Money and Business Cycles: A Real Business Cycle Interpretation

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ABSTRACT

This paper focuses on the role of money in economic fluctuations. While money may play an important role in market economies, its role as an important impulse to business cycles remains a highly controversial hypothesis. For years economists have attempted to construct monetary theories of the business cycle with only limited empirical success. Alternatively, recent real theories of the cycle have taken the view that to a first approximation independent variations in the nominal quantity of outside money are neutral. This paper finds that the empirical evidence for a monetary theory of the cycle is weak. Not only do variations in nominal money explain very little of subsequent movements in real activity, but what explanatory power exists arises from variations in endogenous components of money.

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1 Introduction

Money serves some very important functions in a market economy. Money undoubtedly improves economic efficiency by economizing on the costs of information (e.g. Brunner and Meltzer (1971) and King and Plosser (1986)). Money, without question plays the dominant role in determining the rate of inflation. It also may be true that the Federal Reserve can and does manipulate the federal funds market on a day-to-day basis, although there is considerable question as to its ability to do so for sustained periods and of the consequences. Yet it does not necessarily follow that money must be the prime impulse to business cycles. Nevertheless, a significant portion of the research in monetary economics over the past twenty-five years has been devoted to developing and exploring a monetary theory of the business cycle. These models seek to explain business cycles as arising from independent variations in the nominal quantity of money.

In recent years, however, there has been a resurgence of interest in real theories of the cycle. This class of models, summarized recently by Plosser (1989), are distinguished from pre-Keynesian real theories by their emphasis on the dynamic equilibrium behavior of market economies. They are also purely rel models in that variation in nominal quantities are ignored. These models, of course, have been criticized for the absence of a role for money in the model's environment. Yet these models are not intended to address such important issues as those raised by Brunner and Meltzer (1971), but to address the dynamic character of market economies and how it pertains to business cycles. By some standards these models have been fairly successful in replicating many features of the business cycle.

King and Plosser (1984) expand the class of real business cycle models by explicitly incorporating a financial or banking industry and positing a demand for real currency. The nominal quantity of fiat currency is supplied by a central monetary authority. The basic implication of this framework is that under a variety of conditions, variation in the nominal quantity of outside money (either currency or the monetary base) is neutral. Furthermore, variation in the real quantity of inside or bank money is determined by the real supply and demand for transaction services: the nominal quantity of outside money plays no particular role. Although independent variation in the nominal quantity of outside money is neutral, monetary aggregates such as *M1* or *M2* may indeed be systematically related to real activity because of the endogeniety of inside money.

Distinguishing real theories of the business cycle from monetary theories requires a more careful analysis of Federal Reserve actions than is typically offered. The reason is that the Federal Reserve plays two important, but for the question at hand, distinct roles. One is as a central bank charged with regulating the nominal quantity of money in the economy primarily through open-market operations. The second is as a regulator of commercial banking activity. This role includes, for example, the setting of reserve requirements on deposits and, in the not too distant past, the setting of interest rate ceilings on deposits. In its role as regulator, the Federal Reserve can clearly be a source of real shocks to the banking system and thus to the economy as a whole. On this real theories and monetary theory should agree. What makes a monetary theory of the cycle distinctive is that it assigns an important and independent role to variations in some *nominal* quantity controlled by the central bank in initiating significant fluctuations in real economic activity.

In this paper I survey some of the evidence that has been used to support the importance of money as an impulse to business cycles and reinterpret it in the context of the framework proposed in King and Plosser (1984). I conclude that neither statistical evidence or the historical record provide a convincing case for the dominant role of nominal money in the business cycle.

Consistent with the work of Cagan (1965), I find that to the extent monetary measures are correlated with real activity, it is variation in endogenously determined magnitudes that are most important.

2 A Brief Overview of the Evidence

The evidence that movements in the nominal quantity of money are an important impulse to business cycles can be classified as falling into one of three broad categories. The first category includes analyses of specific historical episodes and is most notably associated with the pioneering work of Friedman and Schwartz (1963a). The second category is the systematic analysis of the cyclical behavior of money using the methods established by Burns and Mitchell (1946). Finally, the last category includes all the more traditional statistical approaches based on some form of regression or correlation analysis.[1]

2.1 Historical Episodes

Perhaps the most famous and influential work in this category is the seminal contribution of Friedman and Schwartz (1963a), *A Monetary History of the United States, 1867-1960.* They conclude from their analysis of the historical record, that independent movements in the stock of money have played a major role in causing business cycles. In summarizing their findings, they emphasize six historical episodes of "deep depression" that support their view that independent movements in the quantity of money have important real effects (see Friedman and Schwartz, 1963a, pp. 686-695 and 1963b, pp. 217-218). In their view the key periods were; *(i)* 1875-78: a decline in high-powered money preceded the banking crisis of 1873 which in turn led to a reduction in the money stock as the public shifted from deposits to currency; *(ii)* 1892-94: an outflow of gold combined with the banking panic of 1893 once again reduced the deposit to currency ratio and the money stock; *(iii)* 1907-08: the banking panic of 1907 precipitated a contraction in the stock of money; *(iv)* 1920-21: a significant increase in the Federal Reserve discount rate was followed by a sharp contraction in Federal Reserve credit and the money stock, albeit with some

[1] In the discussions that follow, the references to over a generation of work by dozens of authors is grossly inadequate. The references cited are only meant to be representative of the work or results, not an exhaustive bibliography.

lag; *(v)* 1929-33: the Federal Reserve's failure to respond to widespread banking failures and the increase in demand for currency resulted in a dramatic decline in the money stock; and *(vi)* 1937-38: the Federal Reserve doubled legal reserve requirements.

Each of these episodes closely corresponded to a major contraction. Friedman and Schwartz (1963b, pp. 60-61), however, acknowledge that in four of these six episodes (1875-78, 1892-94, 1907-08, and 1929-33) a banking crisis played an important role in altering the deposit-currency ratio. Thus the independent role of movements in the quantity of money is not easily isolated.[2] Therefore, there are two critical episodes where bank failures played no role, the discount rate changes of 1920 and the increase in required reserves in 1937. Based on these two episodes and their attempts to isolate independent movements in the quantity money from feed-back in the circumstances associated with the banking crises, they conclude that the money stock is an important, but highly irregular in timing, impulse to business cycles.

Recently, Romer and Romer (1989) have attempted to follow the spirit of the analysis of Friedman and Schwartz by studying specific historical episodes of post-war U.S. monetary experience in order to investigate the real effects of autonomous monetary disturbances. Their strategy was to look for times when the Federal Reserve, as expressed in official documents, discussed a desire or a willingness to tolerate a recession to curb inflation.

The Romers' reading of Federal Reserve documents leads them to isolate six episodes when Federal Reserve officials indicated their desire to restrain the economy. Their description of those episodes are roughly as follows: *(i)* October 1947: the Federal Reserve began a series of open market purchases, an increase in the discount rate and an increase in reserve requirements in an effort to reduce inflation; *(ii)* September 1955: once again the Federal Open Market

[2] Although they argue that in 1875-78 and 1892-94 the decline in the deposit-currency ratio was most likely attributable to a prior monetary disturbance.

