \\
 &\quad (0.02) \quad (1.38) \quad (0.19)
 \end{aligned}$$

$$R^2 = 0.9860$$

$$D.W. = 1.45$$

$$\begin{aligned}
 4.3 \quad T_t^D &= -137.71_t^L + 0.0234YP_t + 31.62A_t + 0.92T_{t-1} \\
 &\quad (5.19) \quad (2.33) \quad (5.54) \quad (14.5) \\
 &\quad + 70.8S_1 + 198.2S_2 + 124.4S_3 + 1.86S_4 \\
 &\quad (1.03) \quad (2.90) \quad (1.78) \quad (0.02)
 \end{aligned}$$

$$R^2 = 0.9980$$

$$D.W. = 1.82$$

$$\begin{aligned}
 4.4 \quad CDDL_t^S &= 12.92R_t^S - 87.521_t^{BR} + 134.51_t^P - 988.4S_1 \\
 &\quad (108.3) \quad (3.72) \quad (1.90) \quad (3.18) \\
 &\quad - 1088.0S_2 - 1157.0S_3 - 1018.0S_4 \\
 &\quad (3.47) \quad (3.64) \quad (3.27)
 \end{aligned}$$

$$R^2 = 0.9960$$

$$D.W. = 2.13$$

$$4.5 \quad R_t^S = 2.97 \Delta P_{t-2} + 14.18 u_{t-1} - 0.287 BPD_{t-3}$$

(0.3)                      (4.57)                      (6.67)

$$+ 0.0219 Y_{t-1} - 224.5$$

(25.3)                      (4.79)

$$R^2 = 0.9525$$

$$D.W. = 2.15$$

$$4.6 \quad I_t^L = 0.1811 I_t^S + 0.066 A_t + 0.4761 I_{t-1}^L + 0.2231 I_{t-2}^L + 0.171$$

(6.36)                      (5.17)                      (3.45)                      (1.89)                      (1.29)

$$R^2 = 0.9682$$

$$D.W. = 1.74$$

$$4.7 \quad C^S = C^D$$

$$4.8 \quad T^S = T^D$$

$$4.9 \quad R^D = R^S$$

$$4.10 \quad CDDL^D = CDDL^S$$

$$4.11 \quad D^S = CDDL^S - T^S - Dg$$

$$4.12 \quad M^D = C^D + D^D + T^D$$

$$4.13 \quad M^S = \frac{1 + C^D/D + T^D/D}{\left(\frac{R^S}{T^D+D}\right)\left(1 + \frac{T^D}{D}\right) + \frac{C^D}{D}} (C^D + R^S)$$

$$4.14 \quad M^D = M^S$$

$$4.15 \quad D^D = D^S$$

The above fifteen equations determine the following fourteen unknowns:  $C^D$ ,  $C^S$ ,  $D^D$ ,  $D^S$ ,  $T^D$ ,  $T^S$ ,  $R^D$ ,  $R^S$ ,  $CDDL^D$ ,  $CDDL^S$ ,  $M^D$ ,  $M^S$ ,  $i^S$ , and  $i^L$ . While the model is ostensibly over-determined, either of equations 4.14 or 4.15 can be eliminated since they can be derived from other equations in the system. This yields a system of fourteen equations in fourteen unknowns. Note that equation 4.13, which is a detailed version of  $M = mB$ , could be replaced with  $M^S = C^S + D^S + T^S$ .<sup>2</sup> This has not been done because we wish to concentrate upon the money supply multiplier.

#### Notation, Estimators, Data, and Variables

The superscripts (D) and (S) refer to demand and supply equations respectively; bracketed figures are t-values of the regression coefficients;  $R^2$  is the

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<sup>2</sup> As noted, equation 4.13 is a detailed version of  $M = mB$ . We have substituted  $C/D$ ,  $T/D$ , etc., for the ratios of the multiplier derived in Chapter II. Equation 4.13 could have been dropped to obtain an equal number of equations and unknowns.

coefficient of determination<sup>3</sup> (corrected for degrees of freedom); and D.W. is the Durbin-Watson statistic.

$S_1$  to  $S_4$  are seasonal intercepts. Equations 4.1 and 4.5 were estimated by Ordinary Least Squares while the remaining equations were estimated by Two-Stage Least Squares. The regression equations were estimated using unadjusted quarterly averages of Average-of-Wednesdays monthly data in nominal terms. The variables appearing in the equations of the model are as follows:

#### Endogenous

- C currency in the hands of the public, including coin;<sup>4</sup>
- D demand deposits in the hands of the public, including the demand accounts of provincial and municipal governments, the demand accounts of private institutions, firms and individuals, and non-personal term and notice deposits;
- T personal savings deposits in the hands of the public;
- R total chartered bank reserves, i.e., vault cash and deposits at the Bank of Canada;

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<sup>3</sup> When the quarter-to-quarter change is substituted for the level of the dependent variable, the  $R^2$  for equations 4.1, 4.2, and 4.3 declined to 0.9216, 0.7569, and 0.7744 respectively.

<sup>4</sup> Neither C nor R is endogenous in the usual sense of being simultaneously determined by the other endogenous variables of the system; both are functions of pre-determined variables exclusively.



CDDL total Canadian Dollar Deposit Liabilities of the chartered banks;

M the stock of money, i.e., C+D+T;

$i^S$  the 91-day Treasury Bill rate;

$i^L$  the yield on Government of Canada bonds maturing in ten or more years;

### Exogenous

Y Gross National Product in current dollars;

YP Permanent Gross National Product in current dollars;

A the average term-to-maturity of the publicly-held public debt in years;

$i^{BR}$  the Official Discount Rate (Bank Rate);

$i^P$  the chartered bank prime lending rate;

Dg Government of Canada deposits at the chartered banks;

P the Consumer Price Index, 1949 = 100.0;

u percentage of civilian labour force unemployed;

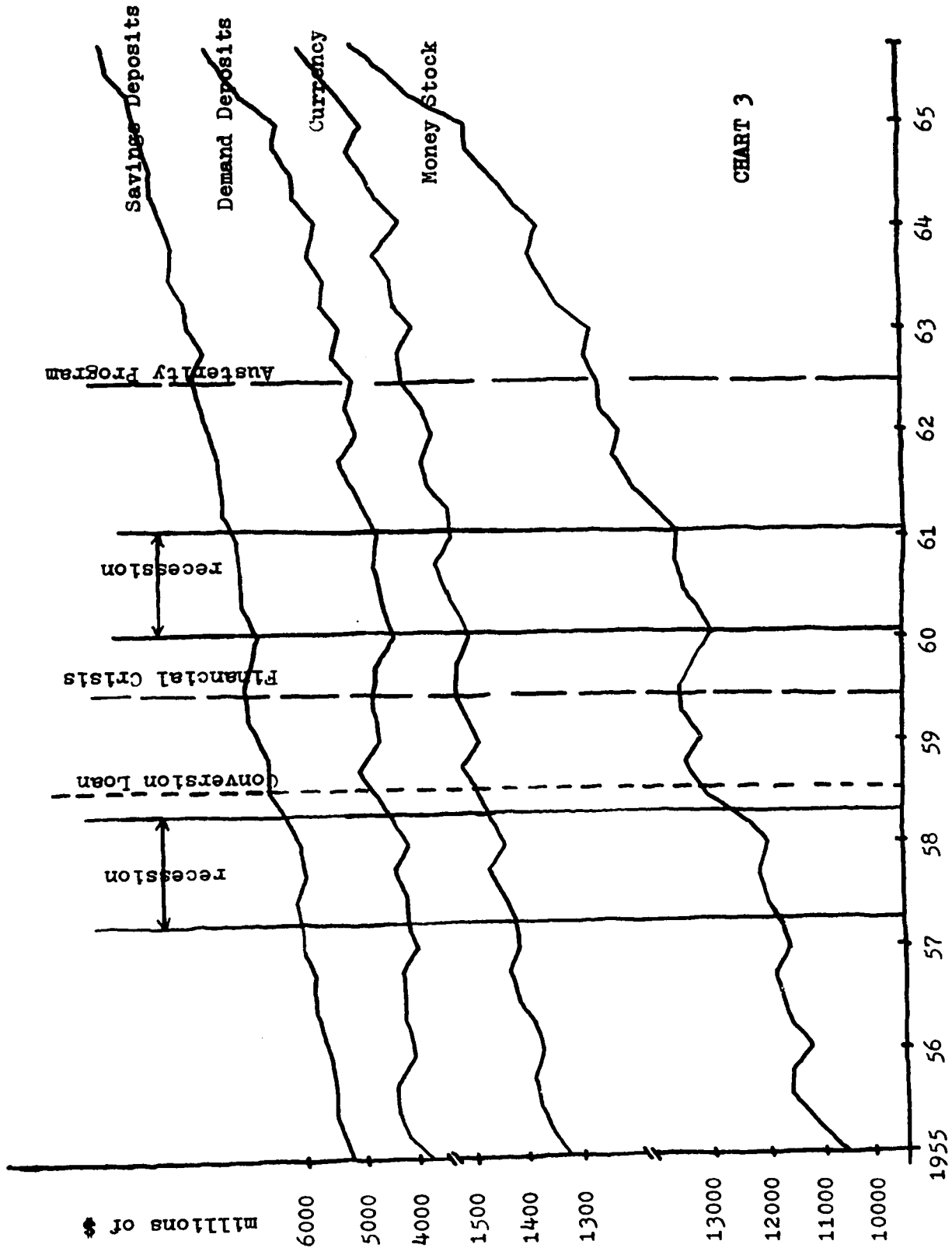
BPD the balance of payments deficit on current account.

Value variables are in millions of dollars; interest rates are in percentages.

(See Chart 3 for the basic series)

### Assumptions of the Model

The model incorporates the following assumptions: first, the stocks of currency and savings deposits held by the public are demand-determined (equations 4.1, 4.3, 4.7, and 4.8); second, the stock of demand deposits held by the



public is simultaneously determined by the public and the chartered banking system (equations 4.2, 4.4, 4.11, and 4.15); third, the stock of bank reserves is determined by the central bank (equations 4.5 and 4.9); and fourth, the central bank directs its attention to bank reserves rather than to the monetary base.

Our assumption that the public's demand for currency is accommodated by the chartered banks and, in turn, the central bank, follows from the nature of the currency itself: because currency is legal tender or "coin of the realm," the banking system must redeem its liabilities for currency and cannot attach price or quantity constraints to the process. Similarly, the central bank, in its roles of lender of last resort and manager of the currency, cannot inhibit or frustrate the ability of the banking system to honour requests for currency in exchange for other forms of money. Our assumption regarding currency is supported by the following statement by the Royal Commission on Banking and Finance:

. . . the amount of notes in active circulation is determined by the preferences of the public  
. . . The Bank of Canada does not normally allow changes in note circulation to affect credit conditions, and accordingly takes the necessary offsetting actions.<sup>5</sup>

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<sup>5</sup> Royal Commission on Banking and Finance, "Techniques of Monetary Policy," quoted in: J. Cairns, H. Binhammer, Canadian Banking and Monetary Policy, Toronto, McGraw-Hill, 1965, p. 128n.

The latter portion of the above quotation implies, of course, that a decline in vault cash associated with a rise in public note demand is offset by the central bank. We have attempted to assess the validity of this proposition by regressing total bank reserves on currency held by the general public.<sup>6</sup> The O.L.S. regression coefficient of reserves on currency is 0.78, which suggests that changes in note circulation are not entirely offset by the central bank. While we might explain incomplete offsetting on a monthly basis in terms of lags in reporting vault cash, on a quarterly basis, the incomplete offset probably reflects conscious central bank policy. We suggest, therefore, that within reasonable limits, the central bank offsets changes in active note circulation only when to do so is consistent with its overall policy on bank reserves.

Our assumption that the stock of savings deposits is demand-determined follows from more basic assumptions about the nature of, and motivation for holding, such deposits. While many individuals use savings balances in the same manner as demand balances, we assume that most savings balances are used to hold wealth and are obtained

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<sup>6</sup> We were unable to include currency in our reserves supply equation. To do so rendered the income term statistically insignificant and caused the unemployment term to take on the wrong sign.

by exchanging part of the current income stream or existing money balances rather than by selling a non-monetary asset such as a security or promise-to-pay to a bank. This does not imply, however, that the banking system cannot alter the willingness of the public to hold such deposits by altering the yield on savings deposits.<sup>7</sup> Rather, at a given rate of interest payable on savings deposits, the banks will accept all such deposits.<sup>8</sup>

The second assumption, that the stock of demand deposits is determined simultaneously by the banking system and the public, requires considerable elaboration since the burden of adjustment in our model falls on demand deposits. The equations which determine the equilibrium stock of demand deposits are 4.2, 4.3, 4.4, 4.11, and 4.15.

On the demand side of the market, equation 4.2 indicates that, for a given level of income, a rise in the short-term interest rate will yield a decline in the public's demand for demand deposits. The short-term

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<sup>7</sup> Recent behavior of the chartered banks following the declaration of the Bank Act of 1967 indicates a keen desire on the part of the banks to induce the public to hold savings accounts with as few checking privileges and as long a term as possible. Apart from a concerted advertising campaign stressing non-price advantages of such deposits, the key selling point has been higher yields.

<sup>8</sup> The same behavior is assumed by S. M. Goldfeld. See: Commercial Bank Behavior and Economic Activity, Amsterdam, North-Holland, 1966, p. 26.

interest rate plays two roles in equation 4.2: it is first a measure of the opportunity cost of holding such deposits; and second it is a proxy for the cost of bank loans eventhough it is more variable than the prime lending rate.

While our model yields a solution for the supply of demand deposits, the structure of our model is such that there is no explicit structural equation for the supply of demand deposits. Even so, the model assumes that, on the supply side, it is demand deposits which adjust to changing market conditions. The chartered banks are assumed to determine the total volume of Canadian Dollar Deposit Liabilities (CDDL), which equation 4.4 indicates is a function of total reserves (R), Bank Rate ( $i^{BR}$ ), and the prime lending rate ( $i^P$ ). Then, given the public's demand for savings deposits (equation 4.3) and Government of Canada deposits (Dg), the supply of demand deposits is adjusted so that:

$$CDDL = T + D + Dg$$

The mechanism by which the supply of demand deposit liabilities is adjusted is greater or lesser purchases of earning assets by the chartered banks. This, of course, suggests that much of the burden of adjustment

falls upon bank loans to individuals and businesses. The banks are assumed to set the prime lending rate (to which all other bank lending rates are tied) and, at that rate, considered as exogenous in our model, to adjust the supply of loans and demand deposits. This analysis is consistent with both the infrequency of changes in bank lending rates and statements by the Canadian Bankers' Association to the effect that periods of stringent monetary policy lead to a general review of lines of credit and types of loans authorized.<sup>9</sup>

If this analysis is substantially correct, it implies that savings deposits play a pivotal role in the determination of the equilibrium stock of demand deposits and bank loans. A rise in public holdings of savings deposits will, for a given level of Government of Canada deposits and reserves, reduce the quantity of demand deposits that the banking system can supply.

