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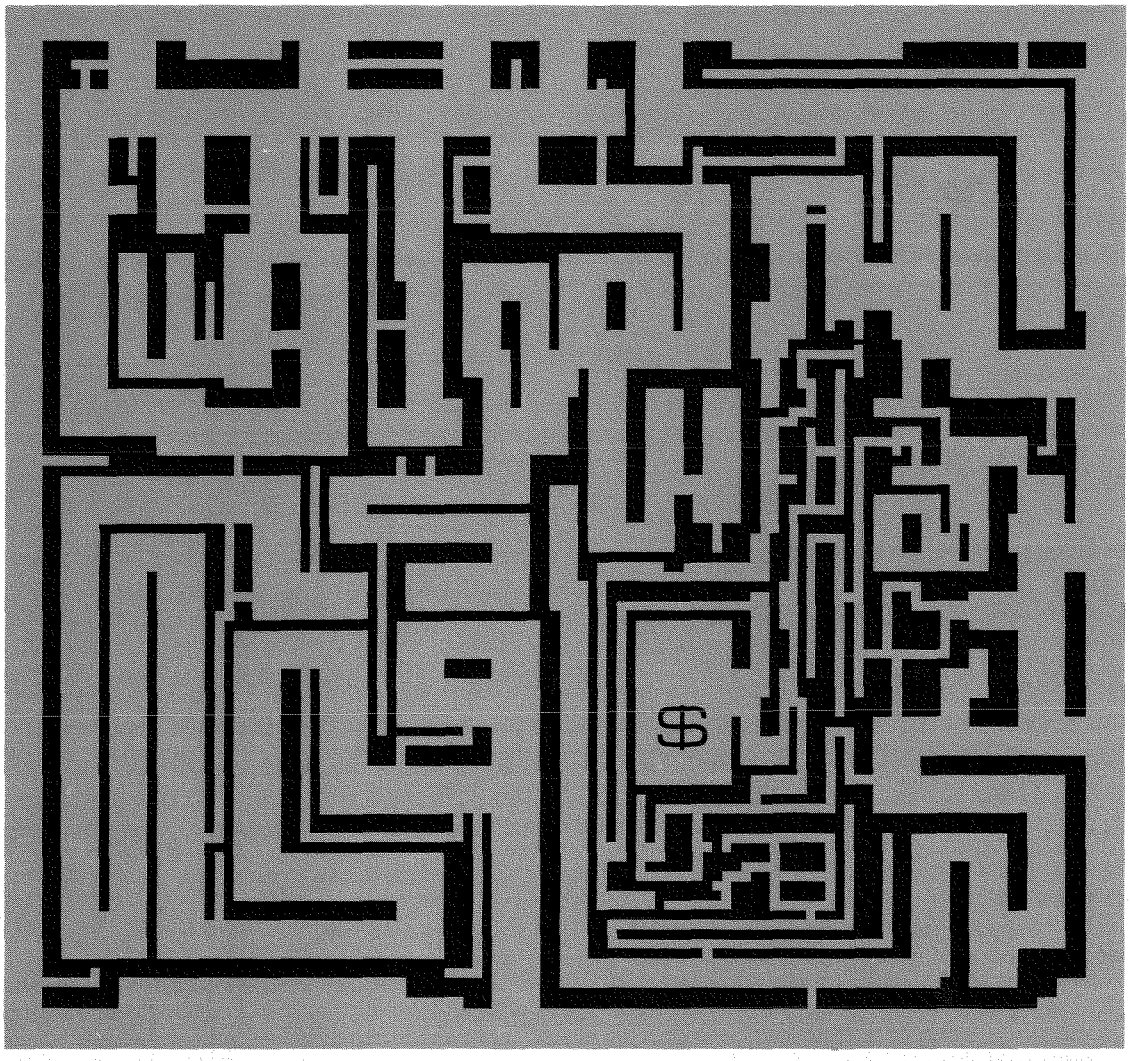

CPI | WPI | M_1 | M_2 | M_3

ALTERNATE STRATEGIES TOWARD INFLATION

FALL 1979

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Alternate Strategies Toward Inflation

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Alternate Strategies Toward Inflation

The United States remains mired in the worst peacetime inflation of its entire history, following a 90-percent upsurge in the general price level over the past decade, and many other industrial nations exhibit similar records. We must carefully examine the causes of this severe problem, and then determine the best way of returning the nation to relative price stability—hence this issue of the *Review*. The first article evaluates the theoretical and empirical evidence on the causes and costs of inflation—as well as the costs of anti-inflation policy—as a means of determining which policy has the most reasonable chance of sustained success against inflation. The next two articles provide a rationale for the Federal Reserve's October 6 shift in monetary policy—a shift which promises greater control over price fluctuations, through its increased emphasis on the control of the monetary aggregates. The final article utilizes the experiences of Japan and three other fast-growing Far Eastern economies to examine the relationship between exchange-rate policy and inflation.

Michael Bazdarich, in the first article, employs a simple macroeconomic analysis to present statements of both monetary and cost-push (or income-share) theories of inflation. He concludes that all these theories require an accompanying increase in the money supply to provide a consistent account of continuing inflation. "It follows that the various theories can explain sustained inflation, such as we have experienced, only to the extent that they can explain systematic increases in the money supply."

Turning to the formulation of an effective anti-inflation policy, Bazdarich notes several questions which policymakers must face. First, should inflation in fact be slowed? "We argue that the costs of inflation are considerable and recurring, whereas the output costs of stopping inflation, while considerable, are temporary, and would be almost wholly absorbed by the economy within a three-to-five year period following a sustained effort to reduce the rate of inflation." Next he asks, what policy instruments should be used if we decide to slow inflation? "The importance of monetary factors in initiating and/or sustaining inflation implies that an effective anti-inflation policy must include a sustained reduction in the growth rates of the monetary aggregates. This is true even if one holds to a strict cost-push view of inflation."

Finally, he asks, how rapid a reduction in inflation should policymakers try to attain? "Though political forces may push for a 'quick fix', the lags from monetary policy to inflation make it impossible to achieve an immediate reduction in the inflation rate. Moreover, attempts to eliminate inflation quickly would make a deep recession inevitable, which would tend to shift political sentiment from fighting inflation to reducing unemployment, and thus could lead to stimulative policies and another inflationary cycle."

John P. Judd and John L. Scadding next turn to the crucial role of monetary policy, specifically to consider the implications of the recent major shift in the focus of short-run policy procedures. First there is the strategic question of translating ultimate stabilization goals, such as price stability and full employment, into intermediate targets for the monetary aggregates. Next, there is the tactical question of choosing an operating instrument as a means of reaching the desired monetary targets. Until recently, this two-step procedure consisted formally of a Federal-funds rate operating instrument designed to achieve intermediate targets for the monetary aggregates. But the authors contend that the reality of policy differs significantly from its appearance. Specifically, they argue that the Federal Open Market Committee (FOMC) operates in such a way to ensure the linkage of operating instrument and intermediate target, so that they cannot in practice be separated in the way suggested by the formal description. This reflects the fact that there are two dimensions to the operating-instrument decision—the choice of instrument, and also the choice of methods of employing the chosen instrument.

Judd and Scadding argue that the FOMC is likely to control whatever operating instrument

it chooses in a cautious manner. This rational approach follows naturally from apparently unavoidable uncertainties about the actual state of the economy and the impact of policy actions. This cautiousness means that the choice of operating instrument largely pre-ordains the effective choice of intermediate targets. Cautious control of the funds rate means that the FOMC, in effect, uses interest rates as its intermediate target, whether or not it has official aggregates targets. An interest-rate approach is most nearly optimal when real-sector disturbances are smaller than monetary-sector disturbances, and when inflation is not a major problem. Cautious control of reserves means that the FOMC uses the monetary aggregates as its intermediate target, which is most nearly optimal when real-sector disturbances are larger than monetary-sector disturbances, and when inflation is a serious source of concern. These conclusions thus suggest two guidelines: 1) Choose the most nearly optimal intermediate target, on the basis of the available empirical evidence; and 2) Choose the operating instrument which, when controlled cautiously, orients policy as much as possible around the chosen intermediate target.

"Monetary policy", they conclude, "should lean more toward a pure aggregates strategy than a pure interest-rate strategy. Given the uncertainties and other constraints on FOMC actions, the reserves approach recently adopted will automatically imply an aggregates orientation of monetary policy. This will be a distinct improvement over former policies which, despite official aggregates targets, were really oriented around interest rates."

Kenneth C. Froewiss and John P. Judd next consider whether it is wise to single out one variable—the money supply—from among all of those on which the Fed might focus its attention. "Indeed, to confer primacy on 'money' goes against a long Fed tradition of 'looking at everything' in attempting to gauge the direction of the economy and the correspondingly appropriate monetary policy." Moreover, that tradition has some support in the theory of "optimal control"—a theory which implies that monetary policy is unlikely to be optimal if available information about goal variables is not used.

Froewiss and Judd agree that the optimal-control argument is theoretically unassailable, but argue that it cannot be considered relevant to policymakers without reference to a related empirical question: which variables, if any, contain information about aggregates in addition to the policy variables on which policymakers naturally rely? Froewiss and Judd reply, "The statistical tests indicate that, once policymakers take account of growth in money (especially M_2), they can gain little additional information about aggregate demand from such variables as bank credit (and its components), interest rates, and flow-of-funds variables."

Generally speaking, Froewiss and Judd find little evidence to support the view that the Federal Reserve should not target money because this involves "throwing away" significant financial-market information. "Furthermore, these results reconfirm the robustness of the association between money and aggregate demand."

Hang-Sheng Cheng, in a final article, analyzes the relationship between exchange-rate policies and domestic inflation. He shows that, in an open economy, any inflationary disturbance from whatever source always manifests itself as a pressure in the foreign-exchange market, in the form of a reserve change or an exchange-rate adjustment (or a combination of the two). He also shows that the essence of an exchange-rate policy lies in a deliberate policy choice regarding the distribution of the "exchange-market pressure" between reserve changes and exchange-rate adjustments. From this analysis, he derives a policy rule for minimizing domestic inflation—permit exchange appreciation and resist depreciation, regardless of the source of inflationary disturbances.

Cheng then applies this rule to assess the actual exchange-rate policies and inflation experiences of Japan, the Philippines, Korea and Taiwan during the 1968-78 period. "All four countries exhibited a strong aversion to currency appreciation and a strong preference for currency depreciation—an attitude exactly opposite to what our policy rule would prescribe." Cheng notes that this attitude may have stemmed from other policy objectives, such as export competitiveness and income growth. "A 'sub-optimal' exchange-rate policy incurs a cost in terms of a higher-than-necessary inflation rate."

The Phenomenon of Inflation, and the Prospects For Anti-Inflation Policy

Michael Bazdarich*

Inflation is currently judged to be the American economy's number-one problem by President Carter, Chairman Volcker, and most other prominent government officials, not to mention the American public. And reducing inflation, of course, is a primary goal of Federal Reserve policy. Clearly, then, the development of an effective anti-inflation policy is a crucial issue.

In order to address this issue, one must first analyze the nature of the inflation process itself, as well as the underlying economic causes of inflation. This is the aim of the present paper. We will evaluate the available theoretical and empirical evidence on the causes and costs of inflation as well as on the costs of anti-inflation policy. We will then use the results of this analysis to determine which anti-inflation policy has the most reasonable chance of sustained success.

To this end, in Section I we employ a simple macroeconomic analysis to present comparable statements of both monetary and cost-push (or income-share) theories of inflation. On the basis of that analysis, we conclude that all these theories require an accompanying increase in the money supply in order for them to provide a consistent account of continuing inflation. It follows that the various theories can explain sustained inflation, such as we have experienced, only to the extent that they can explain systematic increases in the money supply.

In Section II, we use these points to discuss what a meaningful test of the competing theories of inflation should show, and evaluate the empirical evidence on these terms. We see ample evidence there of a strong positive effect of the monetary aggregates on the price level, but find very little evidence that U.S. monetary policy has systematically reacted to accommodate cost-push or monopoly-pricing factors. Also, despite mixed evidence, we find some signs of effects of government spending and federal deficits on the monetary aggregates. These results suggest that U.S. fiscal and monetary policies have had a substantial role in initiating and sustaining inflation over the last two decades.

In Section III, we discuss the economic costs of inflation. Besides increasing uncertainty and redistributing wealth, inflation also causes people to shift out of holding money balances into shopping more often, stockpiling goods, and making speculative investments—all of which lead to inefficient allocations of resources. Also, because of government tax regulations written in terms of nominal amounts, inflation distorts private decisionmaking. We conclude, then, that the costs of inflation are indeed significant.

The rest of our analysis concerns the costs of anti-inflation policy and the choice of the best policy to achieve that end. In Section IV, we discuss the output-employment costs of anti-inflation policy by considering current evidence on the Phillips curve inflation-unemployment tradeoff. The available evidence suggests that significant amounts of output and unemployment would be lost under any anti-inflationary fiscal and monetary policy. Still, it is doubtful that alternative or additional policy actions can avoid such costs while still slowing inflation.

In Section V we consider the implications of this analysis for the formulation of an effective anti-inflation policy. Here we attempt to answer three questions facing the policymaker: 1) Should inflation in fact be slowed? 2)What policy instruments should be used if we decide to slow inflation? and 3) How rapid a reduction in inflation should policymakers try to attain?

The answer to the first question might seem to be a foregone conclusion, yet it's useful to con-

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sider the pros and cons formally. We argue that the costs of inflation are considerable and recurring, whereas the output costs of stopping inflation, while considerable, are temporary, and would be almost wholly absorbed by the economy within a three-to-five year period following a sustained effort to reduce the rate of inflation.[1] In this light, the costs of stopping inflation do not appear to outweigh the costs of inflation itself. Also, given the substantial responsibility of fiscal and monetary policymakers for originally causing inflation, it can be argued that they should direct their efforts toward reducing the inflation problem today.

With respect to the second question, the importance of monetary factors in initiating and/or sustaining inflation implies that an effective anti-inflation policy must include a sustained reduction in the growth rates of the monetary aggregates. This is true even if one holds to a strict cost-push view of inflation. At the same time, we argue that tighter fiscal policy and the removal or easing of governmental regulatory burdens may successfully augment monetary policy by mitigating its contractionary effects on various sectors of the economy. However, we see no useful role for incomes policies in our anti-inflation strategy, partly because there is no clear evidence that wage and price restraints can mitigate cost-push forces, and partly because such policies have historically tended to substitute for rather than complement monetary restraint.

Finally, with respect to the third question, the crucial issue in deciding how quickly to stop inflation is how the costs of stopping inflation can be least painfully imposed. Though political forces may push for a "quick fix", the lags from monetary policy to inflation make it impossible to achieve an immediate reduction in the inflation rate. Moreover, attempts to eliminate inflation quickly would make a deep recession inevitable, which would tend to shift political sentiment from fighting inflation to reducing unemployment, and thus could lead to stimulative policies and another inflationary cycle. This strongly suggests that restrictive policies should be implemented slowly enough to avoid a deep recession, but resolutely enough to have some lasting effect on inflation. That is, policymakers must avoid expansionary temptations once their policies begin to work in slowing inflation. Naturally, such a passive policy course could be politically unpopular, and thus hard to maintain. Nevertheless, it may be the only course of action that can generate a sustainable reduction in inflation without severely distorting or disrupting the workings of the American economy.

I. Inflation in Macroeconomic Theory

For our purposes, theories of inflation can be divided into two major groupings: monetary theories and cost-push—or more precisely, what Charles Schultze has called "income share"—theories of inflation.[2] Monetary theories cite accelerations in the growth of various monetary aggregates as the primary inciting and sustaining factor in inflations. Cost-push or income-share theories, on the other hand, stress the importance of supply factors, such as autonomous increases in important wages or prices, in generating continuing wage-price spirals. Usually, such autonomous increases are said to occur when firms or labor unions exercise their perceived monopoly power in an attempt to increase their profits or wage incomes, respectively.[3] Their actions subsequently lead to price and wage increases throughout the entire economy.

As stated here, both types of inflation theories provide only partial explanations of the inflation process. Monetary approaches provide a reasonably complete description of how the money supply operates through demand and supply to effect an increase in the price level. However, the pressures—political or otherwise—which cause policymakers to allow the money supply to increase in the first place often are not described or documented as fully as are the effects of money on prices. On the other hand, income-share theories generally provide descriptions of the economic and sociological forces leading to cost-push behavior. However, most of these discussions do not provide a cogent enough analysis of how the momentum of cost-generated wage-price spirals can continue without severe disruptions of output and employment. These

respective analytical problems are discussed further below.

Economists typically define inflation as a sustained increase in the average price level, and thus in the money price of virtually all goods. However, industry-specific phenomena—such as bankruptcies, mergers, technological development, and changes in consumer tastes or supply conditions—typically change prices in one industry relative to another, but do not have much effect on the price level in general. Rather, such relative price changes serve as signals to the economy to shift resources among industries—and to shift consumption habits among goods—in order to promote economic efficiency. Some prices will rise and others will fall, but prices on average need not change at all. Under inflation, however, the dominant characteristic is an increase in virtually all money prices, with resource shifts either non-existent or primarily due to factors unrelated to the inflation itself. Thus, there is a fundamental conceptual difference between factors which lead primarily to *relative* price changes and those which lead primarily to *absolute* price-level changes, or inflation.[4]

There is also a distinction between factors which cause continuing inflation and those which cause only one-time movements in the price level. Thus, some factors can have a broad enough impact to raise the general price level once-and-for-all, but cannot cause continuing price increases. Therefore, these factors cannot seriously be considered as causes of sustained inflation such as the United States and other countries have experienced.

Inflation has been linked to increases in the money supply at least since the writings of David Hume some two hundred years ago.[5] The reason is that increases in currency and deposit holdings by the public serve to *increase* demand—and so money prices—for all goods rather than to *shift* demand from one good to another. Moreover, an increase in the money supply serves to increase nominal demand for goods but does not change underlying real supply conditions (i.e., technology and factor supplies). Such an increase ultimately affects only prices, without necessarily inducing resource shifts from one industry to another.

Of course, in the short-run, before prices have adjusted fully, a higher money supply will induce higher output and employment, and other real effects. However, these will disappear once the economy has adjusted fully to the higher money supply.[6] Furthermore, continuing increases in the money supply will exert continuing upward pressure on nominal demand, and so can cause continuing inflation.

In the days of the gold standard, monetary analyses explained secular increases in the supply of specie (gold)—and thus inflation—largely through expropriations or discoveries of gold and silver. In modern economies with fiat monies, the supply of currency and deposits is largely under the government's control, so a complete monetary theory of inflation must explain why the government would, in effect, choose to inflict inflation on an economy by expanding the money supply.

One obvious explanation is the political pressure to maintain high-employment and output conditions. Since prices and resources are not perfectly flexible in the real world, central banks are constantly under pressure to insure that their domestic money supply grows *at least* as fast as money demand. (Otherwise, there would be general downward pressure on prices, which could lead to depressed business conditions if the economy did not react immediately.) In such a case, the money supply inevitably would grow faster than money demand, and thus impart an inflationary bias to the economy.

Also, the lags from monetary expansion to inflation are longer than those from monetary expansion to increases in output. This naturally causes conflict between those with short-term time horizons, who are concerned with output and employment here and now, and those with longer horizons, who are more worried about long-term problems such as inflation and stable growth. When short-term problems are especially pressing, or when those short-run concerns gain superior political force, monetary expansion will accelerate, thus leading to accelerated inflation later on.

Another oft-cited explanation of inflationary monetary expansion is the tendency for higher government expenditures to be financed by

money creation rather than by higher taxes or bond sales to the public. The higher spending therefore leads to faster money-supply growth, which then eventually leads to accelerated inflation. It is important to realize that the same level of government spending would be much less inflationary when financed fully by taxes or bond issues to the public. Higher taxes would in effect shift demand from the general public to the government, so that the higher spending could be accomplished with a small one-time increase in the price level. Public bond issues would either shift demand from investors to the government, or would tend to increase interest rates in credit markets, in either case mitigating price rises.[7] However, when money creation finances government spending, this serves to augment rather than offset the higher government demand for goods. What's more, the money supply will tend to continue growing as long as spending remains at a high level, so that a continuing inflation can occur.

In summary, increases in the monetary aggregates can be seen to lead to the general type of price increases which we have defined as inflation. Monetary theories also cite various political factors which can lead to the initial excessive monetary expansion.

Income-share theories attribute inflation to the struggles of business firms, labor unions, and other groups to increase their share of the economic pie. Initially, these groups attempt to exploit their perceived monopoly power to raise the prices of their goods or services. When higher wages raise costs and prices in an industry and/or when higher commodity prices raise the costs of producing other goods and of maintaining living standards, other firms and unions attempt to keep pace by raising their own prices, which can then cause a wage-price spiral to emerge. Various versions of this approach include cost-push, wage-push and sellers' inflation theories, as described in the writings of John Kenneth Galbraith, Abba Lerner, Edward Bernstein, and others. Similar theories cite shocks to particular industries—such as the OPEC oil price hike of 1973 or various crop failures—as the first causes which raise costs and so generate continuing inflationary spirals.[8]

All the phenomena discussed in this context are primarily sources of relative price change. By themselves, they represent, at most, temporary or one-time pressures on the price level. The typical problem for these theories is to explain how such one-time, industry-specific factors can induce a continuing, general inflation without disrupting equilibrium levels of output and employment.

Consider, for example, an increase in wages in an industry due to union demands. If all other wages and prices in the economy then increase by like amounts in order to maintain real incomes, real wealth will decline due to the lower purchasing power of cash and other assets with fixed money values. Therefore, demand would be insufficient to maintain full-employment output, so that either the price level would fall towards its previous level or the economy would go into recession. In other words, if all prices rise, but aggregate demand conditions remain unchanged, the new set of prices could not be an equilibrium and so could not be sustained.

Thus, for cost-push types of disturbances to be a source of continuing inflation—but not of continuing unemployment—there must be an accompanying stimulus to aggregate demand, as would be provided by an increasing money supply. Accommodative monetary policy in such a situation might occur if policymakers increased the money supply in order to avoid even the temporary losses in output and employment resulting from inflexible prices and inputs. Equilibrium output levels could then be maintained, because the increased money supply would serve to increase the equilibrium price level up to the level of actual prices, and thus to validate the higher prices.

This type of accommodating increase in the money supply must occur to sustain any inflation triggered initially by cost-push influences. An income-share struggle or supply shock would provide the initial spark, and the increasing money supply would provide the fuel to support the continuing inflation. Though analyses of this type emphasize various conflicts and shocks, and hardly even mention the money supply, an accommodative monetary policy nevertheless plays an essential role in sustaining such wage-price spirals.

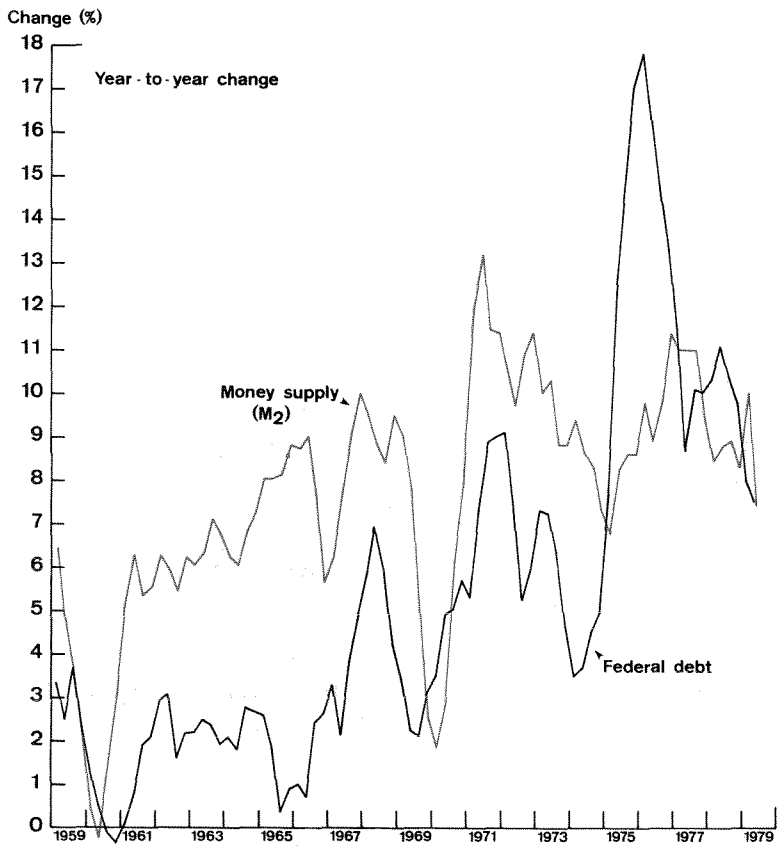
The debate between monetary and income-share theories of inflation can therefore be couched in terms of which is more effective in explaining the actual expansion of the monetary aggregates. That is, does the money supply typically increase because of fiscal-and monetary-policy decisions, with wage and price increases merely symptoms of a general inflationary situation—or are wage and price increases typically autonomous forces, with faster money growth validating higher prices in order to prevent business slumps?[9] An analysis of the empirical evidence can provide some evidence on this issue.