Committee (FOMC) expressed the desire to maintain "restraint" through open market operations even in the event of a downturn; *(iii)* December 1968: continuing concern over inflation and inflationary expectations led to "restraint" despite signs of an economic slowdown; *(iv)* April 1974: experiencing very rapid inflation following the end of wage and price controls and the oil embargo, the Federal Reserve repeatedly pushed for contraction through higher interest rates; *(v)* August 1978: once again concern over inflation resulted in more restrictive policies including increases in the discount rate and reserve requirements; and *(vi)* October 1979: recognizing that the efforts in 1978 were unsuccessful there was a switch to a policy that the FOMC anticipated would raise interest rates by limiting the expansion of money.[3]

The next step in the Romers' analysis is a statistical investigation of industrial production and unemployment. They conclude that the growth rate of industrial production for the three year period following five of the six selected episodes is lower that otherwise might have been predicted from a univariate autoregression.[4] The Romers' conclude that efforts to curb inflation through contractionary monetary actions have important and persistent effects on real output.

2.2 Business Cycle Analysis

The second category of evidence that supports the importance of changes in the money stock for business cycles is based on systematic study of the cyclical behavior of money. The pioneering work of Burns and Mitchell (1946) changed dramatically the way economists think about business cycles. Probably the most important feature of their methodological contribution

[3] The recent desire of the Federal Reserve to reduce inflation would appear to represent another episode based on the Romers' selection criteria. The results of this most recent autonomous change in money have yet to be played out.

[4] The growth rate over a two to two and one half year period year is below expected in all six episodes. At a one year horizon the growth rate appears lower than expected in only three of the six cases. Thus there appear to be "long and variable lags."

was to think, not in terms of calendar time, but, in business cycle time. Their strategy of treating the business cycle as a unit of measurement and to investigate the common characteristics of these units was both controversial and influential.

The methods developed by Burns and Mitchell have been used by several authors, most notably Friedman and Schwartz (1963b), to study the behavior of money over the business cycle (i.e. reference cycle analysis in the terminology of Burns and Mitchell). They conclude that the rate of change in the money stock displays positive conformity to the reference cycle with a long lead. Moreover, the amplitude in the money stock rates of change is much larger for deep contractions than mild contractions.

Cagan (1965) also studied the reference properties of the money stock and some of the key determinants such as the monetary base, deposit-currency ratio, and the deposit-reserve ratio. He concluded that the deposit-currency ratio was the most important single contributor to the cyclical behavior of the money stock.

2.3 Regression Evidence

The last category is intended to encompass the wide variety of empirical studies that have attempted to isolate the statistical link between movements in money and economic activity. The seminal work of Friedman and Schwartz provided the initial impetus to a generation of research into monetary theories of the business cycle. To summarize over twenty years of empirical work is not the task of this paper. I simply try to highlight examples of the sort of evidence that have been produced in support of the importance of monetary impulses for the business cycle.

One of the early studies in this tradition was by Friedman and Meiselman (1963). They focussed on the relative importance of money and investment. Using standard regression techniques they found that the relation between money and income was more significant and stable than the relation between autonomous expenditures and income. Like the earlier work of Friedman and Schwartz, Friedman and Meiselman focussed on nominal income as the dependent variable to be explained. This was also the case for many of the empirical studies in the 1960's. The general view at the time seemed to be that inflation was not a significant factor for most of the sample and, therefore, money income and real income moved together.

The 1960's ended with the influential and controversial empirical work of Andersen and Jordan (1968) and their estimates of what became known as the "St. Louis" equation. Andersen and Jordan regressed various measures of money and fiscal variables on nominal GNP and concluded that the influence of the money stock on nominal GNP was larger and more significant than the influence of fiscal actions.

Sims (1972) further intensified the controversies by arguing that "Granger causality tests" indicated a one-way temporal ordering from money to nominal income. The debate as to whether money helps predict output or not has continued for some 15 years. More recently the attention has shifted to real output instead of nominal income. The approach has been to focus on the predictive content of money for real output in the context of bivariate or multivariate autoregressions (VAR's). Examples, in addition to Sims (1972), include Sims (1980a, b), Litterman and Weiss (1985), Eichenbaum and Singleton (1986) and recently Stock and Watson (1989a).

The results of these studies are mixed. The statistical significance of money appears sensitive to the method of detrending and to the other variables included in the system. The results are also subject to different interpretations since the methods are not based on any structural model.[5] I will take as representative of the current state of this literature, the recent contribution

[5] See Bernanke (1986) for one effort to impose some structure on these methods.

of Stock and Watson (1989a). They conclude that innovations in the growth of nominal M1 are statistical significant for forecasting industrial production in both bivariate money-output specifications and those that include prices and interest rates.

Another line of empirical work on money and real output was stimulated by the work of Lucas (1972), Barro (1976) and others that incorporated rational expectations into monetary models of the business cycle. The empirical work of Barro (1977a, 1978) was particularly influential in this regard. Barro's empirical work focussed on unanticipated monetary growth and its impact on unemployment and real output. He concluded that not only were unanticipated money shocks important, but only the unanticipated part of monetary growth was empirically significant.[6] These results led to an explosion of studies relating unanticipated and anticipated money to almost every conceivable variable.

[6] There developed an extended debate as to whether anticipated money growth was important or not. At this level of discussion this issue is not particularly relevant.

3 The Elusive Transmission Mechanism

The sort of evidence summarized in the previous section has led many economists to conclude that variations in the stock of money play an important role in business fluctuations. Yet without the theory and supporting evidence for the mechanism by which nominal money disturbances are transmitted to the real economy, there is little reason for complacency. After all, the neoclassical model with flexible prices exhibits the dichotomy of real and nominal magnitudes so that changes in the money stock are neutral.

> "Of course, it is one thing to assert that monetary changes are the key to major movements in money income; it is quite a different thing to know in any detail what is the mechanism that links monetary change to economic change;...We have little confidence in our knowledge of the transmission mechanism...Indeed, this is the challenge our evidence poses..." [Friedman and Schwartz 1963b, pp. 227]

Unfortunately, it seems that over twenty-five years after Friedman and Schwartz laid out this "challenge," we are no closer to having a coherent theoretical or empirical understanding of the transmission mechanism of money shocks to real economic activity than they were. Indeed, Friedman and Schwartz (1982, pp. 462) conclude,

> "...we have not succeeded, as we had hoped we would, in giving satisfactory empirical content...bearing on the division over short periods of a change in nominal income between prices and output."

If we are to stress the importance of changes in nominal stock of money for fluctuations in real economic activity, we must come up with an empirically satisfactory explanation of how movements in the nominal quantity of money produce changes in real output. There are numerous mechanisms that researchers have employed to generate monetary non-neutrality. I classify the attempts to explain monetary non-neutrality into three broad categories: *(i)* sticky prices; *(ii)* nominal wage contracts; and *(iii)* imperfect information.

3.1 Sticky Price Models

Many of the rationales for monetary non-neutrality can be classified under the heading of sticky price models. In these models, changes in the nominal quantity of money are translated into changes in real output because the nominal price level (or its constituent parts) does not adjust or adjusts only very slowly. Many different types of models resort to nominal price rigidities of this sort. Some of them are equilibrium rational expectations models that exhibit monetary non-neutrality, but provide little scope for exploitation by policymakers. Other models employ sticky prices but retain the necessary elements that permit policymakers to vary systematically the quantity of money to target real output (e.g. Gordon (1982)).

Recently, for example, McCallum (1986) has stressed that firms acting to economize on costs, optimally choose to set a nominal price over some period. The price setting process incorporates the firms' anticipations of inflation and monetary policy. The implication is that monetary shocks will have real effects within the interval when prices are fixed. Firms and other participants, presumably find the gains to indexing or more frequently adjusting prices sufficiently small that they do not have the private incentive to do so. If the private costs are small, it remains to be explained why these sorts of rigidities should be the key to understanding large economic fluctuations.

