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7 Money, Credit, and Interest Rates in the Business Cycle

Benjamin M. Friedman

The monetary and financial aspects of fluctuations in economic activity have long attracted the attention of economists and other observers of the business cycle. Throughout the nineteenth century and into the early years of the twentieth, business downturns in the United States were typically associated in a quite obvious way with "panics" or other sharp discontinuities in the financial markets. Such readily visible events have all but vanished since the establishment of the Federal Reserve System in 1914 and especially the Federal Deposit Insurance Corporation in 1934, but the pace of activity in the financial markets has continued to vary closely with that in many of the economy's nonfinancial markets. Much of this covariation is by now highly familiar, if not necessarily well understood. The regularities on which macroeconomists have focused most intensively in this context are those involving money (including either high-powered money or deposit money), credit (including public debt, private debt, or the sum of the two), and interest rates.[1] In large part because of the availability of data extending back to the early years of this century, and in some cases still earlier, the documentation of these regularities over fairly long time periods is now broadly familiar.

One factor motivating the long history of interest in this subject is, of course, simply the desire to understand more fully the underlying

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1. Stock prices have also attracted substantial attention in a business cycle context, but less so than have money, credit, and interest rates.

causes and internal dynamics of business fluctuations. Implications for public policy have also been important in this regard, however. A common thread running through decades of literature on the monetary and financial aspects of business cycles has been the actual or potential role of monetary policy in affecting either real economic outcomes or price stability, or both. Indeed, even those strands of literature that have argued vigorously against the existence of any possibility that monetary policy can improve real outcomes have heavily emphasized the negative results to follow, typically via the speed or variability of price inflation, from an ill-chosen (according to that view) policy regime.

The basic theme of this paper, in contrast to much of the extensive literature of the subject to date, is that the quantitative relationships connecting monetary and financial variables to the business cycle exhibit few if any strongly persistent regularities that have remained even approximately invariant in the context of the widespread and, in some instances, dramatic changes undergone by the United States financial markets over familiar time periods both long and short. At a *qualitative* level, of course, broadly familiar regularities have characterized many monetary and financial aspects of United States business fluctuations. The procyclical behavior of money, credit, and interest rates is well known, as is the tendency of money and credit growth to "lead" real economic growth at major business cycle turning points. Nevertheless, these characteristic qualitative features of most business fluctuations have not corresponded to persistent regularities in the *quantitative* relationships that constitute the main focus of modern business cycle analysis.

The finding that stable quantitative relationships to monetary and financial variables have been absent from the United States business cycle experience does not mean that monetary and financial phenomena are unimportant elements of business fluctuations, or that there is no consistent basis for seeking to understand or explain them. The basic monetary and financial elements of economic behavior have no doubt persisted in some fundamental sense. The problem is instead that these basic elements of economic behavior do not correspond straightforwardly in theory or closely in practice to the specific quantities that economists can typically measure. In addition, the relevant behavior is probably far too complex to be readily represented in simple linear relationships limited to very few variables.

From the perspective of positive economics based on familiar and available data, therefore, the main message of this paper is that simple relationships usually taken to be central to monetary and financial aspects of business cycles have in the past changed often and much. From the perspective of inferences about monetary policy, the chief implication is a warning against proceeding as if any one, or a few, of these simple relationships will reliably remain immutable.

Changes in the working of the United States financial markets that are potentially important for monetary and financial aspects of business fluctuations are not difficult to identify. Within the twentieth century the entire apparatus and orientation of United States monetary policy have undergone several dramatic shifts. In addition to monetary policy, major changes in government regulation and the expansion of government intermediation have been potentially important and often shifting influences. Moreover, the nation's private financial institutions and practices have also undergone profound and far-reaching changes over these years, partly in response to changing patterns of government regulation and monetary policy, but also as a result of private institutions' taking advantage of new developments elsewhere in the economy.

Any attempt to see whether the monetary and financial aspects of United States economic fluctuations have remained invariant, or nearly so, in the face of these financial market changes must at the outset confront the methodological choice between structural and reduced-form approaches to this question. A structural framework imposes potentially valuable restrictions on the way the corresponding empirically estimated model summarizes the quantitative relationships exhibited by the prior experience in question. Whatever analysis is grounded in a specific structural model is therefore conditional on those restrictions. Restrictions that are valid reflections of actual economic behavior will enable the model to extract the relevant behavioral relationships from the available data more efficiently, but incorrect or arbitrary restrictions will distort the representation of those relationships. Either kind of error can introduce the appearance of change where in fact there has been continuity, or of continuity where there has been change.

The subject of monetary and financial influences on economic fluctuations is not lacking for suggested structural frameworks. One long-familiar strand of thinking along these lines, which has emphasized interest rate, asset price, and credit rationing effects on specific kinds of spending, is the expanded IS-LM aggregate demand model typical of the post-Keynesian neoclassical synthesis, perhaps best exemplified empirically by the MIT–Penn–Social Science Research Council (MPS) model.[2] A closely related line of structural analysis, which has placed more emphasis on portfolio substitutions and asset valuations, is the disaggregated asset market approach of Tobin (1961, 1969) and of Brunner and Meltzer (1972, 1976). A third line of analysis, which in its structural components is related to these two but has more narrowly emphasized the role of monetary assets in affecting aggregate demand,

2. See, for example, de Leeuw and Gramlich 1968, 1969; Ando 1974; and Modigliani and Ando 1976.

is the monetarist model of Friedman (1956, 1971), as exemplified empirically by the Saint Louis model.[3] A more different line of structural analysis is the rational expectations model of aggregate supply developed by Lucas (1972, 1973), and exemplified empirically by Sargent (1976). A still more recent line of analysis has been the explicit banking sector model of Fama (1980a, b).[4] Moreover, each of these different structural approaches essentially refers to a closed economy. To the extent that the United States economy's increasing openness may also be important for monetary and financial aspects of economic fluctuations, the range of choice—and, consequently, of potential disagreement—is only greater.

The approach taken in this paper is to sidestep the choice among, or synthesis of, these disparate structural models and to employ instead only a reduced-form empirical approach that in principle is compatible with any of them. The basic advantage in this approach is to avoid making the analysis conditional on explicit structural restrictions that would attract sharp disagreement from the outset, and that could indeed be incorrect. The key disadvantages are the loss of efficiency in the extraction of the relevant quantitative relationships from the data and, correspondingly, the loss of explicit connection between the estimated relationships and more specific elements of monetary and financial behavior.

Section 7.1 sets the stage for the empirical analysis by briefly reviewing the major twentieth-century changes in the United States financial markets that would make it surprising if there had been no significant changes in the monetary and financial aspects of United States economic fluctuations during this period—at least under the view that the prevailing institutions, including government structures as well as private business practices, importantly affect economic behavior. Section 7.2 documents at a qualitative level the familiar interrelatedness of money, credit, interest rates, and nonfinancial economic activity in a business cycle context, but it then goes on to point out some changes in these relationships over time that are apparent even at a very simple level of analysis. Section 7.3 digresses to consider the relationships connecting money, credit, and their respective "velocities" to the fluctuations of both nominal and real income during the economy's seven and one-half recognized business cycles since World War II. Section 7.4 applies formal time series and frequency domain methods to examine at a quantitative level, and in an explicitly dynamic context, the

3. See, for example, Anderson and Jordan 1968 and Anderson and Carlson 1970. These models are really reduced-form in spirit, however. See Jonson 1976 for an example of an attempt at a more structural rendering of the same ideas.

4. Empirical work to date among these lines has mostly adopted a reduced-form approach. See, for example, King and Plosser 1981.

familiar relationships introduced in section 7.2. Section 7.5 pursues this line of analysis further, to determine whether differences in these familiar relationships from one time period to another are significant not just in a statistical sense but economically as well. Section 7.6 digresses again to consider the postwar evidence on the economy's "credit cycle." Section 7.7 concludes by summarizing the principal empirical findings presented throughout the paper.

7.1 Changes in the United States Economy's Financial Structure

Whether or not the monetary and financial aspects of economic fluctuations in the United States have changed their character over any specific period of time—within the twentieth century, for example, or since World War II, or since October 1979—is an empirical issue. Before examining the evidence on this question, however, it is appropriate to ask whether during the relevant time period there have been changes in the economy's underlying financial structure that, at least in principle, could have effected changes in the cyclical relationships between monetary and financial variables and nonfinancial economy activity. Three broad categories of changes in the United States economy's financial structure stand out in this regard.

First, within the time period spanned by available data (and studied in this paper), the entire apparatus and orientation of United States monetary policy have undergone dramatic shifts. Before 1914 the United States had no central bank as such but relied instead on a largely unregulated national banking system anchored by a gold standard.[5] Prompted by a recurrent series of financial crises and panics, especially in 1901, 1907, and 1913, Congress created a new Federal Reserve System charged with the basic task of preserving stability in the financial markets—more specifically, instructed "to furnish an elastic currency." The macroeconomic objectives almost universally associated with monetary policy in the post–World War II era, including especially the objective of price stability, received no mention in the original Federal Reserve Act.

Between 1914 and World War II, monetary policy evolved in a variety of ways, as Federal Reserve decision makers gradually came to understand what effects the system's open market purchases and sales

5. Much earlier on the Bank of the United States had constituted a rudimentary form of central bank, but it passed out of existence when Andrew Jackson declined to renew its charter in 1832. From then until the passage of the National Banking Act in 1864, private commercial banks were chartered exclusively by the individual states. Thereafter, until 1914, federally chartered banks enjoyed a monopoly over the note-issuing power but continued (as they do today) to share other banking functions, like deposit taking, with state-chartered banks.

of government securities had in the new world of fractional reserve banking directly based on central bank liabilities. The establishment in 1923 of what subsequently evolved into today's Federal Open Market Committee led temporarily to an increasing emphasis on open market operations in a monetary policy context, but in the 1930s the confusions of the depression and the associated international monetary crisis, including the abandonment of the gold standard in 1934, arrested the development of the monetary policy mechanism. Then, during World War II and thereafter until 1951, this evolution effectively ceased as the Federal Reserve assumed an obligation to support the open market price of the government's outstanding debt (which was then almost entirely a war loan).

In 1951 the Treasury/Federal Reserve Accord relieved the central bank of this obligation, and monetary policy assumed the quasi-independent macroeconomic role it has played ever since. Even so, there have been several major changes in monetary policy orientation and procedures since then. In the early post-Accord years, the Federal Reserve keyed its operations to the net free reserve position of the commercial banking system. By the late 1960s the principal policy focus had changed to setting interest rates on short-term debt instruments, sometimes treasury bills and later on federal funds. From 1970 onward, quantity targets for the growth of various aggregative measures of money and credit, including especially the narrowly defined money stock (M1), played a generally increasing albeit sporadic role in the formulation and implementation of monetary policy. In 1979 the Federal Reserve announced a renewed emphasis on these quantity growth targets and adopted new operating procedures for achieving them, based on the growth rate of nonborrowed bank reserves. In 1982 the M1 target was publicly suspended, however, and the weight placed on even the broader money and credit targets in 1982 and 1983 was uncertain. At present, the role of quantity growth targets in United States monetary policy may be central, irrelevant, or more likely, somewhere in between.

Second, the often shifting evolution of monetary policy has hardly been the only way actions of the federal government (not to mention those of state governments) have effected structural changes that may well have altered, perhaps importantly, how the economy's financial and nonfinancial markets interact in a business cycle context.[6] Government regulatory actions have also been a potentially important and often changing influence. The three most dramatic changes—the in-

6. The discussion that follows focuses narrowly on the financial markets and therefore omits such important elements of the changing role of government as taxes, government spending, bankruptcy arrangements, and so on—all of which could importantly affect the relationships between monetary and financial varibles and levels of economic activity.

surance of private bank deposits, the prohibition of interest on demand deposits, and the separation of the commercial banking and securities industries—all took effect in the 1930s. Further potentially important changes in bank regulation and supervision have occurred from time to time since then, including most prominently the key legislation governing bank holding companies in the late 1960s and the deregulation of banks and other depository institutions in the early 1980s. Moreover, in several further complete turns of the wheel, the prohibition of interest on demand deposits has become effectively inoperative within the past decade, and long-standing prohibitions on interstate banking and on banking firms engaging in the securities business (and vice versa) are even now becoming fictional. Perhaps most important, in recent years the entire distinction between transactions balances and savings balances has become blurred to the point of meaninglessness.

Changes in government financial regulation have also extended well beyond the banking system and other depository institutions. The securities legislation of the 1930s created a whole separate industry, and subsequent regulation has continued to affect how it works. Key regulatory changes effected by the Securities and Exchange Commission have ranged from requiring competitive bidding in most public utility company underwritings beginning in the 1950s, to allowing the spread of open-end mutual funds beginning in the 1960s, to prohibiting fixed minimum commissions on stock exchange brokerage beginning in the 1970s, to permitting "shelf" offerings of corporate securities beginning in the 1980s. As a result of these and many other regulatory actions over the years, the securities markets in the United States function differently today than they did in earlier times.

The National Banking Act of 1933 introduced deposit interest rate ceilings, in part as a response to banks' alleged overaggressive bidding for interbank demand deposits during the 1920s. The ceilings have also applied to time and savings deposits, however, and in this context they have at times had enormous impact on the workings of the financial markets and on the financing of economic activity. Specific episodes of disintermediation during the 1960s and 1970s, owing to regulation Q ceiling rates that remained low in comparison to sharply rising market interest rates, led to the rise of whole new patterns of portfolio behavior and to periodic depression in the homebuilding industry. The Federal Reserve System first moved to eliminate these adverse effects in 1970 by suspending the ceiling on interest paid on most large bank certificates of deposit. As of this time, these ceilings appear to be on the way out altogether as a result of the Depository Institutions Deregulation and Monetary Control Act of 1980.

A related development in the government's role in the credit market, which came about partly in response to the distortions caused by de-

posit interest ceilings, has been the great increase in government intermediation. The Federal Home Loan Bank System and the Federal Intermediate Credit Bank began operations before World War II, but the scale of their activity was small at first, and their initial focus was on agricultural credit. The Federal National Mortgage Association began its lending operations in 1955. Only in the 1960s and 1970s, however, as periodic disintermediation became severe, did the scope and size of government financial intermediation expand greatly. In recent years the government-sponsored credit agencies have been joined by pools issuing mortgage-backed securities that are not only government sponsored but in some cases formally guaranteed. As of the late 1960s, and as recently as 1982, it was not atypical for these quasi-government institutions to account for half or more of all home mortgage lending in the United States in high disintermediation years. Moreover, in recent years the federal government has extended its direct loan and loan guarantee operations far beyond housing- and agriculture-related credits, to the benefit of such diverse borrowers as college students, New York City, and the Lockheed and Chrysler corporations.

Third, the nation's private financial institutions and practices have undergone profound and far-reaching changes over these years, partly in response to changing patterns of government regulation and monetary policy but also in large part as a result of private initiatives taking advantage of new developments elsewhere in the economy, including especially the rapidly changing technology of communications and data processing. New forms of deposits (for example, negotiable time certificates, Eurodollar credits, and money market deposit accounts) and new securities (for example, variable rate mortgages, floating rate notes, interest rate futures, and listed stock options) have come and in some cases gone. So have new kinds of financial institutions (for example, money market mutual funds and mortgage pass-through pools).

Other forms of change in private financial practices have been more gradual, but potentially just as important. The nation's financial markets have steadily become less segmented and presumably more efficient in the classic sense. Diverse regional markets have become more integrated, though they are still far from entirely so, and barriers separating different kinds of borrowers from different kinds of depositors or lenders have steadily eroded. Meanwhile, some institutions like pension funds and credit unions have grown rapidly in relative terms, while others like insurance companies and mutual savings banks have done the opposite. In a further series of developments of potentially very great importance for the questions at issue here, the United States financial markets as a whole have at times become less open to foreign participation, and more recently more so, as capital controls have come and gone, while most (though not all) foreign markets have become

more accessible from here. Indeed, during large parts of the period under study in this paper, many key foreign currencies simply were not convertible.

Although adequately summarizing the elements of these private financial market changes that are of greatest potential importance in a business cycle context is probably impossible in the space available here, several basic trends that are relevant in this context stand out. One is that transactions costs have fallen, irregularly but persistently nonetheless, over the period under study in this paper. Another is that financial assets have increasingly become negotiable, and those that have always been negotiable have become more liquid. A third is that, despite the potentially very important episodes of retrogression, financial markets around the world have in fact become more closely integrated.

In light of these changes in the role of monetary policy, in government regulations and intermediation, and in private financial institutions and practices, it would be astonishing if there had been no changes at all in the relationships connecting money, credit, and interest rates to United States economic fluctuations. In the context of business cycles, however, as opposed to a study of financial markets per se, what matters is whether these (or still other) changes have brought about significant, and economically important, changes in such relationships at the macroeconomic level.