Another assumption of our model is that the stock of chartered bank reserves is controlled by the Bank of Canada. This assumption would be unwarranted were there in Canada a tradition of borrowing reserves from the central

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<sup>9</sup> See: Canadian Bankers' Association, "Submissions to the Royal Commission on Banking and Finance," The Canadian Banker, (supplement), Spring, 1963, p. 20. In a larger model, the prime rate should be endogenous.

bank as there is in both the United States and the United Kingdom. While the chartered banks have access to central bank credit directly, through lines or credit, or indirectly, through some fifteen investment dealers with borrowing privileges at the Bank of Canada, the Bank of Canada is able to control with considerable precision the stock of bank reserves. It can, when a line of credit is exhausted, refuse to renew it or renew it at a prohibitive price, and it can discourage the investment dealers from obtaining central bank credit under purchase and repurchase agreements. For these reasons, we make no distinction between borrowed and unborrowed reserves in our model.

Finally, we assume that the central bank acts to control total bank reserves rather than the monetary base.<sup>10</sup>

#### Statutory vs. Non-Statutory Definitions

Given the peculiarities of the method of calculating the legal reserve ratio in Canada during the period under study, we must decide whether to use statutory or non-statutory definitions of our variables.

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<sup>10</sup> An alternative approach is to define the monetary base as the dependent variable with currency as an argument in the base supply function. This approach is followed by Courchene, op. cit., p. 16.



If we choose the statutory basis, we must either define the monetary base in the current period to consist of all currency outstanding this period plus deposits at the central bank next period, or define the current stock of money to consist of last period's currency and bank deposits in the hands of the public. The former approach, for example, yields a money supply multiplier of the form:

$$m_0 = \frac{1 + c_0 + t_0}{r_1 + r_1 t_0 + c_0}$$

where the subscripts 0 and 1 refer to the current and next periods respectively. We ignore the statutory definitions of reserves and the monetary base in our work.<sup>11</sup>

#### Functional and Dynamic Stability

Each of our regression equations is functionally stable at the 95% level. The test employed is the Chow

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<sup>11</sup> For a discussion of the differences for a free reserves function for the chartered banks arising from statutory and non-statutory definitions, see: David Fand, John Tower, "An Analysis of the Money Supply Process in Canada," Canadian Journal of Economics, May, 1968, pp. 381-400.

test.<sup>12</sup> The 95% level is used because it is a more stringent test of stability, although the probability of making a Type One error is greater at the 95% level than at the 99% level.

Our model contains several structural equations which include the lagged value of the dependent variable as an explanatory variable. In particular, equations 4.1, 4.2, and 4.3 are first-order difference equations while equation 4.6 is a second-order difference equation. In the first-order case, dynamic stability requires that the coefficient of the lagged dependent variable be less than unity.<sup>13</sup> In every case, the point estimate of the lag coefficient satisfies this condition. If, however, we calculate an interval including approximately two standard deviations on either side of the point estimate, for equations 4.2 and 4.3 this interval includes values greater than unity (1.07 for equation 4.2 and 1.04 for equation 4.3). These results do not distress us since the interval can be forced to exclude unity by lowering the confidence level to approximately 90%. Equation 4.6 satisfies the requirement that both roots of the complete solution must be less than unity in absolute value.

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<sup>12</sup> Gregory Chow, "Tests of Equality Between Sets of coefficients in Two Linear Regressions," Econometrica, July, 1960, pp. 591-605.

<sup>13</sup> See: W. J. Baumol, Economic Dynamics, New York, MacMillan, 1959.

## The Real Sector

Our model takes the real sector to be exogenous. Thus we have no equations which determine GNP, investment, imports, etc. Considerable work has been done on the impact of the monetary sector on real sector variables;<sup>14</sup> especially for Canada, systematic studies of the determinants of key monetary sector variables are few.

Concentration on the monetary sector to the exclusion of the real sector ignores potentially important feedback effects and is therefore a partial rather than general equilibrium approach. Although we feel that a partial equilibrium approach is capable of yielding important and useful information, it has two notable drawbacks: first, exclusion of the real sector may yield biased regression coefficients;<sup>15</sup> and, second, it renders any discussion of the behavior of the model over long periods of time somewhat artificial. Thus we feel that our partial equilibrium approach might usefully be integrated into a real sector model at some later date.

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<sup>14</sup> See, for example: Harold Shapiro, The Canadian Monetary Sector: An Econometric Analysis, unpublished doctoral dissertation, Princeton University, 1964. See also: L. H. Officer, An Econometric Model of Canada under the Fluctuating Exchange Rate, Toronto, Saunders, 1968.

<sup>15</sup> An examination of Shapiro, op. cit., and elasticities calculated in Fand, Tower, op. cit., from equations obtained from both partial and general models suggests that this does not constitute a serious problem.

## The Individual Equations

Here we give only a brief description of the structural equations of the model; a complete discussion of the theoretical arguments and empirical work leading to the final specifications is found in the next chapter, Chapter V.

### (a) Currency

The stock of currency demanded by the public is a function of current income and lagged currency. Currency is used primarily for so-called "small ticket" purchases--sundries, meals, entertainment, and is held by small businesses for petty cash. There is some evidence, primarily per-capita currency holdings, that currency is also used as a means to hold wealth, and it has been further suggested that it is used for income tax evasion. We have been unable to detect a satisfactory relationship between currency and interest rates.

### (b) Demand Deposits

The public's demand for demand deposits is a function of the short-term interest rate, current income, and lagged demand deposits. While demand deposits are assumed to be held for transactions purposes, our inclusion of Non-Personal Term and Notice deposits means that a portion of demand deposits consists of the corporate and institutional equivalent of personal savings deposits

and thus reflects short-term wealth-holding considerations. Furthermore, while the "pure" demand deposits component is primarily transactions balances, the negative interest-elasticity of demand deposits is consistent with the Baumol<sup>16</sup> and Tobin<sup>17</sup> hypotheses regarding the management of transactions balances. The positive relationship between income and demand deposits reflects, of course, the widespread practice of depositing salary and other checks for payment in a chartered bank, and the positive relationship between the demand for transactions balances and the number of transactions for which income is a useful proxy.

(c) Savings Deposits

The demand for personal savings deposits is negatively related to the long-term interest rate, and positively related to Permanent Gross National Product, the average term to maturity of the publicly-held public (national) debt, and lagged savings deposits. These

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<sup>16</sup> W. J. Baumol, "The Transactions Demand for Cash: An Inventory Theoretic Approach," Quarterly Journal of Economics, November, 1952, pp. 545-56.

<sup>17</sup> James Tobin, "The Interest-Elasticity of the Transactions Demand for Cash," Review of Economics and Statistics, August, 1956, pp. 241-47.

results indicate the predominance of wealth-holding motives in the demand for savings deposits although the Permanent Income variable undoubtedly captures the influence of transactions motives as well. Some role for transactions motives is not unexpected when we consider that some individuals use savings accounts in precisely the same manner as demand balances. Two interpretations of the average term to maturity variable are possible: it can be viewed as some kind of expectations variable; or it can be viewed as a liquidity index. The former interpretation is not entirely reliable since it can yield either a negative or positive relationship between savings deposits and the term to maturity variable. We therefore employ the second interpretation: an increase in the term to maturity of the public debt represents a general decline in liquidity which some investors will attempt to offset by a movement towards monetary assets, particularly interest-bearing monetary assets.

(d) Canadian Dollar Deposit Liabilities

Equation 4.4 expresses the supply of total Canadian Dollar Deposit Liabilities of the chartered banks as a function of total reserves, Bank Rate, and the prime lending rate. In each case we obtain the expected sign.

The supply of total deposits is clearly dominated by the level of reserves for which the regression coefficient is slightly greater than the reciprocal of the legal reserve ratio (12.50). A much smaller but significant role exists, however, for considerations of both the cost and yield on borrowed reserves ( $i^{BR}$  and  $i^P$ ). It is not necessary that we interpret the Discount Rate as the cost of borrowed reserves, however. Rather, given the lack of variability in the rate and the reluctance of the banks to borrow reserves, we can more compellingly interpret it as an indicator of the desired direction of monetary policy. The negative and significant intercept terms suggest the existence of some excess reserves (on a non-statutory basis) in the Canadian banking system.

(e) The Supply of Reserves

The reserves supply function (equation 4.5) contains variables which can be interpreted as the objectives of, and guides to, monetary policy. In particular, the price level and unemployment terms represent domestic policy considerations while the balance-of-payments term represents the influence of external balance considerations. The income term in our reserves supply equation is basically a "needs of trade" variable.

The statistical failure of the price level term reflects the well-documented "trade-off" between price level changes and unemployment in the Canadian economy<sup>18</sup> and the multicollinearity to which it gives rise. The mechanism by which changes in the current account deficit affect bank reserves differs between the first and second parts of the period: during the Coyne era, characterized by a flexible exchange rate, the Governor's statements suggest that the central bank undertook to reduce imports and the current account deficit by a "tight money policy;" during the second period, characterized by a fixed exchange rate, a rise in the current account deficit led to a reduction in reserves and a rise in the short term interest rate in order to increase short-term capital inflows. The lags employed in equation 4.5 are the result of experimentation and reference to the Johnson-Winder<sup>19</sup> study of lags in the effects of monetary policy in Canada.

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<sup>18</sup> G. L. Reuber, "The Objectives of Canadian Monetary Policy, 1949-61: Empirical Trade-Offs and the Reaction Function of the Authorities," Journal of Political Economy, April, 1964, pp. 109-132.

<sup>19</sup> H. G. Johnson, J.W.L. Winder, "Lags in the Effects of Monetary Policy in Canada," a study prepared for the Royal Commission on Banking and Finance, 1962.



(f) Term Structure of Interest Rates

Equation 4.6 is a simple hypothesis regarding the relationship between the long-term and short-term interest rates and the maturity structure of the public debt. More sophisticated hypotheses, involving various expectations variables as well as direct measures of stocks of government securities of varying maturities were tested, but unsuccessfully.

The role played by the lagged values of the dependent variable suggests that investors tend to extrapolate past behavior of the rate into the future. Any lengthening of the term to maturity of the public debt (be it the substitution of three year for two year, or twenty year for fifteen year securities) tends to raise the long-term rate. The strong role played by the term to maturity variable suggests that a "market segmentation" hypothesis regarding the term structure of interest rates is inappropriate for Canada. The steady-state coefficient for the short-term interest rate is 0.603, consistent with both a simple expectations hypothesis of the term structure and the hypothesis that the long-term rate is an average of expected short-term rates plus a risk or liquidity premium.

Dynamic Properties of the Model

Equations 4.1, 4.2 and 4.3 employ Koyck-type lags

and suggest that the process of adjustment to equilibrium is very long. While our results are consistent with those of Goldfeld,<sup>20</sup> they imply much longer adjustment processes than those detected by Shapiro and Miles.<sup>21</sup> We have experimented with second-order difference equations with very limited success. The steady-state solutions for equations 4.1, 4.2, 4.3, and 4.6 are:

$$4.16 \quad C^D = 0.0367Y + 128.3S_1 + 686.3S_2 + 637.5S_3 + 584.1S_4$$

$$4.17 \quad D^D = -995.8i^S + 0.273Y + 3231.0S_1 + 29.5S_2 - 1780S_3 \\ - 260.0S_4$$

$$4.18 \quad T^D = -1721i^L + 0.292YP + 395.2A + 885.0S_1 + 2477.0S_2 \\ + 1555.0S_3 + 23.25S_4$$

$$4.19 \quad i^L = 0.6031i^S + 0.22A + 0.57$$

The proportion of adjustment to steady-state equilibrium is given in the following table:

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<sup>20</sup> S. M. Goldfeld, op. cit., p. 133

<sup>21</sup> Harold Shapiro, Peter Miles, Demand for Money, unpublished paper, 1966.

TABLE IV  
 PROPORTION OF ADJUSTMENT TO  
 STEADY-STATE EQUILIBRIUM

<u>Quarter</u>	<u>Currency</u>	<u>Demand Deposits</u>	<u>Savings Deposits</u>
1	12.0%	9.0%	8.0%
2	22.6	17.2	15.4
3	33.6	24.7	22.2
4	43.2	31.5	28.4
5	51.8	37.7	34.1
6	59.1	43.3	39.3
7	65.6	48.4	44.1
8	71.3	53.0	48.5
9	76.3	57.2	52.5

As the above table demonstrates, our structural equations imply very long adjustment processes; in the case of savings deposits, nine quarters is required to attain fifty percent of the steady-state value.

We can obtain further information on the dynamic properties of our model by subjecting the model to a change in an exogenous variable and observing the behavior of all the endogenous variables over a number of periods. The following table shows the impact, over ten quarters, of a unit change in Gross National Product on the endogenous variables of the model:<sup>22</sup>

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<sup>22</sup> The technique employed to obtain these results is described in: Arthur S. Goldberger, Impact Multipliers and Dynamic Properties of the Klein-Goldberger Model, Amsterdam, North-Holland, 1959.

TABLE V

## DYNAMIC BEHAVIOR OF ENDOGENOUS VARIABLES

Effect of Y on:	Number of Quarters Elapsed					
	1	2	4	6	8	10
C	.0041	.0077	.0136	.0182	.0218	.0246
D	.0023	.2281	.1971	.1902	.1937	.2006
T	-.0023	.0548	.0858	.0926	.0892	.0822
CDDL	.0000	.2829	.2829	.2829	.2829	.2829
R	.0000	.0219	.0219	.0219	.0219	.0219
$i^S$	.00024	-.0022	.00021	.00009	.00005	.00003
$i^L$	.00004	-.00038	-.00011	-.00003	-.000007	.000004
M	.0041	.2906	.2966	.3012	.3048	.3075

As Table V indicates, the model is dynamically stable, although changes in the endogenous variables are very gradual. In the first quarter, the impact of a unit increase in income is a currency effect exclusively. In successive quarters, however, reserves rise in response to the increase in income and, as a result, both demand and savings deposits rise as well. The growth of neither demand deposits nor savings deposits is monotonic: demand deposits rise, then fall, then rise again; savings deposits decline, then rise, and then decline. Both interest rates display a similar kind of behavior. The money stock rises over time, asymptotically approaching an upper limit. To

derive Table V, changes in permanent income were translated into current income terms.