In an effort to develop the foundations of sticky price models many authors have recently stressed "menu costs" in the adjustment of prices. This line of research (see Ball, Mankiw and Romer (1988) for a survey), argues that in models with monopolistically competitive firms facing menu costs, monetary disturbances can result in social costs that are large even though private costs of price adjustment may be small. Many economists point out, however, that prices do change, sometimes very quickly; consumers bargain over price; sales occur, etc. Moreover, when reported or quoted prices do change, their changes are sometimes very small in magnitude.

Thus, despite the recent flurry of interest in these models and the claim to have revitalized "Keynesian economics," the majority of economists remain unconvinced that small menu costs are the primary reason why money effects real output and thus the rationale behind major economic contractions.

3.2 Nominal Wage Contracts

Another line of research has focussed on "sticky wages" as opposed to "sticky prices" as a source of monetary non-neutrality. For example, Fischer (1977) and Taylor (1980), have stressed the importance of long term nominal wage contracts as a source of nominal rigidity and thus monetary non-neutrality. Both of these models admit the possibility of a stabilizing role for monetary policy.

The attempts to isolate the transmission mechanism of changes in the money supply via stickiness in the nominal wage have met with two sorts of criticism. First, at the theoretical level, Barro (1977b), for example, stresses that these models lack a microeconomic foundation for why labor contracts exist in the form hypothesized in the models and why, if such contracts are socially costly, do they persist. Most attempts to develop the foundations for the existence of long-term labor contracts pertain to contracting for real wages and do not really explain nominal wage stickiness.

A second criticism of these models is empirical. A key prediction of this class of models is that the greater the degree of indexing of wage contracts, the less sensitive should the economy be to monetary disturbances. Ahmed (1987) studies the sensitivity of nineteen Canadian industries to monetary disturbances. The wage contracts in these industries exhibit varying degrees of indexation. Ahmed finds no relation between the degree of indexation and the sensitivity of industry specific output to monetary shocks. This raises important doubts about the relevance of the mechanisms emphasized by these models.

3.3 Imperfect Information Models

For over a decade, the most controversial and most investigated model of monetary non-neutrality stemmed from the work of Lucas (1972, 1973). Lucas' explanation, building on the earlier work of Friedman (1968) and Phelps (1977), stressed the idea that there were informational frictions that resulted in the inability of agents to distinguish changes in relative prices from changes in the absolute price level. Suppliers, when faced with an unanticipated monetary disturbance that raised the general price level, generally attributed some of the rise in price to a shift in the relative price of their good and hence chose to supply more output. A key feature of Lucas' model was that agent's expectations were rational so that anticipated changes in the price level or money supply were entirely neutral. Thus unanticipated movements in money could be a significant business cycle impulse. This type of model received initial empirical support from work of Barro (1977a, 1978) and Sargent (1976). Barro, as noted previously, found empirical support for the proposition that only unanticipated money was important for explaining real magnitudes. Later, Mishkin (1982) and others claimed to find evidence that anticipated money does matter.

An important line of criticism of this class of models was that monetary statistics and price level statistics are readily available to the public, so why are they so frequently misperceived by agents? Boschen and Grossman (1982), for example, found that contemporaneous perceived monetary movement were correlated with real activity in contradiction to the theory. Additional empirical evidence questioning the appropriateness of the Lucas transmission mechanism was reported by King and Plosser (1986). They found that although unanticipated movements in M1 are correlated with output, the same doesn't hold for surprise movements in the monetary base. Moreover, they found that there is little correlation between price surprises and real output. The absence of important correlations between price surprises and output casts doubt on the channels stressed by Lucas.

4 A Real Business Cycle Interpretation

The inability of economists to develop a theoretically and empirically coherent mechanism for explaining why movements in the nominal quantity of money alter real output has, in part, resulted a renewed interest in alternative theories of the business cycle. One line of research has followed the work of Kydland and Prescott (1982) and Long and Plosser (1983) in stressing the important role of real shocks, as impulses to the business cycle.[7] These models are purely real economic models driven by shocks to productivity and thus admit no role for nominal measures of money as an impulse for business cycles.

King and Plosser (1984) integrate money and banking into the real business cycle model. The result is a class of models that predicts a positive correlation between money and real activity but the causation runs from real activity to money and the banking sector. In this section I briefly summarize the arguments of King and Plosser and their implications and predictions for the relation between nominal measures of money and business cycles. Next I discuss the empirical evidence and its potential relevance for this real business cycle view of money.

4.1 Money in a Real Business Cycle

King and Plosser incorporate money and banking into a real business cycle model by introducing a financial or banking industry that supplies an intermediate good called transaction services to a final goods industry. The demand for transaction services arises from the desire to economize on time and other inputs in the exchange of goods. The output of the transactions or financial industry depends on the real costs of providing the services. In the presence of a positive productivity shock to the final goods industry, the production of transaction services rises as well. To relate the flow of transaction services to the stock of deposits, it is assumed that the

[7] See King, Plosser and Rebelo (1988a,b) for a more general development of this class of models and Plosser (1989) for a less technical discussion.

stock of deposit is related to the flow of services by a monotonic increasing function. Thus, the model implies that the volume of real deposits, or real bank money is positively correlated with output.

The economy just described is completely real with no nominal quantities. To incorporate a pure nominal quantity we simply posit a real demand for a noninteresting bearing fiat currency. Deposit or transaction services and real currency are assumed to be substitutes but not perfect substitutes for one another. The demand for currency depends on both a nominal interest rate and the cost of financial services. If, for example, banks are required to hold noninterest bearing reserves, this raises the cost of bank supplied transaction services, reduces its demand while increasing the demand for currency services.

In an unregulated banking environment the price level is determined by the interaction of the demand and supply of currency. What is significant is that bank or inside money plays no role in this model in the determination of the price level. The only way that developments in the financial sector are relevant to price level determination is through variations in the cost of financial services which alters the relative demands for inside and outside money. Thus changes in the quantity of nominal currency are completely neutral. The volume of real deposits are determined solely by variation in the real economy. Assuming prices are not too countercyclical, the nominal quantity of deposits will also be procyclical. An important implication of this framework is that broad measures of money like M1 or M2 are likely to be procyclical because of the endogeneity of bank money. On the other hand, variations in a measure of outside money like currency or the monetary base are neutral.

Another important characteristic of this model is that it highlights the possibility that important real variations in the banking sector may be a source of fluctuations in real output. For example, in a regulated banking environment, a change in reserve requirements alters real opportunities in that it changes the real tax on deposit services. Other real shocks to the financial industry may also arise. The important role played by banking panics in the 19th and early 20th century are another example. The financial system has played an important role in economic fluctuations in the work of Bernanke (1983) and more recently Stiglitz and Weiss (1988).

The real business cycle view forces one to think carefully about what is meant by a monetary theory of the business cycle and how it is different from a real theory. The distinction must be that a monetary theory stresses the importance of independent or exogenous changes in some nominal quantity of money as opposed to variations in banking policies (e.g. changes in reserve requirements) that alter real opportunities. Friedman and Schwartz (1963a) recognized this problem at one level by stressing that in some episodes, like banking panics, variation in the deposit-currency ratio was likely to be demand determined. Thus such episodes did not represent a clean example of independent movements in the money stock. They also stress as important evidence the nearly doubling of reserve requirements in 1937-1938. Yet such changes in the tax on banks are a real disturbance and can not effectively be used to argue for a monetary explanation of fluctuations in preference to a real theory of fluctuations. In the discussion that follows I reinterpret some of the evidence highlighted in section 3 in an attempt to see if it provides the compelling evidence, sometimes ascribed to it, that changes in the nominal quantity of money and the major impulses to business cycles.