7.2 Basic Cyclical Relationships in Monetary and Financial Data

The four panels of figure 7.1 give an overview of the basic relationships of four key monetary and financial variables to United States economic fluctuations by showing these variables' annual variation from either 1891 or 1919 to 1982. The figure does not explicitly include any measure of nonfinancial economic activity, but the conventional shadings indicate business contractions as designated by the NBER.

The top panel of the figure shows the annual percentage change in the money stock, measured both by the Friedman/Schwartz "old M2" concept for 1891–1975 and by the "new M1" concept for 1919–82. The "old M2" measure includes currency held by the public plus "adjusted" total deposits at commercial banks but not at nonbank depository institutions (and also, since 1961, excluding large certificates of deposit).[7] The "new M1" measure is that adopted in 1980 (as "M1-B") by the Federal Reserve System, including currency held by

7. The underying data are annual averages centered on 30 June. From 1890 to 1907 the annual data are averages of quarterly figures. From 1908 to 1945 they are averages of end-of-month data. From 1947 to 1975 they are averages of daily-average monthly data.

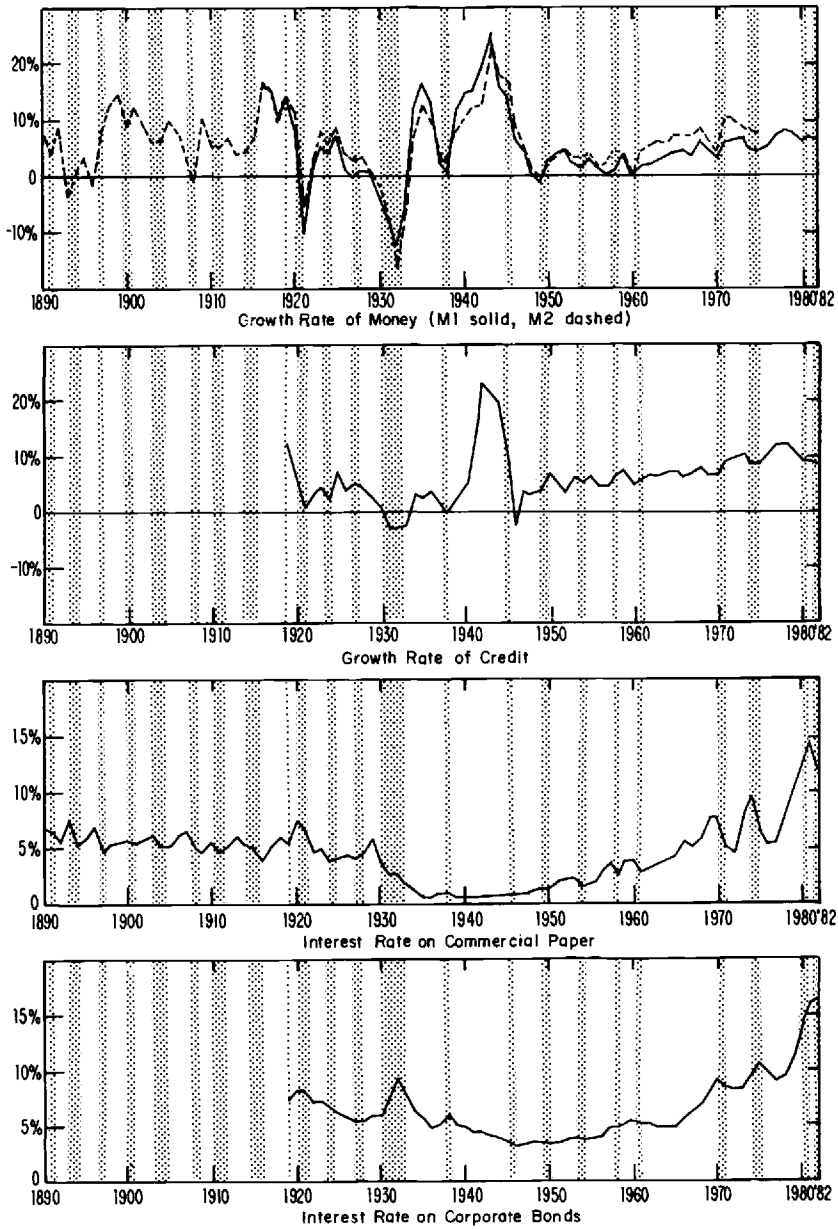

Fig. 7.1 Money, credit, and interest rates in the business cycle.

the public plus all checkable deposits other than those held by foreign commercial banks and official institutions, and as amended in 1982 to include traveler's checks.[8] As is well known from the work of Friedman and Schwartz (1963a, 1970, 1982) and others, the major historical fluctuations in United States nonfinancial economic activity have been accompanied by often sharp fluctuations in the rate of money growth. Prominent examples that stand out in the figure include the episodes of negative money growth in 1921, 1931, and 1949 and the sharp slowing of money growth in 1938. Especially during the post–World War II period, however, fluctuations in economic activity and variations in money growth have both been more modest. The comovement of money growth and real economic growth has been less pronounced also, though it is still readily visible.

The second panel of figure 7.1 shows the annual percentage change in domestic nonfinancial credit, including the total outstanding credit market indebtedness of all United States public and private sector borrowers other than financial intermediaries.[9] As is documented in Friedman (1981, 1983b), domestic nonfinancial credit has also borne a close relationship to United States nonfinancial economic activity, especially in the postwar period. Even before World War II, however, several major episodes of reduced credit growth, including those in 1921, 1931, and 1938, stand out as having occurred in conjunction with recognized economic fluctuations.

The bottom two panels of figure 7.1 show the annual average levels of interest rates on prime four- to six-month commercial paper offered in New York, and on Baa-rated corporate bonds, respectively.[10] The main features that stand out immediately in the interest rate data are the great volatility of both short- and long-term rates before 1930 and after 1970, the extraordinarily low level of both rates during the late 1930s and early 1940s, and the persistent upward trend since World War II. As is thoroughly familiar, however, interest rates also fluctuate cyclically, and many of the recognized business cycle episodes during this period also coincide with readily visible interest rate movements.

Table 7.1 focuses more closely on the comovements of both the M1 money stock and domestic nonfinancial credit with economic activity by arranging seasonally adjusted quarterly data in the context of the seven and one-half complete episodes since World War II designated as contractions and expansions by the NBER.[11] For each designated

8. The underlying data, constructed for this paper, are annual averages of monthly data, including end-of-month data through 1946 and daily-average data since 1947. (The Federal Reserve has constructed the official new M1 series back only to 1959.)

9. The underlying data are end-of-year data. The domestic nonfinancial credit concept is roughly analogous to "primary securities" in the sense of Gurley and Shaw 1960.

10. The data are annual averages of daily-average monthly data.

11. The expansion ending in 1948:4 officially began in 1945:4, but the analysis here and below excludes it so as to avoid any remaining effects due to the wartime economy.

Table 7.1 **Postwar Cyclical Movements of Money and Credit**

Business Cycles		Average Growth Rate of Money (M1)		Average Growth Rate of Credit	
Peaks	Troughs	Contractions	Expansions	Contractions	Expansions
1948:4					
		−0.75%		—	
	1949:4				
			3.90%		—
1953:2					
		1.16		5.28%	
	1954:2				
			1.69		5.67%
1957:3					
		0.64		5.42	
	1958:2				
			2.30		6.77
1960:2					
		1.43		4.65	
	1961:1				
			4.14		6.89
1969:4					
		4.53		6.71	
	1970:4				
			6.72		9.61
1973:4					
		4.38		8.48	
	1975:1				
			6.65		10.90
1980:1					
		6.60		8.81	
	1980:3				
			7.89		9.44
1981:3					
		6.69		8.71	
	1982:4				
Mean for all contractions		3.08%		6.86%	
Mean for all expansions			4.76%		8.21%

Note: Values shown are in percent per annum.

contraction or expansion, the table shows the average per annum growth rate of money and credit, respectively.[12] Despite the secular postwar trend toward faster growth of money and credit, the strongly cyclical aspect of both money growth and credit growth stands out clearly in

12. The table excludes credit growth for the first contraction and expansion because quarterly credit data are available only from 1952:1 onward.

these summary data. Money growth in expansions has exceeded money growth in contractions by 1.68% per annum on average, while credit growth in expansions has exceeded credit growth in contractions by 1.35% per annum on average. The basic cyclical regularity is much more striking than these average differences suggest, however. Money growth in each expansion was faster than in the preceding contraction, and money growth was slower in each contraction than in the preceding expansion. Similarly, credit growth in each expansion was faster than credit growth in the preceding contraction, and credit growth in each contraction was slower than in the preceding expansion.

Table 7.2 presents analogous data (not seasonally adjusted) for the postwar cyclical levels and movements of short- and long-term interest rates. Once again a secular postwar trend, toward higher interest rates and larger (absolute) interest rate changes, stands out immediately. Interest rates have also exhibited strong cyclical regularities, but they are not so striking as in the case of money and credit growth. Interest rate levels have been lower in expansions than in contractions by about 0.75% on average, but there has hardly been uniformity in this respect. In only two expansions were short-term interest rates lower than in the previous contraction, and in only one expansion was the long-term rate lower (by more than a single basis point).[13]

By contrast, the chief cyclical regularity that does stand out in table 7.2 is the rise of the short-term interest rate in every expansion and the corresponding decline in every contraction. The 6.72% (algebraic) difference between the average short-term rate *change* in expansions and in contractions, respectively, dwarfs the small difference in the corresponding average levels. The long-term interest rate has also risen in all seven postwar expansions and declined in six of the eight contractions, though here the (algebraic) difference for the respective average changes has been much smaller, as most familiar theories of the pricing of long-term versus short-term assets would imply.

In summary, both the annual data plotted in figure 7.1 and the cycle-specific averages of quarterly data shown in tables 7.1 and 7.2 give the impression of strong and persistent regularities in the monetary and financial aspects of United States economic fluctuations. On closer inspection, however, many of these regularities turn out not to be so regular or so persistent after all. Although the investigation of these relationships in a dynamic context is the subject of sections 7.4 and 7.5 below, table 7.3 provides a quick overview by showing simple correlation coefficients relating the annual movements of the monetary

13. It is at first tempting to suggest that, given the upward secular trend, the lower average levels for expansions are simply due to the omission of the expansion that began in 1982:4; but any such claim would of course be merely a forecast.

Table 7.2 **Postwar Cyclical Movements of Interest Rates**

Business Cycles		Average Level of Short Rate		Average Level of Long Rate		Change in Short Rate		Change in Long Rate	
Peaks	Troughs	Contractions	Expansions	Contractions	Expansions	Contractions	Expansions	Contractions	Expansions
1948:4									
		1.50%		3.43%		−0.20%		−0.19%	
	1949:4								
			2.00%		3.42%		1.25%		0.47%
1953:2									
		2.28		3.69		−0.99		−0.31	
	1954:2								
			2.68		3.87		2.32		1.38
1957:3									
		3.12		4.79		−2.24		−0.28	
	1958:2								
			3.52		5.00		2.36		0.65
1960:2									
		3.43		5.12		−1.06		−0.19	
	1961:1								
			4.72		5.72		5.61		3.44
1969:4									
		7.89		8.97		−2.32		0.65	
	1970:4								
			6.02		8.38		2.69		0.70
1973:4									
		9.15		9.58		−2.42		2.18	
	1975:1								
			7.57		10.10		7.69		3.04
1980:1									
		11.55		13.42		−4.61		−0.23	
	1980:3								
			14.05		15.20		6.57		3.20
1981:3									
		12.78		16.22		−7.40		−2.36	
	1982:4								
Mean for all contractions		6.46%		8.15%		−2.65%		−0.09%	
Mean for all expansions			5.79%		7.38%		4.07%		1.64%

and financial variables plotted in figure 7.1 to the annual percentage change in real gross national product.[14] For the monetary and credit aggregates, the table also shows analogous correlations for the corresponding aggregates deflated by the gross national product price deflator.

To highlight changes in these relationships over time, table 7.3 presents correlation coefficients separately for the pre–World War I (1891–1916), interwar (1919–40), and post–World War II (1947–82) periods, and also for two subperiods (1947–65 and 1966–82) within the postwar period. Especially from the perspective of changes in monetary policy, other possible breaks in the postwar period would also be logical, including 1951 when the Treasury/Federal Reserve Accord took effect, 1970 when the Federal Reserve System first began to employ explicit monetary aggregate targets and also first began to suspend regulation Q ceilings, and 1979 when the Federal Reserve (temporarily) adopted new operating procedures. The break at 1966 roughly separates the early postwar years of low price inflation, stable real economic growth, and few apparent "supply shocks" from the subsequent years of rapid and accelerating price inflation, less stable and on average slower real growth, and occasional large supply-side disturbances.

For each monetary or financial variable among the eight considered, and for each separate time period, table 7.3 reports the simple correlation of the variable's annual percentage change (for interest rates, the absolute change) with the annual percentage change of real gross national product for three lead/lag relationships: first with the monetary or financial variable leading real growth by one year, next contemporaneously, and last with that variable lagging real growth by one year.

In contrast to the appearance of strong regularities in figure 7.1 and in tables 7.1 and 7.2, the dominant impression given by these correlations is the absence of systematic relationships that have persisted across the different time periods under consideration.[15] The only two consistently significant relationships are the tendency of real M2 growth to be rapid (slow) contemporaneously with rapid (slow) real growth, and of long-term interest rates to fall (rise) in the year before a year of rapid (slow) real growth. Nominal M1 growth was strongly positively correlated with contemporaneous real growth during the interwar period, but less so during either half of the postwar period considered separately and not at all for the postwar period overall. Real M1 growth

14. From 1929 to 1982 the underlying GNP data are the standard national income and product accounts (NIPA) estimates. From 1909 to 1928 the data are United States Department of Commerce estimates, which (in principle) are analogous to the subsequent NIPA estimates at the aggregate level. From 1890 to 1908 the data are Department of Commerce estimates based on Kendrick 1961.

15. In addition, because the underlying variables are serially correlated, the conventional statistical confidence levels indicated in table 7.3 are overstated.

Table 7.3 Simple Annual Correlations With Real Economic Growth

Variable	1891–1916	1919–40	1947–82	1947–65	1965–82
	—	.20	−.22	−.02	−.18
Money growth (M1)	—	.69***	.17	.46**	.43*
	—	.43*	.05	.19	.13
	—	.28	−.04	.11	−.06
Real balances growth (M1)	—	.77***	.42***	.56**	.36
	—	.19	.12	.13	.05
	−.02	.09	—	.04	—
Money growth (M2)	.65***	.64***	—	.22	—
	−.18	.56**	—	.12	—
	−.08	.22	—	.13	—
Real balances growth (M2)	.58***	.85***	—	.44**	—
	−.29	.34	—	.10	—
	—	.25	−.17	.01	.04
Credit growth	—	.69***	.13	.54**	.31
	—	.50**	−.20	−.54**	.12
	—	−.00	−.07	−.01	.01
Real credit growth	—	.34	.49***	.52**	.67***
	—	−.31	.15	−.38	.56**
	−.21	.22	−.34**	−.03	−.48**
Short rate growth	−.39*	−.24	−.65***	−.49**	−.79***
	.56***	.19	.26	.55**	.20
	—	−.59***	−.52***	−.74***	−.52**
Long rate growth	—	−.65***	−.38**	−.05	−.52**
	—	.03	−.02	−.04	−.01

*Significant at .10 level.
**Significant at .05 level.
***Significant at .01 level.

was strongly correlated with contemporaneous real economic growth earlier on, but not during the later postwar period. Neither nominal nor real M1 growth has shown a significant lead or lag relationship to real economic growth on an annual basis. Nominal M2 growth was strongly positively correlated with contemporaneous real growth during the prewar and interwar periods, but not since World War II.

Nominal credit growth resembles nominal M1 growth in being strongly positively correlated with contemporaneous real economic growth during the interwar period and the early postwar period, but not for the later postwar period or for the postwar period as a whole. For the interwar and early postwar periods, lagged credit growth has been significantly correlated with real economic growth, although positively in the former years and negatively in the latter. Real credit growth has been positively correlated with real economic growth on a contemporaneous basis throughout the postwar period, but it was not so earlier on.

Finally, both short- and long-term interest rate changes have been negatively correlated with contemporaneous real economic growth, and (except for short-term rates in the interwar period) with the following year's real growth, throughout the period under study here. Many of these correlations are not significant, however. The contemporaneous relationship for short-term rates is significant except for the interwar years, and for long-term rates it is so except for the early postwar period. The change in short-term rates has been positively correlated with the prior year's real growth, but significantly so only during the prewar and early postwar periods.

Simple correlations based on annual data are a crude way of summarizing economic relationships, of course, even when they allow for modest leads or lags. Nevertheless, if the regularities connecting monetary and financial variables to business cycles were sufficiently powerful and persistent, they would be likely to show up more strongly even in these simple correlations. That they do not is hardly the end of the story, but the fact that it is necessary to look harder in order to find them is itself suggestive.