### Relationship to Other Studies

We have already noted, in Chapter I, the general theoretical differences between our model and those found in other studies. Further elaboration of these differences is in order, especially with regard to assumptions about the real sector and the kinds of portfolio adjustments permitted the banking system and the public. The Goldfeld model,<sup>23</sup> for example, takes the real sector to be endogenous and introduces explicit behavioral functions for excess and borrowed reserves. Furthermore, Goldfeld assumes that the banking system adjusts the price, rather than the quantity, of bank loans. Teigen's<sup>24</sup> model takes the real sector as exogenous while assuming that the stock of time deposits and the currency ratio are constant. The Brunner-Meltzer<sup>25</sup> models take the real sector to be exogenous and assume the marginal propensities

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<sup>23</sup> Goldfeld, op. cit., p. 135.

<sup>24</sup> Ronald Teigen, "The Impact of Monetary Policy," Journal of Finance, May, 1964, pp. 295-6n.

<sup>25</sup> Karl Brunner, Allan Meltzer, "Some Further Investigations of Demand and Supply Functions for Money," Journal of Finance, May, 1964, pp. 240-83.

to hold currency and time deposits to be constant. Our model, as noted above, permits all the constituent ratios of the multiplier to vary, but takes the bank loan rate and the real sector as exogenous.

Empirically, there are differences between our study and other studies of the Canadian monetary sector. Shapiro's model does not distinguish between the public's demands for currency and demand deposits.<sup>26</sup> The Shapiro-Miles study<sup>27</sup> uses two variables which are not publicly available, the two-year theoretical Government of Canada bond rate, and the average holding period of Government of Canada securities. The Shapiro-Miles paper presents several equations for which we possess data as does Shapiro's study. We have attempted to replicate most of these equations with no success. In particular, we have been unable to detect a role for interest-rate expectations although expectations variables play a strong role in the Shapiro-Miles studies.

In the next chapter, we discuss in detail the theoretical arguments and empirical work leading to the final specifications of the structural equations of our model. The reader may omit Chapter V and move on to

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<sup>26</sup> Harold Shapiro, op. cit., p. 17.

<sup>27</sup> Harold Shapiro, Peter Miles, op. cit., appendix 111, IV.

Chapter VI in which we rejoin the analysis of the sources of change in the money supply multiplier.

CHAPTER V  
SPECIFICATION AND ESTIMATION OF  
THE STRUCTURAL EQUATIONS

In this chapter, we present the theoretical arguments and estimation leading to the final specifications of the structural equations of the model presented in Chapter IV.

The Demand for Currency

Our model assumes the demand for currency to be accommodated by the banking system and, ultimately, the central bank. We thus do not estimate a supply function for currency.

Over time, many factors affect the demand for currency: familiarity of the population with banks and banking, changing rural-urban distribution of the population, changing age distribution of the population, the use of credit cards, the advent of coin-operated vending machines, charge accounts, and a lengthening of the average payment period. Most of the above factors can be expected to have a gradual effect on the demand for currency and will, therefore, be of small interest and importance for a short-run study such as ours. The



interested reader is referred to Cagan<sup>1</sup> and Kaufman<sup>2</sup> for studies of the long-run determinants of the demand for currency, including cultural and demographic factors in the United States.

While our initial supposition is that currency is held almost exclusively to finance current transactions, the fact that average per capita currency holdings in Canada in 1965 were \$100. suggests that Canadians hold currency for reasons other than transactions.<sup>3</sup> In general, these "other" reasons can conveniently be labelled as "wealth-holding" reasons. The motivations for holding wealth as currency probably range from a fear of banks to a desire to evade income taxes. In any case, we can classify the motives for holding currency as transactions and wealth holding.

We expect the primary determinant of the transactions demand for currency to be income and further expect the two to be positively related. The basis for

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<sup>1</sup> Phillip Cagan, Determinants and Effects of Changes in the Stock of Money, 1875-1960, Princeton, Princeton University Press, 1965.

<sup>2</sup> George G. Kaufman, The Demand for Currency, Board of Governors of the Federal Reserve System, 1966.

<sup>3</sup> This figure is probably inflated since an undetermined amount of currency is presumed to be lost.

this supposition is, of course, that currency demand is positively related to consumption spending which, in turn, is a positive function of income.<sup>4</sup> While this analysis implies a positive relationship between currency and current income, it is possible that there exists a lag in the consumption function which would imply that currency be positively related to lagged income rather than current income. Alternatively, we can argue that currency is positively related to current income but adjusts slowly to changes in current income.

It is tempting to argue, following Baumol,<sup>5</sup> and Tobin,<sup>6</sup> that the demand for currency, albeit primarily a transactions demand, should respond to interest-rate changes as well as to income. While the Baumol-Tobin hypotheses cannot be faulted on theoretical grounds, we suggest that their application to the demand for currency

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<sup>4</sup> The positive relationship between currency and income may not always hold since, as Ackley notes, over periods as short as a quarter, the relationship between consumption and income may be erratic. See: Gardner Ackley, Macroeconomic Theory, New York, MacMillan, 1961, pp. 252-55.

<sup>5</sup> W. J. Baumol, "The Transactions Demand for Cash: An Inventory Theoretic Approach," Quarterly Journal of Economics, November, 1952, pp. 545-56.

<sup>6</sup> James Tobin, "The Interest-Elasticity of the Transactions Demand for Cash," Review of Economics and Statistics, August, 1956, pp. 241-47. Both Baumol and Tobin postulate a negative relationship between the interest rate and the demand for cash.

is inappropriate on empirical grounds: for those corporations whose treasurers can be expected to alter cash holdings in response to interest-rate changes, the term "cash" more often than not refers to highly liquid assets, primarily demand balances, rather than currency.

For those individuals who hold wealth as currency for reasons other than tax evasion or fear of financial institutions, the logical alternative to currency holdings is probably savings deposits at the chartered banks or other intermediaries.<sup>7</sup> In this instance, we expect a negative relationship between currency demand and appropriate opportunity cost variables such as the personal savings deposit rate or the long-term bond rate.

We therefore expect currency to be positively related to income, possibly with a lag, and negatively related to interest rates.

Before estimating currency demand relations containing income and interest-rate terms, we tested a common proposition, namely that the stock of currency held by the public varies in some stable way with changes in the

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<sup>7</sup> If yield considerations are unimportant, as well they might be for individuals who hold wealth as currency, then demand deposits may be as satisfactory an alternative as savings deposits.

demand deposits.<sup>8</sup> While we found the current stock of currency to be positively related to either current or lagged demand deposits, in no case was the estimating equation functionally stable over the period 1955-65. We therefore reject this proposition (see equation 1, Appendix A).

We tested well over one hundred different hypotheses concerning the relationship between currency and income and interest rates. The best equations to emerge are given below:

$$\begin{aligned}
 5.1 \quad C_t = & -13.521 \frac{L}{t} + 0.0022Y_t + 0.75A_t + 0.98C_{t-1} \\
 & (2.60) \quad (1.15) \quad (0.59) \quad (13.2) \\
 & - 38.0S_1 + 40.3S_2 + 43.1S_3 + 24.7S_4 \\
 & (0.8) \quad (1.1) \quad (1.5) \quad (0.6)
 \end{aligned}$$

$$R^2 = 0.9980$$

$$D.W. = 1.89$$

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<sup>8</sup> This proposition appears, for example, in: Ronald Teigen, "Demand and Supply Functions for Money in the United States: Some Structural Estimates," Econometrica, October, 1964, pp. 476-509.

$$\begin{aligned}
 5.2 \quad C_t &= 0.0041Y_t + 0.88C_{t-1} + 15.4S_1 + 82.0S_2 \\
 &\quad (3.62) \quad (22.12) \quad (0.5) \quad (3.19) \\
 &\quad + 76.5 S_3 + 70.1S_4 \\
 &\quad (3.5) \quad (2.58)
 \end{aligned}$$

$$R^2 = 0.9980$$

$$D.W. = 1.55$$

$$\begin{aligned}
 5.3 \quad C_t &= 0.0037YP_t + 0.80C_{t-1} + 43.2S_1 + 117.7S_2 \\
 &\quad (3.52) \quad (12.63) \quad (1.09) \quad (3.31) \\
 &\quad + 131.0S_3 + 110.7S_4 \\
 &\quad (3.62) \quad (2.89)
 \end{aligned}$$

$$R^2 = 0.9980$$

$$D.W. = 1.31$$

The failure of  $Y_t$  and  $A_t$  in equation 5.1 led us to reject it. Equations 5.2 and 5.3 suggest some lag in the adjustment of currency to income. Of the two, we prefer 5.2 simply because it incorporates current income.<sup>9</sup>

### The Demand for Savings Deposits

Like currency, our model assumes the stock of

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<sup>9</sup> We tested for the influence of coin by regressing total currency minus coin on income. The results were almost identical to those of equation 5.2.

savings deposits to be demand-determined.

While savings deposits are an interest-bearing, riskless<sup>10</sup> monetary asset and thus an ideal form in which to hold wealth, many individuals use such balances for transactions purposes. We must consider the demand for savings deposits to be influenced, therefore, by both transactions and wealth-holding motives.

Because we consider savings deposits to be primarily used to hold wealth, we expect the demand for such deposits to be positively related to non-human wealth. Since it is difficult to obtain reliable estimates of non-human wealth, the influence of wealth on savings deposits must be tested by use of a proxy. Following Friedman, we use Permanent Gross National Product (YP) to this end.<sup>11</sup> The permanent income variable should, of course, capture some of the influence of transactions factors as well.

The rate of return on savings deposits,  $i$ , of course, the savings deposit interest rate ( $i^{PS}$ ). We expect a positive relationship between  $i^{PS}$  and the demand for savings deposits. In addition to the rate of return on such deposits, we expect the demand for savings deposits to

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<sup>10</sup> Riskless in the sense that there is no fear of default.

<sup>11</sup> Milton Friedman, "The Demand for Money: Some Theoretical and Empirical Results," Journal of Political Economy, August, 1959, pp. 327-51.

be negatively related to appropriate opportunity cost variables such as the long-term interest rate.

Shapiro and Miles<sup>12</sup> have found the demand for personal savings deposits to be strongly influenced by investors' expectations about the future behavior of the long-term interest rate. In particular, they achieved excellent results with both a "normal rate" variable and an "extrapolative expectations" variable. The use of these variables is plausible to the extent that there exist wealthy holders of personal savings deposits who are accustomed to altering the composition of their portfolios fairly frequently.

Following Shapiro and Miles, we have also experimented with the hypothesis that the demand for savings deposits is related (positively) to the average term to maturity of the public debt.<sup>13</sup> The term to maturity variable can be interpreted as either an expectations variable or as a liquidity index. The former interpretation is unreliable since it can yield either a negative or positive relationship between savings deposits and the term to maturity variable: if investors have some concept of a "normal" rate, an increase in the term of

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<sup>12</sup> Harold Shapiro, Peter Miles, Demand for Money, unpublished paper, 1966, p. 17

<sup>13</sup> Ibid.

the debt and the associated rise in interest rates may convince them that rates will soon fall. In this case, they will switch from bank deposits to bonds. If investors extrapolate current interest rate movements into the future, they will switch from bonds to bank deposits. We prefer the second interpretation: an increase in the term of the debt represents a general decline in liquidity which some investors will attempt to offset by a movement to monetary assets, particularly interest-bearing monetary assets.

Finally, it is possible that, given a lag in the consumption function or a long-term proportional consumption function, the demand for savings deposits may be positively related to "transitory" income: until a rise in current income establishes itself as permanent, individuals may add to their savings rather than to their consumption expenditures. This hypothesis can be tested by using the difference between current and permanent income as a measure of transitory income.

Of all the formulations of the demand for savings deposits tested, only the following equation emerged as acceptable:



$$5.4 \quad T_t = -107.51 \frac{L}{t} + 0.0269 YP_t + 28.8 A_t + 0.89 T_{t-1}$$

(4.76)      (2.79)      (5.20)      (14.6)

$$+49.5 S_1 + 170.4 S_2 + 104.7 S_3 - 16.9 S_4$$

(0.8)      (2.7)      (1.6)      (0.3)

$$R^2 = 0.9980$$

$$D.W. = 1.71$$

We achieved no success with a number of interest-rate expectations variables nor with the personal savings deposit interest rate. Transitory income was substituted for YP in equation 5.4 and was statistically significant until the application of a Durbin procedure to the time series. On the basis of our experiments, we conclude that the demand for personal savings deposits is a positive function of permanent income, the average term to maturity of the public debt, and lagged savings deposits, and a negative function of the long-term interest rate. Sample equations are found in Appendix A (equations 4 and 5).

#### The Demand for Demand Deposits

While some individuals hold wealth in the form of demand deposits, in general such deposits are held as transactions balances by individuals, businesses and institutions. The wide-spread practice of payment by

check means that many individuals and firms hold demand deposits to bridge the gap between non-synchronous payments and receipts. We expect these deposits to be strongly affected by income. Because corporations and large institutions hold demand balances, we suggest that the Baumol<sup>14</sup> and Tobin<sup>15</sup> hypotheses are relevant to the demand for demand deposits. In this case, we expect a negative relationship between demand deposits and interest rates. Our definition of demand deposits includes Non-Personal Term and Notice deposits which can be considered the corporate and institutional equivalent of personal savings deposits. This causes us to further expect a relationship between the demand for demand deposits and yield considerations. Finally, since a considerable proportion of demand deposits is assumed to be acquired through the sale of earning assets, primarily the promises-to-pay of individuals and businesses, to the banking system, we expect demand deposits to be negatively related to the cost of bank loans.

To test the influence of transactions factors on the demand for demand deposits, we included Gross

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<sup>14</sup> Baumol, op. cit.

<sup>15</sup> Tobin, op. cit.

National Product in current dollars in our regression equations. The role of yield or interest-rate considerations was tested by the use of the 91-day Treasury Bill rate, the average yield on government securities maturing in three or less years, the average yield on government securities maturing in ten or more years, the Non-Personal Term and Notice rate, and the Swap Deposits rate. The cost of bank loans was measured by the chartered bank prime lending rate.