4.2 Historical Episodes

Friedman and Schwartz (1963a) and Romer and Romer (1988) stress a number of historical episodes that, to them, provide convincing evidence that variations in the quantity of money are the most important impulse to business cycles. How convincing is this collection of episodes when viewed from a real business cycle perspective? In attempting to distinguish monetary from real explanations of the cycle it is important to keep in mind two things: First, the key factor that distinguishes a monetary theory of the cycle from a real theory is that the monetary theory assigns the primary impulse to independent variations in the nominal quantity of money. Thus, as stressed by Friedman and Schwartz, variations in money that are attributable to feedback from the real economy can not be relied upon for strong support of monetary explanation. Perhaps just as important is to stress that changes in "monetary policy" that alter real opportunities, perhaps through changes in bank regulation, can not be used to argue for a theory that assigns a major role to nominal variations in money.[8] As discussed above, examples can most frequently be found in changes in regulatory policy by the Federal Reserve such as changes in reserve requirements which alters the tax rate on certain forms of financial intermediation.

The second point to keep in mind is that real theories of the cycle do not stress that every business cycle must be initiated by the same easily identifiable impulse. Variations in real opportunities can arise from many sources, including changes in tax rates; real government spending; changes the terms of trade brought about through tariffs or import-export restrictions; changes in regulations, in addition to more general changes in productivity or preferences just to name a few. Of course, this is part of the theory's strength and weakness. Since there is no single, always easily observable impulse that initiates the cycle, systematic empirical investigations are difficult to conduct. Such difficulties, however, can not be used as prima facia evidence that the theory is wrong.

Romer and Romer (1989) discuss in some detail the episodes designated by Friedman and Schwartz as important independent monetary shocks. They argue that there is evidence of selection bias in the choice of episodes by Friedman and Schwartz. For example, the Romers cite the banking panic in early 1933 when the money stock declined 12% in just two months as an important monetary disturbance. This was the largest two-month decline during the entire period

[8] See Goodfriend and King (1988) for a recent discussion pertaining to the distinction between monetary policy and banking policy functions of the central bank.

1929-1933. Yet despite this dramatic shock to the money stock, the economy bottomed out in March 1933 and began a recovery. The Romers argue that Friedman and Schwartz do not emphasize this episode as evidence in conflict with their hypothesis regarding the importance of monetary disturbances.

The Romers also question the role of monetary shocks in those episodes that were stressed by Friedman and Schwartz. Of particular interest are the contractions of 1920-21 and 1936-37. The Romers suggest that non-monetary factors in the downturn of 1920 were potentially important including declining government spending following the war. Another non-monetary influence was identified by Loungani (1986) in the form of a large rise in the relative price of fuels and power in late 1919 and 1920.

The Romers also cite non-monetary factors influencing the downturn of 1936-37. In addition to their concerns, Friedman and Schwartz, emphasize that the important initial shock involved a doubling of reserve requirements. As discussed previously, such an event should be construed as a real shock to the banking industry and not as a nominal disturbance. Friedman and Schwartz (1963b, p. 218) acknowledge that the decline in the money stock was largely the result of a decline in the deposit-reserve ratio.

The conclusion reached by the Romers is that the interwar episodes stressed by Friedman and Schwartz are not particularly supportive of the hypothesis that nominal monetary disturbances are important for economic fluctuations. In a curious twist, Romer and Romer go on to conclude from their own analysis of U.S. post-war data that monetary disturbances (in particular, anti-inflationary rhetoric) provide "decisive evidence of the importance of monetary policy" (pg. 36).

In contrast to their analysis of the important interwar episodes of Friedman and Schwartz the Romer and Romer narrative of the six episodes that they isolate contains almost no discussion of non-monetary events. For example, they do not seem to see the potential relevance of the major oil shocks of 1948, 1953, 1957, 1973, 1979 and 1980 for the subsequent contractions as stressed by Hamilton (1983). They do not entertain the notion that the major temporary income tax increases from 1968-1970, the sharp reductions in government spending and the elimination of the investment tax credit were relevant at all for the recession of 1970.

In addition, Romer and Romer make no distinction between monetary policy and banking or regulatory policy. For example, in the nine months prior to the onset of the recession in November of 1948, the Federal Reserve raised required reserves by 30% from 20% to 26%. While such a significant increase in the tax on banks was caused by Federal Reserve policy, it is not a nominal disturbance, but a change in real opportunities. Similarly in October 1979 reserve requirements were again raised significantly and expanded to include a broader range of bank liabilities. In April 1980 these reserve requirements were raised again when credit controls were adopted. Another factor sometimes cited as important in the 1981-82 recession is the intertemporal substitution that occurred, after the passing of the tax reform act, because the tax cuts were phased in over several years.

It is also interesting to note that Romer and Romer offer no evidence that the nominal quantity of any money bore any correspondence to the verbal behavior of the Federal Reserve authorities. It is most unlikely that many economists are prepared to believe that the Federal Reserve can talk the economy into a recession. The only evidence they offer in passing is that interest rates rose around the dates of their events. This is not terribly convincing since the short-term nominal interest rate has been procyclical over this period, rising during virtually every expansion. It would not be hard to pick a date at random during any expansion and observe the nominal rate higher on average after the date than before. It is also interesting to note that the average length of post-war expansions is about 39 months. Assuming that recessions are unpredictable based on a univariate autoregression of industrial productivity, it does not seem too surprising that by selecting some date during an expansion that in the subsequent three years a recession could occur. Thus the Romers' narrative and their subsequent statistical tests offer little or no discriminating evidence in support of a monetary theory of the cycle.

4.3 Business Cycle Analysis

Friedman and Schwartz (1963b) and Cagan (1965) applied the method of analysis developed by Burns and Mitchell (1946) to study the business cycle patterns of the money stock. Friedman and Schwartz focussed on the behavior of the growth rate of the money stock and concluded that it conforms positively to the reference cycle with a long lead. I have applied the Burns and Mitchell methodology to the growth rate of various measures of money and plotted the average behavior for the seven complete reference cycles since 1948 in Chart 1.[9] Also plotted is the cyclical pattern of real GNP growth.[10] There are several points to make about these patterns. First, unlike the findings of Friedman and Schwartz, there is very little evidence of a procyclical pattern to broad measures such as M1 or M2. To the extent they follow any cyclical pattern it is because of the sharply lower growth rates and mid-way between the peak and the terminal trough. The monetary base, on the other hand, shows even less evidence of systematic cyclical behavior.

Second, and probably most important, is that Chart 1 confirms the finding of Cagan (1965). In his investigations of the source of cyclical variability of M1, he found that variation

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[9] See Burns and Mitchell (1946) or, more recently, King and Plosser (1989) for a detailed description of the methodology. Generally, the procedure treats the cycle (trough-peak-trough) as a unit and partitions the series into nine stages; three stages of expansion; three stages of contraction and a stage at each of the three turning points.

[10] All data are quarterly with growth rates expressed at annual rates. The data are as follows: real GNP; M1 and M2 are consistent money stock series constructed by Rasche (1988); the monetary base is constructed by the St. Louis Federal Reserve Bank; TD/C is the ratio of the non-currency component of M2 to currency; and DD/C is the ratio of the non-currency component of M1 to currency.

in the deposit-currency ratio was the single most important contributor to the cyclical variation in the money stock. In the chart, it is apparent that the dramatic decline in the growth rate of M1 and M2 during the contraction is closely match by the pattern of cyclical variability of the respective deposit-currency ratios. Moreover, the pattern of declining deviations from average cycle growth throughout the expansion appears largely a phenomenon driven by the deposit-currency ratios.