7.3 Money, Credit, and "Velocity" in Postwar Business Cycles

A subject that has run throughout the long-standing literature of monetary and financial aspects of economic fluctuations is the respective roles in this context of money (or credit) and the associated "velocity" defined simply as the ratio of nominal income to money (or, again, to credit). Before examining the United States experience in this regard, it is useful to point out the absence of any economic meaning of "velocity" as so defined—other than, by definition, the income-to-

money ratio. Because the "velocity" label may seem to connote deposit or currency turnover rates, there is often a tendency to infer that "velocity" defined in this way does in fact correspond to some physical aspect of economic behavior. When the numerator of the ratio is income rather than transactions or bank debits, however, "velocity" is simply a numerical ratio.[16]

As table 7.1 shows for the postwar period, both money and credit grow faster on average during economic expansions than during contractions. The issue of money or credit movements versus their respective "velocities," in a business cycle context, is just the distinction between movements of nominal income that match movements of money or credit and movements of income that do not, and hence that imply movements in the income-to-money or income-to-credit ratio.

Table 7.4, using quarterly data for postwar cyclical episodes exactly analogous to the money and credit growth averages in table 7.1, shows that the "velocity" associated with each aggregate has also exhibited strong cyclical properties. Monetary velocity, which has had an upward secular trend since World War II, has risen on average in each expansion and has declined on average in six of eight contractions. The average growth of monetary velocity in expansions has exceeded that in contractions by 4.76% per annum, a much greater difference than the 1.68% per annum shown in table 7.1 for money growth itself. Credit velocity, which has been trendless on average since World War II, has risen on average in four of six expansions and declined on average in each contraction. The average growth of credit velocity in expansions has exceeded that in contractions by 4.31% per annum, again a much larger difference than the 1.35% per annum difference shown in table 7.1 for credit growth.

Because the numerator of the "velocity" ratio is nominal income, while business cycle expansions and contractions typically refer to fluctuations of real economic activity, it is difficult to go much further in considering money, credit, and their respective "velocities" in a business cycle context without allowing for cyclical variation in price inflation. As table 7.5 shows, however, during the postwar period price inflation has apparently followed the business cycle with a sufficient lag that the movements of real and nominal gross national product during expansions and contractions have almost exactly corresponded on average. Real income, of course, has grown on average in each expansion and declined on average in each contraction, with an (algebraic) difference of 5.83% per annum between the mean for all expansions and the mean for all contractions. By contrast, because of

16. See Cramer 1983, for example, for evidence on the different respective movements of income and total transactions.

Table 7.4 Postwar Cyclical Movements of Money and Credit "Velocities"

Business Cycles		Average Growth Rate of Money "Velocity"		Average Growth Rate of Credit "Velocity"	
Peaks	Troughs	Contractions	Expansions	Contractions	Expansions
1948:4					
		−1.61%		—	
	1949:4				
			5.57%		—
1953:2					
		−2.00		−6.12%	
	1954:2				
			4.46		0.47%
1957:3					
		−1.00		−5.78	
	1958:2				
			4.26		−0.21
1960:2					
		−1.17		−4.39	
	1961:1				
			3.03		0.27
1969:4					
		−0.16		−2.34	
	1970:4				
			3.01		0.12
1973:4					
		2.35		−1.75	
	1975:1				
			3.95		−0.29
1980:1					
		0.47		−1.74	
	1980:3				
			4.34		2.79
1981:3					
		−2.33		−4.35	
	1982:4				
Mean for all contractions		−0.68%		−3.78%	
Mean for all expansions			4.08%		0.53%

Note: Values shown are in percent per annum.

the upward secular trend in price inflation, nominal income declined in the first three postwar contractions but increased in the subsequent five. Even so, the difference between the average growth of nominal income in expansions and contractions, respectively, has been 6.44% per annum—almost identical to the corresponding difference for real income. At least for averages across business cycle expansions and contractions, therefore, relationships to nominal income (like those

Table 7.5 **Postwar Cyclical Movements of Real and Nominal Income**

Business Cycles		Average Growth Rate of Real income		Average Growth Rate of Nominal Income	
Peaks	Throughs	Contractions	Expansions	Contractions	Expansions
1948:4					
		−0.37%		−2.36%	
	1949:4				
			6.36%		9.47%
1953:2					
		−1.94		−0.84	
	1954:2				
			3.43		6.15
1957:3					
		−2.11		−0.36	
	1958:2				
			4.62		6.56
1960:2					
		−0.38		0.26	
	1961:1				
			4.38		7.17
1969:4					
		−0.54		4.37	
	1970:4				
			4.51		9.73
1973:4					
		−2.79		6.73	
	1975:1				
			3.73		10.60
1980:1					
		−2.27		7.07	
	1980:3				
			3.45		12.23
1981:3					
		−1.42		4.36	
	1982:4				
Mean for all contractions		−1.48%		2.40%	
Mean for all expansions			4.35%		8.84%

Note: Values shown are in percent per annum.

based on "velocity" ratios) approximately carry over to relationships to real income, and hence to economic fluctuations in the ordinary business cycle sense. Table 7.6 summarizes these relationships by collecting the means from tables 7.1, 7.4, and 7.5 and the corresponding implied means of price inflation.[17]

17. The reason for calculating the relationships among the nonfinancial variables a second time in the lower half of the table is that quarterly credit data are not available for the first postwar contraction and expansion. The same point applies to table 7.7.

Table 7.6 Cyclical Means for Income, Money, Credit, and "Velocity"

	1948:4 to 1982:4		
Variable	Eight Contractions	Seven Expansions	Difference
Mean X	−1.48%	4.35%	5.83%
Mean Y	2.40	8.84	6.44
−Mean P	−3.89	−4.51	−.62
Mean Y	2.40%	8.84%	6.44%
Mean M	3.08	4.76	1.68
Mean Vm	−.68	4.08	4.76
	1953:2 to 1982:4		
Variable	Seven Contractions	Six Expansions	Difference
Mean X	−1.64%	4.02%	5.66%
Mean Y	3.08	8.74	5.66
−Mean P	−4.72	−4.72	.00
Mean Y	3.08%	8.74%	5.66%
Mean C	6.86	8.21	1.35
Mean Vc	−3.78	.53	4.31

Note: Values are in percent per annum; detail may not add to totals because of rounding.
Definitions of variable symbols:
X = growth rate of real GNP;
Y = growth rate of nominal GNP;
P = growth rate of GNP price deflator;
M = growth rate of M1 money stock;
Vm = growth rate of Y/M;
C = growth rate of domestic nonfinancial credit;
Vc = growth rate of Y/C.

Table 7.7 pursues further the distinction of money and credit growth versus "velocity" growth by showing an analysis of variance for the respective real and nominal income identities summarized in terms of means in table 7.6. The upper half of the table first decomposes the variation of real income growth into components representing nominal growth, price inflation, and their covariance and then decomposes the variation of nominal income growth into components representing money growth, "velocity" growth (that is, nominal income growth that does not correspond to money growth), and the associated covariance term.

The first column of the table applies this decomposition only to contractions, treating each one as a simple observation—in other words, asking what role money growth, "velocity" growth, and price inflation have played in accounting for differences between one business contraction and another. The average (negative) real growth rate has varied little among successive contraction episodes, so that the differences here are almost entirely differences among respective contractions' rates of price inflation and hence of nominal growth.

Table 7.7 **Cyclical Variance Decompositions for Money, Credit, and "Velocity"**

	1948:4 to 1982:4		
Variable	Eight Contractions	Seven Expansions	Fifteen Periods
Var (X)	.89	1.03	9.96
Var (Y)	13.38	5.17	19.96
Var (P)	17.66	6.56	11.74
-2 cov (Y, P)	−30.15	−10.70	−21.76
Var (Y)	13.38	5.17	19.96
Var (M)	8.04	5.64	7.18
Var (Vm)	2.30	.79	7.52
$+2$ cov (M, Vm)	3.04	−1.26	5.25
	1953:2 to 1982:4		
Variable	Seven Contractions	Six Expansions	Thirteen Periods
Var (X)	.81	.30	9.14
Var (Y)	11.28	6.11	16.80
Var (P)	14.04	7.42	10.11
-2 cov (Y, P)	−24.51	−13.23	−17.77
Var (Y)	11.28	6.11	16.80
Var (C)	3.22	4.20	3.85
Var (Vc)	3.42	1.31	7.25
$+2$ cov (C, Vc)	4.64	.60	5.70

Note: Values are in percent per annum squared. See table 7.6 for definitions of variable symbols.

The results show that money growth variations have dominated velocity growth variations in accounting for these differences. Analogous results presented in the second column show an even greater predominance of money growth variations over velocity growth variations in accounting for nominal income growth differences across expansions. The final column of the table presents the results of an analogous decomposition applied to all contractions and all expansions, again treating each as a single observation—in other words, asking what role money growth, velocity growth, and price inflation have played in accounting for differences not just among contractions or among expansions but also between contractions and expansions. In this context the respective variations of money growth and velocity growth have been more nearly coequal, and also importantly correlated.

The lower half of table 7.7 presents the analogous three sets of decompositions including credit and credit "velocity." The results are similar to those for money and money velocity shown above, but in

each case with a smaller role for the aggregate, and consequently a greater role for velocity. Variations in credit growth have predominated over velocity growth variations only in accounting for differences among expansions. For differences among contractions, the two have been approximately coequal and importantly correlated. Variations in credit velocity, and its correlation with credit growth variations, have been more important than variations in credit growth per se in the broader cyclical context of accounting also for differences between expansions and contractions.

7.4 Dynamic Relationships

Simple annual correlations like those shown in table 7.3 fail to convey what it is important to know about the comovement of economic time series in a business cycle context for at least three reasons. First, the relevant lead/lag relationships may be distributed over either more or less than one year. The work of Friedman and Schwartz (1963a), for example, concluded that variations in money growth typically lead variations in income growth by less than a year. Second, even highly significant lead correlations may merely reflect the interaction of contemporaneous (or even lagged) relationships among time series that are individually autocorrelated. In contrast to the propositions that characterized much of the earlier literature on monetary and financial aspects of economic fluctuations, which typically referred simply to the comovement among two or more variables, the modern analysis of business cycles focuses instead on whether movements in one variable are systematically related to those parts of the movements in another that are not purely autoregressive. Third, the relationship of one variable to another may depend on what further variables the analysis includes. The proposition that two variables exhibit a stable relationship to one another without allowance for further variables implies either that other variables are unimportant to that relationship or that whatever other variables are relevant have not varied (will not vary) significantly during the period under study. The results presented in this section of the paper extend the simple overview provided in table 7.3 so as to take account of each of these potentially important considerations.

Table 7.8 presents *F*-statistics for conventional exogeneity ("causality") tests of bivariate annual relationships connecting nominal income growth respectively to the growth of M1, M2, and credit, and the change in short- and long-term interest rates, for the same time periods used in table 7.1. Table 7.9 presents analogous results for bivariate re-

Table 7.8 **Summary of Bivariate Annual Relationships: Financial Variables and Nominal Income**

Variable	1891–1916	1919–40	1947–82	1947–65	1966–82
Equation for *Y*					
F (*Y*)	—	0.21	1.97	1.21	1.20
F (*M1*)	—	1.39	6.87***	6.38**	0.32
Equation for *M1*					
F (*Y*)	—	1.13	1.64	0.93	0.17
F (*M1*)	—	4.77**	13.77***	2.83*	4.10**
Equation for *Y*					
F (*Y*)	4.01**	0.08	—	1.68	—
F (*M2*)	4.07**	1.01	—	0.19	—
Equation for *M2*					
F (*Y*)	2.11	0.54	—	1.11	—
F (*M2*)	3.29*	2.20	—	1.38	—
Equation for *Y*					
F (*Y*)	—	0.16	2.12	0.64	5.82**
F (*C*)	—	3.14*	9.83***	0.40	11.18***
Equation for *C*					
F (*Y*)	—	0.03	18.21***	18.17***	1.98
F (*C*)	—	1.08	64.11***	2.59	11.89***
Equation for *Y*					
F (*Y*)	0.34	2.92*	0.28	1.01	5.75**
F (*Rs*)	4.09**	1.42	1.03	0.67	8.82***
Equation for *Rs*					
F (*Y*)	1.70	0.88	0.51	0.21	0.77
F (*Rs*)	9.86***	0.95	4.29**	3.38*	1.88
Equation for *Y*					
F (*Y*)	—	0.15	0.09	1.12	0.37
F (*RI*)	—	6.23**	0.31	4.32**	1.91
Equation for *RI*					
F (*Y*)	—	0.18	1.48	0.06	1.48
F (*RI*)	—	1.27	8.49***	0.23	1.71

Note: Values shown are *F*-statistics.
Definitions of variable symbols:
Y = growth rate of nominal GNP;
M = growth rate of money stock (M1 or M2);
C = growth rate of domestic nonfinancial credit;
Rs = change in prime commercial paper rate;
RI = change in Baa bond rate.
Significance levels:
*Significant at .10 level.
**Significant at .05 level.
***Significant at .01 level.

Table 7.9 **Summary of Bivariate Annual Relationships: Financial Variables and Real Income**

Variable	1891–1916	1919–40	1947–82	1947–65	1966–82
Equation for *X*					
F (*X*)	—	0.14	0.85	1.69	0.17
F (*M1*)	—	0.19	7.73***	5.57**	2.42
Equation for *M1*					
F (*X*)	—	0.19	2.39	4.20**	0.74
F (*M1*)	—	2.53	22.57***	4.40**	1.10
Equation for *X*					
F (*X*)	2.56	0.78	—	0.47	—
F (*M2*)	0.70	0.06	—	2.40	—
Equation for *M2*					
F (*X*)	5.12**	0.64	—	3.48*	—
F (*M2*)	5.53**	1.91	—	4.98**	—
Equation for *X*					
F (*X*)	—	0.13	0.42	0.73	0.02
F (*C*)	—	0.79	2.42	0.81	1.82
Equation for *C*					
F (*X*)	—	0.58	7.94***	8.08***	2.20
F (*C*)	—	0.78	42.64***	3.92**	14.23***
Equation for *X*					
F (*X*)	0.71	1.98	2.74*	1.68	2.83*
F (*Rs*)	3.65**	1.51	14.91***	3.52*	25.11***
Equation for *Rs*					
F (*X*)	2.48	0.58	0.50	0.02	1.15
F (*Rs*)	10.90***	1.22	3.69**	3.35*	0.48
Equation for *X*					
F (*X*)	—	0.07	.35	2.64	1.21
F (*Rl*)	—	3.57*	4.84**	8.32***	3.13*
Equation for *Rl*					
F (*X*)	—	0.04	0.83	0.13	1.99
F (*Rl*)	—	0.94	9.89***	0.37	2.75

Note: *X* = growth rate of real GNP. See also table 7.8.

lationships to real economic growth.[18] Such exogeneity tests constitute the modern formal analogue to the investigation of leads and lags that has been central to the more traditional business cycle literature. Once again, however, the chief impression given by these results is the absence of persistence over time in familiar simple quantitative relationships.

18. The underlying vector autoregressions include a constant term and two lags on each variable in each equation. The results for analogous autoregressions also including a linear time trend are broadly similar. (The most interesting difference to emerge on the introduction of a time trend is that M1 no longer helps explain nominal income.) Two lags appear to be sufficient to eliminate most, if not all, of the serial correlation in the residuals of the equations based on these annual data. Because each equation includes lags on *both* variables, and therefore a rational distributed lag, there is no limitation on the length of lag in the economic process represented.

The often-assumed relationship by which M1 growth helps explain either nominal or real economic growth, but not vice versa, appears in the results in tables 7.8 and 7.9 only since World War II, and only when the first half of the postwar period is included. Growth in M2 helps explain nominal economic growth only before World War I, and it does not help explain real economic growth in this sense in any of the three periods studied. Credit growth helps explain nominal income growth both in the interwar period and in the postwar period as long as the more recent postwar years are included, but for the postwar period as a whole nominal income growth also helps explain credit growth. Credit growth does not help explain real income growth in this sense in any period. The change in short-term interest rates helps explain both nominal and real income growth, but not vice versa, in the prewar period and in the second half of the postwar period. The change in long-term interest rates helps explain both nominal and real income growth, but not vice versa, in the interwar period and the first half of the postwar period.

It is important to distinguish these generally negative findings from the more traditional propositions, noted and in some cases documented above, about the comovement in a simple sense, including lead and lag relationships, connecting income with familiar monetary and financial variables. As figure 7.1 and tables 7.1 to 7.3 show, each of the five monetary and financial variables considered here has exhibited distinctly cyclical movements, at least during some time periods. What the tests in tables 7.8 and 7.9 seek to establish, however, is not just whether a variable has fluctuated in conjunction with movements in income, but whether it has shown a relationship to that part of the movement in income that is not explainable in purely autoregressive terms. Even a readily visible simple relationship to income fluctuations need not—indeed, evidently often does not—imply a corresponding relationship to the elements of income fluctuations that are not purely autoregressive.