II. Inflation in Fact

Since 1964, consumer-price inflation in the United States has averaged 5.75 percent per year, and has tended to accelerate, and manufacturing wage rates have shown much the same behavior (Chart 1). Relative price changes have indeed occurred over this period, but, as documented in Fama and Schwert (1977), they apparently have not been systematically related to observed inflation.[10] Nor have business slumps and unemployment followed every wave of price increases, or worsened as inflation continued. Rather, the price level has moved inexorably upward throughout the period, during booms and serious recessions, and during shortages *and* surpluses for important commodities like food, steel, and oil. In other words, we have experienced a classic inflation, with actual price behavior generally characterized by accelerating rates of increase of all prices rather than by periodic changes in a few dominant commodity prices. Again, relative price changes and inter-industry shocks have occurred, but have not represented a

Chart 1

Changes in Money Supply and Federal Debt



dominant characteristic of the continuing U.S. inflation.

Over this same period, the monetary aggregates—such as M_1 and M_2 —have also grown at an accelerating rate (Chart 2), as has virtually every nominal variable that one could name. This concomitant increase in money and prices is consistent with our argument that the money supply must increase for inflation to continue. What is more impressive is the massive amount of statistical evidence which documents a systematic link between various money-supply measures and price levels over a wide range of economic experiences. For example, a recent study found that fluctuations in the M_1 measure were able to explain over 60% of quarterly fluctuations in U.S. consumer prices over the 1959-78 period.[11] Thanks to such results, economists nearly unanimously acknowledge the importance of money-supply growth in sustaining inflation.

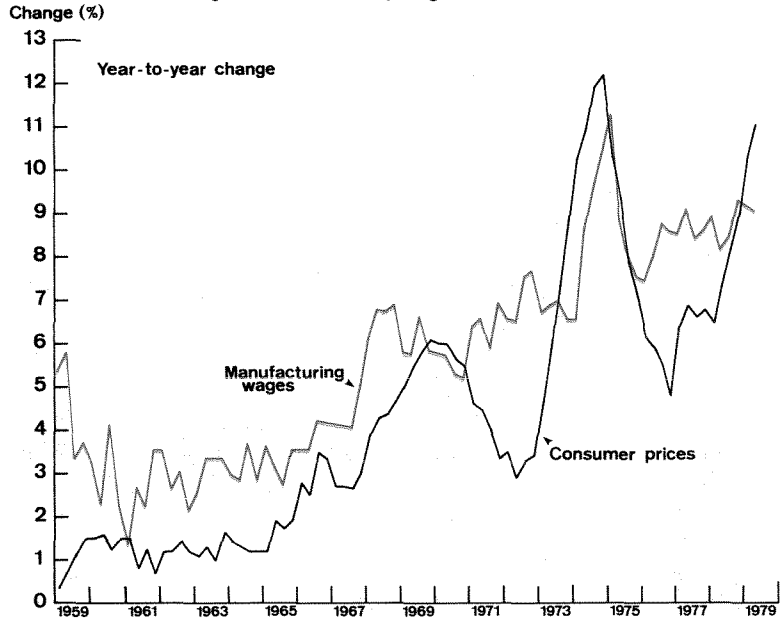
As discussed earlier, however, these results do not explain what factors lead to the initial monetary expansion, and so do not necessarily rule out cost-push-cum-accommodation theories. Still, some studies have directly addressed these issues.

But first, it may be useful to consider some of the more traditional evidence used to support income-share inflation hypotheses. Over the last few decades, several articles have documented a relation between various factors (such as wage increases and changes in industrial concentration) and inflation rates, both secularly and at various points in the cycle.[12] As Levy (1979) points out, however, all these studies have two serious defects: their results are not shown to be inconsistent with a monetary theory of inflation, and the phenomena they cite are not shown to be sources of autonomous shocks rather than reactions to already existing inflationary forces. In any inflation, as we have seen, all nominal variables inevitably rise together. Therefore, merely documenting a statistical correlation between, say, wages and prices, does not rule out the possibility that both are being driven by a third factor, such as the money supply. In the jargon of statistics, tests of the cost-push theory have been of very low power, with little or no ability to rule out competing hypotheses.

A meaningful way to test between monetary and income-share theories would be to acknowledge the long-run monetary nature of inflation, and then to analyze the factors which cause monetary expansion, and so serve to generate or perpetuate inflation, as the case may be. If

Chart 2

Changes in Manufacturing Wages and Consumer Prices



income-share or cost-push factors have typically been the initial causes of inflation, then there should be a systematic effect of these factors on monetary policy—and so on the money supply—if the process is to continue. On the other hand, if ambitious political programs—operating through increased government deficits or expansionary monetary policies—have typically been the source of money-supply growth and inflation, this link too should be identifiable.

These issues have been addressed in independent work by Gordon and Bazdarich, with much the same results. Gordon (1977) tested for causal effects from various cost-push or supply-shock variables to the money supply, using data from seven major industrialized countries over the last two decades. Only for the United States did he find *any* systematic evidence of monetary accommodation, and even this evidence was extremely weak.[13] Over a similar period, Bazdarich tested for monetary accommodation of wages and prices in the Pacific Basin (1978), and for monetary accommodation of a range of cost-push or supply-shock variables in the United States (1979). He found no significant evidence that the narrow money supply (M_1) or the monetary base systematically reacted to any of these factors. The wider money-supply measure (M_2) reacted systematically only to a few highly cyclical variables, such as steel prices, which may have tracked the cyclical nature of M_2 due to disintermediation and similar effects. For an overwhelming majority of the variables, the typical result was strong effects from the various monetary aggregates to the "cost-push" measure, but virtually no reverse effects.

In other work on the U.S. economy, Gordon (1978) concluded that only the acceleration of inflation in 1974 could be attributed to non-monetary factors—in this case to food and oil-price shocks. Still, Bazdarich (1979) found that even this period could be reasonably well explained by 1971-75 money-supply growth and by the 1972-73 removal of wage-price controls.[14]

One might argue that the twenty-year data periods used in these studies are too long to pick up the possibly temporary effects of various cost-push factors. Yet it is also true that such effects lose reliability and applicability if they do not hold up over extended periods of time. For example, a statement that monetary policy reacted to wage pressures, say in 1964, is not testable at all, since we have only one observation—and that was in fact already used to formulate the hypothesis! Futhermore, even if we could prove this assertion, it tells us little about what caused inflation in 1978, or what will cause inflation in 1981. In other words, a theory must be general and have predictive power if it is to have any practical applicability, and the tests of various versions of cost-push inflation have revealed little evidence of these qualities.

As for the effects of government spending and deficits, Gordon (1977) found evidence that Vietnam War financing in the U.S. could explain some of the money-price phenomena in the U.S. and abroad in the late 1960's. Bazdarich (1979) also found evidence of systematic effects of both government spending and government deficits on M_1 and M_2 as suggested by Chart 2, although these results had some unsatisfactory features.[15] In unrelated attempts to measure money-supply "reaction functions," Barro (1976) and others have found effects of fiscal-policy measures and monetary-policy goal variables on various money-supply measures.

These studies identify systematic effects transmitted from various measures of fiscal and monetary policy to money-supply growth, and thence to inflation. Yet on the same terms, they generally fail to find such effects for cost-push variables such as wages, unit labor costs, and various commodity prices. Obviously, monetary-oriented theories cannot explain every wiggle in money supplies and prices, but over extended periods of time—over all phases of the business cycle—they appear to have significantly greater explanatory power for inflation than cost-push or income-share theories.

Still, the question may arise whether there really is a basic distinction between the two theories. While income-share theories cite business and labor pressures on the central bank as creating expansionary policies, monetary theories cite political pursuit of economic goals as leading to monetary expansion. Given the similar political undertones, does it make much difference which description is most accurate? If nothing else, the way in which we have contrasted these theories helps to illuminate the impor-

tance of the money supply and monetary policy in the inflation process. Moreover, the evidence suggests that Congress and the Federal Reserve have been more than merely passive agents swept along on a wave of inflation. These institutions and the political process in which they operate have served to generate as well as perpetuate much of our recent inflation, which is an important consideration in our later discussion of anti-inflation policy.

III. Economic Costs of Inflation

Economists are often criticized, and rightly so, for underestimating the costs of inflation. This reflects the fact that most of the "costs" of inflation *recognized by the public* either represent redistributions of wealth among different groups, with little net cost to society, or arise from popular misconceptions. For example, if an increased money supply leads to higher prices, people on fixed nominal incomes, holders of cash, and creditors will lose. On the other hand, debtors will gain, as will also the beneficiaries of government activities financed by the money creation. Similarly, if inflation were caused by a wage-push-cum-accommodation set of events, those negotiating the higher settlement would gain, while creditors and those on fixed incomes would suffer. These direct gains and losses in wealth due to inflation roughly offset each other, leading to a redistribution of income, but not necessarily to a decline in national income.

Similarly, the public tends to perceive inflation as causing a decline in living standards as household incomes apparently fail to keep up with rising prices. Again, however, real incomes do not typically decline during inflations, and so no loss in real purchasing power occurs for the economy as a whole. Rather, perceived losses typically occur because consumers believe their nominal incomes are rising because of their own merit, and not because of any general inflationary phenomena. Thus, they believe their $20,000 incomes would have accrued to them even if prices had not risen, so that they see a loss in purchasing power compared to what they would have had with $20,000 incomes but lower prices. This naturally leads them to feel that they have been cheated, despite the inconsistencies of their underlying reasoning.

Economists often neglect the redistributions of wealth and increased misperceptions that are inherent in any real-world inflation, because these phenomena are not important in theoretical analyses of inflation. Still, wealth redistributions due to inflation represent returns based on chance rather than effort. These therefore distort the public's psychological incentive to prosper from thrift and hard work, rather than from speculative ventures. Similarly, the "losses" in purchasing power are real enough to families with expectations of future prosperity. These costs are very real to the voting public, and cannot be as easily dismissed by policymakers as they are by economists.

Furthermore, there are very real economic costs imposed by inflation, some of which show up even in theoretical analyses, and some of which are endemic to real-world economies with laws and contracts written in nominal terms. For example, inflation causes individuals to economize on cash holdings, and thus to substitute more time shopping and bartering for the convenience of using cash or financial instruments. The faster that prices rise, the faster money loses its value, and so the more costly it is to hold. This causes individuals to utilize inefficient means of transaction in order to hold as little money as possible.[16] These phenomena have been deemed "shoe leather costs of inflation", as the public spends more time (wearing out shoes) in stores, between stores, or waiting in line, rather than holding more cash and spacing shopping trips farther apart.

Similarly, businesses typically attempt to avoid taxes on inflation-expanded profits by hiring extra accountants and tax consultants to devise (say) exotic depreciation or tax-shelter schemes. Furthermore, as inflation rises, the public experiences greater losses from not anticipating it correctly, and thus devotes more resources to research and information on inflation prospects and less to the production of tangible goods. The growth of T-bill futures, GNMA futures, and the gold market, and the growth of various forecasting services, are testimony to the

vigor of attempts to learn about and hedge against inflation. These efforts largely stem from the increased *variability* of the inflation rate, more than from an increased *level* of inflation, but typically, higher inflation is accompanied by a higher variability of inflation as well.[17] These phenomena may not lower measured GNP, but they reduce living standards by drawing valuable resources (viz., leisure and financial expertise) to socially less efficient uses.

How important are these costs? Rose (1979) cites estimates that every one-percentage-point rise in the inflation rate costs between $1 to $3 billion in current dollars per year in extra transaction costs, or between 0.1 to 0.2 percent of real GNP per year. Moreover, these costs continue to accrue with continuing inflation. If we discount a permanent flow of such costs at a 2-percent real rate,[18] the present value of the costs of each permanent percentage-point increase in the inflation rate would approximate $100 billion, or 5 percent of GNP. These are very rough estimates of the real costs involved. Still, these costs can clearly be enormous—probably on the same order of magnitude as the temporary losses in employment and output caused by an anti-inflationary monetary policy.

Perhaps the most controversial question about the costs of inflation concerns its effect on economic growth. Some economists have concluded that inflation speeds growth by reducing money holdings and so encouraging saving and investment. Such results have typically been obtained in models where all unconsumed output necessarily went to productive investment. However, in the real world, when inflation causes consumers to decrease cash balances and consumption, they often substitute inventories of storeable commodities or precious metals rather than productive investment. Thus, the growth process might be unaffected or even impeded by inflation.[19]

The behavior of stock prices and commodity prices provide some evidence on this issue. If higher inflation increases the demand for capital investment, we would expect strong prices in periods of accelerating inflation. However, if higher inflation merely encourages commodity speculation, we would expect weak stock prices and volatile commodity prices during such periods. Gorham's (1979) findings were mixed on the relation between commodity prices and inflation. However, they showed a strong negative effect of inflation on stock prices, and no reliable sign of a positive effect of inflation on investment. Moreover, a casual look at the numbers suggests that the decade-long acceleration of inflation has coincided with slower growth in output and productivity.

All these costs occur even in simple theoretical analyses of inflation, but many more costs of inflation occur due to the nominal-value orientation of the U.S. legal system. A prominent example is the progressive income tax, where marginal tax rates are calibrated by dollar increments of income. If a worker's salary rises to "keep up" with inflation, the higher salary pushes him into a higher tax bracket, so that a larger fraction of his pre-tax income goes to taxes. Thus, he is left with a lower after-tax real income despite the "cost of living" adjustment. Since actual tax rates are not indexed regularly, inflation therefore can reduce after-tax real income for extended periods of time. Similarly, if the nominal value of productive capital rises due to inflation, the *nominal* rise will be treated as a *real* capital gain by the tax system and taxed accordingly. Therefore, inflation systematically lowers the after-tax real rate of return on capital.[20] Since the government receives these extra tax revenues, there is no immediate social loss. However, the tax system together with inflation lowers the effective returns to labor and capital investment—so that this lowers the incentives to work and invest, lowers the supplies of labor and capital to the economy, and so puts a drag on the growth of domestic output.[21]

Similar effects can occur because of deposit interest-rate ceilings (Regulation Q). When inflation pushes up nominal interest rates on other investments, interest-rate ceilings on deposits cut off funds for deposit institutions. This serves to restrict financing to sectors, such as housing, which depend on a steady flow of funds to deposit institutions. The interaction of rate ceilings and inflation thus impedes the efficient functioning of these sectors.

To summarize, even in an ideal economy with full information and perfect flexibility, inflation imposes significant costs by discouraging the use

of money in financing transactions and otherwise encouraging socially inefficient use of resources. In addition, real-world impediments—such as laws written in nominal terms—combine with inflation to further distort the allocation of resources. These costs, together with the psychological strains caused by inflation, make inflation a very expensive experience for the national economy.

IV. The Inflation-Unemployment Trade-off

Numerous and diverse costs are incurred by an economy during inflation. On the other hand, the costs of stopping inflation can be characterized mainly by the losses in output and employment which anti-inflation policies are likely to impose. These costs can be discussed in terms of the current economic wisdom on the Phillips curve—the supposed inverse relationship between unemployment and inflation.

Samuelson and Solow (1960) first proposed the Phillips curve as an instrument of policy, partly in the belief that higher rates of inflation would allow the economy to achieve permanent reductions in unemployment.[22] This belief stemmed from the then-observed empirical stability of the Phillips relation, despite the fact that economic theory had never achieved a satisfactory explanation of why such a trade-off should exist. However, once policymakers started to exploit this relationship, its stability began to disappear. High inflation rates failed to prevent higher and higher unemployment rates from occurring.

Friedman (1968) argued that no permanent trade-off actually exists between inflation and unemployment. Rather, he asserted that higher inflation temporarily leads to higher output and lower unemployment *solely* because, during any inflation, prices initially rise faster than people expect them to. This causes the public to confuse the general inflation process with a higher demand and higher relative prices for the goods they produce, so that they respond by increasing output and hiring more workers. Once the public has adjusted to the higher rates of inflation, unemployment will return to its "natural rate", or perhaps even to a higher natural rate due to the distortions discussed above. At that point, an even higher level of inflation will be required to again confuse the public and thence reduce unemployment.

Friedman asserted that a fully anticipated inflation will not cause unemployment to drop below normal levels, so that there is no trade-off between *anticipated* inflation and unemployment, and no sustainable trade-off between *actual* inflation and unemployment. These insights explained not only the Phillips curve trade-off, but also the deterioration in the trade-off over time. Furthermore, the subsequent acceleration in U.S. inflation concurrent with rising unemployment insured the existence of a receptive audience for his ideas.

Following ten years of research on this "natural-rate hypothesis," the economics profession has largely agreed on the importance of inflation expectations in correctly specifying the Phillips curve relation.[23] Economists also widely acknowledge that no permanent inflation-unemployment trade-off exists. The remaining debate centers on three issues affecting the nature of the short-run Phillips trade-off: first, how quickly expectations adjust to new phenomena, specifically to changes to policy; second, how quickly unemployment returns to its natural rate once expectations have adjusted; and third, how much the natural rate varies in response to exogenous shocks.[24]

The first two issues are clearly concerned with the extent of short-run gains or losses in output and employment that would accrue from a shift in monetary and fiscal policy. The third issue is also related, since higher (or lower) unemployment levels may persist for long periods of time following policy shifts if the unemployment changes represent shifts in the natural rate as well. Therefore, estimations of adjustment lags which do not allow for shifts in the natural rate could conceivably be biased upward.

Unfortunately, because expectations cannot be observed directly, we cannot easily distinguish among the three types of adjustment lags consid-

ered here. Most studies merely attempt to estimate the lag from changes in prices to changes in output or employment. Pigott (1979) and McElhattan (1979), in evaluating these studies, both conclude that the empirical evidence roughly supports the long-run natural-rate hypothesis (i.e., that there is no long-run trade-off between unemployment and inflation), but they also find substantial lags from changes in policy to changes in inflation.[25]

Pigott, however, also presents a somewhat conflicting analysis of recent international experience. Germany and Japan's slow growth during the 1970's has commonly been attributed to their anti-inflationary policies, whereas the U.S.' faster-than-normal growth has been attributed to a weaker anti-inflation policy. Yet Pigott finds output actually high in the German and Japanese economies, when compared to that in the U.K., Sweden, Canada, and Italy, even though these other industrialized countries have made little or no inroads into inflation. In other words, a comparison of Germany and Japan with the U.S. alone suggests that large output costs are associated with slowing inflation. However, a comparison with a number of other industrialized countries leads to a less forthright conclusion. Persistent slow growth abroad may have been due to anti-inflation policies, or perhaps more likely, to some common occurrence such as the rising relative price of energy.

Still, studies involving U.S. data have typically found that a contractionary monetary and fiscal policy will reduce output and raise unemployment over a subsequent three-to-five year period. Perry (1978) concludes that a contractionary policy which increased unemployment by one percentage point will require three years to shave one percentage point off the inflation rate.[26] Perry attributes these long lags to rigidities in nominal wages and prices, slowness in the adjustment of expectations, and the existence of cost-push factors prolonging inflation. Consequently, he suggests the need for some sort of incomes policies to retard the cost-push process and so ameliorate the output costs of slowing inflation.

Perry's analysis can be questioned on several points. For one thing, his estimates of the length of the adjustment period following policy changes are longer than those in many monetary analyses, although his lags are similar to those found in other studies.[27] A more vulnerable conclusion is his argument that incomes policies can mitigate the output effects of tighter policy.

Presumably, the wage-price rigidities causing Perry's long lags could result from monopolistic behavior by firms and unions. Yet incomes policies would not directly attack these monopoly powers. For example, a union might exert monopoly power by controlling the supply of skilled labor that a manufacturer needs, or by persuading (contractually) a manufacturer to eschew non-union sources. An incomes policy might moderate the *explicit wage* that the union could charge the manufacturer, but it would not prevent the union from exploiting its monopoly power by demanding a myriad of *non-wage benefits,* including better health and pension plans, longer vacations, stricter seniority rules, etc. These would serve to increase unit labor costs as much as equivalent wage increases, and so would have much the same effects on output and employment under an anti-inflation monetary policy.

Therefore, just as price controls do not prevent queuing and other implicit costs from equilibrating supply and demand, incomes policies need not prevent firms or unions from exercising their monopoly power in other ways. Thus, they may not help—and may even hurt—the adjustment process to slow inflation.[28] Advocates of income policies virtually ignore these issues, but they can present a damaging argument against the efficacy of such policies.

The evidence on balance suggests that a substantial period of slow growth will follow any serious attempt to slow the rate of inflation. Furthermore, it is not clear whether incomes policies or the like can shorten this period. While the seriousness of these output costs varies across different studies, it would be hopelessly optimistic to believe that inflation could be slowed without some temporary losses in production and jobs.

V. Stopping Inflation—Odysseus at the Helm

Our conclusions can be used to discuss three basic policy issues: 1) Should inflation be reduced; 2) what instruments should be used in an anti-inflation policy; and 3) how quickly should we attempt to slow inflation.

With respect to the desirability of reducing inflation, a rough cost-benefit calculation can be devised. The costs of slowing inflation include the temporary declines in output and employment discussed in Section IV. The benefits include the removal of the recurrent costs of inflation discussed in Section III.

Perry's (1978) analysis suggests that one percentage-point higher unemployment for three years would be needed to slow inflation by one percentage point. Even if we assumed that each unit of labor contributes a constant share to GNP, these losses in present-value terms amount to less than a 3-percent reduction in GNP to slow inflation by one percentage point. Yet the losses from the continuing inefficient allocation of resources ("shoe leather costs," etc.) due to inflation were estimated at 5 percent of GNP for one percentage point of inflation, in present-value terms.

Consider also the likely sources of error in these calculations. Again, Perry's lags from tight policy to lower inflation are longer—and so his implied output losses from slowing inflation are higher—than those in monetary analyses of inflation. Moreover, it may be incorrect to assume that each percentage-point change in unemployment means a constant one percentage-point effect on GNP. This assumption abstracts from the productive input of capital and other factors in GNP, and also ignores the lower productivity of marginally employed labor, which would be the first to become unemployed. Thus, the output costs of slowing inflation are probably overstated. It could be argued in rebuttal that the costs of inflation are also overstated. However, our calculations included only efficiency losses and ignored other costs of inflation. Also, a 5-percent after-tax *real* rate of return was used to obtain our 2-percent discount rate, which is absurdly high, and so further understates the costs of inflation.[29]

To be sure, these are very rough estimates of the costs and benefits of slowing inflation. Nevertheless, they cast substantial doubt on the argument that inflation is best left alone—that the "cure is worse than the disease." Moreover, given our earlier conclusion that Federal government and Federal Reserve actions have been responsible for much of the problem, and given the public's increasing distaste for inflation, it would seem incumbent on policymakers to face up to the task of slowing the price spiral.

If, then, we conclude that a serious attempt should be made to slow inflation, what instruments should be directed to the task? Our earlier analysis clearly implied that slower growth in the monetary aggregates is a necessary part of any anti-inflation strategy. This is true whatever inflation theory one holds, since no type of inflation can continue without a sustaining monetary expansion. Deregulation of various industries, liberalization of tax laws, or even lower government spending financed by lower taxes (leaving money growth unchanged) would allow one-time declines in the price level, but by themselves could not permanently overcome persistent inflation such as the nation has recently experienced.