Friedman and Schwartz, and Cagan, acknowledge that variation in the deposit-currency ratio is a component of monetary growth that is attributable to the real economy feeding back into the determination of the money stock. The chart clearly shows that the bulk of the cyclical variability of M1 and M2 can be associated with cyclical variability in their respective deposit-currency ratios. Thus cyclical variation in nominal M1 and M2 growth can be interpreted as largely endogenous as predicted in the real business cycle model of King and Plosser.

4.4 Regression Results

The model developed by King and Plosser stresses the distinction between inside or bank money and outside money. In particular, an important implication is that the endogenous factors influencing the growth of money should be more closely correlated with real output fluctuations than exogenous factors. Cagan (1965) decomposed movements in money into three basic components *(i)* movements in high powered money or monetary base which in the post-war period have been under the control of the Federal Reserve; *(ii)* the ratio of deposits to currency which is determined by private agents; and *(iii)* the ratio of deposits to reserves which is determined by banks and legal reserve requirements. The two ratios can be viewed as key determinants of the money multiplier. As noted previously, Cagan concluded that the monetary base and the deposit to currency ratio were the most important services of variability in the money stock. In the empirical analysis I follow Cagan in focussing on the deposit to currency ratio and the monetary base, investigating how they behave relative to movements in real output.

Table 1 presents the summary statistics of the data for five different time periods: 1948-88, 1948-79, 1948-69, 1959-88 and 1959-79. Although there are some differences, the data displays similar properties in all the periods. Several points are worth noting. First, the standard deviation of output is higher than any of the monetary measures. Second, all of the monetary growth measures exhibit more persistence than the growth in real output. Finally, the growth rate of the ratio of the non-currency portion of *M1* to currency *(DD/C)* is not much different from zero in the early part of the sample whereas it displays some negative growth particularly in the 1970's and 1980's. The growth rate of the non-currency portion of *M2* to currency ratio *(TD/C)* exhibits positive growth in all periods although it appears to be smaller in the later periods.

The monetary base numbers are a peculiar mixture of real and nominal elements of monetary policy. The practice of adjusting the base figures for reserve requirement changes confuses real and nominal disturbances. For example, if reserve requirements are lowered (reducing the tax on banks) then the reserve adjustment increases the adjusted base thus inducing a positive correlation between changes in real opportunities and the nominal monetary base. More generally, this happens anytime the public alters its mix of assets among deposits with different reserve requirements. I have attempted to look at this distinction by reporting the percentage change in the adjusted base attributable to changes in the source base ($\Delta SB/B$) and that attributable to changes in the reserve adjustment ($\Delta RAM/B$)[11] These data cover the period 1959-1988. The summary measures of these series are also reported in Table 1.

[11] The basic data for the source base and reserve adjustment components of the monetary base were kindly provided by Mike Belongia of the St. Louis Federal Reserve Bank.

Table 2 presents the cross-correlations of each of the variables with the growth rate of real output. For the period 1948-1988 broad measures of money exhibit some correlation with real output while the monetary base and the source base show almost no correlation. On the other hand the two deposit to currency ratios show more correlation with output than any of the other variables. Across the different time periods the results are broadly similar. Depending on the sample, sometimes *M1* growth is more correlated with real output growth than *M2* and in other periods the reverse is true. The monetary base appears consistently unrelated to real economic activity. The only possible exception is during the 1948-1969 period when real activity seems to help predict the monetary base. In no period does the monetary base appear correlated with future real activity.

Another interesting feature of Table 2 is the correlation between inflation and real activity. Except for the 1948-1969 sample, the correlation between output and inflation is negative. Dividing the sample up into seven nonoverlapping periods beginning with 1948-1953 and ending with 1983-1989, the correlation is negative in five of the seven samples (1948-1953 and 1960-1965 being the exceptions). Others have noted this phenomenon as well. Friedman and Schwartz (1982, pp. 399-400) conclude from phase averaged data that prices or inflation are procyclical only for the interwar period. In the postwar period the average rate of inflation during expansions is actually lower than during contractions. Cooley and Ohanian (1989) have also documented this finding and conclude based on methods much different from those employed by Friedman and Schwartz that the interwar period is the only period for which inflation or prices can be viewed as systematically procyclical.[12]

[12] Mankiw (1989) has argued that real business cycle models such as developed in King and Plosser (1984) are seriously deficient because without a systematic feedback rule for monetary policy, they deliver a counter-cyclical price level. It would appear, however, that the evidence tends to suggest that counter-cyclical prices are the more frequently observed phenomenon.

Table 3 summarizes some of the characteristics of several bivariate autoregressions of real output growth and various measures of money and of deposit-currency ratio. The specification of the regression follows that suggested by Stock and Watson (1989a). All variables are expressed as growth rates, and a time trend is included. They found that this specification consistently yielded significant results in their study of monthly industrial production. In order to give money the maximum opportunity to predict output I have not included interest rates or other variables. If the transmission mechanism is through price surprises or through interest rates, including those variables may diminish the importance of money.[13]

Panel A of Table 3 presents the F-statistics and *p*-value of the hypothesis that the variables specified in the first column can be omitted from the equation for real output growth. As can be seen, the degree of significance varies with the time period. Both *M1* and *M2* have statistically significant (at the 10% level) predictive content for real activity for the overall period. Curiously enough, the evidence is stronger for the post 1959 period than the earlier period. More importantly for a real business cycle interpretation is that the monetary base is not significant in any period. The F-statistic is above 1.0 only in the 1959-1988 sample.[14] As noted previously, the monetary base represents a mixture of banking policy and monetary policy. Interestingly enough, the reserve adjustment component of the base seems to be marginal significant, while

[13] McCallum (1983) has suggested that the observation of Litterman and Weiss (1985) and others subsequently that including interest rates eliminates the predictive role of money is irrelevant. He argues that the Fed has usually employed interest rates as a target. Thus movements in interest rates may in fact represent variations in money. While this argument may have some merit, more recent results reported by Friedman and Kuttner (1989) and Stock and Watson (1989b) find that the spread between the commercial paper rate and the treasury bill rate also eliminates the role of money and the role of individual interest rates. Since this default spread is not generally considered to be a target of monetary policy, it would seem that McCallum's argument may be moot. In any event, I do not include interest rates in any form in order to give variation in money the most opportunity to play a role.

[14] Recently Stock and Watson (1989b) have investigated the bivariate relation between industrial production and 157 series. In terms of predictive content, the monetary base ranked among the bottom ten to fifteen series.

the source base does not. The two deposit to currency ratios have a much greater tendency to have significant predictive content for real activity. The same qualitative results show up when deposits or the money multipliers are used instead of the deposit to currency ratio.[15]

In the lower panel of Table 3, the three year ahead forecast error variance decomposition is present. The first number presented orders the column variable first and real output second in the decomposition of the contemporaneous covariance matrix. This practice attributes all contemporaneous covariance between the variables to the money or ratio variable and so produces a higher contribution to the forecast error variance. The second number (in parentheses) places real output first in the ordering and thus leads to a lower contribution of the variables to output. In periods when *M2* exhibits statistically significant predictive value, it accounts for between 7.6% and 20.9% of the forecast error variance three years out. For *M1* the numbers ranges from 13.6% to 22.4%. Note, however, that these values are sensitive to whether they are placed first or second in the ordering. In some cases the number is reduced by as much as two-thirds. These results confirm a statistically significant role for broad measures of money in predicting real output. Whether one wants to consider the magnitudes of the variance decompositions economically significant is open to debate.