More important, the basic theme of this paper focuses less on what helps explain what than on which, if any, quantitative relationships have persisted across spans of time during which the United States financial markets have undergone changes like those reviewed in section 7.1, which at least in principle could have importantly affected the monetary and financial aspects of economic fluctuations. Table 7.10 presents further F-statistics testing the null hypothesis of absence of structural change in the bivariate relationships summarized in tables 7.8 and 7.9 against the alternative hypothesis of breaks at World War II and at the midpoint of the postwar period to date (and also, for relationships involving M2 and the short-term interest rate, at World

Table 7.10 Test Statistics for Stability in Bivariate Annual Relationships

	Break at 1916	Break at 1940	Break at 1965
Equation for *Y*	—	6.15***	9.34***
Equation for *M1*	—	6.80***	8.07***
Equation for *Y*	22.92***	5.01***	—
Equation for *M2*	12.45***	24.24***	—
Equation for *Y*	—	2.12**	34.49***
Equation for *C*	—	15.45***	5.59***
Equation for *Y*	13.90***	2.56**	5.23***
Equation for *Rs*	4.26***	24.16***	52.23***
Equation for *Y*	—	5.12***	10.93***
Equation for *Rl*	—	4.68***	52.91***
Equation for *X*	—	8.23***	7.92***
Equation for *M1*	—	6.64***	13.26***
Equation for *X*	20.24***	4.26***	—
Equation for *M2*	24.58***	15.49***	—
Equation for *X*	—	1.72	9.42***
Equation for *C*	—	18.97***	10.79***
Equation for *X*	10.76***	2.49**	2.16
Equation for *Rs*	6.43***	22.66***	50.77***
Equation for *X*	—	3.87***	10.91***
Equation for *Rl*	—	4.79***	55.82***

Note: See tables 7.8 and 7.9.

War I). In all but two isolated cases, the data indicate significant structural change. What is especially striking in the results of these stability tests is that even sets of coefficients that tables 7.8 and 7.9 report to be not significantly different from zero are nonetheless significantly different from one another.

Annual data, of course, may simply be too coarse to capture the relevant behavior connecting these aspects of aggregative economic activity. Tables 7.11 and 7.12 therefore present *F*-statistics for analogous bivariate exogeneity tests for the respective relationships of nominal and real income growth to the growth of money (M1) and credit and the change in short- and long-term interest rates, based on quarterly data for the post–World War II period.[19] Money growth consistently helps explain both nominal and real economic growth, as is familiar from previous work, but these results show that either nominal or real income growth also typically helps explain money growth (so that money does not "cause" income in the Granger sense). Credit growth helps

19. The underlying vector autoregression systems include a constant term and four lags on each variable in each equation. (The discussion of lag length in footnote 18 applies here too.) Once again, the results for analogous autoregressions also including a linear time trend are broadly similar.

Table 7.11 **Summary of Bivariate Quarterly Relationships: Financial Variables and Nominal Income**

Variable	1952:1 to 1982:4	1952:1 to 1965:4	1966:1 to 1982:4
Equation for *Y*			
F (*Y*)	3.84***	2.23*	0.28
F (*M*)	10.28***	2.13*	2.80**
Equation for *M*			
F (*Y*)	4.09***	2.30*	1.01
F (*M*)	14.42***	8.31***	1.69
Equation for *Y*			
F (*Y*)	2.95**	2.61**	2.23*
F (*C*)	13.52***	1.69	9.04***
Equation for *C*			
F (*Y*)	2.17*	1.21	1.69
F (*C*)	45.41***	2.50*	28.22***
Equation for *Y*			
F (*Y*)	3.93***	2.94**	0.30
F (*Rs*)	5.43***	5.75***	4.03***
Equation for *Rs*			
F (*Y*)	0.68	1.42	1.02
F (*Rs*)	5.99***	6.71***	2.65**
Equation for *Y*			
F (*Y*)	6.33***	8.39***	0.32
F (*Rl*)	0.94	1.42	0.69
Equation for *Rl*			
F (*Y*)	0.88	1.36	0.81
F (*Rl*)	2.04*	1.10	3.39**

Note: Values shown are *F*-statistics.

Definitions of variable symbols:
Y = growth rate of nominal GNP;
M = growth rate of M1 money stock;
C = growth rate of domestic nonfinancial credit;
Rs = change in prime commercial paper rate;
Rl = change in Baa bond rate.

Significance levels:
*Significant at .10 level.
**Significant at .05 level.
***Significant at .01 level.

explain nominal income, but not vice versa, in the second half of the postwar period. For the postwar period as a whole, credit growth again helps explain nominal income growth, while the reverse effect is only marginally significant. Changes in short-term interest rates consistently help explain nominal income growth, but not vice versa, and the same is true with respect to real income growth in the later postwar years. Changes in long-term interest rates never help explain income at all in this context. Finally, table 7.13 shows that most of these quarterly results also fail to exhibit stability across the earlier and later halves

Table 7.12 **Summary of Bivariate Quarterly Relationships: Financial Variables and Real Income**

Variable	1952:1 to 1982:4	1952:1 to 1965:4	1966:1 to 1982:4
Equation for *X*			
F (*X*)	3.91***	3.43**	1.35
F (*M*)	3.81***	3.72**	3.32**
Equation for *M*			
F (*X*)	2.71**	2.30*	0.97
F (*M*)	21.02***	7.24***	2.05*
Equation for *X*			
F (*X*)	3.16**	6.83***	0.89
F (*C*)	0.69	3.12**	0.54
Equation for *C*			
F (*X*)	4.94***	4.39***	0.84
F (*C*)	58.09***	1.49	24.15***
Equation for *X*			
F (*X*)	4.61***	3.57**	2.63**
F (*Rs*)	5.44***	1.20	5.81***
Equation for *Rs*			
F (*X*)	3.70***	3.46**	1.95
F (*Rs*)	7.40***	4.30***	3.90***
Equation for *X*			
F (*X*)	5.47***	4.90***	1.91
F (*Rl*)	1.00	0.88	0.75
Equation for *Rl*			
F (*X*)	1.31	2.18*	1.73
F (*Rl*)	2.35*	1.39	3.10**

Note: *X* = growth rate of real GNP. See table 7.11.

of the postwar period. Further results (not shown) are also broadly similar for other logical break points like those suggested in section 7.2.

One reason relationships like these may appear to be unstable, of course, is that they are misspecified—for example, by the omission of other relevant variables. Given the results for the bivariate relationships in tables 7.8 and 7.9 and tables 7.11 and 7.12, in which several monetary and financial variables each appear to be related to either nominal or real income growth at least in some periods, it is difficult to justify the use of only bivariate relationships. Table 7.14 presents *F*-statistics for analogous exogeneity tests based on a five-variable annual system including real income growth, price inflation, money (M1) growth, credit growth, and the change in the short-term interest rate, for the same interwar and postwar periods studied earlier.

Even with only three monetary and financial variables in the system, however, it is difficult to draw any solid conclusions from this expanded analysis. Among the three, only money growth significantly helps ex-

Table 7.13 Test Statistics for Stability in Bivariate Quarterly Relationships

	Break at 1965:4
Equation for Y	1.24
Equation for M	1.70*
Equation for Y	2.29**
Equation for C	2.94***
Equation for Y	5.58***
Equation for Rs	0.79
Equation for Y	3.90***
Equation for Rl	1.77*
Equation for X	2.12**
Equation for M	2.30**
Equation for X	1.81*
Equation for C	2.76***
Equation for X	1.63
Equation for Rs	0.31
Equation for X	.83
Equation for Rl	2.51***

Note: See tables 7.11 and 7.12.

plain real income growth—given the presence of the other included variables—in any period examined, and even this effect is evident only for samples including the first half of the postwar period.[20] At the same time, real income growth helps explain both money growth and credit growth during the full postwar period, and it also helps explain money growth during the later postwar years. Real income growth only marginally helps explain the short-term interest rate change. Once again, what significant regularities do appear have not been regular enough to persist across different time periods.

The same generalization also characterizes analogous results for multivariate systems estimated for the post–World War II period using quarterly data. There is little point in displaying vast quantities of empirical results along these lines, since the basic lack of consistency is readily apparent just from a summary of what does and does not help explain real income growth in quarterly systems based on different subperiods. For the quarterly version of the same *five*-variable system shown in table 7.14, neither money growth nor credit growth nor the short-term interest rate change significantly helps explain real income growth, even at the .10 level—again, given the presence of one another—for 1952:1 to 1982:4, 1952:1 to 1965:4, or 1966:1 to 1982:4. By

20. In this system the most interesting difference to appear on the introduction of a time trend is that the one variable that helps explain real income growth is not money growth but the change in short-term interest rates.

Table 7.14 Summary of Annual Relationships: Five-Variable System

Variable	1919–40	1947–82	1947–65	1966–82
Equation for X				
$F(X)$	0.40	3.95**	1.50	1.42
$F(P)$	0.82	1.13	1.46	1.51
$F(M)$	0.59	5.17**	4.11*	2.44
$F(C)$	0.44	0.85	0.40	3.18
$F(Rs)$	2.43	2.49	0.09	3.43
Equation for P				
$F(X)$	4.51**	4.46**	3.67*	1.64
$F(P)$	5.61***	3.50**	0.67	0.83
$F(M)$	8.59***	0.52	1.07	1.10
$F(C)$	2.86	2.75*	0.01	1.74
$F(Rs)$	2.59	6.57***	0.40	3.08
Equation for M				
$F(X)$	1.06	6.15***	2.04	5.04***
$F(P)$	0.82	1.04	0.22	9.35***
$F(M)$	2.18	0.38	1.19	1.95
$F(C)$	1.64	4.58**	0.85	10.41**
$F(Rs)$	2.56	2.74*	0.29	10.66**
Equation for C				
$F(X)$	1.11	11.57***	3.69*	0.88
$F(P)$	0.68	3.25*	0.28	1.00
$F(M)$	1.69	0.34	0.89	1.29
$F(C)$	1.66	11.62***	0.94	4.87*
$F(Rs)$	3.81*	3.44**	0.46	1.39
Equation for Rs				
$F(X)$	0.99	2.74*	0.64	3.70*
$F(P)$	0.54	1.62	0.07	0.35
$F(M)$	0.41	1.12	0.07	2.15
$F(C)$	2.15	2.38	0.12	1.51
$F(Rs)$	0.27	2.24	0.29	2.16

Note: Variables shown are F-statistics.

Definitions of variable symbols:
- X = growth rate of real GNP;
- P = growth rate of GNP price deflator;
- M = growth rate of M1 money stock;
- C = growth rate of domestic nonfinancial credit;
- Rs = change in prime commercial paper rate.

Significance levels:
- *Significant at .10 level.
- **Significant at .05 level.
- ***Significant at .01 level.

contrast, for the *four*-variable system estimated for 1953:1 to 1978:4 in Friedman (1983c), including all of the same variables as in table 7.14 except the interest rate change, money growth and credit growth each significantly help explain real income growth at the .05 level.[21] Similarly, for the *six*-variable system estimated for 1962:3 to 1979:3 in Clar-

21. In this system real growth in turn helps explain money growth but not credit growth.

ida and Friedman (1984), including all the same variables as in table 7.14 plus the change in the federal government budget deficit, credit growth significantly helps explain real income growth at the .01 level, money growth does so at the .05 level, and the short-term interest rate change does so at the .10 level.[22]

Moreover, these multivariate relationships too show significant evidence of instability from one time period to another, thereby revealing that the instability of the bivariate systems documented in table 7.10 is not due to anything so simple as merely omitting a small number of familiar variables. Table 7.15 presents *F*-statistics testing the null hypothesis of absence of structural change in the five-variable annual relationships summarized in table 7.14, and in the corresponding quarterly relationships, against the alternative hypothesis of a break between the interwar and postwar periods or between the first and second halves of the postwar period. The annual data indicate significant structural change in each relationship at World War II, though only for the interest rate equation at 1965. The appearance of stability between the first and second halves of the postwar period is probably just due to lack of degrees of freedom, however, since the corresponding quarterly data indicate highly significant structural change in each relationship at 1965:4. In sum, neither using quarterly data in place of annual, nor using multivariate systems in place of bivariate, nor doing both at once overturns the general finding of heterogeneity from one period to another in the monetary and financial aspects of economic fluctuations.

Finally, because the very notion of business "cycles" suggest the possibility of comovements that recur at possibly regular intervals, it is interesting to see whether the frequency domain properties of the comovements studied here can provide further information to supplement the time-domain properties reported above. In particular, what

Table 7.15 **Test Statistics for Stability in Five-Variable System**

	Annual Relationships		Quarterly Relationships
	Break at 1940	Break at 1965	Break at 1965:4
Equation for *X*	2.42**	2.15	10.82***
Equation for *P*	17.35***	1.15	11.00***
Equation for *M*	6.34***	2.18	14.67***
Equation for *C*	39.82***	2.05	8.32***
Equation for *Rs*	44.09***	7.13***	121.79***

Note: See table 7.14.

22. In this system real growth in turn helps explain money growth but not credit growth or the interest rate change.

light can the associated frequency domain properties of these data shed on familiar questions like the "leads and lags" of monetary and financial aspects of economic fluctuations?

As would be expected, frequency domain methods immediately confirm the presence of strong cyclical comovements along the lines reported in section 7.2. The top two panels of figure 7.2 show the respective power spectra of money growth and credit growth, estimated using the full sets of available postwar quarterly data spanning 1947:1 to 1982:4 for money and 1952:1 to 1982:4 for credit.[23] Both

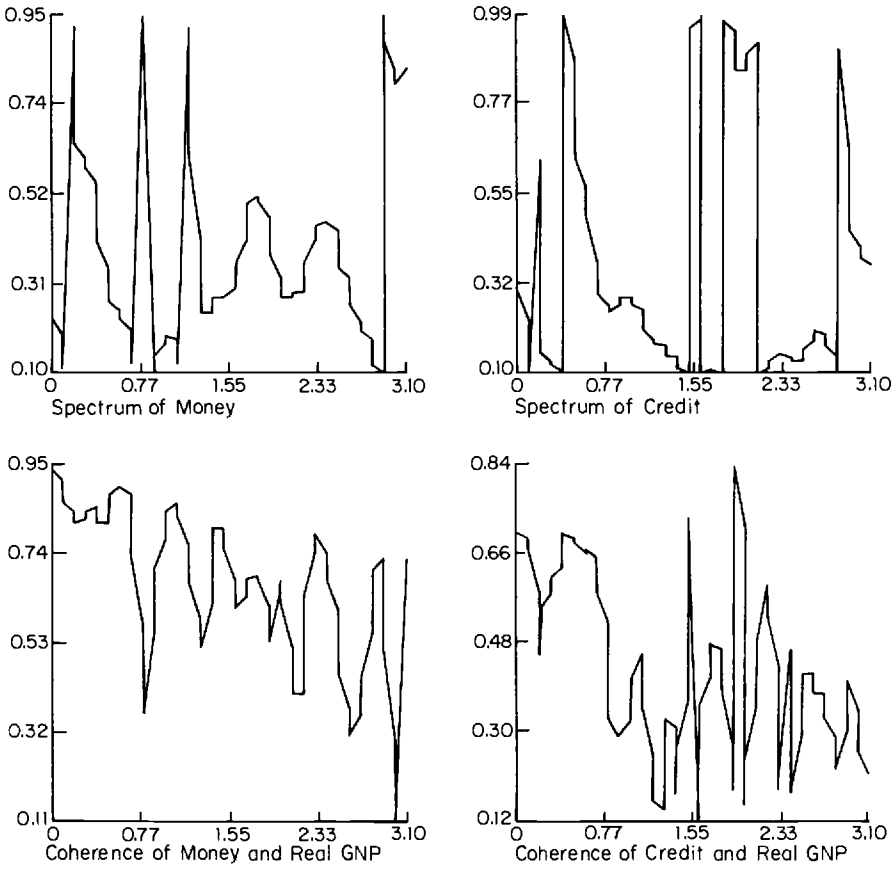

Fig. 7.2 Money and credit: spectra and coherences with real GNP.

23. This exercise relies on data for the full postwar period, despite the time domain evidence of structural change within that period, so as to provide enough observations to make the frequency domain analysis sensible. Both spectra, as well as the coherences displayed below, were estimated using a triangular window with bandwidth eleven.

spectra display substantial "noise" at high frequencies—say, 1.5 radians and above. More important from the perspective of the questions addressed here, both also display significant power at or near frequencies plausibly related to recognized business cycles. The record of seven complete cycles from the peak in 1948:4 to that in 1981:3 implies a mean cycle length of just under nineteen calendar quarters, equivalent to a frequency of almost exactly one-third radian. The spectra of both money growth and credit growth display sharp spikes at just that point.