The evidence does not indicate which monetary aggregate the Federal Reserve should focus on. M_1, M_2 and the monetary base all display similar statistical effects on prices. What would seem more important is that the Federal Reserve concentrate on a particular aggregate of its choice and not switch among aggregates when they give conflicting signals.[30] Otherwise, the Fed might be tempted to choose whichever aggregate was displaying the most convenient signal at a given time.

Actions to reduce government regulations, to liberalize (or index) tax laws, to reduce protective tarriffs, and other such moves could help mitigate the contractionary effects of slower money growth, and could also provide a quick (albeit temporary) reduction in inflation. These steps thus could serve a useful role in augmenting or complementing an anti-inflationary monetary policy. But since these are supplementary actions, the basic question about them is whether they would be intrinsically good for the econo-

my, rather than how much of a temporary reduction in inflation they could effect.

A more vital supplementary policy would involve lower government spending and deficits. As we have seen, federal spending and deficit increases historically have apparently helped stimulate monetary expansion through the monetization of federal debt. A slower money-growth rate unaccompanied by lower deficits would eventually depress the whole economy, but would initially affect housing and similar sectors most heavily because of their vulnerability to high interest rates. Lowering the deficit along with money growth would reduce the strain on credit markets, and would probably allow a smoother approach to lower inflation rates.

A case could be made for incomes policies if one could show that cost-push factors have played a major role in generating inflation, but there is little compelling evidence on that score. Moreover, there is *no evidence* that incomes policies could successfully counter true monopoly power wherever such occurs. Finally, history suggests that incomes policies, when employed, have tended to license renewed growth in the money supply.[31] The proponents of such policies usually emphasize that they are intended as a complement to slower money growth. Nevertheless, as a practical matter, policymakers typically become tempted to expand monetary policy when incomes policies can be relied upon to hold down prices temporarily. For these reasons, incomes policies apparently can do little good but much harm, and so probably should be left unused in formulating plans to slow inflation.

Finally, how fast should we try to reduce inflation? Recent history suggests that a policy of rapid reduction in money growth and inflation cannot be maintained for very long. A drastic reduction in money growth can cause a quick and deep recession. Once the resulting unemployment becomes severe, political sentiment shifts from concern about inflation to worry over unemployment. In that situation, policymakers may yield to short-run pressures and expand the money supply anew. After a brief decline, inflation would then accelerate once more and the situation would become as bad as (or worse than) before.

This apparently is what happened in 1974-76. With inflation at 12 percent in 1974 (see charts), the decline in M_2 growth to 7 percent signified very restrictive policy. This shift, together with the oil-price hike, plunged the economy into a deep recession in 1975. But shortly thereafter, following public consternation over high unemployment, M_2 growth began to accelerate again—and it has since been the prime factor in causing the currently high rate of U.S. inflation.

In sum, the temporary costs of slowing inflation, and the temptation to avoid these costs through expansionary means, provide strong enticements to abandon anti-inflationary policies—even when these are seriously installed. Like the Sirens of the Odyssey, the short-run trade-offs facing policymakers with short-term horizons have a call that requires more than good intentions to resist.[32]

It would seem that the surest way to reduce inflation on a permanent basis is to avoid the large cyclical swings in policy that create swings in public opinion as well. Thus, the rate of growth in the FOMC's chosen aggregate should be lowered slowly, say by 1 to 1½ percentage points per year, over a four-to-six year period.[33] Though increases in unemployment would still occur, these would be smaller than under a more drastic policy, and so would be less unpopular.

Of course, the gains in inflation would also come more slowly. Also, even during a mild slowdown, policymakers might be tempted to expand policy and so accelerate output growth. These pressures are not easy to abide, but they are nevertheless inevitable under any serious attempt to slow inflation. Like Odysseus, the policymaker will have to "tie his hands to the mast" until the progress of his policy takes him safely away from the "Siren's call." Reductions in inflation come slowly under such a policy, but they will not come at all unless the policy is maintained steadfastly for an extended period of time. Perhaps the pressures to "reflate" can be mitigated by introduction of supplementary measures such as those discussed above, which would likely reduce the output costs of slowing inflation.

In a sense, such a policy would involve some of the worst of both worlds. It will not achieve the

rapid declines in inflation which are politically desirable, and unfortunately it will create some losses in jobs and production which are politically painful. Yet as we have seen, a "quick fix" to inflation is unlikely to be maintained, while a "do-nothing" policy leaves inflation at levels that increase with each cyclical expansion. A gradual but steadily maintained attempt to slow inflation runs the middle ground, and should elicit growing support as the public perceives that it is being followed. Although not a happy alternative, it appears to present the best choice available to the Federal Reserve, the Congress, and the Executive Branch.

FOOTNOTES

1. We say "permanently" here, because temporary attempts to reduce inflation that are rescinded by subsequent policy changes would periodically subject the economy to slow growth and lost jobs every time a tight policy is imposed.

2. See Schultz (1959), as well as the reference to this designation in Levy (1979).

3. We say "perceived" monopoly power, because in many studies it appears to make little difference whether the monopoly power actually exists or not. Given a slow reaction of demand to higher prices, as well as downward price rigidity elsewhere in the economy, a price increase even in a competitive industry could generate the type of inflation spiral propounded by cost-push theorists.

4. As shown in Section II, real-world inflations have typically been characterized by such general absolute price increases.

5. In fact, inflation traditionally has been defined as an increase in the money supply, and only recently have rising prices been associated with the word. Thus, **Webster's New International Dictionary, 2nd Edition,** 1936, defines inflation as a:

> Disproportionate and relatively sharp and sudden increase in the quantity of money and credit, or both, relative to the amount of exchange business. Such increase may come as a result of unexpected additions to the supply of precious metals, as in the period following the Spanish conquests in Central and South America or the period following the opening up of large new gold deposits; or it may come in times of business activity by expansion of credit through the banks; or it may come in times of financial difficulty by governmental issues of paper money without adequate metallic reserves and without provisions for conversion into standard metallic money on demand. In accordance with the law of the quantity theory of money, inflation always produces a rise in the price level.

Whatever the quality of economic analysis in this definition, it is interesting to note that it describes inflation as *causing an increasing price level.* The definitional association of inflation with rising prices, as documented in newer editions of Webster's dictionary, has apparently arisen in English usage primarily through historical experience.

6. This assertion embodies the concept of "neutrality of money." The idea is that the nominal supply of currency does not intrinsically affect real factors like tastes, industrial capacity, or demographics, and that a equiproportional change in the magnitudes of all nominal assets and prices would leave real conditions unchanged. Therefore, in the long run, the level of the money supply should have no effect on real magnitudes, but only on prices.

7. Theory specifies that in a full-employment economy, equal increases in government spending and taxes would raise prices, mainly because the lower after-tax level of private wealth would lower money demand. This higher price level would be consistent with the fact that, because of higher government spending, less goods would be left over for private consumption. What's more, this is a once-and-for-all increase in the equilibrium price level, rather than a continuing inflation.

Barro (1974), reflecting David Ricardo, also asserts that bond finance of a deficit is merely a substitution of future taxes for present taxes, since future taxes will need to be higher in order to service the government debt. Therefore, bond financing of spending should have identical effects as tax financing. Bailey (1971, p. 60 ff) and Buchanan (1976) also discuss these issues. While most economists do not accept this extreme specification, it's reasonable to believe that bond issues do raise expectations of future taxes somewhat, in which case they would still be less inflationary than monetization of government debt.

8. For further documentation and discussion of these analyses, see Levy (1979) or Bronfenbrenner and Holzman (1963). Gordon (1977) also discusses the possible effects of 1973 oil-price increases and crop failures on prices.

9. It may appear that income-share conflicts and political pressures for higher growth and employment are only slightly different manifestations of the same sociological forces, and that the various theories are therefore little different. Nevertheless, the different approaches to inflation do make a difference, as is discussed toward the end of the next section.

10. They found a predominantly uniform effect of inflation on prices in various commodity groups. That is, movements in the consumer price index had systematic effects on prices in individual commodity classes that were generally not significantly different from unity. Therefore, CPI movements do not appear to be related systematically to relative price changes. The exceptions to this result were in the categories of rent, homeownership, and utilities prices. These exceptions were found by the authors to be due to special factors, such as measurement problems (rent), as well as non-

market pricing of property taxes (homeownership) and of government-regulated monopolies (utilities prices).

11. This quantitative result is from Bazdarich (1979). As for the traditional work on money and prices, two hallmark works are the empirical studies by various authors in Friedman (1956) and the study by Friedman and Schwartz (1963). Important work can also be found in Meiselman (1970) and in a series of articles by Karl Brunner and Allan Meltzer, as well as many other monetary studies. Our emphasis on recent monetary work is not meant to downplay the importance of earlier analyses by Clark Warburton, Lloyd Mints, and many others, but to concentrate on the more sophisticated statistical analyses of the last twenty years.

12. Early empirical research was done by Means (1935), among others. More recent studies are found in Means (1972), the Cabinet Committee on Price Stability (1969), Wachtel and Adelsheim (1976), Eckstein and Brinner (1972), and Perry (1978). Levy (1979) surveys most of these results.

13. Gordon's technique used a Granger causality-test which measured the effects of wages on money-supply growth at lags of one to four quarters. Only at the third lag was the estimated effect significant for the U.S. Taken as a whole, these results did not show a significant effect. The one significant lag would be reliable evidence only if Gordon were testing the hypothesis that wages affect money at the third lag and at no other. The weaker hypothesis, that wages have *some* effect on money, however, is not supported by these results; that is, its alternative hypothesis that wages have no general effect is not refuted by this evidence.

14. While it's true that world crop failures occurred in 1973 and that oil prices jumped astronomically in 1974, it's also true that monetary expansion accelerated in 1971-72 in the U.S. and elsewhere. Also, in the U.S., price controls in 1971-73 served to suppress much of the inflationary pressure of this fast money growth, postponing it until after the controls were lifted in mid-1973. Bazdarich (1979) estimates that most of the inflation postponed by the controls should have occurred by late 1975. Consequently, he estimates the consumer price level for late 1975 using only money-supply data through 1975. This estimate differed from the actual price level by only three percentage points, suggesting that money-supply behavior could explain much of the total movements in prices over that four-year period.

15. Though government spending had significant effects on money-supply growth, the effects did not become positive until the fifth-quarter lag. Yet one would expect spending financed by money creation to have a much quicker effect on the money supply. Similarly, for statistical reasons (the use of seasonally adjusted data), the results for the effects of the government deficit on the money supply, though ostensibly significant, may not be reliable. See Bazdarich (1979) for details.

16. As evidence of the empirical importance of these phenomena, Gorham (1979) points to a 7-percent decline in real balances (i.e., the M_1 money supply deflated by prices) in the U.S. over the period 1973-78. Keynesian economists have generally taken this as a sign of tight monetary policy over this period (e.g., Heller 1977 and Ackley 1979). Yet over such a long period of time, with the large price-level increases experienced, it seems more realistic to regard this phenomenon as largely induced by the demand for real balances. Thus, in a period where real GNP grew 20 percent, which by itself would suggest a rise in real-balance demand, the acceleration in inflation and in inflation expectations apparently led to a much larger drop in real-balance demand than would have occurred otherwise. Using regression analysis, Gorham also finds systematic evidence that inflation has lowered real balances (demanded) in the U.S. economy.

17. If an acceleration in inflation meant that the average rate of inflation increased, but that the variability of inflation around that average stayed much the same, then inflation would not imply an increase in uncertainty. In fact, however, the historical incidence of inflation is as described in the text. Sjaastad (1975) presents a theoretical explanation of this coincidence in the mean and variability of inflation.

18. Rose obtains the 2-percent discount rate in the following manner: He assumes a 5-percent after-tax real rate of return (clearly a very high estimate) and then subtracts an assumed 3-percent annual rise in "shoe leather" costs, reflecting a 3-percent expected annual rise in real GNP. Thus, present costs should be discounted at a 2-percent (5-3) rate. A lower real rate of return would result in a lower discount rate, which would result in even higher present values of these shoe-leather costs for each percentage point of inflation.

19. Tobin (1965) analyzed the general effects of inflation on growth. Using a consumption function that depended on the rate of inflation, rather than prices, he reached a presumption that inflation speeds growth. Sidrauski (1967), using utility maximization to derive consumption behavior, found no such effect. These and other studies are summarized in Dornbusch and Frenkel (1973).

20. Suppose a unit of capital yields a real rate of return r based on productivity, depreciation, etc. With an inflation rate π, the price of the good that the unit of capital produces wil rise, as will the nominal value of the capital itself. Abstracting from relative price changes, then, the combination of real returns and inflation premia sum to a total pre-tax nominal rate of return of $r+\pi$, so that the pre-tax real rate of return ($r+\pi-\pi = r$) is unchanged by inflation. However, the inflation premia and the real return are both treated as income and so taxed by the government. With a tax rate t, then, the after-tax nominal rate of return is $(1-t)(r+\pi)$. If we then subtract the rate of inflation, the after-tax real rate—or the effective rate—of return of capital is $(1-t)r-\pi t$, which declines as inflation rises (or π increases). Thus, because of the tax on inflationary capital gains, effective returns to capital will fall as inflation rises, thus discouraging investment. Of course, the investor can postpone payment of these inflationary capital gains, but he must eventually pay them.

21. The Council of Economic Advisors (1979) itself has recognized a slowdown in the U.S. sustainable rate of growth. The Council cites as contributing factors the declines in productivity growth and in research and

development, both of which clearly could be reactions to unfavorable changes in after-tax returns due to higher inflation.

22. Discussion of these and other points in this section can be found in McElhattan (1979) and in Pigott (1979).

23. See Phelps et al. (1970) for seminal work on the expectations explanation of the Phillips curve.

24. In this respect, the existence of long-term contracts and other fixed commitments could allow unemployment to differ from the natural rate for a while even after expectations adjust. See Poole (1974) as well as McElhattan (1979). By the same token, however, these factors could also be seen as sources of changes in the natural rate.

25. Also, see Gordon (1976) for a detailed survey of the theory and evidence on the Phillips Curve.

26. This estimate is provided by William Poole, in the discussion following Perry (1978): "If Perry's estimates are taken at face value, a monetary policy that kept the unemployment rate 1 percentage point above the natural rate would be consistent with a decline in the inflation rate by 0.3 percentage point each year."

27. In Perry's analysis, the lag from unemployment to inflation is based on a "mainline" structural model involving aggregate demand, supply, etc. Policy variables affect inflation and unemployment in this model only through their effect on aggregate demand and supply. This framework is unquestionably correct in theory, but such an indirect method of estimation conceivably could bias the estimated reduced-form effects of the money supply on inflation and unemployment. That is, if Perry's hypothesized reduction in unemployment is to be effected through slower money growth, it's likely that a direct, reduced-form estimation of the effects of money on inflation and unemployment would produce shorter estimates of the lags than are contained in Perry's analysis. This is because the reduced-form effects are combinations of a number of structural effects. By estimating each structural effect individually, Perry may be introducing extra sources of error in estimating the reduced form than if he had estimated it directly. Thus, Bazdarich (1979), for example, finds much shorter lags from money to inflation and unemployment. The latter are more consistent than Perry's with the common "monetarist" dictum that slower money supply growth will affect inflation with a lag of generally two years.

28. Incomes polices could hurt the adjustment process because the fringe benefits or tie-in schemes unions and firms might pursue are generally inefficient means of exploiting market power, compared to explicit wage or price increases. Thus, by fostering inefficient, second-best types of arragements, the effects of monopoly power could be even worse under incomes policies.

29. See footnote 18 for details.

30. The question arises as to whether current Federal Reserve operating procedures should be relied upon to effect this slower growth in the FOMC's chosen aggregate, and/or what alternative operating procedures would be suitable. These questions are addressed in Judd and Scadding's article in this issue of the **Review**.

31. In the United States, money-supply growth actually declined in 1970 and early 1971, but then accelerated shortly after the imposition of price controls in August 1971. At the present time, also, it would be hard to argue that the Administration's wage-price guidelines have induced any significant slowing in the growth of M_1 or M_2.

32. In Homer's Odyssey, Odysseus and his men prepare to pass through the straits of the Sirens, whose call no man can resist. He ties rags around his men's ears so that they won't be able to hear. Since someone must be available to signal to his men when it is safe, he leaves his own ears unbound, but has his arms tied tightly to the ship's mast, where he has to endure the agony of being unable to answer the Siren's call.

33. At present, underlying rates of change appear to be about 7 percent for M_1 and 9 percent for M_2, although historically M_2 has tended to grow about 3 percentage points faster than M_1. Also, available existing money-price evidence suggests that growth rates of zero for M_1 and 3 percent for M_2 are roughly consistent with the 3-percent per year inflation suggested by the Humphrey-Hawkins bill. Therefore, if we take this level as a goal, and reduce M_1 and/or M_2 growth by 1 to 1½ percentage points a year, zero M_1 growth and 3-percent M_2 growth would be achieved in four to six years, with 3 percent CPI inflation achieved in about six to eight years.

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Conducting Effective Monetary Policy: The Role of Operating Instruments

John P. Judd and John L. Scadding*

Events have a way of carrying things before them. The following article is a case in point. Its purpose originally was to make the case for why we thought monetary control would be improved by the Federal Reserve concentrating on bank reserves rather than the Federal-funds rate in the day-to-day conduct of monetary policy. On October 6, even while our paper was being prepared for distribution to the Federal Open Market Committee, the Federal Reserve announced in a press release that it would place "a greater emphasis in day-to-day operations on the supply of bank reserves and less emphasis on confining short-term fluctuations in the Federal-funds rate." We are heartened by this step and believe it will prove ultimately to make a significant contribution to economic stability. In the meantime, we think it is important to understand precisely what the move entails, and why it is potentially fundamental and far reaching. This article is designed to provide just such an understanding.

It is now generally recognized that an effective monetary policy is a crucial element in controlling inflation and avoiding recessions. This can be seen clearly in the large body of theoretical and empirical work which addresses the question of what makes for "effective" policy. Until recently most of this work distinguished two separate points. The first, broader, issue was whether the impact of monetary policy on *ultimate targets,* like prices and employment, could be more accurately gauged by movements in interest rates or in the monetary aggregates. This is often referred to as a problem of *strategy*, because it is concerned with the appropriate general framework within which monetary policy should operate. The second, seemingly narrower, issue was whether, with a given monetary-aggregates strategy, the Federal-funds rate or reserves would allow more accurate control of the aggregates. This is a problem of *tactics*—of how to choose an *operating instrument* to best carry out the desired strategy.

Current Federal Reserve procedure formally reflects this compartmentalized approach to monetary policy. Official Federal Reserve procedure consists first of translating ultimate stabilization goals, such as price stability and full employment, into *intermediate targets* for the monetary aggregates, and then of choosing an operating instrument as a means of reaching the desired targets. Until recently, the Fed used the funds rate for this purpose; in other words, the procedure consisted formally of a funds-rate tactic designed to achieve a monetary-aggregates strategy.

We have been careful to insert qualifiers like "formally" and "officially" throughout the last paragraph, because we believe that the reality of Federal Reserve policy is different from its appearance. Specifically, we argue that the Federal Open Market Committee (FOMC) operates in such a way to ensure the linkage of tactics and strategy, so that they cannot in practice be separated in the way suggested by formal description. This is because there are really two dimensions to the tactics decision. The first is the choice of operating instrument—Federal-funds rate or reserves. The second, and equally important decision, is choosing the method of employing the instrument.

The point is illustrated by the *cautious* way in which the FOMC formerly moved the funds rate: it moved the rate only slowly, or by small amounts, when confronted with less than complete evidence that policy should be changed. Of course, cautious control of the operating instrument (whether funds rate or reserves) represents

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a rational response to the considerable uncertainty which FOMC members face in conducting policy, and to certain institutional factors which constrain their actions. But our main point is this: given a procedure of cautious control, the FOMC's choice of the funds rate as its operating instrument effectively represented a commitment to an interest-rate strategy. But the reverse is also true. With the FOMC's adoption of a reserves operating instrument (with a wide-band Federal-funds rate constraint), it is likely to pursue something close to a monetary-aggregates strategy. Thus, the choice of operating instrument dictates the choice of strategy, and in this sense it is impossible, as a practical matter, to compartmentalize Federal Reserve policy.

Two further implications are worth considering. First, the pertinent tactical question is not whether interest rates or reserves allow more accurate control of the monetary aggregates. Given the feasibility of using either reserves or the funds rate in an aggregates strategy, the choice of an operating instrument depends on whether an aggregates or interest-rate strategy comes closer to achieving the Federal Reserve's ultimate stabilization goals. Second, it misses the point to say that the compartmentalization of Federal Reserve procedure prevents it from carrying out policy as effectively as it might with so-called optimal control policies. We have already argued that policy is not in practice compartmentalized. Additionally, in view of the effective linkage of tactics and strategy (through cautious control), *feasible* policy alternatives are likely to exclude the optimal-control solutions.[1]

The plan of the paper is as follows. In Section I, we review the problem of choosing the right strategy, because of the importance of that issue in determining whether policy will be effective or not. Next, in Section II, we show how and why the FOMC typically used the funds rate in a cautious manner in the past. On the basis of that evidence, we conclude that cautious control is independent of the choice of operating instruments, and hence that the FOMC is likely to control reserves cautiously in the future. Also, we present evidence to show that cautious control of the funds rate has most of the hallmarks of an interest-rate strategy as far as its impact on money and GNP growth is concerned. We then argue that a reserves operating instrument would have produced something close to an aggregates strategy, which leads back to the original point—namely, that operating procedures must be evaluated in terms of which entails the more appropriate strategy. In Section III, we survey the evidence on alternative strategies, which supports the choice of an aggregates strategy over an interest-rate strategy. This leads to our conclusion, in Section IV, that the use of reserves as the operating instrument is likely to improve the effectiveness of monetary policy.

I. Choice of Strategy—Basic Conceptual Issues

The following discussion summarizes in nontechnical terms the basic conceptual issues involved in choosing a strategy for monetary policy. The reader who is familiar with the literature on this topic can safely skip to Section II without losing the thread of the argument.[2]

A strategy is defined as an overall plan designed to accomplish some ends. In the case of monetary policy, the ends, called *ultimate targets* or *goal variables*, are the traditional ones—stable prices, full employment and stable exchange rates. The aim of monetary policy is to keep departures in prices, employment (or output) and the exchange rate from their desired levels as small as possible—to stabilize those variables about their targets, in other words. To do that effectively requires: (a) being able to monitor closely the goal variables for any indication that they are going off track, so that remedial action can be taken before the departure becomes serious; and (b) being able to gauge quickly and accurately whether the monetary-policy actions taken are having their desired effect. However, data on the ultimate targets are not received quickly enough for them to be used directly in the formation of policy. Instead, some intermediate variables must be found, which are available on a more timely basis, and which also contain enough information about the ultimate targets for use in monitoring indirectly what is

happening to those ultimate targets. The choice of strategy is simply a decision about what intermediate variable(s) is (are) best for this purpose.

We can illustrate these rather abstract points by focusing on the problem of stabilizing real GNP, as most of the academic debate has done. Within this context, the choice of strategy has typically been cast in terms of whether to use interest rates or the monetary aggregates to gauge the influence of monetary policy on real GNP. In some ways this is a useful approach; in other ways, not. On the plus side, this approach has a great deal of practical relevance, given the very real concern of monetary policy with the problem of promoting high and stable levels of output and employment. Moreover, the problem can easily be analyzed with the use of standard macroeconomic theory. On the minus side, however, by concentrating exclusively on real magnitudes and thereby largely ignoring prices, this approach slights what has become a serious threat to macroeconomic stability—a stubbornly high and disturbingly erratic rate of inflation. In so doing, it tends to misrepresent those strategies which are effective in promoting overall stability—that is, stability of *both* output and prices. This point is of more than academic interest, because of the two strategies typically considered—interest rates and aggregates—only the latter has been seriously advocated as a viable strategy for containing inflation. Thus, by focusing on real GNP and ignoring inflation, we can bias the analysis against an aggregates strategy.[3]

A strategy problem exists, as we have seen, because data on the ultimate targets are collected with too long a lag to permit direct monitoring of those targets. For example, monthly data on real GNP do not exist, while preliminary quarterly data are not available until nearly a month after the end of the quarter, and often these preliminary estimates are significantly revised over a period of three years or more. Ideally, policy actions should respond quickly to unforeseen events which push GNP away from its target. However, the long lag and preliminary character of initial GNP data make it difficult to detect such occurrences. In lieu of up-to-date or "timely" data on GNP, policymakers must try to infer what is happening to GNP by using indirect, readily available evidence. Theoretical discussion has focused almost exclusively on two such intermediate - information variables — interest rates and monetary aggregates. Clearly, both of these variables have considerably smaller data lags than GNP. Interest-rate data are available in published form daily. Money-stock data are available on a somewhat unreliable basis with a one-week lag, and with considerably more reliability with a lag of less than a month. Additionally, interest rates and the monetary aggregates provide information about *future* GNP as well, since changes in GNP typically react with a lag to changes in current interest rates and money stock. Hence they are doubly timely, in the sense that they provide information about values of GNP which will not be observed until much later.