As might be guessed from panel A, the monetary base plays virtually no role in explaining real output three years ahead. The only period when the point estimate is above 10% is 1948-1969. The deposit to currency ratios, on the other hand, are more similar to the broad money aggregates than to the monetary base. One interesting observation is that the growth rate in *TD/C* is less sensitive to the ordering of the variables. Regardless of whether it is ordered before or after real output, its explanatory power for real output is little changed. In addition,

[15] Interestingly, the regressions that use the ratios exhibit a somewhat better fit than those using either the nondeflated deposits or the money multipliers.

while the growth in *DD/C* is more sensitive than *TD/C* to the ordering, *DD/C* is somewhat less sensitive than *M1* is to the ordering. The source base appears to play a small role in the 1959-79 period, but it is sensitive to the ordering.

Table 4 reports the results of three variable systems that include the monetary base and the deposit ratios. As might be anticipated from the bivariate results the growth rates of the deposit to currency ratio is always more significant than the base. The lower panel of Table 4 summarizes the three year ahead forecast error variance decompositions. The first number is based on ordering the base first, the deposit currency ratio second and output last. This ordering maximizes the opportunity for the base to play an important role. The number in parentheses places output first, the base second and the deposit to currency ratio third. There is another ordering issue that is relevant. As discussed previously, the monetary base figures, by construction, are influenced by changes in reserve requirements and changes in the public's mix of bank deposit that are subject to different reserve requirements. As a consequence there is an induced positive correlation between the ratios and the base. Although not reported here, I have computed the forecast error variance decompositions placing the deposit ratio before the base in an effort to account for the feedback. The results are similar to those reported except that the contribution of the base to future output is reduced in every case, sometimes substantially, while the contribution of the ratios rise. For example, in the 1948-69 period ordering the demand deposit to currency ratio before the base reduces the base's contribution to output from 14.2% to 7.8% and increases the demand deposit to currency ratios from 18.0% to 24.4%.

Overall, these results in Table 4 confirm the general view that endogenous elements of money are the major contributors to the predictive value of money to real activity. The evidence that exogenous variations in the nominal quantity of outside is important for subsequent movements in real output is very weak. These findings are consistent with the work of others. For example, Rush (1985) estimates regressions similar to Barro (1978) for the period when the U.S.

was on the gold standard from 1880-1913. He found that neither expected nor unexpected movements in base money affect real output. He also showed that variations in the money multiplier were significantly correlated with real activity. King and Plosser (1984, 1986) have also noted that fact that the monetary base and currency seem unrelated to real activity. Boschen and Mills (1988) have reported similar results. They attempt to identify additional real shocks and to hold them fix to see if money is important for predicting output. Their real variables include oil prices, real government purchases, population, real exports, and changes in the marginal tax rate. They find that while the role of noncurrency components of *M1* and *M2* are sometimes important, currency never plays a significant role. Manchester (1989) reports results based VAR's that focus on the role of the money multiplier instead of the deposit ratios. Her results are similar to those reported here in that the money multiplier appears to play a much more important role than the monetary base.

5 Conclusion

In this paper I have focussed on the role of money in economic fluctuations. While money may play an important role in market economies, its role as an important impulse to business cycles remains a highly controversial hypothesis. For years economists have attempted to construct monetary theories of the business cycle with only limited empirical success. Alternatively, recent real theories of the cycle have taken the view that to a first approximation independent variations in the quantity of outside money are neutral. These models, however, do not necessarily deny the possibility of important real affects arising from real shocks to the financial sector nor that the Federal Reserve can be the initiator of those shocks.

The conclusion of this brief look at some of the various forms of evidence pertaining to money and business cycles is that the case for a monetary theory of the cycle that relies on independent variations in the nominal quantity of money as an important business cycle impulse is weak. Not only do variations in nominal money explain very little of subsequent movements in real activity, but what explantory power exists arises from variations in endogenous components of money. These characteristics are perfectly compatible with the implications of a class of real business cycle models proposed by King and Plosser (1984). Real business cycle models clearly have a long way to go before they offer a complete testable theory of the business cycle. However, their emphasis on real rather than monetary impulses as the primary source of shocks to the business cycle seems appropriate.

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TABLE 1

SUMMARY STATISTICS

Variable	Mean	Std. Dev.	ρ_1	ρ_2	ρ_4
		A: 1948-1988			
$\Delta\log(Y)$	3.24	4.40	.37	.25	-.10
$\Delta\log(M2)$	7.03	3.29	.68	.48	.31
$\Delta\log(M1)$	4.76	4.07	.58	.43	.37
$\Delta\log(B)$	4.95	3.42	.76	.68	.63
$\Delta\log(TD/C)$	2.15	3.58	.71	.50	.23
$\Delta\log(DD/C)$	-0.47	4.42	.48	.29	.16
$\Delta\log(P)$	4.10	3.04	.65	.60	.47
		B: 1948-1979			
$\Delta\log(Y)$	3.40	4.47	.37	.24	-.15
$\Delta\log(M2)$	6.77	3.24	.79	.58	.35
$\Delta\log(M1)$	3.84	3.12	.64	.47	.39
$\Delta\log(B)$	4.24	3.33	.78	.70	.66
$\Delta\log(TD/C)$	2.71	3.40	.76	.54	.19
$\Delta\log(DD/C)$	-0.67	3.43	.58	.40	.26
$\Delta\log(P)$	3.94	3.14	.61	.55	.40
		C: 1948-1969			
$\Delta\log(Y)$	3.69	4.46	.43	.25	-.22
$\Delta\log(M2)$	5.58	2.41	.71	.43	.29
$\Delta\log(M1)$	2.69	2.79	.56	.34	.23
$\Delta\log(B)$	2.67	2.77	.63	.50	.50
$\Delta\log(TD/C)$	3.44	2.86	.72	.43	.10
$\Delta\log(DD/C)$	.22	3.25	.53	.30	.06
$\Delta\log(P)$	2.57	2.51	.28	.20	-.06

(Cont'd.)

TABLE 1 - CONTINUED

SUMMARY STATISTICS

Variable	Mean	Std. Dev.	ρ_1	ρ_2	ρ_4
		D: 1959-1988			
$\Delta\log(Y)$	3.12	3.94	.25	.22	.02
$\Delta\log(M2)$	7.94	3.15	.60	.34	.11
$\Delta\log(M1)$	5.82	4.00	.50	.30	.23
$\Delta\log(B)$	6.32	2.58	.67	.52	.41
$\Delta\log(TD/C)$	1.33	3.59	.66	.43	.15
$\Delta\log(DD/C)$	-1.17	4.60	.43	.22	.14
$\Delta\log(P)$	4.73	2.81	.76	.72	.66
$\Delta SB/B$	5.98	3.39	.60	.48	.42
$\Delta RAM/B$	0.40	2.50	.32	-.03	.11
		E: 1959-1979			
$\Delta\log(Y)$	3.32	3.86	.19	.20	-.01
$\Delta\log(M2)$	7.94	3.09	.75	.48	.13
$\Delta\log(M1)$	4.88	2.85	.60	.37	.28
$\Delta\log(B)$	5.83	2.52	.77	.65	.54
$\Delta\log(TD/C)$	1.84	3.53	.75	.50	.14
$\Delta\log(DD/C)$	-1.79	3.01	.46	.19	.16
$\Delta\log(P)$	4.75	2.93	.73	.69	.61
$\Delta SB/B$	5.64	3.68	.67	.50	.43
$\Delta RAM/B$	0.25	2.48	.42	-.04	.03

Note: The data are quarterly and defined as follows: Y is real GNP; $M1$ and $M2$ are consistent money stock series constructed by Rasche (1988); B is the monetary base as constructed by the Federal Reserve Bank of St. Louis; TD/C is the ratio of the noncurrency to currency components of $M2$; DD/C is the ratio of the noncurrency to currency components of $M1$; and P is the GNP price deflator. The last two variables $\Delta SB/B$ and $\Delta RAM/B$ decompose the base growth into that attributable to changes in the source base ($\Delta SB/B$) and that attributable to the reserve adjustment ($\Delta RAM/B$). All growth rates are expressed at annual rates. ρ_1, ρ_2, and ρ_4 are the first, second, and fourth sample autocorrelations.