Before presenting our results, we should note that we expect demand deposits to be more strongly affected by short-term than long-term interest rates. The reasons for this are as follows: first, the behavior implied by the Baumol-Tobin hypotheses must be characterized as short-run in that the alternative to corporate demand deposits is short-term assets which can be converted to money quickly at little risk of capital loss; and second, Non-Personal Term and Notice deposits are primarily short-term instruments the substitutes for which will also be of short term to maturity. We include the long-term interest rate in our regressions because Shapiro and Miles <sup>16</sup> report success with an expectations variable incorporating a five-year interest rate term. Our best

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<sup>16</sup> Shapiro and Miles, op. cit.

regression equations are given below:

$$5.5 \quad D_t^D = -91.271 \frac{S}{t} + 0.0206 Y_t + 0.94 D_{t-1} - 294.8 S_1$$

$$(4.54) \quad (2.23) \quad (12.47) \quad (2.20)$$

$$+ 25.04 S_2 - 124.1 S_3 - 11.04 S_4$$

$$(0.23) \quad (1.18) \quad (0.09)$$

$$R^2 = 0.9860$$

$$D.W. = 1.50$$

$$5.6 \quad D_t^D = -131.11 \frac{L}{t} + 0.0323 Y_t + 0.87 D_{t-1} - 65.57 S_1$$

$$(2.71) \quad (2.33) \quad (8.78) \quad (0.29)$$

$$+ 217.6 S_2 + 19.8 S_3 + 167.8 S_4$$

$$(1.27) \quad (0.13) \quad (0.91)$$

$$R^2 = 0.9820$$

$$D.W. = 1.21$$

$$5.7 \quad D_t^D = -252.11 \frac{P}{t} + 0.0441 Y_t + 0.77 D_{t-1} + 846.0 S_1$$

$$(2.51) \quad (2.43) \quad (5.86) \quad (1.49)$$

$$+ 1076.0 S_2 + 843.3 S_3 + 1042.0 S_4$$

$$(2.19) \quad (1.89) \quad (2.05)$$

$$R^2 = 0.9820$$

$$D.W. = 1.20$$

where  $i^P$  is the chartered bank prime lending rate. Other equations are found in Appendix A.

Of equations 5.5, 5.6, and 5.7 we prefer equation 5.5 on the grounds that it conforms to our expectations about the relative performance of the interest rate terms in addition to exhibiting the best goodness of fit as measured by  $R^2$  and the Durbin-Watson statistic.

We conclude, therefore, that the demand for demand deposits is a positive function of current income and lagged demand deposits, and a negative function of the short-term interest rate.

#### The Supply of Canadian Dollar Deposit Liabilities

Total Canadian Dollar Deposit Liabilities consist of all chartered bank deposits including those of the Government of Canada, provincial and municipal governments, institutions, businesses, and individuals.

Chartered bank deposits come into existence whenever the banking system acquires additional assets; the banking system is able to expand its assets and liabilities whenever it obtains new reserves, either from a currency inflow or as a result of central bank action. Regardless of how additional reserves are acquired, deposit expansion will occur only if the banks decide to use their new reserves to purchase earning

assets rather than hold them as excess reserves.<sup>17</sup> Because excess reserves yield no explicit interest income, it would appear that almost any interest-bearing asset would be a desirable alternative to excess reserves. This, however, is too simple an analysis: the chartered banks do hold excess reserves periodically on a non-statutory basis, and sound reasons for this exist. While the explicit return on excess reserves is zero, excess reserves will have an implicit return or utility for both the individual bank and the system. First, the existence of some excess reserves reduces the possibility of being unable, either through miscalculation or some unusually large cash outflow, to comply with legal reserve requirements and being forced to obtain reserves from the central bank or the money market at some explicit cost. Second, the banks may hold excess reserves if they expect a rise in interest rates and a concomitant decline in security prices.<sup>18</sup> A third

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<sup>17</sup> Because our model is not formulated on a statutory basis, the term "excess reserves" lacks operational precision. On a statutory basis, any reserves greater than 8% of statutory deposit liabilities are excess reserves; on a non-statutory basis, excess reserves can be interpreted as reserves in excess of some unspecified desired level of reserves, given the level of deposit liabilities.

<sup>18</sup> For a fuller discussion of interest-rate expectations and bank behavior, see: David and Charlotte Alhadeff, "An Integrated Model for Commercial Banks," Journal of Finance, March, 1957, pp. 24-42.

consideration, related to the second, is the absence of a satisfactory loan demand. Both these last two cases are the analytical equivalent of the Keynesian speculative demand for money.

Given that excess reserves yield an implicit return, it follows that the banking system will reduce its holdings of excess reserves in favour of other assets only if the return on such assets exceeds the implicit return on excess reserves. As the banks acquire earning assets and reduce excess reserves, the marginal utility of excess reserves rises and, therefore, the yield on earning assets must rise as well. This produces, of course, an upward sloping supply function for bank deposits.

At any point in time, given the desired ratio of reserves to deposits, the total volume of deposits that the banking system can create is constrained by total reserves; thus, the supply function for total Canadian Dollar Deposit Liabilities must include total reserves as an argument. Because our data are on a quarterly, non-statutory basis, we cannot argue that the relationship between total reserves and total deposits has an upper limit defined by the reciprocal of the legal reserve ratio. On a quarterly, non-statutory basis, it is possible for the deposit expansion coefficient to exceed the reciprocal of the legal reserve ratio.

As a measure of the opportunity cost of excess reserves and the return on earning assets, we include the chartered bank prime lending rate in our supply equation: at any point in time, general loans to individuals and businesses constitute roughly half the banking system's total assets and something more than half of total earning assets. The prime lending rate is not a perfect measure of the return on bank loans: in fact, the prime rate is but one of a number of loan rates and applies to only a few large and extremely credit-worthy borrowers. The ability of the banks to alter loan rates by imposing side conditions on loans further complicates the picture.<sup>19</sup> It appears, however, that movements of the prime rate are coincident with movements in other bank lending rates.

We include the Official Discount Rate (Bank Rate) in our supply equation. Two interpretations of the role of this variable are possible: it can be considered an indicator of the cost to the banks of borrowed reserves; or it can be considered an indicator of the desired direction of monetary policy. Given the infrequency and small

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<sup>19</sup> Such as compensating balances, shorter repayment period, or chattel mortgages.



magnitude of borrowed reserves in the Canadian banking system, we prefer the latter interpretation.

On the basis of the foregoing, we expect the supply of total Canadian Dollar Deposit liabilities to be positively related to total reserves and the prime rate, and negatively related to Bank Rate. Our regression estimate of the supply function is:

$$5.8 \quad CDDL_t^S = 129.41_t^P - 87.611_t^{BR} + 12.93R_t - 975.8S_1$$

$$(2.05) \quad (3.85) \quad (112.3) \quad (3.7)$$

$$- 1076.0S_2 - 1142.0S_3 - 1009.0S_4$$

$$(4.1) \quad (4.3) \quad (3.8)$$

$$R^2 = 0.9801$$

$$D.W. = 2.14$$

Because equation 5.8 indicates a very high deposit expansion coefficient, we attempted to confirm its magnitude by regressing demand deposits only on an estimate of reserves held against demand deposits;<sup>20</sup> second, we regressed demand and savings deposits against total reserves minus reserves held against government deposits:

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<sup>20</sup> The estimate of reserves held against demand deposits is obtained by subtracting from total reserves eight percent of savings and government deposits.

$$\begin{aligned}
 5.9 \quad D_t^S &= 13.40R_t^{DD} - 690.0S_1 - 576.0S_2 - 521.0S_3 \\
 &\quad (46.7) \quad (5.1) \quad (4.3) \quad (4.2) \\
 &\quad - 623.0S_4 \\
 &\quad (4.8) \\
 R^2 &= 0.9800 \\
 D.W. &= 1.57
 \end{aligned}$$

$$\begin{aligned}
 5.10 \quad (D+T)_t &= 12.93R_t^{D+T} - 625.0S_1 - 582.0S_2 - 676.0S_3 \\
 &\quad (114.0) \quad (5.1) \quad (4.9) \quad (5.6) \\
 &\quad - 742.0S_4 \\
 &\quad (6.1) \\
 R^2 &= 0.9965 \\
 D.W. &= 1.63
 \end{aligned}$$

Equations 5.9 and 5.10 confirm the high deposit expansion coefficient of equation 5.8 which embodies both yield considerations and the influence of Bank Rate.

#### The Supply of Chartered Bank Reserves

The arguments of a reserves supply equation can be considered the objectives of, and the guides to, monetary policy. Canadians are in general agreement on the objectives of economic policy: broadly put, these are price stability, full employment of resources (particularly labour), external balance, and economic growth. For a

quarterly study such as ours, the goal of satisfactory economic growth is of little importance. Achievement of the economic growth objective, of course, presumes the achievement of the other objectives of economic policy.

While policymakers may agree on goals and possess the means to achieve one particular goal at a point of time, two points must be stressed: first, the authorities should match goals and policy instruments; and second, simultaneous attainment of our economic objectives may not be possible. For a discussion of the first point, the reader is referred to Mundell.<sup>21</sup> The second problem arises because policy objectives tend to be conflicting.

Much work has been done on the existence and magnitude of conflicts amongst policy objectives; most of it has been concentrated upon conflicts between full employment and price stability. Studies by Klein and Bodkin<sup>22</sup> and Reuber<sup>23</sup> suggest that, for the U. S. and Canada

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<sup>21</sup> Robert A. Mundell, "The Appropriate Use of Monetary and Fiscal Policy for Internal and External Equilibrium," IMF Staff Papers, March, 1962, pp. 70-79.

<sup>22</sup> L. R. Klein and R. G. Bodkin, "Empirical Aspects of the Trade-Offs among Three Goals: High Level Employment, Price Stability, and Economic Growth," Commission on Money and Credit. Inflation, Growth and Employment, Englewood Cliffs, Prentice-Hall, 1964.

<sup>23</sup> G. L. Reuber, "The Objectives of Canadian Monetary Policy, 1949-1961: Empirical Trade-Offs and the Reaction Function of the Authorities," Journal of Political Economy, April, 1964.

respectively, Phillips'<sup>24</sup> hypothesis that price stability is gained only at the cost of some unemployment is applicable. Reuber, for example, suggests that, with constant international prices, the Canadian economy can achieve price stability at the cost of 5% of the labour force unemployed.<sup>25</sup>

The observation that policy goals are sometimes in conflict raises problems for the estimation of a reserves supply equation. First, regression analysis assumes independence amongst explanatory variables yet it is unreasonable to assume that policy goals are pursued independently of one another. The degree or extent of unemployment, for example, may affect the extent of price level changes acceptable to the authorities. Second, the interdependence of policy objectives raises doubts about the applicability of the Chow test of functional stability.<sup>26</sup>

The central bank is presumed to alter the stock of reserves for two reasons: first, the attainment of

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<sup>24</sup> A. W. Phillips, "The Relation between Unemployment and the Rate of Change of Money Wages in the United Kingdom, 1861-1957," Economica, November, 1958, pp. 283-99.

<sup>25</sup> Reuber, op. cit., p. 109

<sup>26</sup> Both these points are raised in: Harold Shapiro, The Canadian Monetary Sector: An Econometric Analysis, unpublished doctoral dissertation, Princeton University, 1964, p. 46.

economic stability; and second, to finance a growing volume of aggregate economic activity. To represent domestic policy considerations, we use the Consumer Price Index (P), the percent of the civilian labour force unemployed (u), and the Gross National Product in current dollars (Y). The last variable can be considered a measure of the "needs of trade." To represent external balance considerations, we employ the balance of payments deficit on current account (BPD, where a deficit is treated as positive).

The use of BPD to represent external balance considerations can be criticized on the grounds that, for the first part of the period under study, Canada operated under a flexible exchange rate and was therefore free, theoretically, from external balance considerations. However, an examination of the public statements of the then incumbent Governor of the Bank of Canada, James Coyne, indicates a continuing concern over the level of imports and the current account balance.<sup>27</sup> Thus, for the first part of the period, the Governor's statements imply a link from reserves to income to imports and the current

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<sup>27</sup> For a discussion of the Governor's proposals, see: H. Scott Gordon, The Economists Versus the Bank of Canada, Toronto, The Ryerson Press, 1961, pp. 40-43.

account balance; for the second part of the period, the link is from reserves to short-term interest rates to short term capital flows.

We can therefore express a general hypothesis about the supply of reserves:<sup>28</sup>

$$R^S = R(P, u, BPD, Y)$$

More exact specification of the reserves supply function requires that we investigate lags in the response pattern of the monetary authorities to changes in policy variables--the so-called "inside lag." Using the Johnson-Winder<sup>29</sup> study of lags in Canadian monetary policy as a guide, we experimented with a variety of lags and forms of our explanatory variables. The best equation to emerge from our experiments is the following:

$$5.11 \quad R_t^S = 2.97\Delta P_{t-2} + 14.18u_{t-1} - 0.287BPD_{t-3} \\ (0.3) \quad (4.57) \quad (6.67) \\ + 0.0219Y_{t-1} + 224.5 \\ (25.3) \quad (4.8)$$

$$R^2 = 0.9525$$

$$D.W. = 2.15$$

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<sup>28</sup> Our reserves hypothesis is similar to that found in Shapiro, op. cit.

<sup>29</sup> H. G. Johnson, J.W.L. Winder, "Lags in the Effects of Monetary Policy in Canada," a study for the Royal Commission on Banking and Finance, Ottawa, Queen's Printer, November, 1962.

Omitting the price level term from equation 5.11 yields:

$$5.12 \quad R_t^S = 14.37u_{t-1} - 0.284BPD_{t-3} + 0.0219Y_{t-1} + 223.3$$

(4.78)            (6.81)            (25.89)            (4.85)

$$R^2 = 0.9520$$

$$D.W. = 2.12$$

The statistical failure of the price level term is attributable to both multicollinearity and the reduced importance of price level considerations during most of the period.<sup>30</sup>

Other variables with which we experimented include deviations of P and u from various "target" levels, international interest rates and differentials, and a variety of dummy variables designed to capture the effects of the change from a flexible to a fixed exchange rate. These experiments were uniformly unsuccessful.

Of equations 5.11 and 5.12, we prefer 5.11 on the grounds that, while the price level term is both statistically insignificant and of the wrong sign, it should be included in any reserves supply function; we expect that estimation over a longer period would reveal a role for the price level variable.

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<sup>30</sup> In only two of the eleven years from 1955-65 did the Consumer Price Index rise by three or more points; in six of the eleven years, it rose between two and three points. For six years (1958-63), the average annual unemployment rate exceeded five percent.

## The Term Structure of Interest Rates

The relationship between or among the yields on securities of different maturities is referred to as the term structure of interest rates. In this section, we are primarily concerned with developing a simple, viable functional relationship explaining the behavior of the long-term rate of interest.

Theories of the term structure of interest rates can be broadly grouped as follows: first, the simple and traditional expectations theory; second, the Hicksian-Keynesian liquidity premium theory; and third, a host of theories stressing institutional arrangements, market imperfections, and investor fallibility.<sup>31</sup>

The simple expectations model argues that the long-term interest rate should be viewed as the average of expected future short-term interest rates. As a result, if short-term rates are expected to rise, long rates must be above short rates and vice versa for an expected decline in short-term rates. The type of market assumed by the simple expectations theory is characterized by perfect arbitraging, no transactions or brokerage costs,

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<sup>31</sup> For an exposition of the various theories of the term structure plus a review of the literature, see: Burton Malkiel, The Term Structure of Interest Rates, Princeton, The University Press, 1966.



confident and accurate expectations about all future short-term rates, and entirely riskless securities. The restrictive nature of these assumptions is evident and has prompted much criticism of the theory.