Besides their timeliness, candidates for strategy variables must bear some systematic and predictable relationship to the goal variable; otherwise they would be incapable of providing information about the latter, which is, after all, their *raison d'etre*. Again, both interest rates and monetary aggregates are natural candidates on this criterion. First, both theory and evidence point towards interest rates as an important determinant of real aggregate demand, and therefore of the level of output. Thus, *ceteris paribus,* it is possible to associate with each level of interest rates (i) a level of output (y); and conversely, to associate with each level of output a level of interest rates that would produce just the right level of real aggregate demand. This relationship between interest rates and real GNP is enshrined in the standard IS curve of macroeconomic theory, or less formally, by the dual-direction arrow between i and y in Figure 1 below.

Figure 1
Intermediate Targets and Strategy Choice

Strategy (Intermediate Target)		Link		Ultimate Target
(a) Interest Rates (i)	⟵	Aggregate Demand (IS)	⟶	GNP (y)
(b) Monetary Aggregates (M)	⟵	Money Demand (LM)	⟶	GNP (y)

Money and real GNP are connected through the money-demand function, which posits that (*ceteris paribus*) for each level of the money stock (M), a level of real income exists at which the public is willing to hold that stock. Conversely, each level of real income determines an amount of money demanded. This relationship between money and real GNP is embodied formally in the standard LM curve, or less formally, by the two-way arrow between M and y in Figure 1.

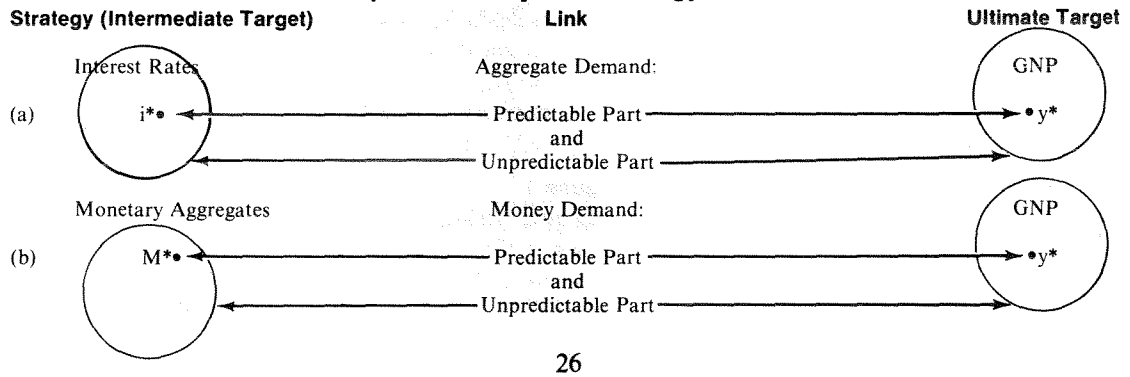
This stabilization model requires modification in one respect. In Figure 1, we assume that the relationships between interest rates and money, on the one hand, and GNP on the other, are completely predictable, so that it is possible to associate with each level of i or M a unique level of y, and vice versa. In practice this is not so because (a) we only have estimates of the relationships, and these are subject to sampling error, and because (b) the relationships depend on other variables which our imperfect knowledge does not allow us either to specify or predict precisely. Hence it is more accurate to think of the relationships as specifying a link between *ranges* of possible outcomes for i and M and *ranges* of possible outcomes for y. This idea can be seen by associating sets of intermediate and final targets rather than single points, as illustrated in Figure 2, where the circles denote sets of outcomes.

Consider the problem of using observations on i and M to predict and attempt to control what is happening to y. Let y* be the target for GNP, and let i* and M* be the interest rate and money stock, respectively, that are most likely to be associated with y*. These "best guesses" are shown as points in Figure 2. Now suppose that policy successfully operates to achieve i* but that the money stock turns out to be lower than M*. How do we interpret this result? Two extremes bound the possibilities:

- The aggregate-demand relationship is "tight," so that for given i*, the range of possible outcomes of y is relatively small. On the other hand, the money-demand relationship is relatively "sloppy," so that an outcome for M is consistent with many different outcomes for y. In this case, it is rational to assume that M is lower than expected because money demand has unexpectedly fallen, not that GNP is too low. The appropriate response is to keep i at i* and allow money to remain at its new lower level.
- The money-demand relationship is relatively exact, while the aggregate-demand relation is susceptible to frequent and significant disturbances which greatly weaken the link between interest rates and output. In this case, it is sensible to treat the observation on M as strong *prima facie* evidence that y is weaker than desired, and to operate to bring M back to M*, even though this will mean lowering interest rates.

This example clearly shows that policy choices are determined by one's view of the world—in particular, by how one regards the relative tightness of the two (interest rate and money) links to income. A choice of interest rates as the intermediate target implies that policymakers are pursuing an interest-rate strategy, while a concentration on the aggregates implies an aggregates or money-supply strategy. The issue at root is an empirical one: Which relationship is the more

Figure 2
Unpredictability and Strategy Choice



stable in the sense of yielding a small predicted range for GNP? In the extreme cases outlined above, where instability (unpredictability) is confined entirely to either one or the other of the relationships, the instability criterion by itself is sufficient to determine the choice of strategy. Thus an interest-rate strategy dominates where money demand is unstable, while an aggregates strategy dominates where the instability is in the aggregate-demand relation. In the general case, where both relationships are unpredictable, the criterion must also take account of the interest sensitivity of money demand and aggregate demand, because these considerations affect the extent to which (unexpected) shifts in money demand or aggregate demand translate into changes in real GNP. As a general rule, the more interest sensitive aggregate demand is, and the less interest sensitive money demand is, the more likely is it that an aggregates strategy will dominate.

Neither strategy, as a theoretical matter, necessarily produces the smallest possible variation of GNP around its target that policymakers could attain. Each is essentially a defensive strategy, designed to prevent the intermediate variables from straying too far from preassigned targets. In general this is not a fully efficient procedure, because evidence that the intermediate variable is going off track provides useful information that the intermediate *targets* themselves need to be revised. Strategies which use this "feedback principle"—optimal control or combination policies—generally produce greater stabilization than the so-called "pure" strategies that we have examined.[4] However, these more efficient strategies typically require more aggressive manipulation of interest rates and the aggregates than we think is feasible, given the FOMC's cautious-control procedures. We have concentrated on the pure strategies because, as we argue below, the FOMC's operating procedures are more likely to lead to a pure strategy than to an optimal combination strategy.

II. Impact of Operating Instruments on Strategies

Given our choice of strategy, the problem of tactics asks how we can operate to keep our intermediate target on track. Typically the literature on this subject makes no distinction between interest rates at the strategy level and interest rates as an operational variable (the Fed funds rate), so that the tactical problem of implementing an interest-rate strategy would be trivial. The literature suggests that the same would not be true for an aggregates strategy, since the money stock can be targeted either with interest rates, operating through the demand function for money, or with reserves, operating through the supply of money. Hence the tactical question generally has focused on whether interest rates or reserves are the better operating instrument for controlling money.

In this compartmentalized view, the tactical question is treated as subsidiary and subordinate to the question of strategy (Figure 3A). But we argue here that this approach gets things backwards—that because of cautious control of the operating instrument, the choice of tactics determines the choice of strategy (Figure 3B).

Cautious Funds Rate Control

According to Federal Reserve public statements as well as empirical evidence, the FOMC attempted as far back as 1970 to control money growth by changing the Federal-funds rate.[5] This attention to the aggregates has been formalized into explicit longer-run target ranges, which are reported periodically to Congress.[6] But the evidence also shows that the FOMC generally has moved its funds-rate operating instrument very cautiously in attempting to achieve these targets. In other words, funds-rate changes have generally not been large enough nor timely enough to stabilize money growth (Chart 1). Except in 1970 and mid-1973, growth in the funds rate and money were highly correlated, and *both* were positively associated with the business cycle.

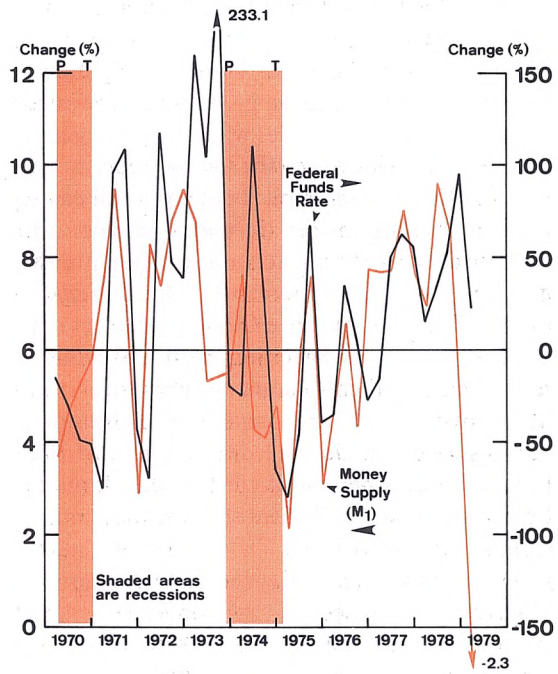
It should be noted that, *ceteris paribus*, money demand is influenced *negatively* by the funds rate and positively by GNP. Thus if the FOMC actively moved the funds rate to hit its money targets, we would observe a positive association between funds-rate movements and the business

cycle, together with fairly constant money growth, as interest rates rose and fell enough to offset the cyclical effect of income on money. Instead, we observe that money growth has been procyclical, increasing and decreasing with GNP. Although the funds rate also has risen and fallen with GNP, these changes have not usually been large enough to stabilize money growth. Two exceptions may be noted: the rapid drop in the funds rate in the 1970 recession, which caused M_1 to accelerate, and the rapid rise in the funds rate in the mid-1973 boom, which caused M_1 to decelerate. But otherwise, throughout the rest of the 1970's, procyclical changes occurred in both the funds rate and money growth.

An analysis of the timing of funds-rate reversals also shows that this operating instrument has primarily followed the business cycle rather than counteracted it. As shown in Chart 1, changes in direction of funds-rate movements have usually been delayed until after a new phase of the business cycle was underway. The funds rate was still being sharply reduced in the first quarter of the 1971 and 1975 recoveries, when an aggregates strategy would have called for a less expansionary policy, given the resurgence in the demand for money and credit as business improved. By the same token, the funds rate was being increased sharply just prior

Chart 1

Changes in the Federal Funds Rate and in the Narrow Money Supply (M_1) (Annual rates, 1970-79)



to and shortly after the business-cycle peak in 1973/Q4, when an aggregates strategy would have produced an "easier" policy.

A recent econometric study has also found evidence of cautious funds-rate control during

Figure 3A
Compartmentalized View of Monetary Policy

Strategy (Intermediate Target)

(a) Interest Rates ← Aggregate Demand → GNP

Or

(b) Monetary Aggregates ← Money Demand → GNP

↓

Tactics (Operating Instrument)

(i) Reserves ← Money Supply Process → Monetary Aggregates

Or

(ii) Interest Rates ← Money Demand → Monetary Aggregates

Figure 3B
Cautious Control and Policy Choice

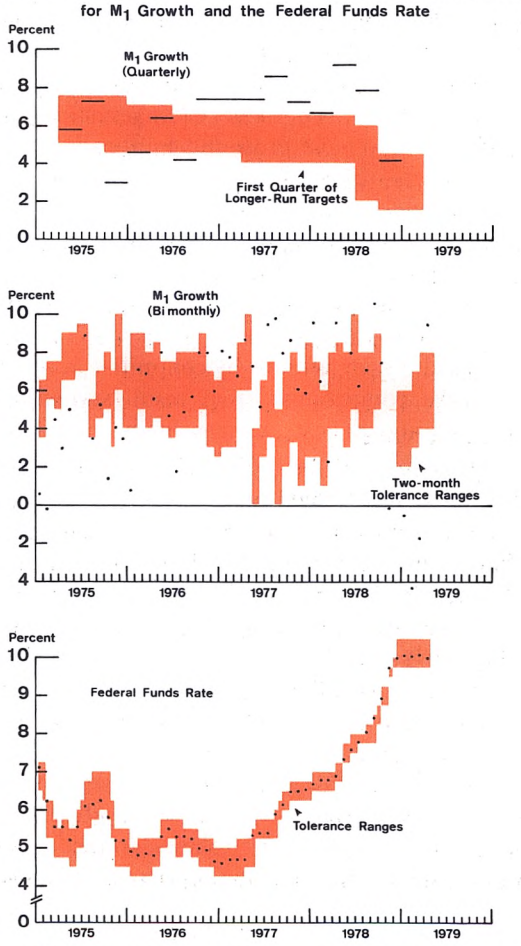
Tactics (Operating Instrument)		Strategy (Intermediate Target)
(a) Cautious Control of Interest Rates	— implies →	Interest Rate Strategy
Or		
(b) Cautious Control of Reserves	— implies →	Monetary Aggregates Strategy

the 1970-74 period.[7] This research involved directly estimating the FOMC's funds-rate reactions to deviations of M_1 from its targets. The results indicated that the FOMC, while attempting to control the growth in the money stock, actually moved the funds rate by only 8 to 9 basis points per month in response to undesired money growth.

This conclusion is reinforced by evidence that the FOMC has been more successful in keeping the funds rate inside the boundaries of its tolerance limits than it has been in keeping M_1 growth inside its short-run and/or long-run ranges. Each month the FOMC Directive to the Trading Desk has specified both a funds-rate range and so-called tolerance ranges for M_1 and M_2 growth over the current and following months (e.g., at January meetings, tolerance ranges would be specified for the January-February period). Thus the tolerance ranges would express the FOMC's short-run aggregates objectives, as distinct from the longer-run objectives expressed by the longer-run target ranges. During the January 1975-April 1979 period, the funds rate almost always remained in the *center* of its target ranges, on a monthly average basis, but M_1 growth often fell outside both its short-run and long-run ranges (Chart 2). This tendency of the funds rate to remain within range may be attributed partly to the fact that the FOMC sometimes adjusted the range when market pressures drove the funds rate to either limit on a weekly basis. Nevertheless, changes in the funds rate have frequently been too small to keep the aggregates on target.

Chart 2

Short-Run Tolerance Ranges, Longer-Run Targets, and Actual Values for M_1 Growth and the Federal Funds Rate



Note: For quarterly M_1 growth (top panel), dashes represent actual growth rates; for bimonthly M_1 growth (middle panel), dots represent overlapping two-month growth rates, and solid lines represent overlapping tolerance ranges; and for Federal funds rate (bottom panel), dots represent actual monthly rates.

Constraints on FOMC Actions

There are a number of reasons why the FOMC stabilized the funds rate when it was used as an operating instrument, and why it is likely to stabilize reserves now that a reserves regime has been adopted.[8] The FOMC is faced with a good deal of uncertainty concerning the current condition of the economy and the precise timing and impact of policy actions. Uncertainty governs the linkages, first, from money and interest rates to the economy, and second, from reserves or the funds rate to money and other interest rates. This uncertainty reflects the current state-of-the-art in the economics profession, and is not likely to be eliminated in the near future. Under these circumstances, the rational policymaker, even with the best available information, should react cautiously in changing the operating instrument when money appears to be off target.[9] Since the impact of potential policy actions is uncertain, the fact that the economy functioned "tolerably" well last month is an important piece of evidence in favor of not substantially changing the operating instrument this month. In this way, large swings in policy are quite rationally delayed "until next month."

Several institutional factors also have contri-

buted to cautious control of the Committee's operating instrument. First, in addition to its stabilization goals, the FOMC may quite reasonably desire to provide a stable policy framework, one which causes as little disruption of the private economy as possible. Changes in Federal Reserve policy have profound implications for private-sector planning and forecasting. Thus, the Fed tends to avoid making frequent changes in policy direction because such changes increase the frequency and uncertainty of private-sector decisions and are detrimental to aggregate economic performance.[10]

Second, policy is made by committee, and the inevitable compromises that result sometimes lead to only modest changes in the operating instrument. The need for compromise will often be greater near business-cycle turning points, when uncertainties about the current and immediate future condition of the economy are greatest. At such a time, opinions regarding the proper setting for the operating instrument may vary widely. Thus the Committee's compromise decisions may be biased toward no substantial reversal until the economy is already in a new phase of the business cycle.

Third, the FOMC is appropriately sensitive to Congressional and public opinions about the effectiveness of monetary policies. In fact, Congress has mandated such a concern, through Joint Resolution 133 in 1975 and the Full-Employment and Balanced Growth Act of 1978 (the so-called "Humphrey-Hawkins Act"). Under this legislation, the Federal Reserve Chairman goes before Congress periodically to explain and justify past and future monetary policies. In this highly visible forum, mistakes of commission elicit larger negative reactions than mistakes of omission—perhaps because such errors can be more easily identified with the FOMC. For example, if the discount-rate increase of November 1978 had not been such a success, Congressional and other complaints would have been much louder than if the discount rate had wrongly been left unchanged.[11] For these reasons, the FOMC quite naturally may tend to pursue a status quo policy until considerable evidence is available to justify a change.

Each of these reasons for cautious control of the funds rate applies also now that the FOMC uses reserves as its operating instrument. Thus the FOMC is likely to control reserves cautiously under its new operating procedures.

Interest Rate Variability

It may be argued that operating-instrument stability was pursued to a greater extent under the funds-rate regime than it will be now under a reserves regime, on the grounds that the FOMC has an ultimate objective of avoiding "excessive" interest-rate variability. Interest-rate variability would, of course, increase with a cautiously controlled reserves operating instrument, and several econometric studies suggest that the added variability would be substantial.[12]

However, these estimates may have substantially overstated the problem. First, the data unavoidably came from an environment where the funds rate had been stabilized by the Federal Reserve. But we know that rational financial-market participants will smooth short-term rates to some extent in a reserves-targeting environment. For example, banks may learn to borrow in advance of periods of heavy seasonal demand, while lenders may delay supplying funds to coincide with periods of heavy expected demand. Both kinds of actions will dampen short-term interest-rate fluctuations.

More importantly, under a reserves operating instrument, funds-rate fluctuations will probably not be transmitted to other money-market rates to the same extent as before.[13] New York Trading Desk operations under the funds-rate regime produced a close association between the (overnight) Federal-funds rate and longer-term money-market rates. The Desk rarely missed its funds-rate targets, and rarely reversed the direction of funds-rate changes, so that the current funds rate provided substantial information about its future levels. In this regard, it should be noted that longer-term rates tend to equal weighted averages of expected shorter-term rates over the life span of the longer-term instruments. The 90-day Treasury-bill rate, for example, should equal some weighted average of 90 future one-day funds rates (plus or minus adjustments for risk, liquidity, and other factors). Since former Desk behavior allowed market participants to forecast future funds-rate levels on the

basis of current rate movements, short-term changes in the funds rate almost immediately became reflected in "longer" term money-market rates. But now, under the reserves operating instrument, day-to-day and week-to-week changes in the funds rate should convey less information about its future levels, and should have a smaller impact on longer-term money-market rates.

German experience confirms this hypothesis—for example, during the January 1973-June 1974 period, when the central bank did not peg very short-term interest rates. In that period, absolute weekly changes in the interbank (overnight) call-money rate varied by an average of 345 basis points, while the (longer term) three-month interbank loan rate varied by an average of only 39 basis points (Chart 3).[14]

A second piece of confirmatory evidence comes from recent U.S. data on daily rate movements (Table 1). Under the funds-rate regime, the Trading Desk pegged the Federal-funds rate to the target rate every day of the week except Wednesday, which is reserve-settlement day for member commercial banks. Since the funds rate

Chart 3

German Interbank Call-Money Rate Versus the Three-Month Interbank Loan Rate

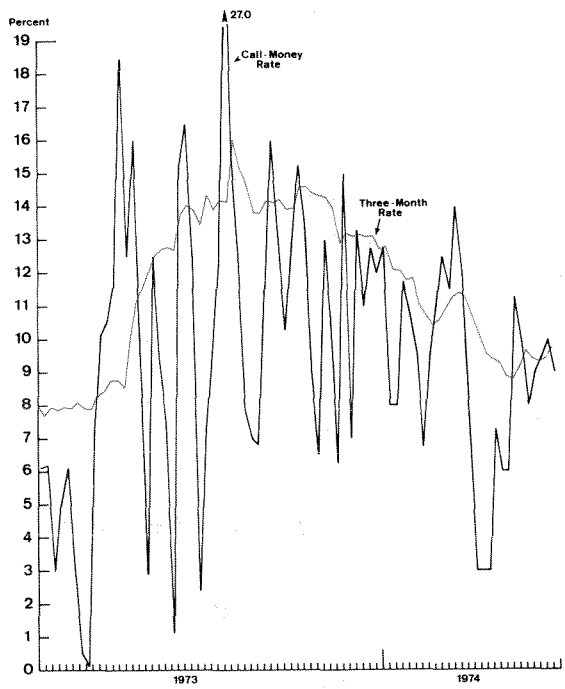


Table 1
Average Absolute Day-to-day Changes, 1977-78
(in basis points)

	Federal Funds Rate	90-Day Treasury Bill Rate
Monday	7.4	7.6
Tuesday	8.3	5.5
Wednesday	20.5	5.0
Thursday	16.9	4.4
Friday	5.2	5.9

primarily reflected private market forces on Wednesdays, the large changes which often occurred on those days were not perceived by market participants as containing significant information about FOMC intentions. Since these changes were not very useful in forecasting future funds-rate movements, Wednesday variability was not in general transmitted to longer-dated money-market rates. The funds rate and the 90-day Treasury-bill rate showed similar variability on Monday, Tuesday, and Friday, but funds-rate variability was significantly larger on Wednesday when this rate often diverged from its target, and on Thursday when it returned to target.

Finally, under the funds-rate procedure, the FOMC was in the position of being publicly responsible for interest rates. It thus came under considerable pressure to keep rates down, especially when they were near Regulation Q ceilings and might trigger disintermediation. But while the FOMC can keep interest rates down in the short-run, this is not true in the long-run. Attempts to lower rates in the face of strong money and credit demands result in fast money growth and ultimately inflation.[15] Indeed, with nominal interest rates reflecting a premium for inflation, attempts to resist interest-rate increases in the short-run often cause higher rates in the long-run. But now, by targeting reserves, the FOMC may be able to divest itself of part of this publicly-perceived responsibility for interest rates, and thus promote a more accurate public perception of the extent to which it can, in fact, control these yields. With the funds rate being more clearly "endogenous" in the reserves regime, the FOMC can more convincingly argue that it is just one of many factors (including private behavior) causing variations in money-market yields.

Strategy Outcomes

The FOMC is likely to use either type of operating instrument cautiously in controlling money, so that the choice of operating instrument effectively determines the more important choice of monetary policy strategy. It would be theoretically possible, of course, to control the money supply as accurately with a Federal funds rate as with a reserves operating instrument (Figure 4). As income rises during recoveries and falls during recessions, money demand also rises and falls procyclically. An increase in money-demand in a cyclical expansion, illustrated by the shift from M_{d1} to M_{d2}, can be fully offset either by raising a funds-rate target or reducing a reserves target, as represented by the shift from M_{s1} to M_{s2}* (point S to M in both panels). The use of either instrument to eliminate deviations of money from target would constitute the pure aggregates strategy discussed in the preceding section. Alternatively, a pure interest-rate strategy, which involves pegging the funds rate and thus accommodating all deviations of money from target, could in theory be achieved with either a funds-rate or a reserves approach.