Closer analysis of these two power spectra indicates, however, that the respective frequency domain properties of money and credit growth are not identical. In the range of 0.20 to 0.79 radian, corresponding to a period of two to eight years, the value of the test statistic for the null hypothesis of no difference between the two spectra is 3.90 (distributed normally with 22 degrees of freedom), indicating that the two spectra do differ significantly at the .01 level.[24] One way to explore further the nature of this difference in the frequency domain properties of money and credit growth is to examine their respective coherences with real income growth, shown in the bottom two panels of figure 7.2. Not surprisingly, both coherences display increases at about one-third radian. In the same range of 0.20 to 0.79 radian, the coherence of real income growth with money growth is .98 with standard error .01, while the coherence of real income growth with credit growth is .96, with standard error .02.[25]

In the same vein as the analysis of lead and lag relationships via the bivariate exogeneity tests reported above, a plausible question to ask in this context is whether these respective coherences indicate that either money growth or credit growth, or both, tends to lead real income growth. In fact, both do so, and credit somewhat more so, although the indicated leads are both surprisingly short in comparison to those usually suggested in the time domain literature. Money growth leads real income growth by a phase angle of only 0.11 radian (or 0.35 quarter, based on the 20-quarter midpoint of the two- to eight-year range) with standard error .05, while credit growth leads real income growth by 0.32 radian (or 1.02 quarters) with standard error .06. Even so, the difference between these two leads is not statistically significant. The value of the test statistic for the null hypothesis of no difference between the two coherences in the same 0.20 to 0.79 radian range is only .39 (distributed as a t-statistic with 22 degrees of freedom), not significant at any reasonable level.

24. I am grateful to Jim Powell for assistance in constructing the tests and for calculating the test statistics and their distributions reported here and in section 7.6 below.

25. With the estimated coherences so close to unity, the calculated standard errors are not well behaved.

In addition, in the same vein as the analysis of partial relationships via the multivariate exogeneity tests reported above, a further plausible question to ask in this context is whether the *partial* coherence of either money growth or credit growth with real income growth is significantly different from zero—in other words, whether either adds significantly to explaining the frequency domain properties of real income growth—given the presence of the other. As is largely consistent with the time domain results, the answer is no in both cases. For the same range of 0.20 to 0.79 radian, the values of the relevant test statistic (distributed as an F-statistic with 2 and 20 degrees of freedom) are .04 for the additional role of money growth and .42 for the additional role of credit growth. Neither value is significant at any reasonable level.

7.5 Statistical Significance and Economic Significance

The results of the stability tests reported in tables 7.10 and 7.15 indicate strong evidence of statistically significant differences, between one time period and another, in both bivariate and multivariate relationships summarizing the monetary and financial aspects of United States economic fluctuations. For many purposes, however, the statistical significance of such differences does not necessarily mean they are significant in a broader economic sense. After all, two corresponding coefficients, estimated for different time periods, can differ by an amount that is statistically significant but economically trivial if each is individually measured with sufficient precision. In addition, in dynamic relationships involving several coefficients, offsetting shifts in different coefficients can leave important properties of the resulting overall relationship unaffected.

The structural shifts in the monetary and financial aspects of the United States business cycle experience reported above are significant not just statistically but economically as well. Table 7.16 shows the full sets of estimation results for the bivariate annual relationship between real income growth and money growth summarized in the top section of table 7.9, for 1919–40, 1947–65, and 1966–82, respectively. As table 7.10 shows, the data indicate statistically significant shifts in these two estimated relationships. Comparison of the three full sets of results shown in table 7.16 confirms that these significant differences are typically due not to small changes in a few precisely measured coefficients but to one or even several quite large changes, sometimes even involving switches of sign.

Figure 7.3 shows the implications of the differences among these respective sets of estimated coefficients for the overall relationship between real income growth and money growth by tracing out the first ten years of the dynamic response pattern exhibited by the solved-out

Table 7.16 **Bivariate Relationships between Real Income and Money**

1919–40					
$X_t =$	.019	+ .190X_{t-1} −	.106X_{t-2} +	.277M_{t-1} −	.157M_{t-2}
	(.9)	(.5)	(−.3)	(.6)	(−.4)
	$\bar{R}^2 = .00$		$SE = .089$		$DW = 2.02$
$M_t =$	.022	+ .024X_{t-1} +	.156X_{t-2} +	.702M_{t-1} −	.581M_{t-2}
	(1.3)	(.1)	(.6)	(1.9)	(−1.9)
	$\bar{R}^2 = .28$		$SE = .071$		$DW = 1.66$
1947–65					
$X_t =$	.060	− .156X_{t-1} +	.351X_{t-2} +	.142M_{t-1} −	1.21M_{t-2}
	(4.1)	(−.5)	(1.5)	(.3)	(−3.3)
	$\bar{R}^2 = .32$		$SE = .023$		$DW = 1.46$
$M_t =$	.020	+ .018X_{t-1} +	.365X_{t-2} +	.216M_{t-1} −	.596M_{t-2}
	(2.6)	(.1)	(2.8)	(.8)	(−2.9)
	$\bar{R}^2 = .38$		$SE = .013$		$DW = 2.13$
1966–82					
$X_t =$	.089	+ .211X_{t-1} −	.164X_{t-2} +	.269M_{t-1} −	.837M_{t-2}
	(3.0)	(.5)	(−.5)	(−.4)	(−1.2)
	$\bar{R}^2 = .19$		$SE = .024$		$DW = 2.01$
$M_t =$	.045	− .034X_{t-1} −	.147X_{t-2} +	.429M_{t-1} −	.071M_{t-2}
	(2.8)	(−.2)	(−.9)	(1.1)	(−.2)
	$\bar{R}^2 = .02$		$SE = .013$		$DW = 2.17$

Note: X = growth rate of real GNP; M = growth rate of M1 money stock; $\bar{R}^2$ = adjusted coefficient of determination; SE = standard error of estimate; DW = Durbin-Watson statistic. Numbers in parentheses are t-statistics.

(but not orthogonalized) moving average representation of each of the three estimated bivariate autoregressions. The implied own-disturbance responses shown in the upper left and lower right panels of the figure are roughly similar among the three systems, but the implied cross-disturbance responses shown in the upper right and lower left panels diverge sharply and even include differences in the direction of the initial responses.

Table 7.17 and figure 7.4 present analogous sets of estimation results and associated dynamic response patterns for the bivariate annual relationship between real income growth and credit growth summarized in the middle section of table 7.9. Here again, large differences appear among corresponding coefficients estimated for different time periods, as do readily visible differences among the implied response patterns, especially for the respective cross-responses. In addition, further results (not shown) indicate similar large differences for systems relating the growth of either money or credit to nominal income growth, as well as for systems relating either real or nominal income growth to the change in short-term interest rates. Finally, still further results (also not shown) indicate large differences in the results for analogous sys-

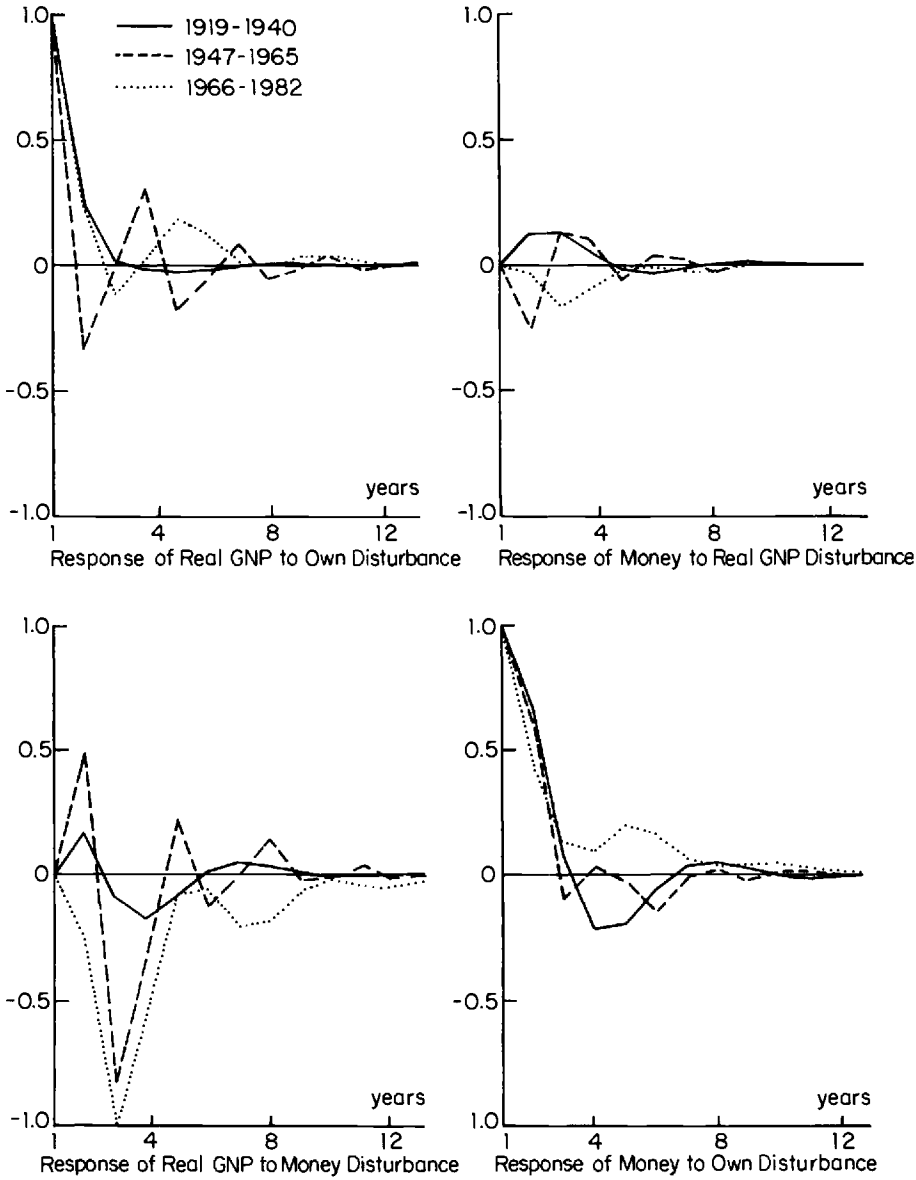

Fig. 7.3 Responses of money and real GNP to unit disturbances.

Table 7.17 **Bivariate Relationships between Real Income and Credit**

1919–40

$$X_t = \underset{(1.1)}{.027} + \underset{(.5)}{.161}X_{t-1} - \underset{(-.2)}{.063}X_{t-2} + \underset{(.8)}{.959}C_{t-1} - \underset{(-1.3)}{.962}C_{t-2}$$

$\bar{R}^2 = .00$ $SE = .086$ $DW = 2.00$

$$C_t = \underset{(1.5)}{.012} + \underset{(1.1)}{.109}X_{t-1} - \underset{(-.3)}{.027}X_{t-2} + \underset{(1.0)}{.350}C_{t-1} - \underset{(-.1)}{.117}C_{t-2}$$

$\bar{R}^2 = .16$ $SE = .026$ $DW = 1.30$

1947–1965

$$X_t = \underset{(.4)}{.015} - \underset{(-.8)}{.235}X_{t-1} + \underset{(1.0)}{.355}X_{t-2} + \underset{(1.3)}{.896}C_{t-1} - \underset{(-.8)}{.563}C_{t-2}$$

$\bar{R}^2 = -.16$ $SE = .029$ $DW = 1.95$

$$C_t = \underset{(3.7)}{.045} - \underset{(-3.9)}{.389}X_{t-1} + \underset{(1.2)}{.135}X_{t-2} + \underset{(2.8)}{.647}C_{t-1} - \underset{(-1.1)}{.242}C_{t-2}$$

$\bar{R}^2 = .45$ $SE = .009$ $DW = 2.05$

1966–82

$$X_t = \underset{(1.7)}{.055} - \underset{(-.0)}{.009}X_{t-1} - \underset{(-.2)}{.052}X_{t-2} + \underset{(1.4)}{1.01}C_{t-1} - \underset{(-1.8)}{1.32}C_{t-2}$$

$\bar{R}^2 = .13$ $SE = .025$ $DW = 2.08$

$$C_t = \underset{(2.5)}{.035} - \underset{(-1.4)}{.195}X_{t-1} - \underset{(-.7)}{.086}X_{t-2} + \underset{(3.7)}{1.16}C_{t-1} - \underset{(-1.5)}{.439}C_{t-2}$$

$\bar{R}^2 = .65$ $SE = .010$ $DW = 2.27$

Note: C = growth rate of domestic nonfinancial credit. See also table 7.16.

tems based on quarterly data, estimated for 1947:1 to 1965:4 and 1966:1 to 1982:4.

In sum, the differences between one time period and another that characterize the monetary and financial aspects of United States economic fluctuations have been significant both statistically and economically, reflecting major differences in the magnitude as well as the timing of the comovements between income and money, credit, and interest rates.

7.6 The Credit Cycle

A final financial aspect of United States economic fluctuations that bears investigation here is the familiar "credit cycle" by which the economy's public and private sectors alternate over the business cycle in their respective volumes of credit-market borrowing. In brief, the basic idea behind this familiar notion is that the federal government's reliance on the credit market typically bulges when weakness in the economy enlarges the government's budget deficit, whereas the private sector's borrowing does just the opposite as a consequence of the cyclical variation of typically debt-financed spending. As a result, federal government borrowing is greater in economic contractions than in

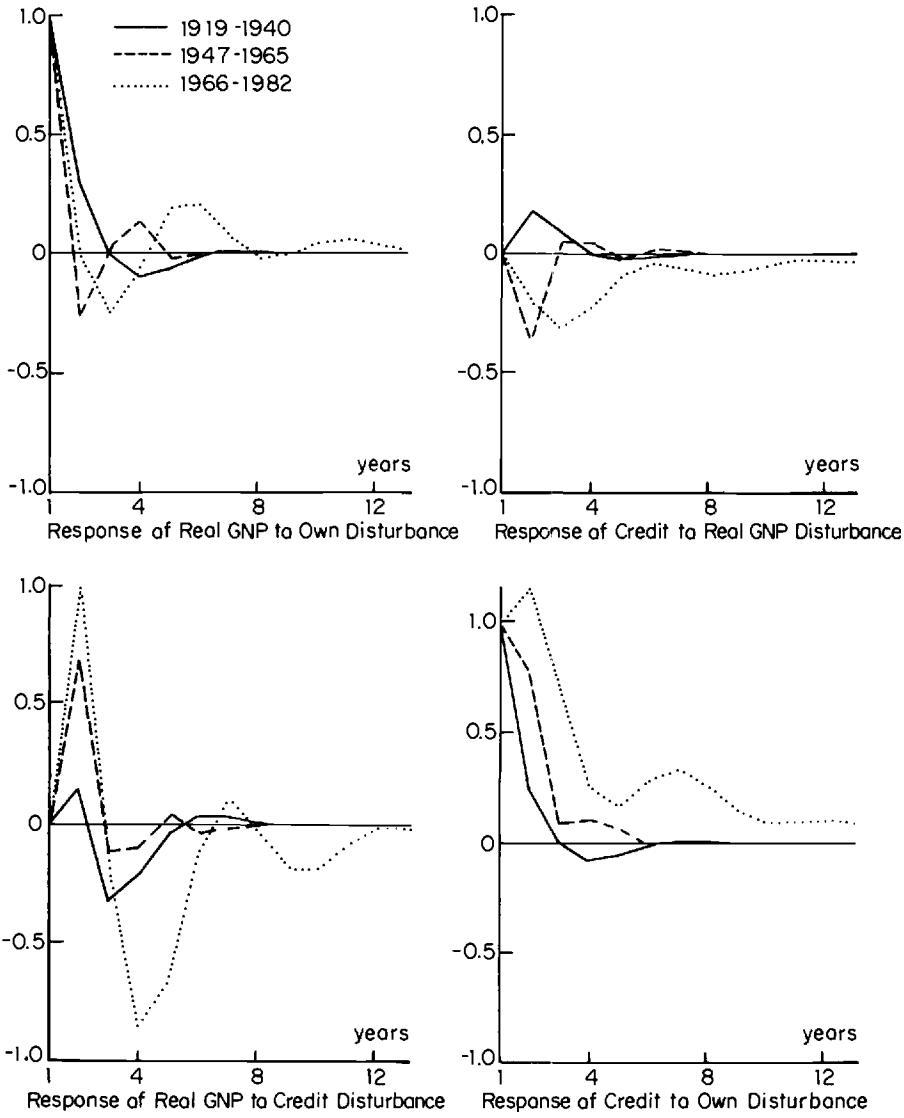

Fig. 7.4 Responses of credit and real GNP to unit disturbances.

expansions, whereas private sector borrowing is greater in expansions than in contractions. This cyclical regularity is broadly familiar in somewhat general terms, although to date little if any formal analysis of it has appeared.