Building upon the assumption that the securities preferences of borrowers and lenders differ and, further, that both lenders and speculators are risk averters, the Hicksian-Keynesian liquidity premium theory of the term structure argues that the long-term rate is an average of expected short-term rates plus a risk or liquidity premium. The liquidity premium is paid to the lender to compensate him for the risks of price fluctuations associated with long-term securities.

Finally, in opposition to both the simple expectations theory and the liquidity premium theory, we have those theories (or perhaps better, those theorists) which contend that, given imperfect foresight, risk aversion and hedging, and institutional borrowers and lenders with preferences for securities of particular maturities, the shape and position of the yield curve is not prone to any simplistic explanation. If any reasonably simple hypothesis is possible, it is that relative supplies of securities of different maturities coupled with the maturity preferences of financial institutions determine the term structure.

It is not our intention to referee the contest among competing theories of the term structure of interest rates. We have experimented with a number of specifications expressing the long-term interest rate as a function of short-term rates, the maturity composition of the public debt, and simple interest rate expectations variables. The best equation we obtained is:

$$5.13 \quad i_t^L = 0.174i_t^S + 0.064A_t + 0.488i_{t-1}^L + 0.206i_{t-2}^L + 0.238$$

(6.09)      (4.97)      (3.50)      (1.72)      (1.51)

$$R^2 = 0.9409$$

$$D.W. = 1.76$$

As we noted in Chapter IV,<sup>32</sup> equation 5.13, when solved for the steady-state equilibrium equation, is consistent with both the expectations and liquidity premium theories of the term structure. Equation 5.13 provides weak grounds for rejecting the market segmentation theory of the term structure (see equation 8 in the Appendix).

In the next chapter, we rejoin our discussion of the sources of change in the money supply multiplier.

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<sup>32</sup>Differences between regression coefficients reported in Chapters IV and V occur because the former are OLS estimates while the latter are TSLS estimates.

## APPENDIX A

## SOME ADDITIONAL EQUATIONS

$$(1) \quad C_t = 0.231D_t + 607.2S_1 + 585.5S_2 + 607.5S_3 + 507.0S_4$$

$$(17.3) \quad (8.6) \quad (8.1) \quad (8.2) \quad (7.9)$$

$$R^2 = 0.8640$$

$$D.W. = 0.15$$

$$(2) \quad C_t - N_t = 0.0032Y_t + 0.88(C-N)_{t-1} + 293.S_1 + 94.4S_2$$

$$(3.72) \quad (25.37) \quad (0.99) \quad (3.74)$$

$$+ 96.2S_3 + 84.4S_4$$

$$(4.24) \quad (3.17)$$

$$R^2 = 0.9960$$

$$D.W. = 1.47$$

$$(3) \quad C_t = 0.033YPD_t + 0.86C_{t-1} - 19.0S_1 + 54.5S_2$$

$$(2.15) \quad (12.17) \quad (0.7) \quad (2.29)$$

$$+ 69.2S_3 + 47.0S_4$$

$$(2.85) \quad (1.75)$$

$$R^2 = 0.9860$$

$$D.W. = 1.13$$

$$(4) \quad T_t = -12.011 \frac{N}{t} + 0.0159 Y_t + 0.92 T_{t-1} + 55.5 S_1$$

$$\quad \quad \quad (0.23) \quad (1.85) \quad (17.0) \quad (0.4)$$

$$\quad \quad \quad + 133.7 S_2 + 3.01 S_3 + 58.3 S_4$$

$$\quad \quad \quad (1.3) \quad (0.00) \quad (0.54)$$

$$R^2 = .8470$$

$$D.W. = 0.95$$

$$(5) \quad T_t = -29.771 \frac{PS}{t} + 0.0151 Y_t + 0.93 T_{t-1} + 113.0 S_1$$

$$\quad \quad \quad (0.4) \quad (1.77) \quad (15.9) \quad (0.9)$$

$$\quad \quad \quad + 194.3 S_2 + 72.1 S_3 + 6.11 S_4$$

$$\quad \quad \quad (1.80) \quad (0.7) \quad (0.05)$$

$$R^2 = 0.9149$$

$$D.W. = 0.97$$

$$(6) \quad D_t = -79.71 \frac{S}{t} + 110.8(1^{ON} - 1^{SW})_t + 0.071 Y P_t + 0.99 D_{t-1}$$

$$\quad \quad \quad (4.00) \quad (2.12) \quad (1.97) \quad (14.6)$$

$$\quad \quad \quad - 508.7 S_1 - 109.8 S_2 - 180.7 S_3 - 134.1 S_4$$

$$\quad \quad \quad (4.47) \quad (1.01) \quad (1.60) \quad (1.16)$$

$$R^2 = 0.9860$$

$$D.W. = 1.78$$

$$(7) \quad R_t^S = -8.66\Delta P_{t-2} + 2.27u_{t-1} + 0.023Y_{t-1} \\
\quad \quad \quad (0.59) \quad \quad (5.22) \quad \quad (18.2) \\
\quad \quad \quad - 12.53(i_t^{SUS} - i_t^{SCAN}) + 69.6 \\
\quad \quad \quad (0.81) \quad \quad \quad (1.1)$$

$$R^2 = 0.8836$$

$$D.W. = 1.16$$

$$(8) \quad i_t^L = 0.231i_t^S - 0.614i_t^X + 0.00015D_t^2 + 0.00017D_t^{10+} \\
\quad \quad \quad (5.73) \quad (0.77) \quad (2.88) \quad (6.00) \\
\quad \quad \quad + 3.16 \\
\quad \quad \quad (3.67)$$

$$R^2 = 0.6561$$

$$D.W. = 1.25$$

Additional Variables used in Appendix A

N	coins in circulation
YPD	disposable permanent income
$i_t^N$	normal rate expectations variable. Equals $i_t^L - (.11i_{t-1}^L + .21i_{t-2}^L + .31i_{t-3}^L + .41i_{t-4}^L)$
$i_t^{PS}$	personal savings deposit interest rate
$i_t^{ON}$	Non-Personal Term and Notice deposit interest rate
$i_t^{SW}$	swap deposit interest rate
$i_t^{SUS}$	U. S. Treasury Bill rate
$i_t^{SCAN}$	Canadian Treasury Bill rate
$i_t^X$	expectations variable. Equals $i_t^L / (\text{average of long rate in previous 4 quarters})$
$D^2$	stocks of Government of Canada securities of two

or less years maturity outstanding  
D<sup>10+</sup> stocks of Government of Canada securities of ten  
or more years maturity outstanding.

All variables, except expectations variables, obtained  
from the Bank of Canada.

## CHAPTER VI

### SOURCES OF CHANGE IN THE MONEY MULTIPLIER: II

In this chapter, we continue our discussion of the sources of change in the money multiplier. As income, interest rates, bank reserves, and the maturity composition of the public debt change, so will the constituent ratios of the multiplier and the multiplier itself change. The constituent ratios change, of course, because the public and the banking system alter their relative demands for currency, demand and savings deposits, and excess reserves. In the following sections, we examine the determinants of the constituent ratios and, hence, the multiplier.

#### Methodology: (a)

We have two sets of data upon which to base our analysis: (1) the structural equations of our model and their steady-state solutions; and (2) the reduced-form equations derived from our model. We have derived three sets of reduced-form equations. The first two sets take

reserves to be exogenous and utilize, respectively, the initial and steady-state regression coefficients of our model.<sup>1</sup> The third set incorporates reserves as an endogenous variable<sup>2</sup> and is based upon the steady-state coefficients (the reduced-form equations are collected in the Appendices). While our structural equations contain two income variables, current income and permanent income, we have translated the effects of changes in permanent income into current income terms in order to simplify and clarify the analysis.<sup>3</sup>

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<sup>1</sup> Because current income does not enter our reserves supply equation, we can consider reserves as exogenous in order to investigate the impact of a unit change in reserves on the other endogenous variables of the model. While income enters the reserves supply function in steady-state equilibrium, by continuing to treat reserves as exogenous, we can again observe the impact of reserves on the remaining endogenous variables. In all these cases, currency, which is a function of predetermined variables exclusively, is considered to be endogenous.

<sup>2</sup> Although the supply of reserves is a function of lagged income, in steady-state equilibrium, lagged and current income are considered equivalent. A change in income therefore affects not only currency and demand and savings deposits, but reserves as well.

<sup>3</sup> Permanent income is a weighted average of current and past values of Gross National Product:  $Y_P = 0.1756Y_t + 0.1580Y_{t-1} + 0.1422Y_{t-2} + 0.1280Y_{t-3} + 0.1152Y_{t-4} + 0.1038Y_{t-5} + 0.0934Y_{t-6} + 0.0838Y_{t-7}$ .

Because current income receives a weight of 0.1756 in the calculation of permanent income,  $dY_P = 0.1756dY_t$ . The expression of course holds for partial derivatives as well. In steady-state equilibrium, a unit change in permanent income is identical to a unit change in current income. Note that this weighting scheme, provided by the Bank of Canada, causes  $Y$  to always exceed  $Y_P$  in a growing economy.



We can express the impact of a unit change in an exogenous variable (X) upon for example, the currency ratio (c) as follows:

$$6.1 \quad c = C/D$$

$$6.2 \quad \log(c) = \log(C) - \log(D)$$

$$6.3 \quad d\log(c) = d\log(C) - d\log(D)$$

$$6.4 \quad \frac{d\log(c)}{d\log(X)} = \frac{d\log(C)}{d\log(X)} - \frac{d\log(D)}{d\log(X)}$$

The expression on the left-hand side of equation 6.4 is the elasticity of the currency ratio with respect to X and is denoted as  $e(c;X)$ . Equation 6.4 can thus be written as:

$$6.5 \quad e(c;X) = e(C;X) - e(D;X)$$

The values for  $e(C;X)$ ,  $e(D;X)$ , etc. can be calculated from the regression coefficients of our structural equations and from the coefficients of the reduced-form equations.<sup>4</sup> The most relevant elasticities are presented

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<sup>4</sup> In terms of derivatives,  $e(c;X) = (dC/dX)(X/C) - (dD/dX)(X/D)$ . All elasticities are calculated at mean values of the variables.

in the tables given below:<sup>5</sup>

TABLE VI  
STRUCTURAL EQUATION ELASTICITIES

<u>Elasticity</u>	<u>1sr Qtr.</u>	<u>s/s</u>	<u>Elasticity</u>	<u>1st Qtr.</u>	<u>s/s</u>
e(C;Y)	0.088	0.789	e(D;Y)	0.182	2.020
e(T;Y)	0.021	1.518	e(c;Y)	-0.094	-1.231
e(t;Y)	-0.161	-0.502	e(R;Y)	0.000	0.794
e(r;Y)	0.000	-0.929	e(D;i <sup>S</sup> )	-0.060	-0.667
e(T;i <sup>L</sup> )	-0.086	-1.084	e(c;i <sup>S</sup> )	0.060	0.667
e(t;i <sup>S</sup> )	0.060	0.667	e(t;i <sup>L</sup> )	-0.086	-1.084
e(T;A)	0.041	0.513	e(t;A)	0.041	0.513

In the above table, the labels 1st Qtr. and s/s refer to first quarter and steady-state elasticities respectively.

The elasticities calculated from the reduced-form equations are as follows:

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<sup>5</sup> The structural elasticities implicitly assume that reserves are forthcoming to support the increases in demand and savings deposits. The steady-state elasticities incorporate the influence upon the supply of reserves of changes in income.

TABLE VII

## REDUCED-FORM ELASTICITIES

<u>Elasticity</u>	<u>1st Qtr.</u>	<u>s/s (R exogenous)</u>	<u>s/s (R endogenous)</u>
e(C;Y)	0.088	0.789	0.789
e(D;Y)	0.014	-0.162	0.991
e(T;Y)	-0.101	0.114	0.769
e(R;Y)	0.000	0.000	0.794
e(c;Y)	0.074	0.951	-0.202
e(t;Y)	-0.024	0.276	-0.222
e(r;Y)	0.000	0.000	-0.066
e(D;A)	-0.033	-0.015	-0.015
e(T;A)	0.022	0.010	0.010
e(c;A)	0.033	0.015	0.015
e(t;A)	0.055	0.025	0.025
e(r;A)	0.000	0.000	0.000
e(i <sub>S</sub> ;Y)	2.640	2.757	1.430
e(i <sub>L</sub> ;Y)	0.356	1.220	0.648
e(i <sub>S</sub> ;i <sub>BR</sub> )	0.817	0.817	0.817
e(i <sub>L</sub> ;i <sub>BR</sub> )	0.110	0.021	0.021

The column "s/s(R endogenous)" embodies the impact, in steady-state equilibrium, of income upon the supply of reserves. We now turn to the analysis of the determinants of the constituent ratios, utilizing the elasticities of Tables VI and VII.

The Currency Ratio

Changes in the currency ratio occur as the public alters its relative holdings of currency and demand deposits. Although the central bank supposedly does not permit changes in the demand for currency to affect credit conditions, we have seen that changes in the currency ratio which affect the money multiplier, and, ceteris paribus,

the money stock, do occur and that these changes are exceedingly potent as a source of change in the multiplier. Turning first to the structural-equation elasticities, the determinants of the currency ratio are current income and the short-term interest rate. A unit increase in income will generate an increase in the demand for both currency and demand deposits but will yield a decline in the currency ratio since the elasticity of demand deposits with respect to income is approximately twice the elasticity of currency with respect to income (0.182 vs. 0.088). The first-quarter income elasticity of the currency ratio is, therefore, -0.094. In steady-state equilibrium, the income elasticity of the currency ratio is -1.231. Thus, a rise in income produces a decline in the currency ratio which is amplified over time. A rise in the short-term interest rate concomitant with the increase in income will damp the rise in demand deposits and the decline in the currency ratio somewhat (the first-quarter and steady-state elasticities of the currency ratio with respect to the short-term interest rate are 0.060 and 0.667 respectively).

The reduced-form elasticities yield slightly different results when reserves are treated as exogenous but similar results when reserves are endogenous. A unit increase in income yields an increase in the currency ratio

in the first quarter because, despite the positive relationship between income and both currency and demand deposits, the rise in demand deposits is attenuated by the positive relationship between income and the short-term interest rate. The cause of a rise in the currency ratio in steady-state equilibrium with reserves exogenous is a redistribution of existing bank deposits that goes against demand deposits.<sup>6</sup> When reserves respond to income, however, the net result of a unit increase in income is a decline in the currency ratio (the steady-state income elasticity of the currency ratio with reserves endogenous is -0.202).