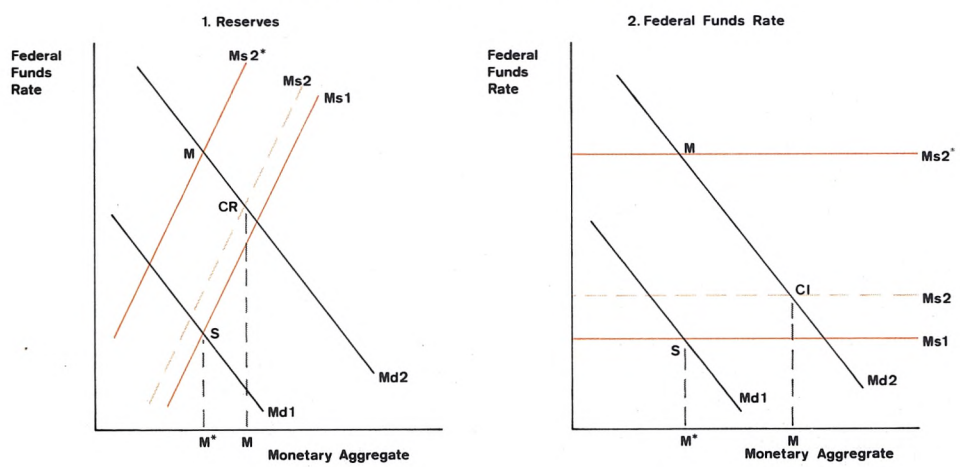
As we have argued above, the FOMC is likely to follow neither of these "pure" strategies precisely, but rather to move its operating instrument cautiously. To see what this means for monetary control, assume that each operating instrument is moved only one-fourth of the way to levels which fully offset cyclical movements in money demand—which means a shift from M_{s1} to M_{s2} (points S to CR in panel 1, and S to CI in panel 2). In this case the procyclical error in the money stock (M-M*) is much larger if the funds rate is used than if reserves are used. The reasons are clear: under a funds-rate target, money demand is fully accommodated at that funds rate, while under a reserves target, demand is accommodated only to the extent that the behavior of banks and the public *partially offsets* Federal Reserve behavior.[16]

Thus, under the FOMC's former tendency to make only cautious movements in the funds rate, deviations of money from target were largely accommodated—which is characteristic of an interest-rate strategy. This strategy is most nearly optimal when money is deviating from target mainly because of disturbances in the monetary sector of the economy. Now that the FOMC is using a reserves operating instrument, its partial responses will result in a strategy which is close to a pure aggregates approach, where money is not allowed to deviate from target. This strategy is most nearly optimal when the disturbances are coming mainly from the real sector.

In view of the likelihood that the FOMC will continue its rational approach of cautiously using its operating instrument, the two constrained policies just described are the feasible alternatives for monetary policy. While neither of these strategies is optimal in the theoretical context of optimal control, they represent the

Figure 4

Monetary Control Errors Under Alternative Operating Instruments



alternatives from which rational policymakers normally choose in practice. Thus the FOMC must decide which of these two constrained policies leads to the most nearly optimal results for the economy.

III. Empirical Issues in the Choice of Strategy

The question of the optimum strategy—interest rates or monetary aggregates—is ultimately an empirical one. Theory can point to the relevant issues—the relative unpredictability of the aggregate demand and money-income relations and their interest elasticities—but it cannot itself resolve them. Our intention is not to give an exhaustive catalogue of relevant empirical results, but instead to survey briefly what we think are the major areas of investigation and their major conclusions.[17] As one might expect, much of the empirical evidence is indirect, suggestive rather than definitive, and seldom totally unambiguous. Nevertheless, given the variety of approaches and data sources involved, the sum of evidence may be considered more compelling than the individual parts if it shows any sort of consensus. Such is the case here, we believe, with the evidence arguing for an aggregates strategy.

The first piece of evidence is the large accumulation of statistical work, covering the pre-1974 period, showing a highly stable relationship between the demand for money and GNP and interest rates (Item 1b, Table 2).[18] This work draws on a long historical record for the U.S. as well as many other countries. It is hard to think of another macroeconomic relationship, with the possible exception of the consumption function, which has stood up to such exhaustive and intensive scrutiny.

Since mid-1974, the demand function for M_1, the narrowly-defined money supply, has apparently shifted, and the continuing uncertainty about the cause of this shift has obviously increased its unpredictability.[19] Consequently, some observers have concluded that an aggregates strategy is no longer appropriate, whatever the case might have been for it previously. This seems to us an extreme position. In the first place, the instability in M_1 does not appear to have infected M_2 and the other aggregates nearly as severely.[20] Many people appear wedded to the idea of M_1 as *the* definition of money, and resist the idea of conducting policy in terms of M_2. Nevertheless, until 1975, it has been difficult to detect any differences in the stability of demand functions for M_1 and M_2, and thus in their respective abilities to predict GNP (Item 3b). Hence, pursuing an M_2 strategy may not produce seriously inferior results com-

Table 2
Major Issues in Survey of Empirical Evidence

	(a) For an Interest Rate Strategy			(b) For an Aggregates Strategy
			(1b)	Is the demand function for money stable?
			(2b)	Is the interest elasticity of demand for money low?
			(3b)	What is the appropriate definition of money?
(4a)	How well does the aggregate-demand relation by itself predict GNP?	versus	(4b)	How well does the money-demand relation by itself predict GNP?
(5a)	How well do interest rates predict GNP?	versus	(5b)	How well do the aggregates predict GNP?
(6a)	Do policy variables which operate through the aggregate-demand relation, such as government spending, exert a significant and predictable impact on GNP?	versus	(6b)	Do such variables provide any help in predicting GNP, above and beyond what the monetary aggregates tell us?
(7a)	Do simulations of an interest-rate strategy show that it contributes to stabilizing GNP?	versus	(7b)	Do simulations of an aggregates strategy show that it contributes to stabilizing GNP?

pared to what M_1 would have yielded had it continued to be well-behaved.

The well-documented finding of a low interest-elasticity of money demand (Item 2b) predicts that money is capable of exerting a significant effect on prices and output. This expectation has been amply confirmed in extensive single-equation tests, which have shown that current and lagged changes in money exert a sizable and predictable influence on GNP (Items 4b, 5b, and 6b). In contrast, similar attempts to explain GNP using interest rates and or measures of autonomous spending frequently (in some instances, almost uniformly) yield inferior results (Items 4a, 5a and 6a).[21] Again, as Froewiss and Judd show in this issue of the *Economic Review,* interest rates contain little or no information about GNP over and above that contained in M_1 or M_2 (Item 5a). Furthermore, these findings have not been contradicted by simulation experiments, using both small- and large-scale macroeconomic models, which indicate that the money stock provides a more reliable indicator of the thrust of monetary policy than interest rates, and that an aggregates strategy produces smaller variation in GNP than an interest-rate strategy (Items 7a and 7b).[22]

Other evidence, of a more inferential nature, tends to question the supposed stability of the aggregate-demand relation. One piece of evidence is the rediscovery of Irving Fisher's distinction between the nominal and real rates of interest, which explains the difference by the anticipated rate of inflation.[23] This reemphasizes the point that aggregate demand is a function of real rates of interest, which are unobservable. Hence attempts to predict GNP using interest rates run up against the problem of how to measure real rates of interest. This in turn requires making some estimate of the anticipated rate of inflation—a difficult task in a world where current inflation rates are substantially different from most of our historical experience, and where the problem has worsened considerably over the past decade. The failure to resolve this question in a conclusive way has added to our uncertainty about the relationship between aggregate demand and market rates of interest, and in so doing has reduced the predictability of the aggregate-demand relation.

The successive oil-price shocks experienced since 1973-74 have also served to underline the point that the aggregate demand (and supply) relation is vulnerable to large unpredictable shifts. The vagaries of international politics can have an important impact on domestic inflation, and we still do not fully understand how oil price increases work their way through prices and the real economy. This suggests that predicting GNP through the aggregate-demand relation is going to be a chancy exercise for the foreseeable future.

These doubts about the stability of the aggregate-demand relation should be remembered when so much attention has been focused on alleged recent instability in the demand for money. The preoccupation with money-demand instability has tended to obscure one important point: what matters is not whether the predictability of money demand has deteriorated per se, but rather whether it has deteriorated enough to make a money-stock strategy no longer appropriate. To do that would require showing that aggregate demand and supply are stable enough to make an interest-rate strategy workable. So far this has not been demonstrated.

Moreover, the evidence of current instability in the demand for M_1 should be placed in its proper context. Surely the massive evidence for the historical stability of money demand counts for something. In particular, it argues for a skeptical attitude toward new and still inconclusive evidence that money has suddenly begun to behave quite unpredictably. Uncertainty argues for cautious changes in a policy when policymakers are confronted with fragmentary evidence, as past experience demonstrates. In 1971, for example, it was widely claimed that the demand for money had shifted. Subsequent analysis showed that this had been a false alarm—that the putative shift was well within the normal range of historical experience.[24]

And finally, as mentioned earlier, an aggregates strategy clearly has an edge when we turn our attention from the problem of income stabilization to the problem of combatting inflation.[25] While some evidence indicates that market rates of interest contain information about future

inflation,[26] it does not follow that an interest-rate strategy—especially the usual type of cautious, defensive strategy—will help to keep inflation under control. Indeed, a telling criticism against an interest-rate strategy is its tendency to accentuate or prolong inflation by (inadvertently) setting up a vicious spiral. The spiral may begin with inflation expectations stimulating rising interest rates, which the Federal Reserve initially attempts to resist. The result is faster money growth and eventually even more inflation. In contrast, an aggregates strategy dampens inflationary impulses by refusing to finance the increases in expenditures that are necessary to keep inflation going.

IV. Policy Implications

From this analysis, we may conclude:

- The FOMC is likely to control whatever operating instrument it chooses in a cautious manner. This rational approach follows naturally from apparently unavoidable uncertainties about the actual state of the economy and the impact of policy actions.
- Cautious control of the funds rate means that the FOMC, in effect, pursues a strategy which is most nearly optimal when real-sector disturbances are smaller than monetary-sector disturbances, and when inflation is not a major problem. Cautious control of reserves means that the FOMC pursues a strategy which is most nearly optimal when real-sector disturbances are larger than monetary-sector disturbances, and when inflation is a serious source of concern.

These conclusions suggest the following monetary-policy guidelines:

- Choose the most nearly optimal strategy on the basis of the available empirical evidence.
- Choose the operating instrument which, when controlled cautiously, brings policy as close as possible to the chosen strategy.

This decision-making sequence should be followed unless monetary control were seen to be technically infeasible with the chosen operating instrument. Since empirical evidence indicates that both reserves and funds-rate operating instruments represent technically feasible alternatives,[27] the crucial decision should be based on which operating instrument produces the most nearly optimal strategy.

We have argued that monetary policy should lean more toward a pure aggregates strategy than a pure interest-rate strategy. Given the uncertainties and other constraints on FOMC actions, the reserves approach recently adopted will automatically imply an aggregates orientation of monetary policy. This will be a distinct improvement over former policies which, despite official aggregates targets, were really oriented around interest rates.

With the switch to a reserves operating instrument, the Federal Reserve has made a serious attack on inflation while promoting the stabilization of the business cycle. The new operating procedures mean that the FOMC's rational responses to the uncertainties it must face will translate into a more effective monetary policy.

FOOTNOTES

1. An excellent exposition of the argument that a two-stage procedure is inefficient can be found in Benjamin M. Friedman, "The Inefficiency of Short-Run Monetary Targets for Monetary Policy," **Brookings Papers on Economic Activity** (1977): 293-335. It is perhaps worth repeating here the point we argue later on, that given considerable uncertainty about the precise impact and timing of FOMC actions on macroeconomic activity, it is not clear that the cautious strategies we concentrate on are necessarily suboptimal.

2. The classic work in this field is William Poole, "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model," **Quarterly Journal of Economics**, 84 (May, 1970): 197-216. A good summary of relevant issues in the literature can be found in Benjamin M. Friedman, "Targets, Instruments and Indicators of Monetary Policy," **Journal of Monetary Economics**, 1 (1975): 443-473.

3. Michael Bazdarich, in his contribution to this issue of the **Economic Review,** has documented the important role for the aggregates in effectively fighting inflation. The reader should keep in mind that this evidence makes a case for an aggregates strategy independent of the evidence we discuss here.

4. A good exposition of the issues involved here can be found in Stephen LeRoy and David L. Lindsey, "Determining the Monetary Instrument: A Diagrammatic Exposition," **American Economic Review**, 68 (Dec, 1978): 929-934.

5. In early 1970, the language in the FOMC's published directives to the Federal Reserve Bank of New York's Open Market Trading Desk switched from emphasizing conditions in the credit markets to focusing on the monetary aggregates and the funds rate. See Richard G. Davis, "Implementing Open Market Policy with Monetary Aggregates Objectives," **Monetary Aggregates and Monetary Policy,** Federal Reserve Bank of New York, 1974, pp. 7-19. In addition, econometrically estimated Federal Reserve reaction functions appear to have shifted in 1970. See Paul DeRosa and Gary H. Stern, "Monetary Control and the Federal Funds Rate," **Journal of Monetary Economics,** April 1977, especially pp. 218-219.

6. The Federal Reserve currently is required by the Humphrey-Hawkins Act to report target ranges for M_1, M_2, M_3, and bank credit for periods beginning in the fourth quarter of the preceding year and ending in the fourth quarter of the current year.

7. DeRosa-Stern (1977), op. cit., pp. 217-230.

8. This point is briefly mentioned in William Poole, "Discussion and Comments," to Benjamin M. Friedman, "The Inefficiency of Short-run Monetary Targets for Monetary Policy," op. cit., p. 342.

9. William Brainard, "Uncertainty and the Effectiveness of Monetary Policy," **American Economic Review,** May 1967, pp. 411-425.

10. The financial markets are usually the first to react negatively to frequent policy changes, simply because they feel the impact of these changes almost immediately. Thus the FOMC may tend to be more concerned about financial-market reactions to policy changes than goods markets reactions, which tend to be more delayed and thus less directed at specific FOMC actions.

11. On November 1, 1978, the Federal Reserve raised the discount rate by one percentage point, and imposed a supplemental reserve requirement of two percent on large time deposits.

12. Richard G. Davis, "Short-Run Targets for Open Market Operations," and John H. Ciccolo, "Is Short-Run Monetary Control Feasible?", in **Monetary Aggregates and Monetary Policy,** Federal Reserve Bank of New York, 1974, pp. 40-59 and 82-91, respectively.

13. Raymond Lombra and Frederick Struble, "Monetary Aggregate Targets and Volatility of Interest Rates: A Taxonomic Discussion," **Journal of Money, Credit and Banking,** August 1979, pp. 284-300.

14. Hang-Sheng Cheng, "The Variability of the Federal Funds Rate and the Stability of Money Market Conditions," unpublished paper, Federal Reserve Bank of San Francisco, 1979.

15. Milton Friedman, "The Role of Monetary Policy," **American Economic Review,** March 1968, pp. 1-17.

16. For a discussion of the various ways in which this can happen see Albert E. Burger, **The Money Supply Process,** Wadsworth Publishing Company, Belmont, California, 1971.

17. Some of the evidence summarized here is discussed in more detail in John Scadding, "Optimal Strategy: Interest Rates or Aggregates?", unpublished paper, Federal Reserve Bank of San Francisco, 1979.

18. A good summary of the secular evidence is given in David E. W. Laidler, **The Demand for Money: Theories and Evidence,** 2nd ed., New York: Don Donnelley, 1977, Chap. 7. Postwar evidence is summarized in Stephen M. Goldfeld, "The Demand for Money Revisited," **Brookings Papers on Economic Activity,** 3 (1973): pp. 577-638.

19. The shift is well documented, though the precise reasons for it remain elusive. See Stephen M. Goldfeld, "The Case of the Missing Money," **Brookings Papers on Economic Activity,** 3 (1976): pp. 683-740, and Jared Enzler, Lewis Johnson and John Paulus, "Some Problems of Money Demand," **Brookings Papers on Economic Activity,** 1 (1976): pp. 261-280.

20. See, for example, Goldfeld, op. cit., p. 725. Note, incidentally, Goldfeld's reluctance to believe that M_2 is an appropriate aggregate despite evidence of its stability.

21. The source of the evidence on single-equation tests of the relation between monetary aggregates and fiscal variables on the one hand, and GNP on the other, is Leonall C. Anderson and Keith M. Carlson, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," Federal Reserve Bank of St. Louis **Review** 50 (November, 1968): pp. 11-24. The evidence of the links between interest rates and GNP is reviewed in Michael Gorham, "Money or Interest Rates: Which is the Better Indicator of Monetary Policy?"

unpublished paper, Federal Reserve Bank of San Francisco, 1979. The literature on the relationship between autonomous spending and GNP begins with Friedman and Meiselman's investigation of the relative stability of the multiplier versus velocity: Milton Friedman and David Meiselman, "The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States, 1897-1958," in **Commission on Money, Credit and Stabilization Policies,** Prentice Hall: New York, 1963. That article spawned a running controversy whose record is scattered throughout the literature. A partial summary and update of the evidence is provided in William Poole and Elinda B. F. Kornblith, "The Friedman-Meiselman CMC Paper: New Evidence on an Old Controversy," **American Economic Review,** 63 (Dec. 1973): pp. 908-17. Postwar evidence using quarterly data is provided in Moshin S. Khan, "The Relative Stability of Velocity and the Investment Multiplier: Some Further Tests," **Journal of Monetary Economics,** 4 (Jan. 1978): pp. 103-120.

22. Richard Zecher examined the indicator properties of money and interest rates in four macro-economic models. See his "Implications of Four Economic Models for the Indicators Issue," **American Economic Review,** 60 (May 1970): pp. 47-54. Robert Holbrook and Harold Shapiro used a small macroeconomic model to examine whether a money-stock or interest-rate strategy would have produced smaller variability in GNP. "The Choice of Optimal Intermediate Targets," **American Economic Review,** 60 (May 1970): pp. 40-46. A similar experiment, done more recently, is reported in Benjamin M. Friedman, "The Inefficiency of Short-Run Monetary Targets for Monetary Policy," op. cit., pp. 293-335.

23. Irving Fisher. **The Purchasing Power of Money,** New York: MacMillan, 1918, pp. 56-58.

24. The episode is discussed in Michael Hamburger, "The Demand for Money in 1971: Was There a Shift?" **Journal of Money, Credit and Banking,** (May 1973): pp. 720-725. See also Hamburger's skepticism about the seriousness of the shift in M_1 demand since mid-1974 in "Behavior of the Money Stock: Is there a Puzzle?" **Journal of Monetary Economics,** 3 (1977): pp. 265-288.

25. See Bazdarich's article in this issue.

26. See, for example, Eugene F. Fama, "Short-Term Interest Rates as Predictors of Inflation," **American Economic Review,** 65 (June 1975): pp. 269-282.

27. John P. Judd, "Federal Funds Rate or Reserves: Which Allows for the More Precise Monetary Control?" unpublished paper, Federal Reserve Bank of San Francisco, October 1979.

Optimal Control and Money Targets: Should the Fed Look At "Everything"?

Kenneth C. Froewiss and John P. Judd*

Target rates of growth for the monetary aggregates have played an increasingly prominent role in discussions of Federal Reserve policy over the last decade. The Federal Open Market Committee (FOMC) first incorporated the notion of monetary targets into its policy directives in 1970. More recently, the establishment of such targets has been mandated by Congress, first in Joint Resolution 133 in 1975 and then in the Full Employment and Balanced Growth Act of 1978 (the so-called "Humphrey-Hawkins Act").

While virtually all economists agree that the behavior of the money supply has an important effect on economic activity, many question the wisdom of singling out this one variable from among all of those on which the Fed might focus its attention. Indeed, to confer primacy on money goes against a long Fed tradition of "looking at everything" in attempting to gauge the direction of the economy and the correspondingly appropriate monetary policy. Fed spokesmen have, in fact, maintained that they do not interpret the announced monetary targets in any rigid, mechanistic way.[1] Rather, they view these targets as broad guides to policy which may be revised as necessary in the light of new economic information.

The intuitive argument that the Fed should "look at everything" in setting policy instead of slavishly aiming at preannounced monetary targets has found support in the theory of "optimal control".[2] Described in more detail below, the optimal-control literature essentially criticizes the use of targets as being wasteful of information, which, if properly employed, would permit policymakers to be more successful in the pursuit of their economic goals. While we do not dispute the theoretical basis of this optimal-control position, we intend to assess its empirical significance within the context in which it is likely to be used. Specifically, we ask this question: Do those financial-market variables which are frequently cited as being important for the determination of monetary policy convey reliable information about aggregate spending in the economy beyond that contained in the movements of the money supply?

In Section I, we set out the basic principles of optimal-control theory, and then review how these ideas have been used to criticize a policy of monetary targeting. Also, we examine the use of information in the context of "real-world" policymaking. In Section II, we translate these theoretical considerations into econometric tests of the information about aggregate demand contained in a large number of financial-market variables—bank credit and its components, interest rates, and flow of funds—*over and above* monetary policy aggregates targeted by the Federal Reserve. From these tests, we conclude that once policymakers look at a monetary aggregate, they can gain little additional information about nominal GNP by also looking at other financial-market variables. These conclusions, as well as some limitations of the study, are summarized in Section III.

I. Optimal Control and Monetary Policy

Although the theory of optimal control has its origin in the engineering literature, its fundamental ideas can be easily explained in terms of the problems confronted by economic policymakers. The most inexorable problem is uncertainty. In theory, we can think of the economy as being accurately described by a large number of so-called structural equations. This "true model" of the economy includes equations specifying all of the relationships which make up the structure

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of the economy—such as consumption behavior, the demand for money, and so on. Even if policymakers were confident that they knew the "true" model of the economy, in the sense of knowing which variables belong in each equation, the equations of that model would still contain random components which cannot be empirically estimated with complete precision. In fact, policymakers' problems are compounded by a lack of certainty about the underlying structure of the economy.

Another problem is the general inability of available policy tools to affect directly the variables of ultimate concern, such as employment, inflation, and real-output growth. In the language of optimal control, the policy tools are known as "instruments" and the variables such as employment are known as "goal variables." The policymaker, then, chooses settings for the instruments believed consistent with the desired values of the goal variables, while recognizing that the link between the two is uncertain.

The situation is further complicated by the fact that the resulting actual values of the goal variables may not be immediately observable. There may be lags in the transmission of policy. For example, a change in the rate of growth of the money supply may not be fully reflected by a change in the rate of inflation for a period of up to two years.[3] Moreover, there may be further lags in the gathering of data. Figures for GNP are not available until after the end of the quarter to which they refer, and the initial figures are routinely revised, often by substantial amounts. As a result of these lags, the economy could veer off course for some time without policymakers being aware of the situation. Indeed, this possibility is not purely hypothetical. In 1974, a large revision in the inventory-valuation adjustment sharply changed perceptions regarding the overaccumulation of inventories and, hence, the likely severity of the ensuing recession. It is conceivable that, had policymakers access to better information in 1974, their decisions would have been different.

Of course, policymakers need not wait for the release of GNP data to learn about the economy, because monthly figures on personal income, industrial production, retail sales, etc., provide clues as to how the economy is evolving. Based on the observation of these "information variables," they can draw inferences about the unobserved goal variables, and reset instruments if that appears warranted. "Optimal control" makes an important contribution by showing policymakers how to make the most effective use of the feedback from information variables when deciding whether to change the setting of the instruments. The process is "optimal" in the sense of minimizing some measure of the deviation of the actual paths of the goal variables from their desired paths.[4]

The formal mathematics of optimal control theory is complex and will not be presented here. But the underlying logic is simple: In order to achieve optimal settings of the policy instruments, it is necessary to utilize all available information on the unobserved goal variables.[5] Thus, the adherents of an optimal-control approach argue that a policy of monetary targeting inherently wastes information. We now turn to an appraisal of that criticism.