Table 7.18 summarizes the main outlines of this regularity by showing the respective quarterly average growth rates of federal government

Table 7.18 **Postwar Cyclical Movements of Government and Private Sector Debt**

Business Cycles		Average Growth Rate of Government Debt		Average Growth Rate of Private Debt	
Peaks	Troughs	Contractions	Expansions	Contractions	Expansions
1953:2					
		2.50%		7.86%	
	1954:2				
			−0.74%		10.49%
1957:3					
		2.71		7.08	
	1958:2				
			2.49		9.14
1960:2					
		−0.41		7.21	
	1961:1				
			2.23		8.63
1969:4					
		3.40		7.62	
	1970:4				
			5.01		10.74
1973:4					
		5.20		9.21	
	1975:1				
			11.92		10.69
1980:1					
		11.02		8.31	
	1980:4				
			10.88		9.11
1981:3					
		15.42		7.03	
	1982:4				
Mean for all contractions		5.69%		7.76%	
Mean for all expansions			5.30%		9.80%

Note: Values shown are in percent per annum.

debt and the remainder of domestic nonfinancial credit (including the debt of state and local governments) during the six and one-half recognized business cycles since 1953. In part because of the lag of federal tax receipts behind fluctuations in economic activity, but also in part because of the upward secular trend in the growth rate of federal debt outstanding (as budget deficits have grown, while the level of federal debt outstanding has shrunk, relative to nonfinancial economic activity), the basic regularity of the "credit cycle" is more uniformly de-

scriptive of private than of public borrowing.[26] In four contractions out of six, average federal debt growth was faster than in the preceding expansion, but the mean difference in growth rates between contractions and expansions has been only 0.39% per annum. By contrast, private debt growth in each expansion has been faster than in the preceding contraction, and private debt growth in each contraction has been slower than in the preceding expansion, resulting in a mean growth rate in expansions 2.04% per annum greater than in contractions.

Attempts to analyze the dynamic aspects of these regularities using the same time-domain results applied in section 7.4 yielded few interesting results, but the corresponding frequency domain results do bear inspection. The top two panels of figure 7.5 show the respective power spectra of federal and private sector debt growth, estimated using quarterly data for 1952:1 to 1982:4. The spectrum for federal debt growth displays an obvious spike at almost exactly the mean cyclical frequency of one-third radian, while that for private debt growth exhibits a large spike at a frequency only moderately higher. In contrast to the results reported in section 7.4 for the growth of money and credit, the respective frequency domain properties of federal and private debt growth do not exhibit significant differences. In the range of 0.20–0.79 radian, the value of the test statistic for the null hypothesis of no difference between these two spectra is only .44 (distributed normally with 22 degrees of freedom), not significant at any reasonable level. The bottom two panels of figure 7.5 show the respective coherences of federal debt growth and private debt growth with real income growth. Both show increases at about one-third radian, although the coherences are smaller than those reported above for the growth of money and credit. In the same range of 0.20–0.79 radian, the coherence of real income growth with federal debt growth is .36 with standard error .19, while the coherence between private debt growth and real income growth is .77 with standard error .09.

In addition to this evidence of regular comovements of federal and private debt growth with real income growth at cyclical frequencies, the associated phase relationships (corresponding to leads and lags in the time domain) provide some support for the idea that private borrowing helps in part to determine real income while the federal government's budget posture reacts passively.[27] Federal debt growth *lags*

26. See Friedman 1983a for a discussion of the divergent trends in federal deficits and federal debt outstanding in relation to economic activity.

27. This idea is consistent with a cyclical role for "credit crunches." It is also consistent with the fact that only about one-fourth of the cumulative federal budget deficit incurred during the period under study here would have emerged had the economy remained at "high employment" throughout; see again, for example, Friedman 1983a.

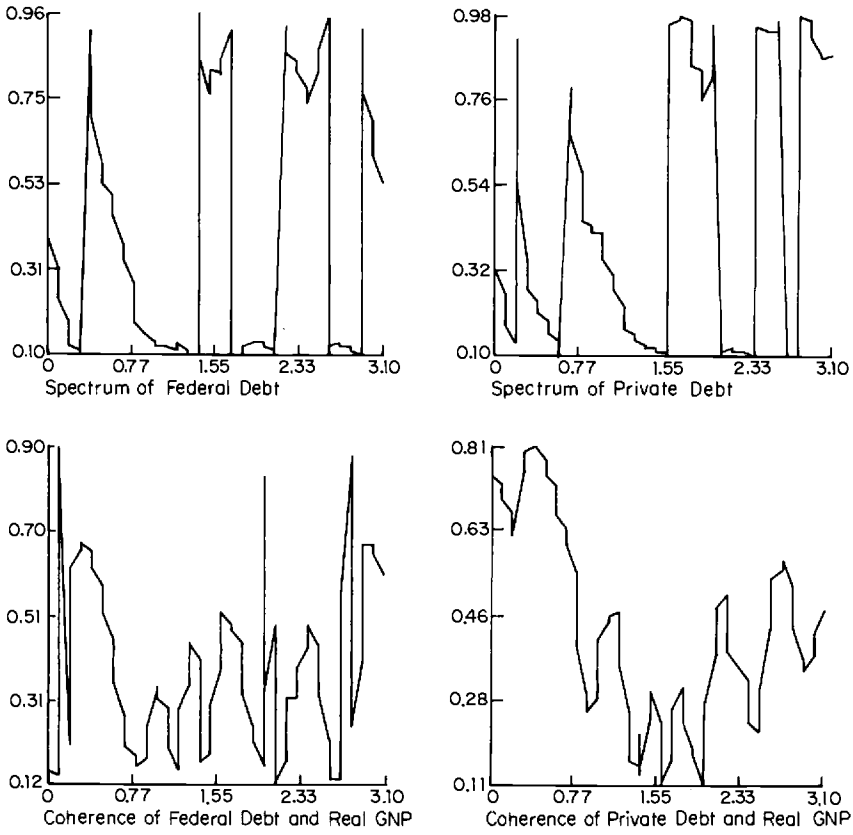

Fig. 7.5 Federal debt and private debt: spectra and coherences with real GNP.

real income growth by a phase angle of 1.47 radians (or 4.7 quarters) with standard error .55, while private debt growth *leads* real income growth by a phase angle of 0.97 radians (or 3.1 quarters) with a standard error of .18. Despite the small standard errors, however, these apparent differences are not statistically significant. The value of the test statistic for the null hypothesis of no difference between the two coherences in the same 0.20–0.79 radian range is only 0.002 (distributed as a t-statistic with 22 degrees of freedom).

Similar negative results emerge from asking whether either federal debt growth or private debt growth significantly contributes to explaining the frequency domain properties of real income growth in the presence of the other.[28] In the range of 0.20–0.79 radian, the values of the

28. The lack of significance here parallels the results of time domain exogeneity tests.

test statistic (distributed as an F-statistic with 2 and 20 degrees of freedom) for the partial coherence of real income growth with federal debt growth and with private debt growth—in each case taking the other as given—are respectively 1.49 and 0.17. Neither is significant at the .10 level.

In sum, there is evidence of a "credit cycle" in the sense of regular movements of federal and private sector debt growth, and regular comovements of each with real income growth, at cyclical frequencies. In addition, there is some indication that private debt growth leads real income growth while federal debt growth lags, but the differences between these respective comovements are not statistically significant, nor does either federal or private debt growth contain significant information about real income growth beyond what is also in the other.

7.7 Summary of Conclusions

There can be no doubt that economic fluctuations in the United States have their monetary and financial side. The comovements among money, credit, interest rates, and nonfinancial economic activity are evident enough at the crudest eyeball level of inspection, as well as in the results of more sophisticated time and frequency domain exercises. Moreover, many of these comovements have coincided with major historical business cycle episodes.

On closer inspection, however, these monetary and financial aspects of United States economic fluctuations exhibit few quantitative regularities that have persisted unchanged across spans of time in which the nation's financial markets have undergone profound and far-reaching changes. The evidence for the absence of such persistent quantitative regularities assembled in this paper shows major differences among the pre–World War I, interwar, and post–World War II periods, and between the first and second halves of the postwar period. Evidence suggesting changes from one period to another repeatedly emerges, regardless of whether the method of analysis is simple or sophisticated, whether the underlying data are annual or quarterly, and whether the relationships under study are bivariate or multivariate. Moreover, the differences between one period and another reported here are significant not just statistically but economically as well, in the sense of major differences in the magnitude and timing of cyclical comovements.

The paper's main message, therefore, is a warning against accepting too readily—either as a matter of positive economics or for policy purposes—the appearance of simple and eternal verities in much of the existing literature of monetary and financial aspects of business fluctuations. More complicated models involving many variables and/or nonlinear relationships may have remained stable, but the evidence

clearly shows that simple linear relationships among only a few such variables have not.

Comment Stephen M. Goldfeld

Benjamin Friedman has given us an extensive empirical analysis of the behavior of monetary and financial variables over the businesss cycle. One aim of this paper seems to be engendering humility regarding what we as economists think we know about the world. More specifically, by a range of alternative procedures, Friedman seeks to establish the proposition that the cyclical behavior of monetary and financial variables does not exhibit persistent regularities. Put in somewhat oversimplified terms, movements in both nominal and real GNP do not seem to be related in a stable fashion to a conventional set of monetary and financial variables. Or to put it more crudely still, the great ratios of economics are not so great.

A second aim of the paper, and perhaps the major one, is to impart the message that this humble view of what we know should condition our policy prescriptions. That is, we should avoid making monetary policy on the presumption of any assumed statistical regularity, let alone on the presumption that this regularity will persist for long periods. Although not so identified, this is clearly the intergenerational battle of the Friedmans, and while my heart lies with the younger generation, I'm not sure the evidence presented is ultimately as persuasive as young Friedman suggests.

Friedman begins by characterizing the dramatic changes in the financial structure of the United States economy over the past seventy years. He considers three classes of change—in the role of monetary policy, in government regulations and intermediation, and in private financial institutions and practices—and amply documents each. The list provided is impressive, so impressive, in fact, that Friedman says it would be astonishing if the cyclical behavior of monetary and financial variables had not been altered. One almost senses that Friedman is ready to declare victory at this point, but he wisely recognizes that the negative-thinking approach to positive economics is not particularly persuasive and turns to the evidence.

The evidence presented is diverse in terms of technique, ranging from the pictorial and arithmetic to relatively sophisticated techniques for analyzing time series. To begin with, the long-term behavior of a number of monetary and financial variables is displayed visually. The

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basic cyclical relationships are then quantified for the postwar period. These apparent regularities are then subjected to closer scrutiny. This is first done by computing simple annual correlations between real economic growth and a substantial number of variables, measuring changes in money, credit, and interest rates for various leads and lags and for alternative sample periods. On the whole, these calculations show substantial variations, in terms both of magnitude and of statistical significance, across time periods.

However, the lack of stability of simple correlation coefficients is rather weak evidence of any more fundamental structural change. These correlation coefficients are merely summary statistics of a complex multivariate stochastic process, and these is no reason, even if the underlying process remains the same, for these bivariate correlations to remain "stable" across time periods. For example, in a conventional simultaneous equations model, we know that the correlation between any two endogenous variables will depend on all the exogenous variables in the system. The finding that two endogenous variables have different sample correlations for different time periods may simply reflect the behavior of the exogenous variables in the two time periods. Friedman, of course, is well aware of these potential difficulties and consequently presents an alternative analysis of the same data using the more sophisticated vector autoregression technique (VAR).

Friedman first estimates bivariate VARs with annual data using either real or nominal GNP growth and a measure of money or credit growth. Overall summary measures of statistical significance are reported for various time periods, and inspection suggests that persistent regularities are few and far between. Friedman confirms this impression with an extensive set of tests for structural stability that generally indicate widespread structural change. With the recognition that annual data may be incapable of capturing the relevant dynamics, Friedman repeats a similar exercise with postwar quarterly data and an expanded set of financial measures. Structural instability is once again evident and widespread.

Finally, the robustness of these results is examined with reference to larger VAR models. Selected results are presented for a five-variable annual model, suggesting that structural change is again present. Formal stability tests with this model, for both annual and quarterly data, confirm these impressions.

The punchline, then, is that monetary and financial variables do not bear a stable relationship to changes in real and nominal GNP. Moreover, Friedman examines dynamic response patterns and suggests that these instabilities have economic as well as statistical significance. As a consequence, policies based on a presumed stability are to be avoided. As noted earlier, I have considerable sympathy for both parts of the

punchline, but I wonder whether those not so inclined will find the evidence persuasive.

My doubts on this score stem from the fundamental difficulty of "proving" that instabilities exist. The standard retort to such exhibitions of instability is that one is simply working with the wrong specification. This was certainly the response of the vast hordes, myself included, who attempted to fix up an apparently errant money demand function in the 1970s. In the present case, the skepticism of those who are not willing to accept Friedman's results is bolstered by the seeming sensitivity of the VAR technique to the size of the model used.

In discussing his reasons for using a reduced-form approach such as a VAR technique, Friedman cites the benefits of being able to sidestep the inevitably controversial specification issues inherent in a structural approach. Although these same issues may appear less controversial in a VAR approach, they are nonetheless of equal substance. For example, Friedman briefly reports comparative results for four-, five-, and 6-variable VAR systems, suggesting, as others have similarly found, that adding a single variable to a VAR system can often reverse conclusions. When one adds to this all the other conventional specification issues (e.g., lag length, use of differencing to achieve stationarity), one can see why it is tricky to establish the presence of instability. These difficulties are further compounded in the present case by an implicit assumption made in the tests, namely that the variances in the several subperiods considered are identical. This assumption is somewhat suspect in the light of the well-established differences in variability for many economic variables between the prewar and postwar periods. Given this, it might be desirable to test the hypothesis of coefficient stability without maintaining the constancy of variances across subperiods. Standard methods for doing this are available.

Overall, then, in the face of these specification and technical issues, it is difficult to know what degree of confidence one can have in the tests of stability reported. Indeed, some may feel there remains substantial room for indulging one's prior beliefs. Nevertheless, let us suppose we are fully comfortable with the notion that the instabilities of the sort Friedman reports are truly genuine. Does it necessarily follow that something like a constant money growth policy is necessarily worse than it would be in a world where the VAR models had passed stability tests? Put another way, while I am perfectly willing to believe that a constant growth rule is not optimal even in a world that passes stability tests, does such a rule become more suboptimal when structural stability tests fail? Friedman strongly implies this is the case, and this view does have some intuitive appeal. However, on closer examination I am not sure how one would establish this case.

The problem in evaluating a particular monetary policy proposal is, as in most things, Compared to what? One must be prepared to specify

such an alternative and see how it performs in the face of presumed instabilities. This in turn would require a more complete characterization of the nature of the instabilities and the learning process whereby the authorities discover the presence of structural shifts. Furthermore, to be fair to a constant money growth rule, one would not have to restrict this to a single number to be followed no matter what the emerging evidence. The only feature necessary to capture the spirit of this idea is that the constant growth be maintained for some substantial period. I do not know how the results of such an exercise would turn out, but as a matter of logic it does not seem that the sorts of instabilities Friedman found necessarily add to the case against a constant growth rule.

To reiterate, I am neither surprised nor disappointed with Friedman's findings of instability and his policy bias. I would be surprised, however, if the battle did not go on.

Comment Allan H. Meltzer

Near the start of his paper, Benjamin Friedman writes: "The basic theme of this paper . . . is that the quantitative relationships connecting monetary and financial variables to the business cycle exhibit few if any strongly persistent regularities that have remained even approximately invariant in the context of the widespread and, in some instances, dramatic changes undergone by the United States financial markets." In the conclusion, he repeats this theme: "economic fluctuations exhibit few quantitative regularities that have persisted unchanged across spans of time in which the nation's financial markets have undergone profound and far-reaching changes." And he warns us not to accept "the appearance of simple and eternal verities in much of the previous literature of monetary and financial aspects of business fluctuations."

I find these conclusions misleading for at least two reasons. First, even if we accept Friedman's evidence, it is not clear that it rejects any well-established proposition. Friedman does not give any clues about the particular "simple and eternal verities" that should not now be accepted. Economists have known that *numerical* estimates of structural parameters and reduced-form coefficients are subject to change whenever there are changes in behavior. (This is a principal implication of the early Cowles Commission work on identification that has been more fully developed in Lucas 1976.) Second, Friedman's paper is

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atheoretical, and much of his evidence comes from two-way comparisons of financial and real variables. Failure at this level of testing is informative but not alarming. Vector autoregressions (VARs) using five or six variables are more informative, but this technique has well-known limitations that Friedman (1983b) recognizes.

My comment is in three parts. First, I reconsider some of the propositions on the role of money in business cycles developed in the sixties by Milton Friedman and Anna J. Schwartz (1963a, b), Phillip Cagan (1965), and Karl Brunner and Allan H. Meltzer (1964). I report some of the evidence on these relations I find in the paper. Second, I comment on some reasons that Friedman and I draw different conclusions from his data and suggest that his work is most usefully interpreted as a test of the quantitative significance of the well-known Lucas critique of econometric practice. Third, I comment briefly on his discussion of the credit variable during business cycles.