On the basis of the structural equation elasticities, we conclude that a rise in income will yield a decline in the currency ratio which implies, of course, an increase in the money supply multiplier, ceteris paribus. The reduced-form elasticities suggest a positive relationship between the currency ratio and income when reserves are treated as exogenous but a negative relationship when reserves respond to a change in income. For the exogenous reserves cases, our elasticities indicate a negative

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<sup>6</sup> In our model, if there is no increase in reserves beyond that required to offset the currency drain, an increase in demand deposits can be accommodated only if there is a decline in savings deposits.

relationship between income and the multiplier; when reserves are endogenous, the multiplier is positively related to income. Finally, the structural equation elasticities indicate a positive relationship between the currency ratio and the short-term interest rate which implies a negative relationship between the short-term rate and the money multiplier.

A decline in the currency ratio generates a rise in the multiplier and the money stock, ceteris paribus, because it alters the distribution of total currency outstanding in favour of the banking system. The reduced-form elasticities indicate that when both currency and demand deposits rise in response to an increase in income, the multiplier will rise only if there is an increase in reserves.<sup>7</sup> Even with the complete currency offset assumed by our model, a rise in income yields a rise in the currency ratio and a decline in the multiplier. Since our studies indicate that the currency drain may not be offset entirely, our estimates of  $e(c;Y)$  are probably too low: the rise in currency and the concomitant fall in bank reserves with incomplete offsetting should mean an

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<sup>7</sup> As in the steady-state estimate of  $e(c;Y)$  for reserves endogenous.

even smaller increase in demand deposits and, consequently, a greater rise in the currency ratio. Nevertheless, on the basis of our examination of the determinants of the currency ratio, we submit that assertions to the effect that the currency drain is unimportant require re-examination and that changes in the currency ratio merit as much attention from the monetary authorities as changes in the currency drain itself.

#### The Savings Deposit Ratio

The savings deposit ratio changes as the public alters its relative holdings of demand and savings deposits. Turning first to the structural equations and elasticities, the determinants of the savings deposit ratio are income, the average term to maturity of the public debt, and the short- and long-term rates of interest.

Although both savings deposits and demand deposits rise in response to a unit increase in income, because the income elasticity of demand deposits far exceeds the income elasticity of savings deposits, both initially and in steady-state equilibrium, the income elasticity of the savings deposit ratio is negative.

A rise in the term to maturity of the public debt yields an increase in the savings deposit ratio (the

first-quarter and steady-state term to maturity elasticities of the savings deposit ratio are 0.041 and 0.513 respectively).

While the elasticity of savings deposits with respect to the long-term interest rate exceeds the elasticity of demand deposits with respect to the short-term rate, the impact of a rise in interest rates upon the savings deposit ratio is ambiguous since the short-term rate exhibits much more variability than the long-term rate.

On the basis of the structural equation elasticities, then, a rise in income decreases the savings deposit ratio; a rise in the term to maturity of the public debt raises the ratio; and the impact of interest rates on the ratio is uncertain.

In the reduced-form cases, a rise in income yields an initial decline in the savings deposit ratio. This occurs because there is a redistribution of existing bank deposits in favour of demand deposits. In steady-state equilibrium, with no change in reserves, the final redistribution of existing deposits is in favour of savings deposits and, consequently, the savings deposit ratio rises. When reserves respond to the change in income, however, the savings deposit ratio declines in



steady-state equilibrium. This occurs because the income elasticity of demand deposits exceeds the income elasticity of savings deposits (0.991 vs. 0.769).<sup>8</sup>

The effect of an increase in the term to maturity of the public debt in the reduced-form cases is a rise in the savings deposit ratio which diminishes over time. Initially, the rise in the term to maturity variable has a greater impact on the short rate than on the long rate, causing an increase in savings deposits relative to demand deposits. In steady-state equilibrium, the rise in the term to maturity has a greater impact on the long rate than on the short rate; as a result, the rise in savings deposits relative to demand deposits is damped, and the steady-state impact of the term to maturity variable is less than the initial impact.

In summary, the structural equation elasticities suggest a negative relationship between the money multiplier and income, and a positive relationship between the term to maturity of the public debt and the multiplier. The final effect of interest rate changes on the multiplier, via the savings deposit ratio, is ambiguous.

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<sup>8</sup> Notice that the steady-state income elasticities of the short-term and long-term interest rates are 1.430 and 0.648 respectively.

The reduced-form elasticities indicate a negative relationship between income and the multiplier (except in the steady-state case with reserves exogenous), and a positive relationship between the multiplier and the term to maturity of the public debt.

### The Reserve Ratio

A change in total reserves and/or a change in chartered bank deposits brings about a change in the reserve ratio. It is difficult to extract meaningful conclusions about the determinants of the reserve ratio from our model; of the various reserve ratio elasticities presented in Tables VI and VII, only the steady-state estimate of  $e(r;Y)$  in Table VI and the steady-state estimate, for reserves endogenous, of  $e(r;Y)$  in Table VII are not artificial. In the latter cases, the effect of a unit increase in income is a decline in the reserve ratio.

Because we lack an operational definition of excess reserves on a quarterly, non-statutory basis, our model does not permit us to formulate even tentative conclusions about chartered bank portfolio management: such conclusions will emerge only from a full-scale study of chartered bank portfolio behavior. We note, however, that our supply function for Total Canadian Dollar Deposit

liabilities implies an average quarterly reserve ratio (non-statutory) of 7.74%. While this is reasonably close to the legal reserve ratio of 8%, direct calculation of the non-statutory ratio places it between a low of 7.9% and a high of 8.5%.

### Changes in the Money Supply Multiplier

In the foregoing sections of this chapter, we examined the impact of the exogenous variables of our model upon each of the constituent ratios of the multiplier separately. We now turn to an examination of the final or combined effects of a change in an exogenous variable upon the money multiplier.

#### Methodology: (b)

Using the chain rule for partial derivatives, we can express the relationship between a change in the money supply multiplier and, for example, a change in income as follows:

$$6.6 \quad \frac{\partial m}{\partial Y} = \frac{\partial m}{\partial c} \frac{\partial c}{\partial Y} + \frac{\partial m}{\partial t} \frac{\partial t}{\partial Y} + \frac{\partial m}{\partial r} \frac{\partial r}{\partial Y}$$

This expression, in turn, can be rewritten in terms of elasticities:

$$6.7 \quad e(m;Y) = [e(m;c)] [e(c;Y)] + [e(m;t)] [e(t;Y)] \\ + [e(m;r)] [e(r;Y)]$$

where  $e(m;Y)$  is the elasticity of the money multiplier with respect to income. Similar expressions can be derived for the effects of changes in other exogenous variables upon the multiplier. The values of  $e(m;c)$ ,  $e(m;t)$ , and  $e(m;r)$  used for calculation purposes are those estimated and presented in Chapter III. We assume that the initial and steady-state elasticities of the multiplier with respect to the constituent ratios are identical. The elasticities of the money multiplier with respect to selected exogenous variables are presented in the following tables:

TABLE VIII

## STRUCTURAL MULTIPLIER ELASTICITIES

<u>Elasticity</u>	<u>1st Qtr.</u>	<u>s/s (R exogenous)</u>	<u>s/s (R endogenous)</u>
$e(m;Y)$	0.002	1.265	0.822
$e(m;A)$	0.020	0.263	n.a.
$e(m;i^S)$	-0.023	-0.245	n.a.
$e(m;i^L)$	-0.044	-0.564	n.a.

TABLE IX

## REDUCED-FORM MULTIPLIER ELASTICITIES

<u>Elasticity</u>	<u>1st Qtr.</u>	<u>s/s (R exogenous)</u>	<u>s/s (R endogenous)</u>
$e(m;Y)$	-0.045	-0.411	0.062
$e(m;A)$	-0.001	0.000	n.a.
$e(m;R)$	0.576	0.582	n.a.
$e(m;i^{BR})$	-0.023	-0.023	n.a.
$e(m;Dg)$	-0.185	-0.185	n.a.

The entry "n.a." means not applicable and refers to those cases in which the particular exogenous variable does not enter the reserves supply function.<sup>9</sup>

Tables VIII and IX contain few surprises: the structural equation elasticities reveal a positive relationship between the money multiplier and both income and the term to maturity of the public debt, and a negative relationship between the multiplier and both interest rates. The reduced-form steady-state elasticities (reserves endogenous) also reveal a positive relationship between the money multiplier and income. The reduced-form income elasticities of the multiplier (reserves exogenous) suggest that an inflationary period characterized by stringent monetary policy might yield a

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<sup>9</sup> Differences among the steady-state estimates of  $e(m;Y)$  in Tables VIII and IX arise from differences of reserve behavior and interest-rate effects. The structural elasticities do not incorporate the positive influence of income on both interest rates; as a result, both demand and savings deposits rise by the full ceteris paribus impact of an increase in income. Turning first to Table VIII: the estimate of  $e(m;Y) = 1.265$  assumes that reserves rise only by an amount sufficient to support the rise in demand and savings deposits while the estimate of 0.822 involves a greater increase in reserves and, ceteris paribus, a higher reserve ratio and lower multiplier. For Table IX, the estimate of -0.411 assumes no change in reserves and, hence, a redistribution of existing bank deposits. Because this redistribution goes against demand deposits in steady-state equilibrium, there is a rise in both the currency and savings deposit ratios, with the former dominating the latter. The estimate of 0.062 embodies the positive impact of income upon reserves. Because reserves increase, both demand and savings deposits increase.

counter-cyclical decline in the money multiplier.<sup>10</sup>  
 We return to this point in the next chapter. We also reserve discussion of  $e(m;R)$  and  $e(m;i^{BR})$  for the next chapter.

Our findings to this point on the determinants of the multiplier are generally confirmed by the following regression equation:<sup>11, 12</sup>

$$6.8 \quad m_t = -0.074i_t^L + 0.0000102Y_t + 0.017A_t + 0.52m_{t-1} \\
 (4.48) \quad (4.70) \quad (4.23) \quad (4.78) \\
 + 2.22S_1 + 2.22S_2 + 2.13S_3 + 2.18S_4 \\
 (4.37) \quad (4.40) \quad (4.26) \quad (4.33)$$

$$R^2 = 0.8968$$

$$D.W. = 1.38$$

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10 The decline in the multiplier does not require a decline in reserves; all that is required is that the change in reserves does not exceed the currency offset. In our model, this of course means no change in reserves.

11 We say that equation 6.8 "generally" confirms our findings because the signs of the regression coefficients are consistent with our expectations. The elasticities calculated from equation 6.8 differ considerably from those of Tables VIII and IX: the elasticities of the multiplier with respect to income, the term to maturity of the public debt, and the long-term interest rate calculated from equation 6.8 are 0.077, 0.034, and -0.070 respectively.

12 On the basis of our findings in Chapter V, we estimated several equations relating the money multiplier to income, permanent income, interest rates, etc. We chose equation 6.8 simply because it gave the best "fit" as measured by  $R^2$ . Equation 6.8 confirms our statement on p. 39 that the multiplier displays little seasonality.

The positive relationship between the multiplier and income has important implications for those studies which have attempted to demonstrate the predictive superiority of the neo-quantity theory of money over the Keynesian income-expenditure theory.<sup>13</sup> In particular, they have assumed that the link between money and income runs only from money to income. Our results suggest, however, that there is also a link from income to money. To the extent that our analysis is correct, the conclusions of these studies can be called into question.<sup>14</sup>

In the next chapter, we utilize the results of this and earlier chapters to analyse the money multiplier as a source of instability and weakness in monetary policy.

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<sup>13</sup> See: Milton Friedman, David Meiselman, "The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States," Commission on Money and Credit, Stabilization Policies, Englewood Cliffs, Prentice-Hall, 1963, pp. 165-268; and George Macesich, "The Quantity Theory and the Income-Expenditure Theory in an Open Economy," Canadian Journal of Economics and Political Science, August, 1964, pp. 368-90.

<sup>14</sup> It is not necessary that the relationship between the multiplier and income be positive: since the Friedman-Meiselman-Macesich studies require that  $dm/dY$  be zero, a negative relationship between the multiplier and income is also inconsistent with their studies.

## APPENDIX A

REDUCED-FORM EQUATIONS, FIRST QUARTER

$$(1) \quad C_t = 0.88C_{t-1} + 0.0041Y_t + 15.4S_1 + 82.0S_2 \\ + 76.5S_3 + 70.1S_4$$

$$(2) \quad D_t = 0.197D_{t-1} + 51.281^L_{t-1} + 25.101^L_{t-2} + 0.002Y_t \\ - 17.62A_t - 68.471^{BR}_t + 105.231^P_t - 0.782Dg_t \\ + 10.10R_t - 892.0S_1 - 1005.7S_2 - 1037.4S_3 \\ - 803.0S_4 + 18.42 - 0.719T_{t-1}$$

$$(3) \quad T_t = -0.197D_{t-1} + 0.719T_{t-1} - 51.281^L_{t-1} - 25.101^L_{t-2} \\ - 0.002Y_t + 17.62A_t - 19.041^{BR}_t + 29.261^P_t - 0.217Dg_t \\ + 2.81R_t - 96.38S_1 - 82.2S_2 - 119.5S_3 - 214.9S_4 \\ - 18.42$$

$$(4) \quad CDDL_t = -87.521^{BR}_t + 134.51^P_t + 12.92R_t - 988.4S_1 \\ - 1088.0S_2 - 1157.0S_3 - 1018.0S_4$$

$$(5) \quad M_t = 0.88C_{t-1} + 0.0041Y_t - 87.521^{BR}_t + 134.5^P_t - 1.00Dg_t \\ + 12.92R_t - 973.0S_1 - 1006.0S_2 - 1080.0S_3 \\ - 947.8S_4$$

$$(6) \quad i_t^S = 0.008T_{t-1} - 0.5721^L_{t-1} - 0.2801^L_{t-2} + 0.00024Y_t \\ + 0.196A_t + 0.7641^{BR}_t - 1.171^P_t + 0.00872Dg_t \\ - 0.1127R_t + 6.70S_1 + 11.25S_2 + 9.78S_3 + 8.69S_4 \\ - 0.205$$



## APPENDIX A continued

$$(7) \quad i_t^L = 0.0014T_{t-1} + 0.3721i_{t-1}^L + 0.1821i_{t-2}^L + 0.000044Y_t \\ + 0.101A_t + 0.1381^{BR}i_t - 0.21251^P_t + 0.00158Dg_t \\ - 0.0204R_t + 1.21S_1 + 2.03S_2 + 1.77S_3 + 1.57S_4 \\ + 0.133$$