Monetary Policy Targets

As mentioned at the outset, the Federal Reserve has repeatedly stressed in official statements that it does not formulate short-run monetary policy mechanistically, according simply to the criterion of whether the money supply is growing on target. Thus, although we present here a highly stylized representation of monetary targeting, we do not intend this to be used as a description and assessment of how the Fed currently conducts its affairs. Instead, we intend it simply as an expositional device to help highlight some of the key issues in the debate over the virtues of formal money targets.[6]

Consider the situation faced by monetary policymakers at the time targets are initially established. They wish to see the goal variables of unemployment, inflation, and real income growth follow certain desired paths over the planning period for which targets are to be set. For simplicity, these three distinct goal variables can be grouped under the single rubric of "income."[7] On the basis of historical empirical relationships, policymakers then choose growth targets for the monetary aggregates which they believe will be consistent with achievement of the desired path for income.

However, the money supply is not a variable over which the Federal Reserve has direct control, i.e., it is not an "instrument." The Fed can control directly the availability of reserves to the banking system or alternatively it can influence even this variable indirectly by setting a value for the Federal funds rate and providing whatever quantity of reserves is necessary to maintain that rate.[8] Under present Federal Reserve regulations, member banks must hold certain percentages of their various deposit categories in the form of reserves. This means that deposit growth is ultimately constrained by the rate at which reserves are allowed by the Fed to expand. On October 6th, the Fed announced a change in its operating procedures which would involve directly setting the volume of bank reserves (rather than the previous method of using the Federal-funds rate) to attempt to achieve its monetary-aggregates targets. Thus the Fed is now using reserves as its instrument, whereas up to October 6th the instrument was the Federal-funds rate—see the article by Judd and Scadding in this issue. But it would not be appropriate to call money the instrument under either regime.

In the terminology of optimal control, money is an information variable. Observations on the money supply are available on a more timely basis than are observations on income. More importantly, changes in the rate of growth of the money supply tend to lead changes in overall economic activity. If the rate of money growth is observed to be deviating from its target, we may assume that income is (or will be) deviating from its desired path, since the money target was expressly chosen to be consistent with the latter. In this situation, strict adherence to a policy of monetary targets would require that the supply of bank reserves be altered to bring money growth back on target.

This simple description of the workings of a money-targeting policy begs a host of real-world issues. For example, what is the proper time period over which to compare actual and targeted money growth? One week? One month? Furthermore, what should the policy response be when one measure of the money supply is exceeding its target while another is below target? And should *forecasts* of money growth be given any weight, or only *actual* money growth?

While all of these questions are important for the implementation of a targeting procedure, they can be safely ignored for purposes of this study. Here, the concern is with two more fundamental issues. First, can a policy which relies solely on the information contained in money to infer the behavior of income ever be optimal? And second, would a policy which consisted of mechanically moving reserves to bring money back on target whenever it went off track represent an optimal use of the information in money itself? According to the adherents of the optimal-control approach, the answer to both of these questions is, "No."

The logic of the response is intuitively appealing in the case of the first question. Data on a whole host of economic variables other than money are available on a more timely basis than are national-income statistics. For example, the Federal Reserve publishes weekly numbers on bank loans at the same time that it releases its money-supply figures. A large body of economic literature suggests that these numbers should provide important clues to the strength of economic activity.[9] Similarly, interest rates on a wide range of securities can be monitored on a continual basis (as the Open-Market Desk of the Federal Reserve Bank of New York indeed does). To the extent that interest rates are an important link in the transmission of monetary policy, they presumably provide another valuable source of information about income. *A priori,* it is hard to understand why policymakers should choose to ignore such information.

The reasoning behind the optimal-control position on the second issue raised above—whether automatically bringing money back on track, once it has strayed, represents the best use of the information conveyed by the money supply—is less obvious though easily explainable. We look to money for information on income because of the assumption that there is a stable relationship between the two through the money-demand function. If money demand is subject to random disturbances, however, deviations of money from target may merely reflect these random influences, and need not indicate that income is off its desired path. If, for example, the Federal Reserve were to offset a random downward shift in money demand that was

unrelated to income, the result would be an excess of money supply over demand, which if it persisted would lead to inflation. If, on the other hand, the drop in money were caused by a random decrease in real economic activity, an increase in the money supply by the Federal Reserve to raise aggregate demand would be appropriate. Furthermore, if other variables than income enter the money-demand equation, policymakers must consider the response of money to these variables when formulating the optimal policy reaction to a deviation of money from target. Since money demand apparently is both subject to stochastic disturbances and responsive to changes in interest rates, it follows that mechanically moving money back to target will not, in theory, be the optimal policy. This is true even if money is used as the sole source of information about income.[10]

The empirical analysis in the remainder of this article focuses only on the first of these two separate issues—that monetary targets waste information. Further, we restrict our attention to financial-market variables as possible supplements to the information on income contained in money. We do not assume that "real" variables convey no information on income. Rather, we limit his study to financial variables because of their prominence in the literature on the transmission of monetary policy to economic activity. An investigation of potential real-sector information variables could be the subject of another long paper. Furthermore, our choice of variables is meant to reflect the natural inclination of monetary policymakers to look to the financial markets for a reading on the economy.

Finally, restricting the analysis to financial variables does not undermine the practical relevance of this study. In early 1979, for example, money growth as measured by both M_1 and M_2 was sluggish, while bank lending was growing rapidly. Policymakers were forced to decide whether the money-supply figures accurately reflected the imminence of a period of slack in real economic activity, despite the surge in bank loans.[11] In fact, the empirical estimation in the next section is based on the kind of analysis which policymakers at least implicitly perform when confronted with such divergent trends.

Information Variables: Policy Context

We noted previously that one of the problems faced by policymakers is their lack of knowledge of the "true model" of the economy. If they knew the equations of that model (or even the variables involved), they would presumably be able to extract information about income out of currently available data. But their uncertainty about the true model leaves them little choice but to rely on a few variables which in their experience have been *correlated* with GNP in the past, and which are available on a timely basis. Because of differences in individual judgment and experience, differences also occur in policymakers' choices of variables to watch. Not surprisingly, then, policy briefings tend to involve the presentation of the latest figures from a wide range of economic time series, from which each policymaker can choose the two or three variables which he or she believes convey the most information about economic activity.

In effect, each policymaker replaces the (unknown) full structural model with a single-equation model, in which income is explained by several variables on which he has focused his attention. These variables generally include monetary-policy and fiscal-policy measures, but are not limited to them. Since many financial-market measures are "endogenous" (i.e., determined in the full model), the single equation is properly called a "semi-reduced form," to distinguish it from a "reduced form" in which only "exogenous" or policy variables are used to "explain" movements in income. Also, these equations do not necessarily represent the optimal way for policymakers to use indirect information about aggregate demand. Instead, they are designed to represent a reasonable approximation to the way policymakers use such information in practice.

In this sense, and only in this sense, we use such equations to establish a strong presumption for the existence of (or lack of) "information" about aggregate demand in the variables tested. Given the use of this concept of "information," the problem reduces to searching for *correlations* between potential information variables and nominal GNP. Where such correlations are found to be statistically significant, we conclude that available information is sufficiently reliable

to be potentially usable by policymakers.

Any search for information variables would logically begin with measures of monetary and fiscal policy. Examples would include the policy variables for which the Federal Reserve currently reports targets to Congress (M_1, M_2, M_3, and bank credit). The Fed presumably believes that these aggregates contain significant information about GNP, and besides, it is required under the Humphrey-Hawkins Act of 1978 to specify growth ranges for them in conducting monetary policy. Our basic equations express growth in nominal GNP as functions of growth in several monetary-policy variables (M_1, M_2, and bank credit)—and in addition, as a function of a fiscal-policy variable (high-employment federal expenditures).[12] These basic equations are the familiar St. Louis equations, which have been widely discussed in the economics literature,[13] generally as measures of the relative importance of monetary and fiscal policy. However, we employ these equations in a completely different way. We add various information variables to these equations and ask the question: Do these financial-market variables contain any *additional information* about aggregate demand not already contained in variables measuring monetary and fiscal policy?

The financial-market variables examined include (1) bank credit and its major components, (2) interest rates of various maturities, and (3) aggregate activity in the credit markets. In selecting variables for testing, we tried to be theoretically agnostic: to "run the gamut" of financial variables which are commonly used in economic-policy briefings, and which might logically flow from either Keynesian or Monetarist theories.

Contemporaneous values of these variables were entered in the equations, even though policymakers lack access to some current information because of lags in the data. Thus our equations test for information in the variables themselves, and do not determine whether policymakers actually have access to such information. This is no problem for interest rates, where there are no effective data lags. Also it is only a minor problem for monetary and banking data, where the lags are only a week—but where revisions are occasionally substantial. In the case of flow-of-funds data, however, the lags exceed one quarter, so that any potential information involves the use of either forecasts or lagged data. Since our basic tests may overstate the amount of accessible information in the flow-of-funds variables, we include additional (forecasting) regressions to determine whether our basic results with these particular variables would be affected.

II. Testing for Financial Market Information

The preceding discussion conceptually defined the empirical tests conducted for the information content of financial-market variables. We next describe the particular form of these tests, which are based on econometric estimates of semi-reduced form equations. As mentioned earlier, the equations are designed to determine whether or not the financial-market information variables add significantly to the precision with which monetary—and fiscal—policy variables by themselves explain aggregate demand. Specifically, we use F-tests to determine if standard errors from aggregate-demand equations including only the policy variables are significantly higher than standard errors from equations which also include financial-market variables. The estimating equations are described in (1) below.

The policy variables include those that would normally be found in standard St. Louis equations[14]—high-employment government expenditures as the fiscal-policy variable,[15] and M_1, M_2, and bank credit alternatively as the monetary-policy variable. Bank credit, although having less operational significance for monetary policy at present than the monetary aggregates, has received strong support as an alternate policy measure, especially during the extended debate on this subject in the early 1970's.[16] In agnostic fashion, we have simply performed our tests with all three monetary-policy aggregates.

$$Y_t = a + \sum_{i=0}^{4} b_i M_{t-i} + \sum_{i=0}^{4} c_i F_{t-i} + \sum_{i=0}^{4} d_i I_{t-i} \qquad (1)$$

where all variables are entered approximately as percentage changes[17] and are defined as follows.

See Appendix 1 for data sources and glossary.

Y = nominal gross national product.
M = monetary-policy aggregates.
- M_1 = currency plus commercial-bank demand deposits adjusted
- M_2 = M_1 + commercial-bank saving and time deposits except large negotiable certificates of deposit
- total bank credit (BC)

F = fiscal-policy variable = high-employment Federal expenditures.
I = financial-market "information" variables.
- commercial-bank variables
  - total bank credit (BC)
  - loans to nonfinancial business (BL)
  - ratio of total loans to total bank credit (P)
- interest rates
  - Federal funds rate (RFF)
  - 4-6 month prime commercial-paper rate (RCP)
  - Moody's Aaa corporate-bond rate (RCB)
- flow-of-funds variables
  - total outstanding credit extended to all nonfinancial sectors (TCE)
  - total outstanding credit extended to the household sector (TCE/HH)
  - total outstanding credit extended to the nonfinancial business sector (TCE/NFB)
  - liquid assets, nonfinancial business sector (LA/NFB)
- Sample period:
  - 1961:1-1977:4 (quarterly observations).
- Distributed lags:
  - fourth-degree Almon distributions over times t through t-4 where coeffients at times t+1 and t-5 are tied to zero.
- Serial correlation:
  - first degree Cochrane-Orcutt adjustment, where serial correlation was indicated.
- Instrumental variables:
  - contemporaneous values of nonpolicy-information variables replaced by fitted values from instrumental-variables regressions (see Appendix 2 for a description of the instruments used).

In choosing particular series within each of the financial-market categories, we tried to include variables which are systematically involved in the process by which Federal Reserve open-market operations influence the economy. Our purpose was not to advance particular hypotheses, but rather to test as many credible variables as possible. It should be noted that bank credit enters the equations in two roles. This variable appears as a monetary-policy aggregate in conjunction with financial-market information variables, and, alternatively, as a financial-market information variable in conjunction with M_1 and M_2.

The end-point for the sample period was chosen as 1977.4 because later data were influenced by changes in the monetary aggregates, brought about by recent changes in banking regulations.[18] Indeed, an even earlier end-point could have been chosen, because some evidence showed that the demand for money (especially M_1) actually began shifting in 1974.3.[19] But preliminary estimates indicated that the inclusion of 1975-77 in the sample period *uniformly* raised the standard errors of the equations estimated (with and without information variables) and thus did not change any of our conclusions. Meanwhile, the beginning point of the sample period was chosen as 1961.1, because that marked the beginning of some well-documented changes in bank behavior (i.e., the development of liability management).[20]

As mentioned earlier, the equations are semi-reduced forms, in that they include exogenous policy variables which belong in the reduced form of nominal GNP[21] and, in addition, endogenous financial variables. In order to avoid the statistical problems associated with estimating equations with endogenous explanatory variables, we used an instrumental variables approach with respect to the contemporaneous values of the financial-market information variables. Actually, the results from ordinary least-squares (OLS) regressions are presented in the text, since these results are very similiar to those obtained with instrumental variables, and thus do not affect the article's conclusions. The

instrumental-variables results are shown in Appendix 3, and the instruments are described in Appendix 2.

Empirical Results

The top row of numbers in Table 1 represent the standard errors from three "St. Louis" equations with nominal GNP regressed on high-employment government expenditures and a monetary-policy variable (alternatively, M_1, M_2, and bank credit), and no financial-market information variables. The standard errors from regressions which include information variables were compared with those from the St. Louis equations, by means of 5-percent and 1-percent F-tests, to see if the information variables could reduce the standard errors in the respective St. Louis equations by a statistically significant amount.

Table 1
Standard Errors of Regressions
1961.1-1977.4
(Ordinary Least Squares Regressions)

Information Variables	Policy Variables M_1,F	M_2,F	BC,F
None	2.95	2.89	3.16
M_1	N/A	2.92	2.99*
M_2	2.92	N/A	2.91**
BC	2.99	2.90	N/A
BL	3.00	2.90	3.16
P	2.95	2.93	3.09
P,RCP	2.94	2.89	3.03
RCP	2.89	2.82	2.97*
RFF	2.88	2.80	2.97*
RCB	2.94	2.96	3.20
RCB,RCP	2.91	2.84	3.00
TCE	2.93	2.88	2.98*
TCE/HH	2.50**	2.53**	2.58**
TCE/NFB	2.86	2.87	3.09
LA/NFB	2.81*	2.84	2.90**

*Indicates standard errors which are significantly lower (at 5 percent) than those of corresponding regressions with no information variables.
**Indicates standard errors which are significantly lower (at 1 percent) than those of corresponding regressions with no information variables.
N/A = not applicable

None of the three bank-credit information variables—aggregate bank credit, bank loans to nonfinancial borrowers, and the ratio of total bank loans to bank credit—passed either test. None of the three contained information in addition to M_1, and M_2, while the latter two credit variables did not significantly reduce the standard errors from the St. Louis equation with bank credit as the monetary policy variable.[22]

Similarly, the various long- and short-term interest rates tested were not found to contain additional information in the M_1, and M_2 equations. But in the bank-credit equation, both the funds rate and the commercial-paper rate significantly reduced the standard errors. Thus tests of eight bank-credit and interest-rate variables (and combinations thereof) against three measures of monetary policy (23 regressions in all) produced only two cases in which additional information was found. Both of these cases involved short-term interest rates as information variables, and bank credit as the measure of monetary policy.

In contrast, the tests of the flow-of-funds variables (last four rows of Table 1) produced a number of cases in which information existed over and above that in the policy variables. Total outstanding credit extended to households was significant for M_1, M_2, and BC. Liquid assets of nonfinancial business significantly reduced the standard errors in the M_1 and BC equations,

Table 2
Standard Errors of Regressions
1961.1-1977.4
(Instrumental Variables Regressions)

Information Variables	Policy Variables M_1,F	M_2,F	BC,F
None	2.95	2.89	3.16
TCE	2.95	2.89	3.02*
TCE/HH	2.68**	2.65**	2.97**
TCE/NFB	2.93	2.89	3.18
LA/NFB	3.01	3.04	3.11

* Indicates standard errors which are significantly lower (at 5 percent) than those of corresponding regressions with no information variables.
** Indicates standard errors which are significantly lower (at 1 percent) than those of corresponding regressions with no information variables.

while outstanding credit extended to all nonfinancial sectors passed the F-test in the BC equation.[23] Thus additional information was detected in six out of the twelve equations estimated with flow-of-funds variables.

Because of the time lag in the availability of flow-of-funds data, the results probably overstate the *usable* information in those variables. To try to extract the necessary information, policymakers would presumably attempt to forecast contemporaneous values of flow-of-funds variables. The instrumental variables regressions provide a convenient approximation to this forecasting situation. In these regressions, the contemporaneous values of financial-market information variables are replaced by in-sample estimates from first-stage equations. Since in-sample estimates are generally more accurate than out-of-sample forecasts, the instrumental-variables regressions perhaps overstate the amount of usable information in flow-of-funds variables. Nevertheless, they should do a better job than the ordinary least-squares regressions summarized in Table 1.

Table 3
Long-Run Elasticities of Y with Respect to M
1961.1-1977.4
(Ordinary Least Squares Regressions)

Information Variables	Policy Variables M_1,F	M_2,F	BC,F
None	.74**	.84**	.32*
M_1	N/A	.73*	-.03
M_2	.08	N/A	-.13
BC	.79**	.91**	N/A
BL	.80**	.90**	1.91
P	.68**	.74**	.35*
P,RCP	.70**	.72**	.43*
RCP	.75**	.74**	.47**
RFF	.74**	.74**	.45**
RCB	.73**	.88**	.24
RCB,RCP	.73**	.90**	.58**
TCE	.36	.56	.08
TCE/HH	.51*	.48*	.21
TCE/NFB	1.10**	.88**	.69**
LA/NFB	.39	.58*	.11

* Indicates long-run elasticities which are significantly different from zero at the 5-percent level.
** Indicates long-run elasticities which are significantly different from zero at the 1-percent level.
N/A = not applicable

These more realistic results (see Table 2) fail to detect additional information in liquid assets of nonfinancial business in the M_1 and BC regressions, as did the OLS tests. The significance of outstanding credit extended to households (with M_1, M_2, and BC), and the same measure for all nonfinancial sectors (with BC) hold up in the instrumental-variables runs. As for the M_1 and M_2 equations, it is difficult to say why credit extended to the household sector would contain additional information, while the same measure for all nonfinancial sectors and the nonfinancial business sector do not.

The results in Table 1 can also be used to assess the Federal Reserve's practice of targeting more than one monetary-policy aggregate. Is the explanatory power of a single aggregate improved when a second aggregate is also considered? Our results indicate that BC can be improved upon by also looking at M_1 or M_2, but that the reverse is not true.

M_1 and M_2 thus outperform BC as a measure of monetary policy, as can be seen from the fact that the St. Louis equations yield somewhat lower standard errors with M_1 and M_2 (2.95 and 2.89 respectively) than with BC (3.16). In addition, only one of the thirteen information variables tested improved upon the M_1 and M_2 equation, while there were seven such variables for BC.

Further evidence is presented in Table 3, which shows the long-run elasticities of nominal GNP with respect to the monetary-policy variable indicated at the top of each column, when the information variable(s) indicated for each row is (are) also in the regression. M_2 maintains its highly significant coefficient when M_1 and BC are separately added to the equation. M_1 retains its significant coefficient when BC is included in the equation, but becomes insignificant in the presence of M_2. Finally, the significance of BC is eliminated by both monetary aggregates. When the entire list of information variables is considered, the long-run coefficients on M_1 and M_2 are significant in all but a few cases, while this is true for BC in only six of thirteen cases.

The empirical results can be summarized as follows:

1. After testing a large number of potential information variables measuring various aspects of bank credit, interest rates and flow of funds, we found only one variable (total credit extended to households) which contained information about aggregate demand *in addition* to M_1 and M_2 (when separately paired with a fiscal-policy variable).

2. When bank credit was used as the measure of monetary policy, we found that two interest rates (on commercial paper and federal funds) and two flow-of-funds variables (total credit extended to nonfinancial sectors and to the household sector) contained additional information.

3. M_2 uniformly outperformed M_1 which, in turn, outperformed bank credit as a measure of monetary policy. We found that BC contained no information over and above that in either M_1 or M_2, while both of the latter variables contained information in addition to BC.

This study thus has accumulated a great deal of negative evidence on the information content of credit-market variables. But in doing so, it has produced one very strong positive result: once money (especially M_2) is included in an aggregate-demand equation, there is little to be gained by also looking at credit-market variables, or for that matter, at other monetary-policy variables.

III. Conclusions

Optimal-control theory implies that monetary policy is unlikely to be optimal if available information about goal variables is not used. While this conclusion is theoretically unassailable, it cannot be considered relevant in practice without determining which variables, if any, contain information in addition to the policy variables on which policymakers naturally rely. This article addresses that important policy question for a representative set of financial-market variables. The statistical tests indicate, in particular, that once policymakers take account of growth in money (especially M_2), they can gain little additional information about aggregate demand from such variables as bank credit (and its components), interest rates, and flow-of-funds variables.

The study has several limitations. First, we have not tested potential information variables from the real sector of the economy. Second, our study uses quarterly data, whereas monetary policy is conducted on a month-by-month basis, so that we may be missing some information from credit-market variables about very short-run changes in aggregate demand. Third, we have not investigated the possibility that only the unexpected portion of movements in financial-market variables contain information about GNP. Finally, as noted earlier, we have not addressed the question of how the Federal Reserve should respond to deviations in money from target—which is an important question if money is used as the sole source of information about aggregate demand. Despite these caveats, we believe that the present research has put the burden of proof on those who argue that the Federal Reserve should not target money because this involves "throwing away" significant financial-market information. Furthermore, these results re-confirm the robustness of the association between money and aggregate demand.

APPENDIX 1

Variable Names and Sources of Data

BC = Total loans and investments of all commercial banks (FR Board)
BL = Loans to nonfinancial business of all commercial banks (Flow of Funds Accounts)
C = Constant term
F = High-employment federal expenditures (FRB St. Louis)
LA/NFB = Liquid assets of the nonfinancial business sector (Flow of Funds Accounts)
M_1 = Currency plus demand deposits adjusted (FR Board)
M_2 = M_1 + time and savings deposits at commercial banks other than large negotiable certificates of deposit (FR Board)
P = Total bank loans of all commercial banks/BC (FR Board)
RCB = Moody's Aaa bond rate (Moody's Investors Service)
RCP = 4-6 month prime commercial paper rate (FR Board)
RFF = Federal funds rate (FR Board)
TCE = Total credit extended to nonfinancial sectors (Flow of Funds Accounts)
TCE/HH = Total credit extended to the household sector (Flow of Funds Accounts)
TCE/NFB = Total credit extended to the nonfinancial business sector (Flow of Funds Accounts)
Y = Nominal gross national product

APPENDIX 2

Instrumental Variables Specifications

The following equations were used to generate the instrumental variables used in the instrumental variables regressions. See Appendix 3 for those regression results.

$$I_t = a + \sum_{i=1}^{2} b_i' I_{t-i} + \sum_{i=1}^{2} c_i' M_{t-i} + \sum_{i=1}^{2} d_i' RFFN_{t-i} + \sum_{i=1}^{2} e_i' F_{t-i} + f' pop_{t-1}$$

where all variables are measured in changes in natural logarithms, and

I = financial market information variables as defined in the text.
M_1 = currency plus demand deposits adjusted.
RFFN = federal-funds rate, unless I = federal-funds rate, in which case RFFN = 90-day prime commercial-paper rate.
F = high-employment federal expenditures.
pop = total U.S. population.