Money and Business Cycles

G. L. Bach (1963, 3) summarized Friedman and Schwartz's contribution at a previous NBER conference as follows: "The Friedman and Schwartz paper, together with Friedman's other published works, provide the strongest empirical foundation for the proposition that the supply of money is a—probably the—dominant variable in determining the level of total spending on current output. . . . there was a general willingness to admit that the supply of money does now appear to be an important variable in explaining the level of aggregate spending."

Friedman and Schwartz (1963b) offered a number of propositions about the stock of money and its rate of change during business cycles, measured according to NBER chronology, and about the relation of changes in money growth to business cycles. They investigated cyclical patterns of velocity and demonstrated the procyclical conformity of velocity—the finding that velocity rises relative to trend during expansions and declines relative to trend during contractions. They summarized their principal findings as showing "beyond any reasonable doubt that the stock of money displays a systematic cyclical behavior. The rate of change in the money stock regularly reaches a peak before the reference peak and a trough before the reference trough, *though the lead is rather variable*" (1963b, 63; italics added).

These and other conclusions were extended in a study of the Federal Reserve system by Brunner and Meltzer (1964), in a study of the cyclical and secular behavior of the money stock by Cagan (1965), and in Friedman and Schwartz's (1963a) *Monetary History of the United States*. One or more of these studies presented evidence for the following propositions that, together, constituted a major part of the foundations for "monetarism": (1) money growth rises and falls procyclically; (2) accelerations and decelerations of money are frequently

followed after a lag by cyclical expansions and contractions of real output;[1] (3) sustained money growth relative to the growth of output is a sufficient condition for inflation; (4) market interest rates typically rise in periods of cyclical expansion and fall in contractions; and (5) velocity growth is procyclical.

Benjamin Friedman's study of postwar data supports several of these propositions. His table 7.1 shows, as he notes, that money growth is higher in each expansion than in the preceding or following contraction.[2] This finding supports proposition 1.

For each peak and trough beginning with the fourth quarter 1949, I chose the peak and trough in the quarterly rate of money growth nearest to the quarterly reference peaks or troughs recorded by the NBER. Friedman and Schwartz (1963b, 37) used peaks and troughs in monthly rates of money growth as one means of dating specific cycles in money and computing the leads of money growth at business cycle turning points. There are now more sophisticated methods of computing leads and lags, but my method permits replication of Friedman and Schwartz's work on an extended sample. Multiplying the average lead of money growth measured in quarters by three to compare to Friedman and Schwartz's monthly data shows that the average lead of money growth is 10.5 months at reference cycle troughs and 15.4 months at reference cycle peaks. This lead is one to two months shorter than the earlier estimates. Given the relatively high variability of the leads that Friedman and Schwartz note, the difference is not impressive.[3] This *quantitative* proposition stands up well.

Table C7.1 **Computed Average Lead of Specific Cycles in Money Growth (*M1*) before Reference Cycle Turning Points**

Peaks	
Average at peaks 1953–81	−15.4 months
Average all peaks 1870–1960	−17.6 months
Average all mild cycles 1870–1960	−16.4 months
Troughs	
Average at troughs 1949–82	−10.5 months
Average all troughs 1870–1960	−12.0 months
Average all mild cycles 1870–1960	−11.8 months

1. Economists would now substitute "unanticipated money growth" for "accelerations and decelerations of money." It is not clear that the more precise restatement makes a major difference for United States data.

2. There is one minor exception. Money growth is higher on average during the 1969–70 contraction than in the preceding expansion. The lengthy expansion includes a period of relatively low money growth and low inflation.

3. Dating for each peak and trough is shown in the appendix. Friedman and Schwartz used M2; I used M1. Where the two series overlap, differences in dating are small.

These data, and econometric studies by Barro (1978), Korteweg (1978), and others support proposition 2 on the role of changes in money growth as a dominant impulse in business cycles. Proposition 3 on the central role of money growth for inflation is now accepted by economists with many fewer reservations or disclaimers than twenty years ago. Friedman's comparison of average rates of growth of nominal and real GNP during expansions and contractions casts doubt on the relationship, however. He reports that the differences between the average rate of change in expansion and the average rate of change in contraction is the same (6.5%) for nominal and real GNP. Taken literally, this implies that the average rate of inflation has been the same for expansions as for contractions. Since average money growth is procyclical, money growth differs systematically between half-cycles.

Comparing cyclical average rates of growth of money with inflation using Friedman's data shows a persistent effect of money growth on inflation. The comparative size of money growth and inflation is positively associated without any allowance for lags, supply shocks, or the effects of real output growth. Rank correlations of half-cycle average rates of money growth and inflation are .74 for the eight contractions and .89 for the seven expansions. These rank correlations are significant at better than the .05 and at the .01 level respectively.

Friedman's table 7.2 shows that the average change in short-term rates is negative in each contraction and positive in each expansion, as required by proposition 4. The average change in long-term rates is positive in two of the eight contractions, however, contrary to the proposition. One of the exceptions includes the first oil shock, when interest rates were raised by the effects of the supply shock.

Friedman's discussion of table 7.4 notes that monetary velocity rises in every expansion and falls in every contraction. This supports a strong form of proposition 5, since no allowance has to be made for trend. Velocity growth, like money growth, is higher in each expansion than in either the preceding or the following contraction.

The five propositions of monetary economics are supported by Friedman's study. Among other propositions, one is of particular interest for policy. In a recent paper, Brunner and Meltzer (1983) pointed out that covariances of money growth and velocity growth computed from quarterly data are positively correlated at times. Friedman shows that the positive correlation of money growth and velocity growth is found also for the eight cyclical contractions and for the combined contractions and expansions. Further, Friedman finds that the variance of nominal GNP growth is dominated by the variance of money growth in both contractions and expansions. These findings imply that constant money growth would lower the variability of GNP growth by reducing or eliminating the variability of money growth and by removing the

covariance of money growth and velocity growth found during expansions.

If households are risk averse, welfare increases as the variability of GNP growth declines. Friedman's estimates suggest that the static effect of constant money growth on nominal GNP growth is a reduction of more than 80% of measured variability in the cyclical averages. Or to put the same point another way, the data in his table 7.7 imply that the variability of velocity growth would have to rise by an average of 570% in contractions and 650% in expansions to raise the variability of GNP growth following the adoption of a rule mandating constant money growth. This suggests again, that the Federal Reserve's discretionary policy has lowered welfare by adding more variability to GNP growth than it removed and, at times, by maintaining positive correlation of money growth and velocity growth.

Differences in Interpretation

Friedman reports and comments on several of the relations discussed in the preceding section. In addition, he analyzes some power spectra and reports evidence of coherence that is consistent with propositions relating money growth to the fluctuations we call business cycles. Why, then, is his principal conclusion a warning against accepting these regularities as a reliable basis for theory or policy?

One reason is that Friedman may have been misled by the data he presents. He recognizes that the bivariate relationships can be misleading because they omit relevant variables and replace partial responses with total responses. The vector autoregressions (VAR) have been the subject of many recent criticisms, and it is now well known that this method is sensitive to changes in the ordering of variables and the number of variables included in the VAR, and that the results are subject to the Lucas critique. Elsewhere, Friedman (1983b, 33) has recognized these criticisms and makes only modest claims about what can be learned from VARs.

The bivariate relationships are subject to other, no less trenchant criticisms. Correlations between annual data are unlikely to yield useful information about business contractions that last less than four quarters or are spread over parts of two calendar years. Four of the eight postwar contractions are of this kind. Quarterly relations are not subject to this criticism, but they are open to two others.

First, some of Friedman's tests are not tests of plausible economic relations. Included here are bivariate tests of a relation between money growth and the growth of real income. As tests of a relation running from money to income, the tests either fail to distinguish between anticipated and unanticipated money growth or, in the case of the VARs, impose tight restrictions on anticipations. As tests of a relation

running from income to money, they fail to hold prices and interest rates constant, as required for the demand for money, and fail to take account of relevant foreign variables and exchange regimes as required for the supply of money. Other tests also have problems. Economic theory does not imply that interest rates are related in a simple way to the growth of real or nominal income or to the growth rate of money. Tests of the relation between growth of income, money growth, and interest rates shed no light, and Friedman does not attempt to interpret them or provide an analytic foundation to help the reader interpret them.

Second, work on monetary relations published in the sixties, and cited above, made no claims that lags are constant or that numerical values are fixed. Typically, the emphasis was on the variability of lags.

The five propositions discussed in the previous section do not require constant coefficients. Earlier work using the NBER's business cycle method encouraged a search for common features of business cycles but did not impose uniform leads or lags or other constant coefficients on the data. The basic unit of time in these studies is not a year or a quarter; it is a cyclical phase of varying length when measured in calendar time but assumed to be comparable to similar phases of other cycles. The NBER also distinguished, at times, between wartime and peacetime cycles, between mild and severe recessions, and between the recoveries from mild and severe recessions. While I have not found the NBER's method attractive, I find it more useful *for bivariate comparisons* than Friedman's use of years or calendar quarters as units of observation.

One reason is that the seven expansions studied by Friedman vary in length from 12 to 106 months, roughly four to thirty five quarters. The eight contractions vary from 6 to 16 months, or from two to more than five quarters. It would be surprising if the forces (including policy) influencing the length of expansions and contractions had no influence on the measured length of lags and other parameters.

An additional reason for believing that Friedman's null conclusion is misleading is that economic theory gives no reason for assuming that lags are constant. The variability of the lead of money growth at business cycle turning points has frequently been remarked upon. Recent work shows that the length of leads or lags varies directly with the ratio of the variance of permanent to the variance of transitory changes. See Brunner, Cukierman, and Meltzer (1980).

Current research on policy rules or regimes, recognizing the so-called Lucas effect, makes no claim that the parameters of economic models are invariant to changes in policy rules. At times during this century, the United States has followed the rules of the gold standard, the gold exchange standard, the Bretton Woods system, the system of fluc-

tuating exchange, and the 1942–51 system of pegged interest rates. Other countries have experienced as many changes, and often more violent ones, in monetary regime. Each of these regimes, in principle, changes the path through which money influences economic activity or the timing of the responses of income to the stock of money or the responses of demand for money to income and other variables.

Friedman's findings are not inconsistent with this view. Although he does not mention the particular changes in policy regimes, in principle the same conclusion applies to the introduction of federal deposit insurance that changed the risk of banks' deposit liabilities, the development of substitutes for money, or changes in the effective ceilings on interest rates arising from the combination of regulation and increased rates of anticipated inflation.

Friedman's findings are part of the accumulating analysis and evidence on the problems faced by policymakers who seek to control or modify economic activity using either econometric models and sophisticated feedback, control procedures or fully discretionary policies based on judgment about average responses, or the many mixtures of these control techniques.[4] The results that he calls "qualitative," and the evidence I summarized in the preceding section, do not rule out the relevance of economic research and economic theory for economic policy. Nothing in Friedman's work rejects such *quantitative* relations as: (1) the so-called Fisher equation relating nominal rates of interest to anticipated inflation; (2) approximate long-run proportionality between growth of nominal income and money growth; and (3) long-run purchasing power parity.

The Role of Credit

A considerable part of Friedman's paper compares cyclical properties of credit and money and studies cyclical relations between credit and other variables. I ignored these sections in the previous comments because I do not know how to interpret the findings, and Friedman offers little guidance. A section on the credit cycle discusses some regular features of cyclical changes in public and private debt but concludes that movements of private debt provide no information about the growth of real income that is not contained in the growth of public debt. In an earlier section, Friedman concludes that the growth rate of credit or of money provides no useful information once the other growth rate is known.

This last comparison and Friedman's parallel treatment of credit and money throughout the paper suggest that he finds little basis for choos-

4. His finding of an absence of any effect of money on real income—other than those reported in table 7.9 that are purely autoregressive—is consistent with rational expectations.

ing between the two measures. Although I am convinced that the study of intermediation is useful, I am as skeptical about Friedman's parallel treatment of credit and money as I am about his procedure for studying the role of credit or intermediation during business cycles.

Friedman defines credit as the total liabilities of nonfinancial borrowers—private and public—that have been issued in the financial markets. He computes a measure of credit velocity, defined as the ratio of GNP to credit, and compares this measure of velocity with monetary velocity, the ratio of GNP to money.

It is always possible to analyze a stock flow relation by multiplying a particular stock by its velocity, measured in units per time, so that the product is equal to the flow. The quantity equation shows that this tradition is as old as systematic thinking about money. The initial appeal of the quantity equation, and its persistence through time, owed much to the (quantitative) empirical observation that prices and other nominal values move over time in direct proportion to money, although the correspondence may not be close during a particular year or quarter.

The relation of money to nominal GNP has been formalized in the quantity theory. Whatever reservations one may have about the content of this hypothesis, there can be no doubt about its survival or its usefulness in explaining differences in rates of inflation between countries and in the same country at different times.

There is no comparable hypothesis about domestic nonfinancial credit. Is there more than arithmetic behind Friedman's idea that the growth rate of credit plus the growth of credit velocity equals the growth of nominal GNP? Is the growth of nominal GNP independent of the growth of money and dependent on credit? How dependent is the postwar growth of credit relative to money on the effects of prohibitions on interest payments and regulation Q in the presence of inflationary monetary policy? How dependent is the growth of the private component of credit on the growth of the public component—the growth of the public debt?

Although Friedman does not pursue these issues, his data provide some answers. Rank correlation of his measures of the growth of public and private debt show very little relation between the two during either expansions or contractions, contrary to the complete crowding out hypothesis. The difference between the growth of private debt and money is negatively related to the short-term rate of interest. This difference is a measure of the growth of intermediation, since M1 and the monetary base grow at approximately parallel rates during half-cycles. The measure declined in both expansions and contractions as interest rates rose. The decline is dramatic, more than 50% on average, between half-cycles during which short-term market rates are below regulation Q ceilings and the half-cycles in which short-term rates are

substantially above the ceilings. A smaller and less uniform decline in the growth of intermediation is shown by the comparison of interest rates and the difference in the growth rate of total credit and money.

The introduction suggests that the paper will explore relationships of this kind. Regrettably, it does not do so. Friedman is too eager to dismiss what is known and too reluctant to use his data to extend existing theories of the relation of credit and money, or the theory of intermediation, during business cycles.[5]

Conclusion

This conference has produced a large number of null results, and Friedman's paper is of this kind. I am not persuaded that the null conclusions tell us as much about business cycles as they do about the method common to many of the papers. Perhaps a principal conclusion to be drawn is that you cannot get something for nothing. If we are unwilling to impose a structure on the data by stating testable hypotheses, the data may mislead us into accepting that the world is as lacking in structure as this approach.

Benjamin Friedman has ably summarized the data for main financial variables. I find in his null results additional information about the errors that are likely to be made when policymakers rely on estimates from quarterly equations or models. The results are far less damaging—and often supportive—of well-known qualitative and quantitative relations between monetary and other variables. My comments try to make this distinction and to suggest the limits to the scope of reliable quantitative knowledge that economists and policymakers face.

At least since the time of Lucas's (1976) critique of econometric practice and policy simulation, economists have been aware that parameter estimates of economic models are subject to change when private or public policies change. The quantitative significance of Lucas's results has been left largely to individual judgment, and judgments differ. Friedman's work, summarized in tables 7.10 and 7.15 and in his discussion of the *economic* significance of his findings, can be interpreted as evidence of the quantitative significance of the Lucas's critique. Although Friedman avoids this interpretation, I find it appealing and suggestive of the way his study can be a useful start on the quantitative analysis of an important topic.

5. One surprising claim is that financial panics "have all but vanished since the establishment of the Federal Reserve System in 1914 and especially the Federal Deposit Insurance Corporation in 1934." This statement neglects the experience from 1929 to 1933 and particularly the waves of banking failures from 1930 until the bank holiday in March 1933.

Appendix

Leads of Money Growth at NBER Turning Points

Reference Cycle Dates (Quarters)		Money Growth Specific Cycle		Lead in Quarters	
Peak	Trough	Peak	Trough	Peak	Trough
	1949:4		1948:4		4
1953:2		1951:4		6	
	1954:2		1953:3		3
1957:3		1954:4		11	
	1958:2		1957:4		2
1960:2		1959:1		5	
	1961:1		1959:4		5
1969:4		1968:4		4	
	1970:4		1969:3		5
1973:4		1972:3		5	
	1975:1		1973:3		6
1980:1		1979:2		3	
	1980:3		1980:2		1
1981:3		1981:1		2	
	1982:4		1982:2		2
Mean lead in quarters				5.14	3.50
Mean lead in months				16.4	10.5

Reply

Benjamin M. Friedman

Allan Meltzer asks what familiar proposition the empirical evidence assembled in my paper contradicts. Meltzer's question is a useful one, and it deserves a serious answer.