TABLE 2

CROSS-CORRELATIONS WITH REAL OUTPUT

Variable	Cross-Correlations with $\Delta\log(Y_{t-j})$ -4	-3	-2	-1	0	1	2	3	4
				A: 1984-1988					
$\Delta\log(M2)$	.02	.07	.17	.19	.11	-.08	-.13	-.13	-.18
$\Delta\log(M1)$	-.07	-.02	.15	.16	.17	-.02	-.03	-.09	-.05
$\Delta\log(B)$	-.07	-.05	-.01	.04	.06	-.03	.02	.02	-.04
$\Delta\log(TD/C)$	.24	.25	.29	.23	.08	.08	-.10	-.15	-.15
$\Delta\log(DD/C)$	.12	.13	.30	.23	.19	-.06	-.05	-.13	-.04
$\Delta\log(P)$	-.10	-.11	-.06	-.05	-.08	-.09	-.15	-.25	-.24
				B: 1948-1979					
$\Delta\log(M2)$	-.00	.13	.20	.21	.18	.03	-.09	-.12	-.16
$\Delta\log(M1)$	-.12	.02	.17	.19	.28	.15	.04	-.01	.01
$\Delta\log(B)$	-.11	-.06	-.03	-.01	-.08	.03	.08	.09	.03
$\Delta\log(TD/C)$	.26	.33	.36	.29	.15	-.08	-.19	-.23	-.25
$\Delta\log(DD/C)$	.14	.25	.37	.31	.29	.05	-.07	-.13	-.07
$\Delta\log(P)$	-.15	-.20	-.09	-.02	-.02	-.02	-.01	-.06	-.07
				C: 1948-1969					
$\Delta\log(M2)$	-.05	.09	.20	.22	.18	.00	-.07	-.07	-.07
$\Delta\log(M1)$	-.10	.08	.25	.30	.37	.24	.11	.02	.00
$\Delta\log(B)$	-.07	-.03	.04	.09	.19	.16	.22	.28	.13
$\Delta\log(TD/C)$	.24	.28	.31	.12	-.05	-.32	-.34	-.39	-.32
$\Delta\log(DD/C)$	.18	.28	.40	.24	.19	-.07	-.15	-.30	-.24
$\Delta\log(P)$	-.21	-.19	.07	.19	.23	.24	.21	-.03	-.04

(Cont'd.)

TABLE 2 - CONTINUED

CROSS-CORRELATIONS WITH REAL OUTPUT

Variable	Cross-Correlations with $\Delta\log(Y_{t-j})$ -4	-3	-2	-1	0	1	2	3	4
				D: 1959-1988					
$\Delta\log(M2)$	.15	.15	.26	.26	.15	-.05	-.10	-.13	-.23
$\Delta\log(M1)$	-.03	-.04	.16	.14	.13	-.10	-.06	-.13	-.07
$\Delta\log(B)$	.01	-.01	.06	.12	.08	-.08	-.00	-.09	-.14
$\Delta\log(TD/C)$	.21	.24	.29	.25	.14	-.02	-.09	-.06	-.12
$\Delta\log(DD/C)$	.03	.03	.22	.16	.14	-.10	-.05	-.09	.01
$\Delta\log(P)$	-.25	-.33	-.30	-.29	-.27	-.22	-.22	-.11	-.09
$\Delta SB/B$	-.13	-.14	-.11	-.25	.07	.10	.10	.05	-.02
$\Delta RAM/B$	.19	.18	.21	.20	-.01	-.22	-.14	-.16	-.12
				E: 1959-1979					
$\Delta\log(M2)$	.13	.27	.33	.33	.29	.13	-.05	-.14	-.24
$\Delta\log(M1)$	-.13	-.02	.13	.10	.21	.12	.10	-.04	-.02
$\Delta\log(B)$	-.10	-.05	.01	-.01	.09	-.01	.06	-.04	-.07
$\Delta\log(TD/C)$	.23	.37	.40	.38	.29	.08	-.09	-.11	-.20
$\Delta\log(DD/C)$	-.01	.14	.27	.23	.29	.10	-.05	-.01	.03
$\Delta\log(P)$	-.09	-.29	-.25	-.27	-.26	-.18	-.18	-.06	-.05
$\Delta SB/B$	-.19	-.18	-.09	-.15	.08	.11	.20	.04	-.00
$\Delta RAM/B$	.29	.22	.14	.21	-.03	-.18	-.23	-.11	-.07

Note: All variables are defined in Table 1. The cross-correlations are between the column variable at time t and $\Delta\log(Y)$ at time t-j. The large sample standard error for the cross-correlations is .08 in panel A, .09 in panels B and D, and .11 in panels C and E.

TABLE 3

SUMMARY OF THE REGRESSIONS FOR REAL OUTPUT IN BIVARIATE VAR'S

Variable	1948-88	1948-79	Sample Period 1948-69	1959-88	1959-79
	A. Exclusion Restrictions: F-statistics and *p*-values[a]				
$\Delta\log(M2)$	1.95(.10)	1.51(.21)	0.67(.61)	2.46(.05)	3.52(.01)
$\Delta\log(M1)$	2.35(.06)	1.71(.15)	1.20(.32)	2.29(.06)	1.99(.10)
$\Delta\log(B)$	0.67(.61)	0.10(.98)	0.42(.79)	1.11(.36)	0.17(.95)
$\Delta\log(TD/C)$	2.34(.06)	1.95(.11)	1.59(.19)	2.20(.07)	3.11(.02)
$\Delta\log(DD/C)$	2.58(.04)	2.85(.03)	2.43(.05)	1.93(.11)	1.76(.15)
$\Delta SB/B$	--	--	--	0.32(.86)	1.30(.28)
$\Delta RAM/B$	--	--	--	2.78(.03)	2.03(.10)
	B. Three Year Ahead Forecast Error Variance Decomposition[b]				
$\Delta\log(M2)$	7.6(5.7)	13.4(8.5)	11.1(4.4)	11.3(10.5)	20.9(18.3)
$\Delta\log(M1)$	16.7(6.1)	24.9(7.2)	23.8(8.4)	13.6(7.1)	22.4(7.5)
$\Delta\log(B)$	6.5(1.8)	8.5(0.5)	12.6(2.8)	6.7(4.7)	5.6(1.1)
$\Delta\log(TD/C)$	8.0(8.2)	9.7(9.7)	7.6(7.4)	10.6(10.6)	17.5(17.4)
$\Delta\log(DD/C)$	11.1(7.3)	20.4(13.4)	20.0(15.7)	9.9(6.5)	18.5(7.9)
$\Delta SB/B$	--	--	--	4.3(2.0)	14.3(7.2)
$\Delta RAM/B$	--	--	--	12.4(12.7)	13.9(13.4)

[a] The bivariate VAR includes four lags of $\Delta\log(Y)$, four lags of the appropriate money or ratio growth rate variable and a time trend. The F-tests are for the hypothesis that the coefficients on the fours lags of the money or ratio growth rate variable are jointly equal to zero. The corresponding *p* values are in parenthesis.