APPENDIX 3
Results from Instrumental Variables Regressions

Table 1A
Standard Errors of Regressions

1961.1-1977.4
(Instrumental Variables Regressions)

Information Variables	Policy Variables M_1,F	M_2,F	BC,F
None	2.95	2.89	3.16
M_1	N/A	2.92	2.99*
M_2	2.92	N/A	2.91**
BC	3.00	2.91	N/A
BL	3.21	3.15	3.17
P	2.95	2.94	3.09
P,RCP	2.95	2.92	3.06
RCP	2.90	2.83	2.99*
RFF	2.88	2.80	2.98*
RCB	2.95	2.97	3.21
RCB,RCP	2.91	2.85	3.01
TCE	2.95	2.89	3.02*
TCE/HH	2.68**	2.65**	2.75**
TCE/NFB	2.93	2.89	3.18
LA/NFB	3.01	3.04	3.11

* Indicates standard errors which are significantly lower (at 5-percent level) than those of corresponding regressions with no information variables.
** Indicates standard errors which are significantly lower (at 1-percent) than those of corresponding regressions with no information variables.
N/A = not applicable

Table 2A
Long-Run Elasticities of Y with Respect to M

1961.1-1977.4
(Instrumental Variables Regressions)

Information Variables	Policy Variables M_1,F	M_2,F	BC,F
None	.74**	.84**	.32*
M_1	N/A	.73*	-.08
M_2	.08	N/A	-.11
BC	.83**	.89**	N/A
BL	1.00**	1.17**	1.90
P	.65**	.72**	.36
P,RCP	.73**	.79**	.48*
RCP	.78**	.76**	.51**
RFF	.76**	.76**	.49**
RCB	.73**	.88**	.25
RCB,RCP	.75**	.90**	.60**
TCE	.30	.51	.08
TCE/HH	.48	.37	.21
TCE/NFB	1.29**	.93**	.49
LA/NFB	.26	.42	.02

* Indicates long-run elasticities which are significantly different from zero at the 5-percent level
** Indicates long-run elasticities which are significantly different from zero at the 1-percent level.
N/A = not applicable

FOOTNOTES

1. This position was first made clear by Arthur Burns in his "Testimony before the Joint Economic Committee", July 23, 1970, and has since been reiterated on a number of occasions.

2. See in particular Benjamin M. Friedman, "The Inefficiency of Short-Run Monetary Targets for Monetary Policy", **Brookings Papers on Economic Activity** (1977:2), pp. 293-335.

3. Milton Friedman and Anna Jacobson Schwartz, **A Monetary History of the United States, 1867-1960** (Princeton, 1963).

4. In particular, the variance of the difference between the actual and desired values of the goal variable(s) over time is generally used.

5. While this condition is necessary for optimal control, it is clearly not sufficient. As discussed in the next subsection, optimal-control adherents also criticize monetary-policy targets for causing inappropriate responses to the information contained in money about GNP.

6. On the question of the usefulness of this simplified description, see B. Friedman (1977), pp. 294-295.

7. The assumption that there is only one goal variable avoids the problem of whether in fact there are sufficient instruments available to achieve several independent goals.

8. The Fed can, of course, affect the volume of reserves through changes in the discount rate, and can alter the effective level of reserves through changes in reserve requirements. These complications are not important for the analysis here, however.

9. See, for example, the discussion in Tim Campbell, "Monetary Policy and Bank Portfolio Composition," **Journal of Money, Credit, and Banking**, 2 (May 1978), pp. 239-251.

10. For a fuller development of this issue, see B. Friedman, (1977), pp. 311-314.

11. See William Poole, "The Monetary Deceleration: what Does It Mean and Why Is It Happening?", **Brook-**

ings Papers on Economic Activity, 1 (1979), pp. 231-240, for a discussion and analysis of the monetary deceleration.

12. A long debate exists in the economics literature over the statistically and conceptually superior measure of fiscal policy. If any consensus has developed, it favors the high-employment federal expenditures measure. See "Technical Notes for Estimates of the High-Employment Budget" Federal Reserve Bank of St. Louis, unpublished paper, March 1968, for a description of this variable. Also see footnote 13 for papers using this variable.

13. See Leonall Anderson and Jerry Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," Federal Reserve Bank of St. Louis **Review** (November 1968), pp. 11-24, Benjamin M. Friedman, "Even the St. Louis Model Now Believes in Fiscal Policy," **Journal of Money, Credit, and Banking** (May 1977), pp. 365-67; and Keith M. Carlson, "Does the St. Louis Equation Now Believe in Fiscal Policy?," Federal Reserve Bank of St. Louis **Review** (February 1978), pp. 13-19.

14. See footnote 13.

15. See footnote 12.

16. See the series of papers by Michael Hamburger, Frederick Schadrack, and Fred Levin under the heading, "The Choice of Intermediate Targets," in **Monetary Aggregates and Monetary Policy,** the Federal Reserve Bank of New York, 1974. A summary discussion of those results may be found in Benjamin Friedman, "Empirical Issues in Monetary Policy," **Journal of Monetary Economics** (1977:3), pp. 87-101.

17. Specifically, the equations are estimated in changes in logarithms, which is similar to using data expressed as percentage changes. Percentage changes have been found to have superior statistical properties than dollar changes in standard St. Louis equations estimated over 1953-1976. See Carlson (1978).

18. See Thomas D. Simpson, "A Proposal for Redefining the Monetary Aggregates," **Federal Reserve Bulletin** (January 1979), pp. 13-42.

19. See Richard D. Porter, Thomas D. Simpson and Eileen Mauskopf, "Financial Innovation and Monetary Aggregates," **Brookings Papers on Economic Activity** (I:1979), pp. 213-229. A paper disputing that a shift occurred is Michael Hamburger, "Behavior of the Money Stock: Is There A Puzzle?" **Journal of Monetary Economics** (April 1978), pp. 151-192.

20. See Jack Beebe, "A Perspective on Liability Management and Bank Risk," Federal Reserve Bank of San Francisco, **Economic Review** (Winter 1977) pp. 12-25.

21. Several researchers have shown that money is exogenous with respect to nominal GNP. A recent example is Y.P. Mehra, "Is Money Exogenous in Money-Demand Equations," **Journal of Political Economy** (1978:2), pp. 211-228.

22. Cambell (1978) obtained significant results with the composition of bank credit in an equation similar to our "P,RCP" equation shown in Table 1. However, he used the 1953-72 sample period, and the raw government surplus for a fiscal variable. The reverse-causation bias in this variable in aggregate-demand equations was the major reason for the development of the high-employment government expenditures variable in Anderson-Jordan (1968).

23. The insignificance of this variable in the M_1 and M_2 equations is consistent with the results in Richard G. Davis, "Broad Credit Measures as Targets for Monetary Policy," **Quarterly Review** (Federal Reserve Bank of New York), pp. 13-22.

Exchange-Rate Policies and Inflation: Theory and Evidence

Hang-Sheng Cheng

During the last decade, inflation has become a worldwide concern. At the same time, with the abandonment of pegged exchange rates under the Bretton Woods system, member countries of the International Monetary Fund (IMF) have become free to choose their exchange-rate policy under general IMF surveillance.[1] How to exercise this freedom so as to minimize domestic price inflation is obviously a question of considerable policy interest.

The purpose of this paper is to utilize economic analysis and empirical evidence to shed light on the subject of exchange rates and domestic inflation. We start with a simple model of a small two-sector economy—a tradable-good sector and a nontradable-good sector. With this model, we compare how various types of disturbances to the national economy (e.g., world inflation, capital flows, domestic wage increases, crop failures, monetary expansion) affect the domestic price level under fixed and flexible exchange rates. A large number of cases are analyzed, corresponding to the various alleged causes of inflation, to see if the choice of exchange-rate policy makes a systematic difference in the extent to which the domestic price level is affected by various internal and external disturbances.

The analysis shows, first, that in an open economy, any inflationary disturbance from whatever source always manifests itself as a pressure in the foreign-exchange market, in the form of a reserve change or an exchange-rate adjustment (or a combination of the two). The analysis also shows that the essence of an exchange-rate policy lies in a deliberate policy choice regarding the distribution of the "exchange-rate market pressure[2]" between reserve changes and exchange-rate adjustments. Depending on the source of inflation, the exchange-market manifestation may be an upward pressure on the national currency (i.e. exchange appreciation or reserve accumulation) or a downward pressure (exchange depreciation or reserve depletion). In the case of an upward pressure, exchange appreciation would always result in less domestic-price increase than reserve accumulation; in the case of a downward pressure, on the other hand, reserve depletion would always result in less domestic inflation than exchange depreciation. Thus, an optimal exchange-rate policy for minimizing domestic inflation would be to *permit exchange appreciation and resist depreciation*, regardless of the source of inflationary disturbances. Since the manifestations of the exchange-market pressure are readily observable, and the exact nature of the underlying inflationary disturbances is not, this policy rule would make policy choices considerably easier and more operational than having to decide about the sources of inflation—imported or of domestic origin, demand-pull or cost-push, attributable to monetary or real factors.

We have applied the rule to assess the actual exchange-rate policies and inflation experiences of four Pacific Basin countries: Japan, the Philippines, Korea, and Taiwan, during the 1968-78 period. Buffeted by both internal and external disturbances, the four countries experimented with a variety of exchange-rate policies during this period. Japan floated in 1973; the Philippines nominally floated in 1970 but in fact pursued a flexible-peg approach; Korea originally floated but then shifted to a pegged rate in 1972; and Taiwan maintained a pegged rate until the very end of the period, when it adopted a floating rate.

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Despite the variety of avowed exchange-rate policies, all four countries except Japan exhibited a greater readiness to depreciate the currency than to appreciate. Even in Japan's case, both appreciations and depreciations were tempered by a "leaning-against-the-wind" policy, whereby the Bank of Japan intervened in the market to slow down or moderate the extent of exchange-rate fluctuations.[3] The aversion to currency appreciation resulted in rapid money growth and inflation in a number of episodes, notably for Japan during 1970-72, Korea during 1975-77, the Philippines during 1972-73, and Taiwan during 1972-73 and 1976-78. Actual currency depreciations meanwhile resulted in higher domestic-price increases than would have occurred under fixed-rate regimes, in Japan during 1973-75, the Philippines during 1970-71, and Korea in 1970-72 and 1975-77.

This informal survey of inflation experiences indicates that domestic inflation in the four countries might have been lower had they adopted optimal exchange-rate policies.

Finally, several caveats are in order. First, it should be borne in mind that the "optimality" of exchange-rate policy is defined in this paper solely in terms of reducing domestic inflation in the face of internal and external disturbances. As important as that objective may be, policymakers might well have other objectives in mind, e.g., domestic income stabilization and economic growth. Hence, although a less-than-optimal exchange-rate policy in the present context means a higher domestic inflation rate than otherwise, it does not necessarily imply a wrong policy. Second, the recommendation for resisting depreciation as an anti-inflation policy is predicated on the assumption that the exchange-market pressure is transitory, or that appropriate adjustment mechanisms can work rapidly enough to restore balance in the nation's international payments before its foreign reserves or foreign-credit facilities are seriously depleted. Specifically, it is not an endorsement of a pegged exchange rate under continuing domestic inflation, with the exchange rate sustained by extensive trade and exchange restrictions. Third, the assumption of a "small open economy," defined in the next section, should be underscored. This implies that foreign repercussions of the country's policy actions can be ignored. The analysis is particularly inapplicable to large economies such as the United States, whose economic activities significantly affect the rest of the world.

I. Framework of Analysis

The analytical framework presented in this paper is one familiar in the literature on policy choice for maintaining internal and external balance. This approach, pioneered by Robert Mundell, Marcus Fleming and others, is simplified here by assuming full-employment output and no bond market, so as to focus on the relationship between the exchange rate and the domestic price level.[4] Those who are not interested in formal economic analysis may skip to the next section, where the analytical results are summarized.

We also assume in this analysis that the country is a price taker in the world market for both its exports and its imports. That is to say, it possesses no monopolistic power over its exports and no monopsonistic power over its imports, so that the world demand for its exports and the supply of its imports are both perfectly elastic. Moreover, terms-of-trade changes are ignored, so that the country's exports and imports are regarded as one good, a "tradable good," in distinction to another good, the "nontradable good."

Both the tradable good and the nontradable good are produced and consumed by the residents of the country. The production of each good is assumed to depend only on the relative prices of the two, while the demand depends on real income, relative prices, and real money balances. The price of the nontradable good is determined by the domestic demand and supply conditions in that market. The price of the tradable good, on the other hand, is equal to its given foreign price multiplied by the exchange rate, which is defined as the price of the foreign currency in terms of the national currency. Under flexible rates, the exchange rate is determined by supply and demand in the foreign-exchange market, which in turn depends on the

nation's trade balance and exogenously-given net capital flows. Under fixed exchange rates, the exchange rate is by definition set by the monetary authorities through exchange-market interventions, with resultant changes in the central bank's foreign reserves and the domestic money supply.

Finally, in order to simplify the analysis, we assume that both consumers and producers are devoid of "money illusion"; that is to say, the demand and supply of each good are dependent only on real magnitudes and relative prices, so that proportionate changes in all prices and the money supply would leave both demand and supply unaffected.[5] This money-neutrality assumption, which is standard in neo-classical economic theory, insures the same proportionality of all price changes as a given change in the money supply.[6]

Consider now various sources of inflation, and compare how the aggregate price level—defined as a weighted average of the two commodity prices—would be affected under fixed and flexible exchange rates. Four types of disturbances may be distinguished: foreign price increases, domestic credit expansion, autonomous changes in domestic demand or supply in the two goods markets, and net international capital flows. Obviously, these four types cover a very large variety of disturbances which can be sources of inflation in a country open to international trade and capital flows.

The four types of disturbances affect the domestic price level through their effects on the demand and supply of tradable and nontradable goods. Three types of impacts are considered in this model: a "relative price effect," a "real balance effect," and a "real income effect." The first refers to the response of the domestic demand and supply of the two goods to a change in their relative prices: the quantity supplied is postulated to rise, and the quantity demanded to fall, with a rise in the price of the good relative to that of the other good. In addition, the model assumes that demand is positively related to both real income and the real money balance held by the public—the latter being defined as the nominal money supply adjusted for changes in the domestic price level—such that an increase in either will increase the demand for both goods. The stability of the two-sector model requires that the marginal propensity to spend on either good (the real income effect) be less than unity, and that the real-balance effect on demand of a price change in one sector be algebraically smaller than the sum of its relative-price effects on both the demand and the supply in that sector. Finally, the model assumes that changes in the nominal money supply are determined partly by changes in the central bank's foreign reserves and partly by domestic credit expansions or contractions.

World Price Increase. Under a fixed exchange rate, the domestic price of the tradable good will rise in proportion to the rise in its world price. Through the relative-price effect, which by assumption outweighs the real-balance effect, the domestic output of the tradable good will rise and the demand for it fall, resulting in an improvement in the nation's trade balance, an increase in its reserves, and domestic monetary expansion. The monetary expansion, through the real-balance effect, implies an increase in the demand for both goods, thus raising the price of the nontradable good and reducing the trade surplus. Final equilibrium will be attained in both markets when both prices have risen proportionately to restore the same relative prices as at the initial equilibrium, and the trade surplus is completely eliminated.

Under flexible exchange rates, on the other hand, a world price increase will result in an appreciation of the national currency in proportion to the world price increase, thus leaving the domestic price of the tradable good unchanged. There is neither a relative-price effect nor a real-balance effect. Hence, there is no change in the domestic price level.

Thus, a fixed exchange rate exposes a country to inflation pressures from abroad, while upward flexibility of the exchange rate insulates the domestic price level from such pressures. In both cases, the world inflation pressures are manifested in the foreign-exchange market—in the form of a reserve accumulation in the fixed-rate case and of exchange-rate appreciation in the flexible-rate case.

Domestic Credit Expansion. Domestic credit expansion will result in an increase in the money supply and, through the real-balance effect, in an

increase in domestic demand in both tradable-good and nontradable-good markets. Under a fixed exchange rate, only the nontradable-good price will rise, as the price of the tradable good is fixed by its world price and the pegged exchange rate. As relative prices change, the supply of the tradable good will fall and its demand rise, thus bringing about a trade deficit and hence a decline in foreign reserves and in the domestic money supply. Through the real-balance effect, demand will fall back in both markets, until the nontradable-good price returns to its original level and the trade deficit is eliminated. Full equilibrium will be restored when the two prices and the money supply all fall back to their respective initial levels. In the end, the only consequence of the domestic credit expansion is an exchange of domestic assets for foreign assets in the central bank's portfolio, with no net effect on either absolute or relative prices, domestic output or expenditures.

Under a flexible exchange rate, on the other hand, whenever domestic credit expansion brings about an increase in the money supply, the real-balance effect will raise domestic demand in both tradable-good and nontradable-good markets, as in the fixed-rate case. However, because the exchange rate can now fluctuate, the prices of both goods are flexible, so that under domestic demand pressure the prices of both goods will rise. Full equilibrium will be restored when prices have risen in proportion to the increase in the money supply, in accordance with the money-neutrality assumption.

Thus, when a domestic credit expansion creates inflation pressure, a fixed exchange rate relieves that pressure through a trade deficit—and also sets off an adjustment mechanism, through reserve depletion and monetary contraction, which reduces both the inflation pressure and the trade deficit. A flexible exchange rate, on the other hand, through exchange depreciation, seals up the inflation pressure at home, so that the full strength of that pressure is exerted on the domestic price level, as in a closed economy. Again, in both cases, the inflation pressure is manifested in the foreign-exchange market—reserve drain in the fixed-rate case and exchange depreciation in the flexible-rate case.

Autonomous Demand or Supply Changes. Disturbances of this type can occur in either of the two goods markets. Instead of analyzing all such cases, we shall consider only the case of a supply increase—say, due to successful adoption of advanced technology—in the tradable-good sector, and briefly summarize all the other possibilities.

Under a fixed exchange rate, an output expansion in the tradable-good sector will result in an improvement in the nation's trade balance, an accumulation of reserves, and a monetary expansion, with no effect on the domestic price of the tradable good. However, because of the higher real income and the induced monetary expansion, domestic demand for both goods will rise, leading to a rise in the price of the nontradable good and a reduction in the trade surplus. Full equilibrium will be restored when the nontradable-good price has risen sufficiently for the relative price-effect to completely offset the combined real-income and real-balance effects, and when the trade surplus is completely eliminated. In the end, the domestic price level will be higher than at the initial equilibrium.

Under a flexible rate, on the other hand, output expansion in the tradable-good sector will lead instead to an appreciation of the national currency and a consequent reduction in the domestic price of the tradable good, with no effect on the trade balance and the money supply. Through the relative-price effect, which by assumption must be greater than the real-balance effect, supply will rise and demand will fall in the nontradable-good sector, but demand for the nontradable good will rise because of the real-income effect arising from the output expansion. The net effect on the price of the nontradable-good is indeterminate. But regardless of the effect on the nontradable-good price, the aggregate price level will definitely be lower than at the initial equilibrium.[7]

Thus, a supply increase in the tradable sector results in a rise in the price level under a fixed exchange rate but a decline under a flexible rate. These different results arise because the disturbance leads to a reserve accumulation in the fixed-rate case and to exchange appreciation in the flexible-rate case. Again, the form in which the disturbance manifests itself in the foreign-exchange market, as determined by the

exchange-rate policy, makes a critical difference in its impact on the domestic price level.

Without going through the analysis, we shall merely note that a supply increase in the nontradable sector will result in a decline in the domestic price level under both a fixed and a flexible exchange rate. The decline will be smaller under the former than under the latter, the difference again being due to the resultant reserve accumulation (hence monetary expansion) in the fixed-rate case and to exchange appreciation in the flexible-rate case. Moreover, as would be expected, the results of supply decreases are symmetrical (i.e., of opposite signs) to those of supply increases, and those of demand changes symmetrical to those of corresponding supply changes.

Capital Flows. Capital flows affect the domestic price level indirectly through their impact on the exchange rate or on foreign reserves. Under a flexible rate, a net capital outflow will result in a depreciation of the national currency, thus directly raising the price of the tradable good and indirectly raising that of the nontradable good through the relative-price effect. The domestic price level will definitely be higher. Under a fixed rate, on the other hand, the capital outflow will result in a reserve loss, monetary contraction, and (through the real-balance effect) in a reduction in demand for both goods. At the final equilibrium, the domestic price level will be lower than at the initial equilibrium. A net capital inflow will have exactly the opposite results. Again, the exchange-rate policy makes a critical difference in the response of the domestic price level to the given disturbance, depending on whether the exchange-market pressure is manifested in exchange-rate adjustments or in reserve changes.

II. Analytical Results

So far, we have examined the impact on the domestic price level of four types of disturbances: foreign price increases, domestic credit expansions, domestic demand or supply shocks, and international capital flows. A large number of cases have been analyzed, because in reality inflation can be attributed to a variety of causes. Our purpose is to construct a model that can analyze the impact on the domestic price level of all such disturbances, and see if any generalization could be derived from the results that might be useful to policymakers. The results are summarized in Figure 1.

Figure 1
Impact of Disturbances on Domestic Price Level

	Fixed Exchange Rates		Flexible Exchange Rates	
Type of Disturbance	**Reserve Change**	**Price Level**	**Exchange Rate**	**Price Level**
Foreign price increase	Increase	+	Appreciation	0
Credit expansion	Decrease	0	Depreciation	+
Domestic supply changes				
Expansion, tradable good	Increase	+	Appreciation	–
Expansion, nontradable good	Increase	–	Appreciation	––
Contraction, tradable good	Decrease	–	Depreciation	+
Contraction, nontradable good	Decrease	+	Depreciation	++
Capital flows				
Net outflow	Decrease	–	Depreciation	+
Net inflow	Increase	+	Appreciation	–

Symbols: "0" denotes no change in the domestic price level.
"+" denotes a rise in the domestic price level.
"++" denotes a larger rise in the domestic price level than would occur under the fixed-rate case.
"–" denotes a fall in the domestic price level.
"––" denotes a larger fall in the domestic price level than would occur under the fixed-rate case.

In an open economy, as shown in Figure 1, any disturbance to the economy is always reflected in the foreign-exchange market, either as a reserve change under fixed exchange rates or as an exchange-rate adjustment under flexible exchange rates. Moreover, the various types of disturbances may result in either an *upward* exchange-market pressure on the national currency (i.e. a reserve increase or an exchange appreciation) or a *downward* pressure (i.e. a reserve decrease or an exchange depreciation). Where the exchange-market pressure is upward—as in the case of a foreign-price increase, an expansion in domestic supply of either good, or a net capital inflow—a flexible-rate policy permitting appreciation would in every case result in a smaller price increase or a larger price decline than would occur under a fixed-rate policy. Conversely, where the market pressure is downward—as in the case of a domestic credit expansion, a contraction in domestic supply in either market, or a net capital outflow—a fixed-rate policy drawing down reserves would in every case lead to a smaller price rise or a larger price decline than would occur under a flexible-rate policy. Thus, an exchange-rate policy designed to minimize domestic price inflation should *permit exchange appreciation and resist depreciation,* regardless of the source of inflation.

The rationale behind this policy rule can be better understood by considering the relationship between the exchange-market pressure and changes in the domestic price level. The foreign-exchange market is like a set of valves adjusting the reciprocal excess demand or supply of national currencies through changes in their exchange rates. An upward pressure signals an excess demand for the national currencies by the holders of foreign currencies, because of their desire to acquire the goods, services, and financial assets denominated in the nation's currency. (For brevity, call it the "foreign" excess demand, even though it refers to that of the holders of foreign currencies, be they domestic or foreign residents.) A fixed-exchange-rate policy would keep the adjustment valves wide open, thus allowing the foreign excess demand to spill fully into the domestic market and raise the domestic price level. A flexible-rate policy, on the other hand, would shut off the valves by making the national currency dearer in terms of foreign currencies, thereby discouraging the foreign excess demand from the national market. Under these circumstances, a flexible-rate policy permitting exchange appreciation is clearly to be preferred.

A downward pressure, on the other hand, signals an excess demand for foreign currencies by the holders of the national currency, because of their desire to acquire goods, services, and financial assets denominated in foreign currencies. (Term it the "domestic" excess demand.) A flexible-rate policy would again turn off the valves by making the foreign currencies dearer in terms of the national currency. This would shut in the domestic excess demand and compel it to apply all its pressure on the domestic price level. A fixed-rate policy, on the other hand, would call for the central bank to draw down foreign reserves so as to satisfy the domestic excess demand for foreign currencies. This would keep the valves open and thus would channel the domestic inflation pressure toward foreign goods, services and financial assets, and away from the domestic market. In the process, the central bank would reduce the amount of the national currency in the public's holdings, and thus erode the basis of the excess demand for foreign currencies. Under such circumstances, a fixed-rate policy would help reduce the domestic inflation pressure.