## APPENDIX B

REDUCED-FORM EQUATIONS, STEADY-STATE,  
RESERVES EXOGENOUS

- (1)  $C = 0.0367Y + 128.3S_1 + 683.3S_2 + 637.5S_3 + 584.1S_4$
- (2)  $D = -0.022Y - 42.851BR + 65.861P + 6.32R - 8.11A$   
 $- 0.489Dg + 731.4S_1 - 1730.6S_2 - 2236.3S_3$   
 $- 375.4S_4 - 480.3$
- (3)  $T = 0.022Y - 44.661BR + 68.631P + 8.11A - 0.510Dg$   
 $- 1719.8S_1 + 642.6S_2 + 1079.3S_3 - 375.4S_4$   
 $+ 6.59R - 480.3$
- (4)  $CDDL = -87.521BR + 134.51P + 12.92R - 988.4S_1 - 1088.0S_2$   
 $- 1157.0S_3 - 1018.0S_4$
- (5)  $M = 0.0367Y - 87.521BR + 134.51P + 12.92R - 1.00Dg$   
 $- 860.1S_1 - 404.7S_2 - 519.5S_3 - 433.9S_4$
- (6)  $i^S = 0.00025Y + 0.04301BR - 0.06611P - 0.0063R$   
 $+ 0.0081A + 0.00049Dg + 2.51S_1 + 1.76S_2$   
 $+ 0.45S_3 + 0.38S_4 - 0.48$
- (7)  $i^L = 0.00015Y + 0.02591BR - 0.03981P - 0.0038R$   
 $+ 0.2249A + 0.00029Dg + 1.51S_1 + 1.06S_2$   
 $+ 0.27S_3 + 0.23S_4 + 0.27$

## APPENDIX C

REDUCED-FORM EQUATIONS, STEADY-STATE,  
RESERVES ENDOGENOUS

$$(1) \quad C = 0.0367Y + 128.3S_1 + 683.3S_2 + 637.5S_3 + 584.1S_4$$

$$(2) \quad D = 0.1348Y + 18.79\Delta P + 89.71u - 1.81BPD - 42.851^{BR} \\ - 65.861^P - 8.11A - 0.489Dg + 731.4S_1 \\ - 1730.6S_2 - 22.36S_3 - 692.5S_4 + 1908.7$$

$$(3) \quad T = 0.1480Y + 19.58\Delta P + 93.49u - 1.89BPD - 44.661^{BR} \\ + 68.631^P + 8.11A - 0.510Dg - 1719.8S_1 \\ + 642.6S_2 + 1079.3S_3 - 375.4S_4 + 999.8$$

$$(4) \quad R = 0.0219Y + 2.97\Delta P + 14.18u - 0.287BPD + 224.5$$

$$(5) \quad CDDL = 0.2829Y + 38.37\Delta P + 183.2u - 3.70BPD - 87.521^{BR} \\ + 134.51^P - 988.4S_1 - 1088.0S_2 - 1157.0S_3 \\ - 1018.0S_4 + 2900.5$$

$$(6) \quad M = 0.3196Y + 38.37\Delta P + 183.2u - 3.70BPD - 87.521^{BR} \\ + 134.51^P - 1.00Dg - 860.1S_1 - 404.7S_2 \\ - 519.5S_3 - 433.9S_4 + 2900.5$$

$$(7) \quad 1^S = 0.00013Y - 0.018\Delta P - 0.090u + 0.0018BPD \\ + 0.04301^{BR} - 0.06611^P + 0.0082A + 0.00049Dg \\ + 2.51S_1 + 1.76S_2 + 0.45S_3 + 0.38S_4 - 1.90$$

## APPENDIX C continued

$$(8) \quad i^L = 0.00008Y - 0.01\Delta P - 0.54u + 0.0010BPD \\ + 0.0259i^{BR} - 0.039i^P + 0.22A + 0.00029Dg \\ + 1.51S_1 + 1.06S_2 + 0.27S_3 + 0.23S_4 - 0.58$$

## CHAPTER VII

### THE MULTIPLIER AS A SOURCE OF INSTABILITY

Since the 1930's, monetary policy has not been highly regarded as a tool of stabilization policy. Several reasons for the impotency of monetary policy have been advanced and include the Keynesian liquidity trap, an interest-inelastic demand for investment schedule, perverse or inconsistent behavior by the monetary authorities, or long recognition, implementation, and transmission lags in monetary policy.<sup>1</sup> So complete was the humiliation of monetary policy that, until the early 1950's (in the United States, dated by the famous "Accord" between the U. S. Treasury and the Federal Reserve), monetary policy was confined to the support of government bond prices. The return to favour of monetary policy, made possible in part by the arguments

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<sup>1</sup>For a survey of the causes of alleged weakness in monetary policy, see: Howard S. Ellis, "Limitations of Monetary Policy," in: Neil Jacoby, ed., United States Monetary Policy, New York, Frederick Praeger, 1964, pp. 195-214.

of Robert Roosa,<sup>2</sup> was short-lived. In the late 1950's monetary policy again became suspect. To the existing list of sources of weakness was added the existence and growth of non-bank financial intermediaries documented by Raymond Goldsmith.<sup>3</sup> Those who viewed this growth with alarm argued that the availability of a wide spectrum of liabilities having most or all the properties of money except the name ("... a rose by any other name would smell as sweet") would diminish the control of the monetary authorities over credit and spending.<sup>4</sup> In its most extreme form, this position was translated by the Radcliffe Committee<sup>5</sup> into the notion of an infinitely malleable income velocity of money: a characteristically more moderate statement of this position is given by the Canadian Bankers' Association:

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<sup>2</sup>See: Robert V. Roosa, "Interest Rates and the Central Bank," in: Money, Trade, and Economic Growth: In Honor of John Henry Williams, New York, MacMillan, 1951.

<sup>3</sup>R. W. Goldsmith, Financial Intermediaries in the American Economy Since 1900, New York, Princeton University Press, 1958.

<sup>4</sup>See, for example: J. G. Gurley, E. S. Shaw, "Financial Aspects of Economic Development," American Economic Review, September, 1955, pp. 515-38.

<sup>5</sup>Committee on the Working of the Monetary System, Report, London, Her Majesty's Stationary Office, 1960.

Under present conditions, as competing forms of financial claims grow relative to chartered bank deposits, monetary policy has either to become more broadly directed against the total supply of liquidity or progressively more vigorous on chartered bank deposits in order to bring about a given expansion or contraction of total money expenditure.<sup>6</sup>

There are, broadly speaking, two prongs to this type of argument: first, it is simply argued, as the above quotation implies, that a large body of financial claims is outstanding which, given the fact that only chartered bank reserves are subject to the direct action of the central bank, means that central bank action falls directly on only a portion of the financial system; and second, it is argued that the existence of a wide spectrum of claims permits shifts among assets or claims by the public and financial institutions which will reduce the impact of a given change in chartered bank reserves or the monetary base on not only the total stock of credit but the money stock as well. In our model and analysis, such asset shifts will be reflected in variations in the money supply multiplier. We thus return to our original theme, namely that variations in the money multiplier may constitute a source of weakness in monetary policy.

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<sup>6</sup> Canadian Bankers' Association, "Submission to the Royal Commission on Banking and Finance," The Canadian Banker, (supplement), Spring, 1963, p. 95.

We know that the money multiplier does vary over time; we also have isolated some of the determinants of these variations. Before we can utilize this information to assess the role of the multiplier in stabilization policy, we must address ourselves to the question: under what conditions can variation in the multiplier be construed as a source of weakness in monetary policy?

There exists no straightforward answer to this question. One criterion, albeit extreme, would be that any change in the money multiplier weakens monetary policy unless it is accurately predicted or quickly counteracted. We reject this criterion as being unrealistic on two grounds: first, the multiplier does vary; and second, we suggest that the Bank of Canada's description of reserve management as a process of successive approximation can readily be interpreted as evidence against accurate prediction.

A second criterion would be that any change in the multiplier which is opposite in direction to a change in reserves or the monetary base weakens monetary policy. Thus, if during recession, a rise in bank reserves is accompanied by a decline in the multiplier, the



effectiveness of monetary policy is diminished.<sup>7</sup> This criterion of course presupposes that changes in reserves or the base are in the "right" direction. If, for example, the central bank misreads the state of the economy during recession and tightens the growth of reserves, should a rise in the multiplier be described as weakening monetary policy? This criterion does not include accurate prediction as a necessary condition.

While there may be cases for which the second criterion is inapplicable, it is a reasonable standard by which to judge movements of the money multiplier so long as we consider the monetary authorities competent to formulate and execute policy. (In the post-war years, there has been only one instance in which the competence of the central bank was questioned.)<sup>8</sup>

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<sup>7</sup>The second criterion is not the monetary equivalent of the automatic stabilizers of fiscal policy or the fiscal system. The theory of automatic stability is phrased in terms of the response of government revenues and expenditures to changes in income and/or employment. For the monetary sector, the equivalent to the fiscal stabilizers would be the response of the multiplier to changes in income and, for exact equivalence, we would require that  $e(m;Y)$  be negative.

<sup>8</sup>This, of course, was the famous letter written by Canadian economists to the Minister of Finance in 1960 urging the dismissal of James Coyne, Governor of the Bank of Canada. For a review of this episode in Canadian economic history, see: H. Scott Gordon, The Economists Versus the Bank of Canada, Toronto, Ryerson Press, 1961.

The Evidence

The second criterion can be used to formulate a simple test of the contribution of the multiplier to monetary policy over the period studied:

$$\begin{aligned} \text{Let:} & \quad M = mB \\ \text{then:} & \quad \log(M) = \log(m) + \log(B) \\ \text{or:} & \quad d\log(M) = d\log(m) + d\log(B) \\ \text{or:} & \quad e(M;B) = 1 + e(m;B) \end{aligned}$$

If changes in the money multiplier are neutral,  $e(M;B)$  will be unity; if changes in the multiplier enhance monetary policy,  $e(M;B)$  will exceed unity; and, if changes in the multiplier weaken monetary policy,  $e(M;B)$  will be less than unity. Consider the following regression equation:

$$\begin{aligned} 7.1 \quad M_t = & 3027.0m_t + 5.041B_t - 15220.0S_1 - 15220.0S_2 \\ & (26.00) \quad (154.4) \quad (29.7) \quad (30.3) \\ & - 15220.0S_3 - 15210.0S_4 \\ & (30.0) \quad (29.9) \end{aligned}$$

$$R^2 = 0.9880$$

$$D.W. = 0.21$$

The elasticity of the money stock with respect to the base calculated from the above equation is 1.002. This

suggests that  $e(m;B)$  is 0.002 and that, for the period, the multiplier made a positive contribution to monetary policy. Our estimate of 1.002 is lower than the elasticities reported by Fand and Tower but this is partly because they deflate the base by the amount of borrowed reserves in the system.<sup>9</sup> The above estimate is also lower than we expected in view of our report in Chapter I that approximately nine percent of the change in the money stock between 1955 and 1965 is attributable to changes in the money supply multiplier.<sup>10</sup>

Further evidence that the multiplier satisfies the second criterion is the estimate of the elasticity of the multiplier with respect to reserves presented in the previous chapter. That estimate suggests that a one percent rise in bank reserves will yield a rise in the multiplier of 0.576% in the first period and 0.581% in steady-state equilibrium. On the basis of several positive estimates of  $e(M;B)$ , Fand and Tower have argued that the Canadian monetary system is highly responsive

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<sup>9</sup> Fand and Tower report values for  $e(M;B)$  ranging from 1.01 to 7.57, depending on the specification of the money supply function. See: David Fand, John Tower, "An Analysis of the Money Supply Process in Canada," Canadian Journal of Economics, May, 1968, p. 391.

<sup>10</sup> Of course, our estimate of  $e(m;B)$  embodies only the influence of changes in the base on the multiplier; other factors, as we have seen, also cause the multiplier to change.

to the actions of the central bank<sup>11</sup> and they attribute this responsiveness to portfolio shifts by the public and the banking system. Our estimate of  $e(m;R)$  tends to support their supposition regarding the behavior of the public and banks. (Fand and Tower also find the Canadian monetary sector to be more responsive to central bank action than the American system.)<sup>12</sup>

Since it is possible that the central bank may be more concerned with interest rates than the money stock, we must consider the impact of monetary policy upon interest rates. The reduced-form equations of our model, contained in Appendix A and Appendix B of the previous chapter, indicate a negative relationship between reserves and both the short- and long-term interest rate. This, of course, is hardly surprising; of interest, however, is the fact that, for both rates, the initial impact of a change in reserves upon interest rates greatly exceeds the steady-state impact. This latter result is consistent with Tucker's hypothesis that lags in the demand for money, because of their effect on interest rates, may constitute a source of strength rather than weakness in monetary

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<sup>11</sup> Fand and Tower, op. cit., p. 394.

<sup>12</sup> Ibid.

policy.<sup>13, 14</sup> The positive relationship between the multiplier and reserves necessitates an even greater "over-shooting" of interest rates than would be the case if  $e(m;R) = 0$ . Thus, in the event that the monetary authorities pursue an interest rate objective, changes in the money multiplier reinforce rather than weaken monetary policy.

Fand and Tower have further argued, on the basis of their estimates of  $e(M;B)$ , that the alleged slippage or looseness in the Canadian monetary sector arising from the reserve ratio calculation method and the one-month settlement period<sup>15</sup> may largely be a myth:

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<sup>13</sup> Tucker suggests that a lag in the demand function for money may increase the impact of monetary policy on the economy and on investment in particular. If, for example, the money supply rises, in order for the market to clear when there exists a lag in the money demand function, the interest rate will have to decline markedly, or at least more than would be the case were there no lag in the demand function. See: Donald Tucker, "Dynamic Income Adjustment to Money-Supply Changes," American Economic Review, June, 1966, p. 433-49.

<sup>14</sup> T. J. Courchene has also presented evidence consistent with the Tucker hypothesis. See: T. J. Courchene, "The Canadian Money Supply: An Econometric Analysis with Special Emphasis on the Money Supply Multiplier," a paper presented to the meetings of the Canadian Economics Association, Calgary, 1968, p. 45.

<sup>15</sup> H. G. Johnson and J.W.L. Winder argue that the system is characterized by excessive looseness. See: "Lags in the Effects of Monetary Policy in Canada," a study prepared for the Royal Commission on Banking and Finance, 1962, pp. 139-43.

If our findings are empirically correct, they would suggest that a monetary system where the constraints on the banking system are derived from behavior functions (the demand for free reserves, vault cash and currency) may be more responsive than one where the primary constraint on the banking system in the short run derives from legal requirements.<sup>16</sup>

Because our findings are consistent with those of Fand and Tower, and appear to confirm the Tucker hypothesis, we suggest that the problem of lags in monetary policy in Canada may be one of recognition and reaction (the "inside" lag) rather than one of transmission (the "outside" lag). Recall that our reserves supply function incorporates lags ranging from one to three quarters.

Because the central bank possesses policy instruments other than its control of chartered bank reserves, we have investigated the impact of changes in the Bank Rate and the federal government account on the multiplier. We expect the multiplier to be negatively related to Bank Rate and positively related to the federal government account. A rise in Government of Canada deposits at the chartered banks produces a one-to-one increase in reserves.<sup>17</sup>

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<sup>16</sup> Fand, Tower, op. cit., p. 394n.