[b] The forecast error variance decompositions are in percent. The first number places real output growth second in the variance decomposition and the number in parentheses places output first, which is the more usual practice.

TABLE 4

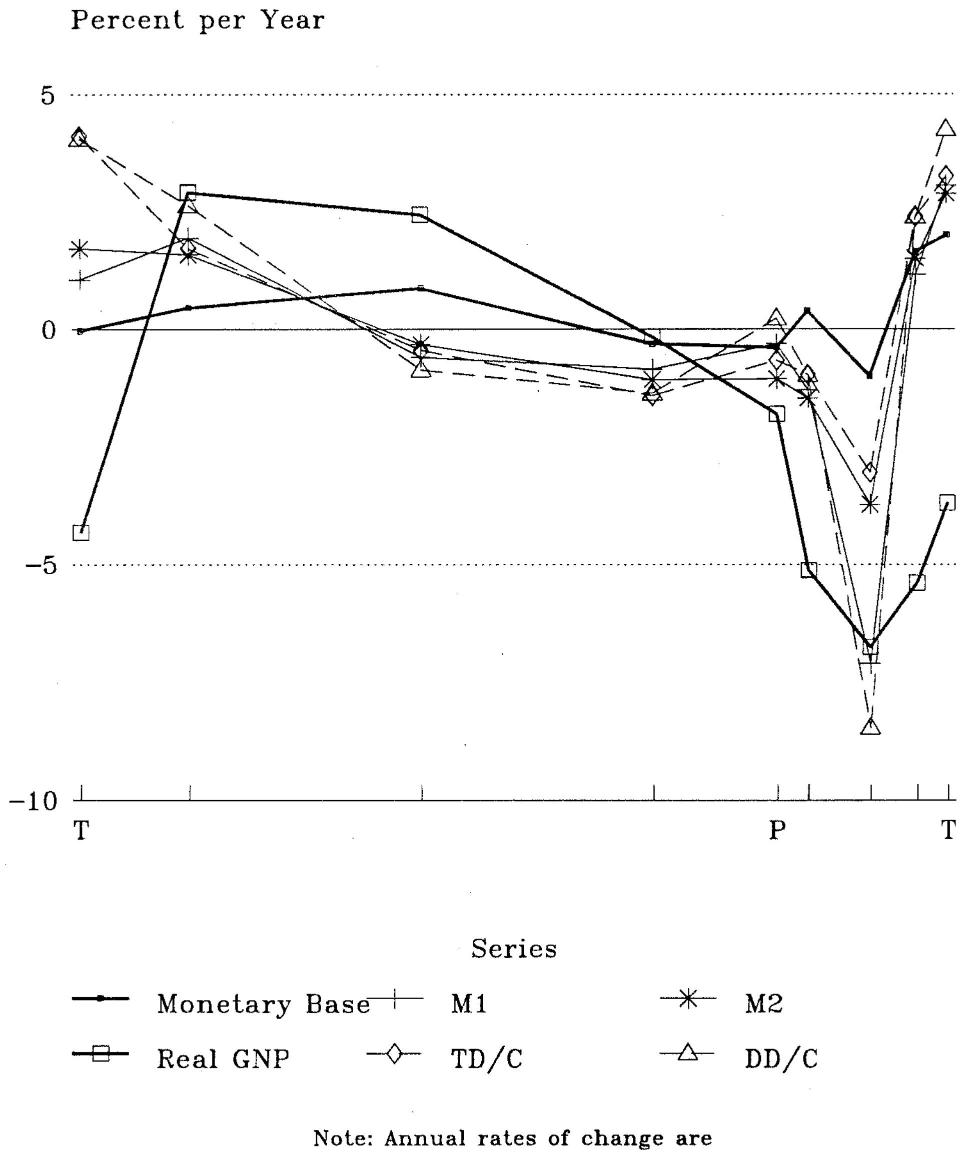
SUMMARY OF THE REGRESSIONS FOR REAL OUTPUT IN THREE AND FOUR VARIABLE VAR'S

Variable	Sample Period 1948-88	1948-79	1948-69	1959-88	1959-79
	A. Exclusion Restrictions: F-statistics and p-values[a]				
System: $\Delta\log(B), \Delta\log(TD/C)$					
$\Delta\log(B)$	.75(.56)	.26(.90)	.51(.73)	1.24(.30)	.26(.90)
$\Delta\log(TD/C)$	2.39(.05)	2.09(.09)	1.64(.18)	2.30(.06)	3.05(.02)
System: $\Delta\log(B), \Delta\log(DD/C)$					
$\Delta\log(B)$	.69(.60)	.27(.89)	.48(.75)	.79(.53)	.25(.91)
$\Delta\log(DD/C)$	2.56(.04)	2.95(.02)	2.39(.06)	1.58(.19)	1.76(.15)
System: $\Delta SB/B, \Delta RAM/B, \Delta\log(TD/C)$					
$\Delta SB/B$	--	--	--	1.36(.25)	.47(.76)
$\Delta RAM/B$	--	--	--	2.61(.04)	.54(.70)
$\Delta\log(TD/C)$	--	--	--	.76(.55)	1.38(.25)
	B. Three Year Ahead Forecast Error Variance Decomposition[b]				
System: $\Delta\log(B), \Delta\log(TD/C)$					
$\Delta\log(B)$	4.8(1.2)	8.7(0.5)	13.1(3.4)	3.5(2.7)	7.5(1.0)
$\Delta\log(TD/C)$	9.1(8.9)	10.9(10.9)	10.9(10.5)	12.5(12.3)	17.9(17.3)
System: $\Delta\log(B), \Delta\log(DD/C)$					
$\Delta\log(B)$	7.7(2.3)	8.4(0.8)	14.2(4.0)	7.0(4.2)	10.0(1.5)
$\Delta\log(DD/C)$	10.0(7.4)	19.2(13.4)	18.0(16.1)	8.5(5.6)	15.9(6.8)
System: $\Delta SB/B, \Delta RAM/B, \Delta\log(TD/C)$					
$\Delta SB/B$	--	--	--	4.2(2.9)	13.1(4.6)
$\Delta RAM/B$	--	--	--	12.1(10.3)	6.0(2.9)
$\Delta\log(TD/C)$	--	--	--	6.9(6.9)	16.4(14.9)

[a] The data are all quarterly and defined in Table 1. The three variable system includes four lags of $\Delta\log(Y)$, four lags of $\Delta\log(B)$, and four lags of either $\Delta\log(TD/C)$ or $\Delta\log(DD/C)$ and a time trend. The F-tests are for the hypothesis that the coefficients on the indicated variable are jointly equal to zero. The corresponding p-values are in parentheses.

[b] The forecast error variance decompositions are in percent. The first number is based on an orthogonalization that orders the variables $\{\Delta\log(B), \Delta\log(TD(\text{or}DD)/C, \Delta\log(Y)\}$. The second number is based on the ordering $\{\Delta\log(Y), \Delta\log(B), \Delta\log(TD(\text{or}DD)/C)\}$. In the four variable system $\Delta\log(B)$ is replaced by $\{\Delta SB/B, \Delta RAM/B\}$ so that variation due to the source base is always placed first relative to the reserve adjustment component.

Chart 1. AVERAGE REFERENCE CYCLE PATTERNS, 1947 – 1988
Averages of Seven Cycles



Note: Annual rates of change are expressed as deviations from cycle averages.