This book is about business cycles. The focus of my contribution to it is the behavior, in a business cycle context, of money, credit, and interest rates. Like the book's other papers, mine follows conventional understanding in taking "business cycles" to mean aggregate-level fluctuations in real economic activity, typically lasting more than a year (for the full cycle) but well under a decade. At the same time, because money and credit are nominal variables and so may bear a stronger connection to nominal economic activity, much of the analysis in the paper focuses on both real and nominal activity measures in parallel.

Of the five *qualitative* propositions Meltzer lists on pages 442–43 of his comment, therefore, all but the third involve business cycles and

hence are of at least some interest here. Indeed, as he points out, my paper presents evidence corroborating each of them. By contrast, of the three *quantitative* relationships he lists on page 447 of his comment, none is of interest here (although the Fisher equation certainly could be).

What familiar proposition, then, does the evidence presented in my paper contradict? It is, in Meltzer's wording, "the role of changes in money growth as a dominant impulse in business cycles"—or, in Bach's even stronger wording, which Meltzer quotes, "the proposition that the supply of money is a—probably the—dominant variable in determining the level of total spending on current output."[1] This proposition has become as familiar an idea as any that macroeconomics has to offer. Although it is far from universally believed, there can be little doubt that acceptance of it—by economists, by policymakers, and by the general public—has grown enormously in the twenty years since the publication of the work Meltzer cites by Friedman and Schwartz, himself and Brunner, and others.

In his reference to his own table C7.1 and to work by Barro and by Korteweg, Meltzer treats this *quantitative* proposition about what is a (or the) driving force underlying business cycles as equivalent to the *qualitative* proposition that changes in money growth "are frequently followed" by fluctuations of real output. But the two are not the same. The issue is not whether it is possible to replicate the mean lag findings of Friedman and Schwartz, as Meltzer does, but whether the evidence warrants singling out money as playing some special, dominant role in the initiation or propagation of cyclical movements in economic activity.

In short, is there anything special about the role of money in business cycles? Given that there is no dispute about Meltzer's first and second qualitative propositions—that money growth varies procyclically and that it frequently leads cyclical variations of output growth—my paper addresses this question in three ways. The first is to go beyond the documentation of whether movements in money growth tell anything about movements in income growth by asking whether movements in money growth tell anything about movements in income growth that prior movements in income growth itself cannot say equally well. The second is to examine the importance of other variables in this context, either indirectly by asking whether what movements in money growth have to say about movements in income growth varies from one time period to another, or more directly by asking what movements in several variables (including money growth) have to say together. The third

1. The part of Bach's statement Meltzer quotes could, of course, be taken to refer only to nominal spending without any implications at all for real economic activity and hence business cycles. A reading of Bach's introduction makes clear that this is not the case, however, so that Meltzer's citation is apt in the business cycle context.

is to undertake comparisons, by asking whether what movements in money growth tell about movements in income growth differs from what movements in credit and interest rates tell.

The conclusion indicated in my paper is that the evidence does not identify anything special, or dominant, about the role of money in the business cycle context. First, although for some time periods there is evidence that movements in money growth tell something about movements in income growth that prior movements in income growth do not already say, that evidence is hardly overwhelming, and for other time periods there is no such evidence. Second, just what it is that movements in money growth tell about movements in income growth varies substantially from one time period to another,[2] and movements in money growth do not stand out in this context in a multivariate setting. Third, movements in other financial variables—specifically, interest rates and credit—tell about as much about movements in income growth as do movements in money growth.

No, of course these findings do not contradict the *qualitative* propositions that money growth varies procyclically and that it frequently leads real income growth. But they do cast doubt on the *quantitative* proposition that the impulse to business cycles from money growth is dominant in any ordinary sense.

Meltzer's criticism of the use of two-variable relationships to address such questions—including in part relationships between nominal money and real income—has merit, as my paper should also make clear.[3] But his brusque treatment of the subject does not get to the fundamental underlying tension it involves.

At one level, what is being asserted is indeed a relationship between two variables, one nominal and one real: nominal money growth varies procyclically, nominal money growth leads real income growth, nominal money growth is a (the) dominant impulse driving real income growth, and so on. Meltzer's own table C7.1 is itself one way of examining just this bivariate relationship between nominal money and

2. It is difficult to understand Meltzer's claim that my paper does not acknowledge "changes in policy regimes" as a source of these differences. Of the three categories of change in the economy's financial structure that section 7.1 sets forth as reasons for not expecting to find unchanging business cycle relationships, the first one discussed is monetary policy and the second is financial regulation. It is also ironic in this context that Meltzer's detailed discussion of what some of my paper's findings imply for a constant money growth rule simply assumes that the variability of the velocity ratio would remain invariant to that specific regime change.

3. Meltzer also criticizes the use of natural time units rather than business cycle phases in examining these relationships, but this criticism seems misplaced. If money growth is dominant in determining income growth, why take the length of a business expansion or contraction as exogenous? Regression or vector autoregression relationships based on natural time units allow the length of each movement in income growth to be determined by the length of each movement in money growth if the data so indicate.

real income. Yet Meltzer wants to disallow evidence from bivariate relationships in addressing the three questions posed above. Why is it admissible to ask if money growth leads real income growth but not to ask if money growth leads the part of real income growth that is not already predictable from past real income growth itself? Why is it legitimate to examine the relationship of real income growth to money growth but not to credit growth or interest rates?

The tension here arises because, if other things beside money growth matter for business cycles, then a simple two-variable relationship between money growth and real income growth is fundamentally misspecified. This misspecification has significant implications both for the use of simple money/income relationships in economic forecasting and policymaking and for the investigation of hypotheses like those in question here. In both settings it is then necessary to admit that the world is more complicated, and to advance to richer representations importantly featuring variables other than money. In the research context, my paper shows that simply moving to nonstructural systems of modestly higher order does not satisfactorily represent this complexity (nor does it indicate any special role for money growth), and here I fully agree with Meltzer about the need for structural analysis. As most readers of this volume surely know, however, it is hardly the case that the evidence from structural models clearly points toward money growth as the driving force behind business cycles either.

In sum, the thrust of Meltzer's comment is that somehow economists know, presumably from the work of Friedman and Schwartz and their followers, that money growth is what matters most for business fluctuations, and that efforts to question whether this is so, or to examine the role of other variables, must accept the burden of proof. That position is untenable. One cannot simultaneously embrace the long tradition of nonstructural investigation of the relation between money growth and the business cycle—including simple lead/lag analysis early on, then straightforward regression analysis, and more recently bi- or even multivariate autoregression analysis—but ignore parallel investigations showing comparable results for other variables. One cannot accept the conclusions of whatever structural analyses indicate a unique role for money yet discard all those that do not.

Nowhere is this schizophrenic view more apparent than in Meltzer's concluding section remarking on the approach maintained throughout my paper of examining, in a way parallel to that applied to money, the role of credit—that is, of a nominal financial quantity other than money. Meltzer acknowledges that the results provide little or no empirical basis for choosing between money and credit as a (the) dominant impulse underlying business cycles if one wants to make such a claim. Instead, he says he is "skeptical" about the entire parallel treatment

of money and credit, arguing that empirical examination of business cycle relationships is somehow legitimate for money but not for credit. Meltzer motivates this presumption in favor of money by appealing to the quantity theory.

But what quantity? And what theory? The mere statement that the growth of "money" bears a relation to income growth is no more than a hypothesis subject to empirical testing. That people have believed in it for many years would not make it so if the available empirical evidence systematically contradicted it. Similarly, that people have believed in this relation for a long time does not, in the absence of evidence, make it more valid than any other relation. A long tradition of belief that money growth bears such-and-such a relation to income growth also does not make it a "theory" in the sense of a behavioral explanation that is applicable to one observed relationship but not to others.

To be sure, the theoretical literature provides many models of the demand for money for transactions purposes, as well as of the demand for asset holding. To justify Meltzer's presumption, however, it is necessary to connect the theory to the quantity in question and also to show that the theory does not connect to other quantities as well. In an earlier era, Milton Friedman's "Restatement" of the quantity theory explicitly defined money as claims "that are generally accepted in payment of debts,"[4] yet Friedman and Schwartz's empirical work focused on an aggregate also importantly including savings balances. Today, neither M1 nor M2 readily corresponds with either the transactions or the savings models of money demand, respectively. The deposits included in M1 often serve a savings function, and these deposits and currency are hardly the only way to make payments anyway. The more comprehensive M2 certainly does not represent total financial assets, or even total liquid assets.

Failing these conditions, the theory that is needed to relate any of the familiar Ms to the business cycle is a more general theory describing *inside* asset holding, and in particular a theory relating the holding of inside assets to the determination of nonfinancial economic activity.[5]

4. Popular usage of the "quantity theory' idea notwithstanding, Friedman's "Restatement" in no way provided a rationale for describing movements of income growth in terms of movements of money growth alone. Even after all of the simplifying assumptions Friedman imposed, his final equation related nominal income not only to money but also to interest rates, equity returns, the rate of price inflation, the ratio of human to nonhuman wealth, and real income, in addition to any variables affecting tastes and preferences.

5. Models in which all assets are outside assets and (inside) liabilities do not exist have been a staple of monetary economics for decades, and they have provided valuable theoretical insights. But the world they describe corresponds to a modern economy only if the inside assets and liabilities that obviously exist do not matter much. The empirical evidence relating the monetary base to nonfinancial economic activity suggests that that is not so in this context. The base does not show relationships to income that M1 and M2 do not, and often the base shows weaker relationships than either M1 or M2.

As Tobin and others have shown, however, theories of inside asset holding are inseparable from theories of inside liability issuing. Regardless of whether credit is viewed as an aggregate of debt assets held or an aggregate of debt liabilities issued, there is no reason to presume that a satisfactory theory exists for M1 or M2 in isolation from other inside assets and liabilities, or that a comprehensive theory of inside asset holding and liability issuing would somehow point to a special role for M1 or M2.

Whether there is something special about "money" in initiating or propagating business cycles is an empirical question. The evidence presented in my paper indicates that there is not.

Discussion Summary

Christopher Sims took issue with Allan Meltzer's claim that VARs are particularly unrobust to specification changes by noting that, first, a fortiori the same could be said of structural models. Second, while it was true that time series relationships change through time, the changes were not enormous. Third, a standard of comparison was needed before one could claim that the relationships estimated were poorly captured.

Phillip Cagan observed that the NBER research on the relation between output and money had found that from the Civil War to the end of the 1950s the qualitative evidence favored the view that variations in the supply of money from various sources did affect output and prices subsequently. This was not necessarily the case recently, since Federal Reserve behavior might have shifted, but there remained the question whether these changes affected the relationship between money and GNP in an economically significant way.

Geoffrey Moore drew attention to the fact that money and credit behavior is very different at the peaks and troughs of the cycle and that one should not expect simple time series methods necessarily to show stability over time. Stanley Fischer suggested a more general hypothesis than the one in the paper, that persistent monetary expansion is eventually followed by inflation. This, he said, seemed to be a consistent qualitative result. Anna Schwartz took exception to Friedman's assertion in the paper that velocity is "only a ratio," which has no relevance beyond that.

Benjamin Friedman stressed that what was important for the conduct of monetary policy along "monetarist" lines was that relationships should remain *quantitatively* stable and said he had shown that such stability does not exist. While qualitative features of the money/nominal income relationship might persist, these are of limited use for policymakers.

References

Anderson, Leonall C., and Keith M. Carlson. 1970. A monetarist model for economic stabilization. [Federal Reserve Bank of Saint Louis] *Review* 52:7–25.

Anderson, Leonall C., and Jerry L. Jordan. 1968. Monetary and fiscal actions: A test of their relative importance in economic stabilization. [Federal Reserve Bank of Saint Louis] *Review* 50:1–24.

Ando, Albert. 1974. Some aspects of stabilization policies, the monetarist controversy and the MPS model. *International Economic Review* 15:541–71.

Bach, G. L. 1963. Introduction. *The state of monetary economics. Review of Economics and Statistics,* suppl. 45 (February): 3–5.

Barro, R. J. 1978. Unanticipated money, output and the price level in the United States. *Journal of Political Economy* 86: 549–80.

Brunner, K., A. Cukierman, and Allan H. Meltzer. 1980. Stagflation, persistent unemployment and the permanence of economic shocks. *Journal of Monetary Economics* 6 (October): 467–93.

Brunner, K., and Allan H. Meltzer. 1964. *The Federal Reserve's attachment to the free reserve concept.* Washington, D.C.: House of Representatives, Subcommittee on Domestic Finance, Committee on Banking and Currency.

———. 1972. Money, debt, and economic activity. *Journal of Political Economy* 80:951–77.

———. 1976. An aggregative theory for a closed economy. In *Monetarism,* ed. Jerome Stein. Amsterdam: North-Holland.

———. 1983. Strategies and tactics for monetary control. In *Money, monetary policy, and financial institutions,* 59–103. Carnegie-Rochester Conference Series on Public Policy 18. Amsterdam: North-Holland.

Cagan, P. 1965. *Determinants and effects of changes in the stock of money, 1875–1960.* New York: Columbia University.

Clarida, Richard H., and Benjamin M. Friedman. 1984. The behavior of U.S. short-term interest rates since October 1979. *Journal of Finance* 39 (July): 671–82.

Cramer, J. S. 1983. Transactions demand and the circulation of money in the United States, 1950–1979. Mimeographed, University of Amsterdam.

de Leeuw, Frank, and Edward Gramlich. 1968. The Federal Reserve–M.I.T. econometric model. *Federal Reserve Bulletin* 54:11–40.

———. 1969. The channels of monetary policy: A further report on the Federal Reserve–M.I.T. model. *Journal of Finance* 24:265–90.

Fama, Eugene F. 1980a. Banking in the theory of finance. *Journal of Monetary Economics* 6:39–57.

———. 1980b. Inflation, output and money. Mimeographed, University of Chicago.

Friedman, Benjamin M. 1981. The relative stability of money and credit "velocities" in the United States. Mimeographed, National Bureau of Economic Research.

———. 1983a. Implications of the government deficit for U. S. capital formation. In *The economics of large government deficits*. Boston: Federal Reserve Bank of Boston.

———. 1983b. Money, credit and Federal Reserve policy: Reply to Porter and Offenbacher. [Federal Reserve Bank of Richmond] *Economic Review* 69 (November): 30–34.

———. 1983c. The roles of money and credit in macroeconomic analysis. In *Macroeconomics, prices and quantities: Essays in memory of Arthur M. Okun*, ed. James Tobin. Washington, D.C.: Brookings Institution.

Friedman, Milton. 1956. The quantity theory of money—A restatement. In *Essays in the quantity theory of money*, ed. Milton Friedman. Chicago: University of Chicago Press.

———. 1971. A monetary theory of nominal income. *Journal of Political Economy* 79:323–37.

Friedman, Milton, and Anna J. Schwartz. 1963a. *A monetary history of the United States, 1867–1960*. Princeton: Princeton University Press.

———. 1963b. Money and business cycles. In *The state of monetary economics. Review of Economics and Statistics*, suppl. 45 (February): 32–64.

———. 1970. *Monetary statistics of the United States: Estimates, sources and methods*. New York: National Bureau of Economic Research.

———. 1982. *Monetary trends in the United States and the United Kingdom: Their relation to income, prices, and interest rates, 1867–1976*. Chicago: University of Chicago Press.

Gurley, John G., and Edward S. Shaw. 1960. *Money in a theory of finance*. Washington, D.C.: Brookings Institution.

Jonson, P. D. 1976. Money and economic activity in the open economy: The United Kingdom, 1880–1970. *Journal of Political Economy* 84:979–1012.

Kendrick, John W. 1961. *Productivity trends in the United States*. Princeton: Princeton University Press.

King, Robert G., and Charles I. Plosser. 1981. The behavior of money, credit and prices in a real business cycle. Mimeographed, National Bureau of Economic Research.

Korteweg, P. 1978. The economics of inflation and output fluctuations in the Netherlands, 1954–1975. In *The problem of inflation*, 17–68. Carnegie-Rochester Conference Series 8. Amsterdam: North-Holland.

Lucas, Robert E. 1972. Expectations and the neutrality of money. *Journal of Economic Theory* 4:103–24.

———. 1973. Some international evidence on output-inflation tradeoffs. *American Economic Review* 63:326–34.

———. 1976. Econometric policy evaluation: A critique. In *The Phillips curve and labor markets,* ed. Karl Brunner and Allan Meltzer, 19–46. Carnegie-Rochester Conference Series on Public Policy 1. Amsterdam: North-Holland.

Modigliani, Franco, and Albert Ando. 1976. Impacts of fiscal actions on aggregate income and the monetarist controversy: Theory and evidence. In *Monetarism,* ed. Jerome Stein. Amsterdam: North-Holland.

Sargent, Thomas J. 1976. A classical macroeconometric model for the United States. *Journal of Political Economy* 84:207–37.

Tobin, James. 1961. Money, capital and other stores of value. *American Economic Review* 51:26–37.

———. 1969. A general equilibrium approach to monetary theory. *Journal of Money, Credit, and Banking* 1:15–29.