<sup>17</sup> This is discussed in: J. W. O'Brien, Canadian Money and Banking, Toronto, McGraw-Hill, 1964, pp. 100-01. A rise in the government account arising from tax collections does not increase reserves.

Consider the following regression equation:

$$7.2 \quad m_t = -0.0261 \overset{BR}{t} + 0.00078 \overset{RA}{t} + 0.00065 Dg_t + 4.36 S_1$$

$$\quad \quad (3.45) \quad (12.53) \quad (15.88) \quad (93.2)$$

$$\quad + 4.35 S_2 + 4.03 S_3 + 4.32 S_4$$

$$\quad \quad (84.6) \quad (79.0) \quad (82.3)$$

$$R^2 = 0.8649$$

$$D.W. = 0.89$$

where  $R^A$  is total reserves minus  $Dg$ . The  $t$ -values of the regression coefficients remained statistically significant after application of a Durbin procedure to the time series. The signs of the regression coefficients satisfy our expectations and provide further evidence that the multiplier moves in a manner that reinforces rather than weakens monetary policy.

The results of equation 7.2 are consistent with the estimates of  $e(m;R)$  and  $e(m;i^{BR})$ , but in conflict with the estimates of  $e(m;Dg)$ , presented in Table IX. Because a negative sign for the latter elasticity is built into our model, we attach little importance to it. The elasticity of the multiplier with respect to Bank Rate calculated from equation 7.2 is  $-0.019$  and  $e(m;i^{BR})$  calculated from the reduced-form equations is  $-0.023$ . Both these estimates

are lower than the Fand-Tower estimates of the elasticity of the money stock with respect to the money-market rate.<sup>18</sup>

Again, should the monetary authorities pursue an interest-rate objective, the reduced-form equations reveal the expected positive relationship between Bank Rate and both the short- and long-term rates of interest. Furthermore, the initial impact of  $i^{BR}$  on  $i^S$  and  $i^L$  exceeds the steady-state impact. The cause of this latter effect is the negative relationship between the money supply multiplier and Bank Rate.

All the evidence to this point suggests that the money multiplier tends to move in a manner that contributes to the achievement of the objectives of monetary policy rather than inhibits it. Even our negative estimate of  $e(m;Y)$  can be interpreted as in support of this proposition: the negative estimate occurs because reserves do not increase in the face of an increased demand for bank deposits. This situation might occur in the real world

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<sup>18</sup> Fand and Tower use the money market rate as a proxy for Bank Rate. Their estimates of the elasticity of the money stock with respect to the money market rate range from -0.064 to -0.354, depending on the money supply function employed. That our estimates of  $e(m;i^{BR})$  are lower than their estimates of  $e(M;i^M)$  is not surprising given that  $e(M;i^{BR}) = e(m;i^{BR}) + e(B;i^{BR})$ . The Fand-Tower estimates are found in op. cit., p. 391.



when the central bank refuses to "validate" an excess-demand inflation by supplying additional reserves. As is well known, a pure excess-demand inflation ceases when, for a given volume of reserves, the rate of interest rises to a level at which investment is choked off:<sup>19</sup> in this case, the negative elasticity of  $m$  with respect to  $Y$  reinforces the upward movement of interest rates and serves to damp the excess-demand inflation.

Finally, we turn to Chart 4 for evidence on the money multiplier as a source of weakness in monetary policy. The first striking aspect of Chart 4 is the rough synchronous relationship between the money multiplier and both the monetary base and reserves. This, of course, is what we expect. There are, however, clear-cut cases of non-synchronous behavior. These occur during both the 1957-58 and 1960-61 recessions, and at the time of the Austerity Program of June, 1962. Between 1955.II and 1956.IV, the multiplier and the base exhibit irregular but generally non-synchronous behavior as well.

Both recessions during the period studied were preceded by a decline in the money multiplier (as, to be precise, were the Financial Crisis of Summer 1959 and the Austerity Program). In 1957-58, the multiplier continued to decline until the third quarter of 1957 when it began to rise. In 1960-61, the multiplier rose gradually

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<sup>19</sup>See: T. F. Dernburg, D. M. McDougall, Macro-Economics, New York, McGraw-Hill, 1963, pp. 222-26.

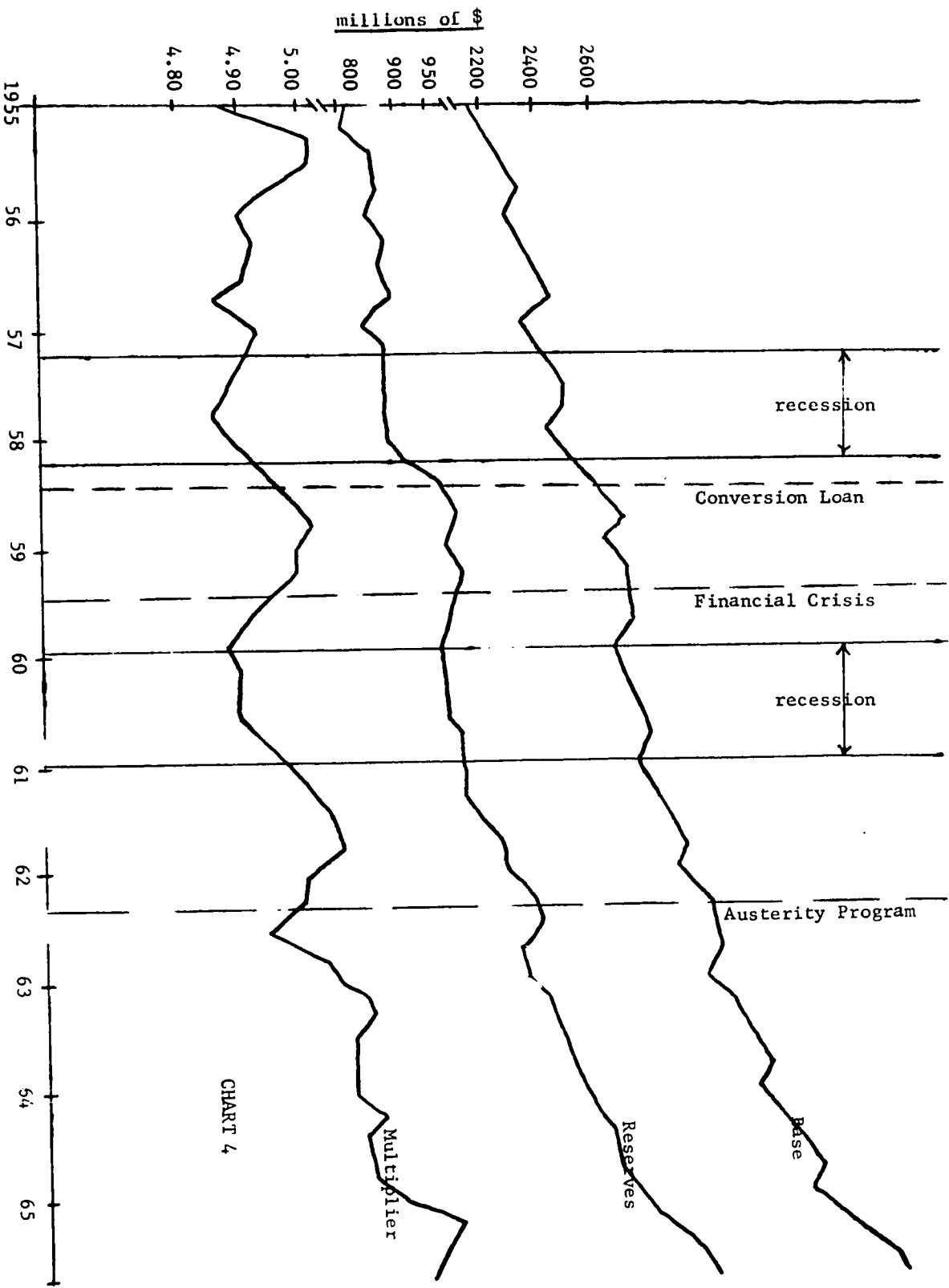


CHART 4

through 1960 and then rapidly from 1960.IV onwards. During both recessions, the growth of chartered bank reserves and the monetary base was negligible. While Johnson and Winder suggest August, 1957 as the point at which the Bank of Canada adopted an expansionary monetary policy,<sup>20</sup> H. Scott Gordon hotly denies this, arguing that the central bank pursued a "tight money" policy throughout 1957:

Far from expanding cash reserves, the Bank (of Canada) held them, throughout the whole latter half of 1957, consistently below the levels of 1956. The Bank did not expand chartered bank reserves at all until early 1958--a full eight months after the recession had begun. . . In 1958 cash reserves were expanded very rapidly. This . . . was a result of the Conversion Loan, not the Bank's policy.<sup>21</sup>

In the case of the second recession, Johnson and Winder date the adoption of an expansionary policy at October, 1960. Again, Gordon is in disagreement, arguing that reserve levels were lower in 1960 than 1959 and that, in January, 1961, the central bank appeared unaware that a recession had occurred.<sup>22</sup> During both recessions, the money multiplier made a positive contribution to recovery while the central bank did nothing, or acted with "too

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<sup>20</sup> Johnson, Winder, op. cit., p. 8.

<sup>21</sup> H. Scott Gordon, op. cit., p. 35.

<sup>22</sup> Ibid.

little, too late." Although our estimates of the relationship between the multiplier and income would suggest that the multiplier moves in a pro-cyclical fashion, in the above cases, the multiplier exhibited definite counter-cyclical behavior. Finally, we note that the multiplier declined sharply at the time of the Austerity Program (June, 1962), and rose from 1962.III onwards.

The bulk of the evidence presented in this chapter suggests that, despite fears to the contrary, portfolio shifts by the public and the banking system have contributed to rather than inhibited the attainment of the objectives of monetary policy. Furthermore, there is some evidence that the control of the monetary authorities over the banking and financial system is prone to less "slippage" than is commonly believed and that, if there are lags in the effects of monetary policy, they may well be largely lags of recognition (the "inside" lag). These results seem tenable whether the monetary authorities pursue an interest-rate or a money stock objective.<sup>23</sup> On the other hand, the rather "autonomous" behavior of the money supply multiplier during the two recessions of the period should caution us against overly-optimistic statements about the salutary role of the money multiplier.

In the next and final chapter, we draw together the results and implications of this and preceding chapters.

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<sup>23</sup>The "ultimate" objectives of the central are presumably those enumerated on p. 105.

## CHAPTER VIII

### SUMMARY, IMPLICATIONS, SUGGESTIONS

In this final chapter, we survey the work of this study, enumerate our major findings, and suggest areas in which future work might be profitable.

Our first chapter indicated the nature of the problem with which we have been concerned, namely, that the behavior of the public and the banking system is an integral part of the theory of the money supply process and raises the possibility that such behavior may be destabilizing. We outlined our method of approach, the use of the money multiplier concept, and discussed alternative theoretical and empirical approaches to money stock determination.

In the second chapter, we derived and discussed our version of the money supply multiplier. In addition, we demonstrated how the multiplier concept might be extended to cover a variety of financial institutions and to incorporate different concepts of money and credit.

Chapter III began the investigation of the sources of change in the money multiplier by attributing to changes

in the constituent ratios of the multiplier observed changes in it. We concluded that, while the method used therein is a good first step and may be extremely valuable for long-period studies, for short-period analysis, it is limited in scope.

In Chapter IV we presented an econometric model of the Canadian monetary sector, discussed its properties and assumptions, and noted work done by others on the Canadian system.

Chapter V consists of a detailed discussion of the theoretical arguments and empirical work leading to the final versions of the structural equations of our model.

In Chapter VI, we utilized the model of Chapter IV to isolate the determinants of the constituent ratios and thus of the money multiplier. We developed several expressions relating the money multiplier to selected predetermined variables and found the multiplier to be positively related to income and the maturity structure of the public debt., and negatively related to interest rates.

In Chapter VII, we investigated the contribution of changes in the money multiplier to the attainment of, or the inhibition of monetary policy's objectives.

### Major Conclusions

- (1) In Chapter II, we demonstrated the existence of a strong relationship between the concepts of the multiplier and the income velocity of money. In particular, we argued that changes in velocity require changes in the multiplier and that the multiplier is a richer theoretical construct than velocity.
- (2) In Chapter III, we demonstrated that the currency ratio is probably the most potent source of change in the money multiplier, followed by the savings deposit ratio and the reserve ratio. The strong role detected for the currency ratio suggests that statements that changes in public note circulation do not affect credit conditions and the money stock are without foundation: not only is such a statement incorrect were the currency drain completely offset, but we discovered that perfect offsetting is not, in fact, the case in Canada.
- (3) We were able to refute a common proposition in Money and Banking, namely, that the demand for currency is related in some stable, functional way to the stock of demand deposits held by the public.
- (4) In Chapter V, we suggested that application of the Baumol and Tobin hypotheses regarding the interest-elasticity of the transactions demand for cash to the demand for currency may be inappropriate.

(5) In Chapter VI, we concluded that the money supply multiplier is related to real sector variables such as income and to other monetary variables such as interest rates. These results, especially the former, suggest that those studies which have attempted to demonstrate the predictive superiority of the neo-Quantity Theory of Money over the Keynesian income-expenditure theory oversimplify when they assume the nominal stock of money to be unaffected by the real sector.

(6) Our major findings in Chapter VII were that, contrary to much opinion, the behavior of the banking system and the public appears to enhance rather than inhibit monetary policy. This result seems to hold whether the monetary authorities pursue a money stock- or interest rate-objective. We dispute the contention that, for legal reasons primarily, the Canadian banking system is prone to an unduly high degree of looseness or slippage and that lags in the impact of monetary instruments on the banking system are long and variable. We found evidence, furthermore, to support the Tucker hypothesis regarding the effect of lags in the demand function for money on the impact of monetary policy on the financial system.

(7) Graphical analysis of the behavior of the money supply multiplier convinced us that, for the two



recessions covered by this study, movements of the money multiplier compensated for inadequate action on the part of the central bank.

#### Suggestions for Future Research

- (1) We suggest that it would be fruitful to expand the multiplier to include a few non-bank financial intermediaries, particularly Trust and Loan companies and Credit Unions.
- (2) Future work should involve expansion of the model to incorporate the real sector.
- (3) A full-scale analysis of chartered bank portfolio behavior is warranted in view of the difficulty involved in obtaining meaningful hypotheses about the determinants of excess reserves and the reserve ratio.
- (4) As data become available, it should prove useful to investigate the effects for the multiplier and the money supply of differential reserve ratios for demand and savings deposits.
- (5) We are intrigued with the notion that the multiplier might prove not only a useful monetary indicator, but an indicator of general economic conditions as well, and hope to pursue especially the former question in the future.