This interpretation helps bring out several implications of the proposed exchange-rate policy. First, the policy rule means a deliberate attempt to shield the nation from foreign inflation pressures and to direct domestic inflation pressures toward the rest of the world. Obviously, this asymmetrical policy can be operative only for those nations that do not have to worry about repercussions from the rest of the world. Foreign countries, for instance, might react by appreciating their currencies against the nation's currency, in effect sealing the inflation pressure within the nation from which it originates. Alternatively, where the inflating nation depends on foreign borrowings to finance its deficits, the foreign lenders could progressively make their terms of lending more onerous. As for the second implication, the proposed downward exchange-rate rigidity presumes ample reserves in relation to

the reserve drain, as well as an effective adjustment process for reducing the reserve drain. The policy is merely a short-run stop-gap measure. Impeding the adjustment process by continued domestic monetary expansion, for instance, would ultimately destroy its usefulness.

III. Experiences of Pacific Basin Countries

With this policy rule in hand, we now turn to examining the inflation and exchange-rate experiences of four Pacific Basin countries—Japan, Korea, the Philippines, and Taiwan—during the 1968-78 period. We assess the appropriateness of their policies from the viewpoint of minimizing domestic inflation, to see if the policy rule can help interpret actual events in the period studied. The data for the four countries are selected on the basis of the economic analysis presented above (Tables 1-4 and Charts 1-2).

Japan

The Japanese yen was at first pegged to the U.S. dollar, drifted up after August 1971, and then officially floated in February 1973. After that, it fell during the oil crisis and world recession of 1974-75, and then rose sharply in 1976-78.

During the fixed-rate period of 1968-70, the exchange-market pressure was relatively mild. The overall balance-of-payments surplus averaged a relatively small $1 billion a year. During 1971-72, the payments surplus leaped to an average of $6.7 billion a year, in spite of the 18-percent yen appreciation from 1970 to 1972. The Bank of Japan responded to this strong upward pressure with a combination of exchange-market interventions and exchange-rate adjustments. As a result of the market interventions, the annual money-growth rate rose from an average of 17 percent in 1968-70 to an average of 27 percent in 1971-72 (Chart 2). As shown in the central bank's balance sheet (Table 1), the 1971-72 increase in total assets, amounting to ¥2.8 trillion, was more than explained by a rise of ¥3.9 trillion in its foreign-asset holdings. Given the lag between monetary expansion and price increases[8], the high money-growth rate of 1971-72 set the stage for the double-digit price inflation in 1973-74. The 1973-74 inflation thus can be traced, at least in part, to the 1971-72 exchange-rate policy.[9]

Under heavy exchange-market pressure, the yen officially floated in February 1973 and appreciated by 12 percent on a year-to-year average basis. However, during 1973 the

Table 1
Japan: Inflation, Exchange Rates, Balance of Payments and Money, 1968-78

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Inflation Rate[1]	4.4	6.0	7.8	5.4	4.5	16.5	24.5	8.5	9.4	6.2	3.4
Exchange Rate[2]	99.5	100.1	100.1	103.0	118.3	132.2	123.0	120.8	120.9	133.6	170.4
Balance of Payments[3]											
Current Account	1.0	2.1	2.0	5.8	6.6	–0.1	–4.7	–0.7	3.7	10.9	17.5
Capital Account	–0.2	–1.4	–0.8	4.6	–3.6	–6.2	5.9	0.1	0.1	–4.4	–7.5
Money Growth Rate[4]	13.4	20.6	16.8	29.7	24.7	16.8	11.5	11.1	12.5	8.2	13.4
Central Bank Assets[5]											
Total	0.91	0.92	1.08	0.25	2.51	2.04	2.44	1.57	1.19	2.24	n.a.
Foreign Assets	0.32	0.27	0.43	3.03	0.89	–1.89	0.39	–0.22	1.17	1.94	n.a.
Claims on Government	0.48	0.32	0.33	–1.16	–0.54	0.47	2.48	3.56	–0.33	–0.47	1.77
Claims on Banks	0.12	0.33	0.32	–1.62	2.17	3.45	–0.44	–1.77	0.35	0.77	0.27

1 Percentage change in consumer-price index, fourth quarter to fourth quarter.
2 Exchange rate vs. U.S. dollar, annual average, June 1970=100.
3 Balance on current and capital accounts, in billions of U.S. dollars.
4 Percentage change in M_1 (currency plus bank demand deposits), year end to year end.
5 Change in assets, in trillions of yen, year end to year end.
Source: International Monetary Fund, *International Financial Statistics,* various issues.

exchange-market pressure reversed its direction, as the current-account balance turned into a small deficit, and a large net capital outflow occurred. The Bank of Japan intervened heavily to support the yen, so that its foreign-exchange holdings fell from $16.5 billion to $10.2 billion between year-end 1972 and year-end 1973, while the money-growth rate dropped from 25 percent to 17 percent between 1972 and 1973. The central bank's total assets rose by ¥2.0 trillion, while foreign assets declined by ¥1.9 trillion. The exchange-market interventions played a significant role in reducing money growth in 1973, and thus contributed to the reduction of inflation pressures in subsequent years.

The yen continued to decline in 1974 and 1975. The Bank of Japan persisted in its policy of reducing the money-growth rate, bringing it

Chart 1

Exchange Rate Pressures

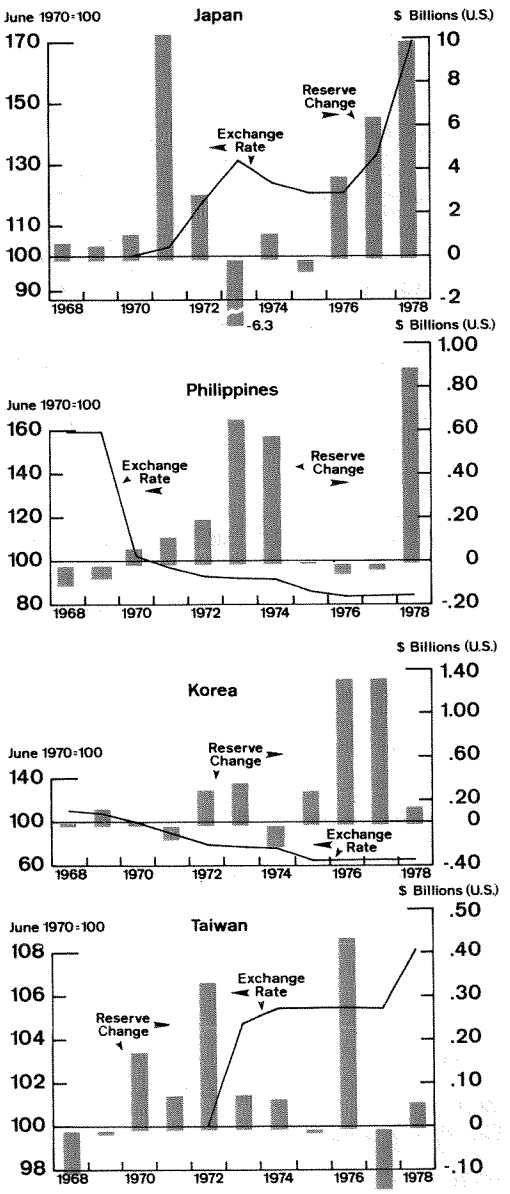
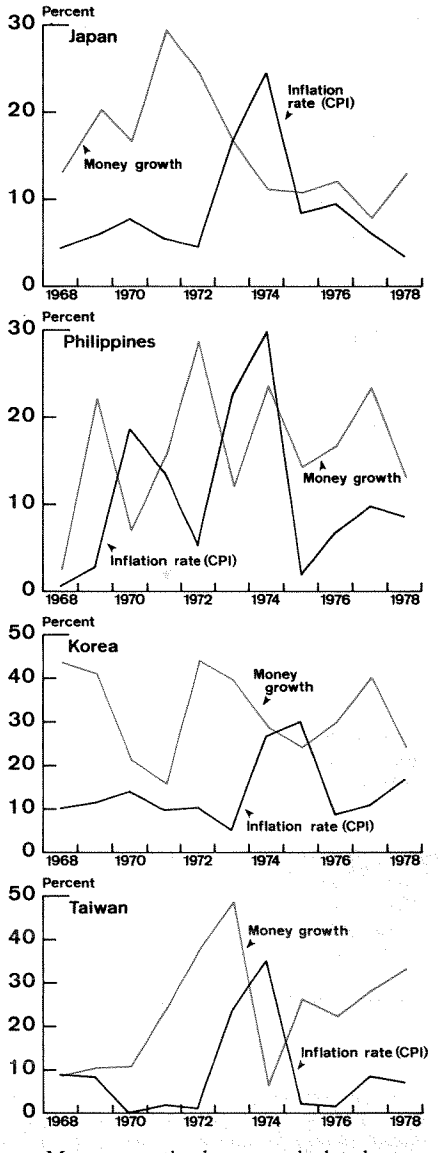


Chart 2

Money-Growth and Inflation Rates



Note: Money-growth changes calculated on a year-end to year-end basis, and inflation rates on a fourth-quarter to fourth-quarter basis.

down further to 11 percent in 1975. The inflation rate finally came down from 24 percent in 1974 to 8 percent in 1975. However, exchange-rate policy apparently contributed little to anti-inflation policy during this period, with little central-bank intervention to moderate the yen depreciation.

From 1975 to 1978, the situation again changed as the yen came under heavy upward pressure in the exchange market. Japan's current-account balance swung from a deficit of $0.7 billion in 1975 to a surplus of $17.5 billion in 1978. Again, the Bank of Japan adopted a "leaning against the wind" policy of attempting to moderate the yen's appreciation by heavy exchange-market interventions. In 1977-78, while the yen appreciated by 40 percent, the Bank of Japan added $16.5 billion to its foreign reserves. Although this action went against our exchange-rate policy rule, the Bank of Japan was able to hold the money-growth rate at 11 percent during the 1977-78 period—about the same as during 1974-76, but only about half the rate of the 1971-73 period. As a result, the inflation rate dropped precipitously from 25 percent in 1974 to only 3 percent in 1978.

To summarize, Japan's 40-percent exchange appreciation during 1977-78 was in accordance with our exchange-rate policy rule and probably contributed significantly to the reduction in Japan's inflation rate. In addition, heavy exchange-market interventions allowed foreign excess demand to affect domestic markets, but the Bank of Japan—through a tight monetary policy—was able to offset both the direct market impact and the secondary monetary impact. This experience suggests that our policy rule is by no means absolute. Other policy measures, such as a steady application of tight monetary policy, can bring inflation under control with little assistance from this source.

The Philippines

After sustaining a deteriorating payments deficit since 1967, the Philippines abandoned fixed exchange rates in February 1970—at which point the peso depreciated 39 percent over a seven-month period. Since September 1970, the Philippine Bankers Association has set a daily "guiding rate" for all foreign-exchange transactions, and the central bank has intervened to keep the peso-dollar rate within the range set by the Association. Nominally, the daily guiding rate is free to float, but in fact it has remained stable and has been adjusted from time to time only in small steps. For practical purposes, the

Table 2
Philippines: Inflation, Exchange Rates, Balance of Payments and Money, 1968-78

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Inflation Rate[1]	0.5	2.8	18.7	13.6	5.2	22.6	29.8	1.8	6.7	9.7	8.6
Exchange Rate[2]	159.3	159.3	102.4	96.4	92.7	91.8	91.4	85.4	83.4	83.8	84.2
Balance of Payments[3]											
Current Account	-0.27	-0.25	-0.05	0.00	0.01	0.48	-0.21	-0.92	-1.10	-0.83	-1.22
Capital Account	0.18	0.19	0.13	0.13	0.20	0.19	0.80	0.93	1.05	0.80	2.12
Money Growth Rate[4]	2.9	22.5	7.3	16.3	29.1	12.3	24.0	14.5	17.1	23.7	13.4
Central Bank Assets[5]											
Total	0.3	0.5	0.7	0.7	2.1	4.0	6.2	3.2	2.0	-1.0	8.3
Foreign Assets	-0.1	-0.2	0.7	0.6	1.0	4.3	3.6	-0.4	2.3	-0.7	2.7
Claims on Government	0.2	0.5	0.3	0.1	0.8	0.3	1.1	-1.1	0.9	0.7	1.5
Claims on Banks	0.2	0.2	-0.3	0.0	0.3	-0.6	1.5	4.7	-1.2	-1.0	4.1

1 Percentage change in consumer-price index, fourth quarter to fourth quarter.
2 Exchange rate vs. U.S. dollar, annual average, June 1970=100.
3 Balance on current and capital accounts, in billions of U.S. dollars.
4 Percentage change in M_1 (currency plus bank demand deposits), year end to year end.
5 Change in assets, in billions of pesos, year end to year end.
Source: International Monetary Fund, *International Financial Statistics*, various issues.

peso/dollar rate remained unchanged from 1975 to 1978 (Chart 1).

After the 1970 devaluation, exchange-market pressures turned upward on the peso. In 1971 and 1972, the current-account deficits of past years were eliminated, while net capital inflows continued. Aided by a world commodity boom, the current-account balance showed a substantial surplus of $480 million in 1973. In the following year, the world oil crisis turned it into a deficit of $210 million, but the deficit was more than offset by a $800 million net capital inflow. All this would have led one to expect an appreciation of the peso from 1970 to 1974; in fact, it depreciated by 11 percent. The explanation lies in the central bank's foreign-exchange purchases, which raised its foreign-exchange reserves from $200 million at the end of 1970 to $1.4 billion at the end of 1974.[10]

This policy of achieving currency depreciation in the face of upward exchange-market pressures is, of course, exactly opposite to what our policy rule would suggest for reducing domestic inflation. The central bank did not try to use currency appreciation to discourage foreign excess demand from spilling into the domestic market, but rather encouraged this process through deliberate depreciation. Consequently, the money-growth rate increased from 11 percent in 1968-70 to 20 percent in 1971-74 (Chart 2). The central bank's balance sheet shows that 73 percent of the increase in its total assets during the 1971-74 period was due to foreign-asset accumulation. Thus, the central bank's exchange-rate policy apparently aggravated the rapid monetary growth in 1971-74 and was at least partly responsible for the high inflation rate—averaging 26 percent a year—in 1973-74.

This policy of deliberate depreciation was abandoned after 1974. As the current-account balance deteriorated to an average deficit of about $1 billion a year in 1975-78, the peso was kept stable largely through heavy foreign borrowings. Although the money-growth rate remained as high as 17 percent, the inflation rate declined sharply to an average annual rate of 7.5 percent from 30 percent in 1974. Since apart from foreign borrowings, the exchange-market pressure during the period was clearly downward, the nation's exchange-rate policy of resisting depreciation agreed well with our policy rule. But there was one important exception: Foreign borrowings enabled the central bank to add to its reserves, and thus thwarted the adjustment process for restoring balance-of-payments equilibrium through reserve depletion and monetary contraction, as envisaged in our model. Prolonged continuation of this policy could exacerbate inflation pressure in the Philippines.

Korea

Korea maintained a flexible exchange rate from March 1965 to August 1972, with the won-dollar exchange rate being set daily by a group of designated government-owned exchange banks. But between August 1972 and December 1974, Korea maintained the won at a fixed rate of W400 to the dollar, and then devalued to W484 (Chart 1).

From 1968 to 1971, the exchange-market pressure was downward on the won, as the currency depreciated steadily with little official intervention, except for a period in 1971 when the Bank of Korea attempted to slow the rate of depreciation. The source of the exchange-market pressure was an upsurge in monetary growth (32 percent a year) due to domestic credit expansion.

Surprisingly, the central bank's asset portfolio showed significant increases in foreign-asset holdings during this period (Table 3). However, since Korea's major banks were all government-owned, the distribution of foreign assets between the central bank and the commercial banks was not as meaningful as it would have been in other countries. From an examination of the balance sheet of the consolidated banking system, it becomes clear that the banking system's foreign assets actually declined during the period, and that all of the rapid monetary growth was due to banking credits extended to the domestic sector.

Apparently, Korea's authorities pursued a policy of liberal credit expansion to finance domestic economic development, and coupled this with a flexible exchange rate to free the authorities from balance-of-payments concerns. The policy succeeded in providing the country with a 10-percent annual average growth rate of real output during those years. However, it also led to an 11-percent inflation rate during the 1968-71 period—the highest among all four countries during that period (Chart 2).

Korea abandoned the floating exchange rate in 1972, and accompanied this move with strict price controls. The nominal consumer-price index rose only 5 percent in 1973. Moreover, as a result of vigorous export growth, the current-account deficit dropped sharply from $850 million in 1971 to an average of only $340 million in 1972-73, while net capital inflows continued at the rate of $700 million a year. The resultant reserve increases added directly to domestic money growth and indirectly also encouraged an acceleration of domestic credit expansion (Table 3). The result was a 43-percent annual money-growth rate in 1972-73, compared to 19 percent in 1970-71. The way was thus paved for a steep price rise, averaging 28 percent a year, in 1974-75. Since the increase in foreign assets accounted for about one-fourth of the banking system's total credit expansion of the 1972-73 period, it appears reasonable that that period's exchange-rate policy contributed significantly to the subsequent rapid inflation.

The 21-percent devaluation of the won in December 1974 was a reaction to the sharp deterioration in Korea's current account as a result of the oil-price increase and world recession. The move was perhaps inevitable in view of Korea's exceedingly slender foreign reserves[11] and its continued domestic credit expansion. Nevertheless, inflation might have been lower in 1975 had Korea been able to resist devaluation through, for instance, larger foreign borrowings.

Aside from its inflation effect, the devaluation helped set the stage for a remarkable strengthening of Korea's international-payments situation.[12] While foreign borrowing continued at a high rate, the current account improved dramatically from an annual average deficit of $2.0 billion in 1974-75 to a small surplus in 1977. With the exchange rate fixed against upward exchange-market pressure, the central bank's foreign assets rose rapidly in 1976 and 1977, and this accounted for 70 percent of the central bank's asset increase and 35 percent of the consolidated banking system's total credit extension in those years. Meanwhile, the money-growth rate rose from 25 percent in 1975 to 41 percent in 1977. The fixed-exchange-rate policy under mounting upward exchange-market pressure was clearly incompatible with domestic

Table 3
Korea: Inflation, Exchange Rates, Balance of Payments and Money, 1968-78

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Inflation Rate[1]	10.2	11.4	13.9	9.7	10.3	5.1	26.6	30.0	8.7	10.8	16.8
Exchange Rate[2]	111.8	107.2	99.5	88.2	78.6	77.7	76.3	64.0	64.0	64.0	64.0
Balance of Payments[3]											
Current Account	-0.44	-0.55	-0.62	-0.85	-0.37	-0.31	-2.03	-1.89	-0.30	0.01	-1.09
Capital Account	0.48	0.71	0.68	0.71	0.70	0.70	1.81	2.21	1.65	1.35	1.25
Money Growth Rate[4]	44.5	41.8	22.1	16.4	45.1	40.6	29.5	25.0	30.7	40.7	24.9
Central Bank Assets[5]											
Total	42	71	80	-5	195	265	393.7	646.3	686.3	959.1	736.7
Foreign Assets	36	44	22	-24	-16	136	-163.9	264.7	560.4	586.3	-200.1
Claims on Gov't	-1	11	3	-3	144	28	171.1	362.0	125.6	210.7	292.0
Claims on Banks	7	16	55	22	68	101	386.5	19.6	0.3	162.1	644.8
Banking System Assets[5]											
Total	213	304	216	206	428	671	674	939	1389	1852	2584
Foreign Assets (Net)	5	22	5	-71	68	197	-417	-57	475	666	-254
Domestic Credit	208	282	211	277	360	474	1091	996	914	1186	2838

1 Percentage change in consumer-price index, fourth quarter to fourth quarter.
2 Exchange rate vs. U.S. dollar, annual average, June 1970=100.
3 Balance on current and capital accounts, in billions of U.S. dollars
4 Percentage change in M_1 (currency plus bank demand deposits), year end to year end.
5 Change in assets, in billions of NT dollars, year end to year end.
Source: International Monetary Fund, *International Financial Statistics,* various issues.

monetary stability. The inflation rate thus rose from 8 percent in 1976 to 17 percent in 1978.

Under these circumstances, our policy rule would call for currency appreciation to relieve the inflation pressure. Korea, however, took a different route. Instead of currency appreciation, it chose the path of trade liberalization to reduce its payments surplus, with such measures as tariff reductions, abolishment of import quotas, and official foreign purchases. These measures have led to a shift in the nation's current account, resulting in a $1.1-billion deficit in 1978. Moreover, from the viewpoint of long-run economic growth, the trade-liberalization measures should stimulate improvement in productive efficiency through enhanced competition. However, greater productive efficiency in the Korean context is likely to mean an accelerated export-growth rate. Unless import growth can keep pace, sooner or later Korea may have to face up to the need for an appropriate exchange-rate policy to reduce its very high domestic inflation rate.

Taiwan

Among the countries examined, Taiwan was the most successful in maintaining domestic price stability during the 1968-78 period. Except for the 1973-74 period, the consumer inflation rate averaged 4.5 percent a year during the period, compared to 6.2 percent for Japan, 7.5 percent for the Philippines, and 10.8 percent for Korea (Chart 2).

Taiwan was also the only country among the four that consistently maintained a fixed exchange-rate policy. Throughout the eleven-year period, the New Taiwan dollar (NT) was pegged to the U.S. dollar—except for a revaluation from NT40 to NT 38 in February 1973, and another revaluation to NT36 in July 1978 (Chart 1). The 1978 revaluation was accompanied by a decision to float the currency, which was put into effect on February 1, 1979, thus officially abandoning the long-standing fixed-rate policy.

Taiwan's exchange-rate policy presents another example of the difficulty of maintaining a fixed exchange rate under mounting upward exchange-market pressure. Since 1968, the country's current account improved steadily because of a rising export surplus, except for a major break in trend that occurred during the oil crisis and world recession of 1974-75.

Table 4
Taiwan: Inflation, Exchange Rates, Balance of Payments and Money, 1968-78

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Inflation Rate[1]	8.9	8.5	0.1	1.9	1.6	23.6	34.8	2.2	1.5	8.4	7.1
Exchange Rate[2]	100	100	100	100	100	104.7	105.4	105.4	105.4	105.4	108.1
Balance of Payments[3]											
Current Account	-0.12	-0.03	0.0	0.18	0.52	0.57	-1.11	-0.59	0.32	0.98	1.74
Capital Account	0.01	0.01	0.18	-0.10	-0.18	-0.49	1.18	0.58	0.12	-1.12	-1.68
Money Growth Rate[4]	9.4	11.1	11.4	24.6	37.9	49.3	7.0	26.9	23.1	29.1	34.1
Central Bank Assets[5]											
Total	4.0	3.8	8.9	6.2	24.2	25.7	29.7	20.3	44.6	52.2	77.9
Foreign Assets	0.7	5.9	8.8	6.7	23.9	-2.5	0.7	10.1	19.1	-6.0	0.8
Claims on Gov't	1.0	-0.4	0.3	-2.4	-0.2	1.9	5.3	-2.0	3.1	-2.0	-1.4
Claims on Banks	2.3	-1.7	-0.2	1.9	0.5	26.3	23.7	12.2	22.4	60.2	78.5
Banking Assets[5]											
Total	6.9	12.8	21.0	27.9	45.8	64.3	61.9	74.0	94.5	148.2	196.6
Foreign Assets (Net)	-1.3	2.6	8.6	5.7	24.5	21.4	-21.6	-6.9	38.4	45.9	69.5
Domestic Credit	8.2	10.2	12.4	22.2	21.3	42.9	83.5	80.8	56.0	102.3	127.1

1 Percentage change in consumer-price index, fourth quarter to fourth quarter.
2 Exchange rate vs. U.S. dollar, annual average, June 1970=100.
3 Balance on current and capital accounts, in billions of U.S. dollars.
4 Percentage change in M_1 (currency plus bank demand deposits), year end to year end.
5 Change in assets, in billions of won, year end to year end.
Source: International Monetary Fund, *International Financial Statistics,* various issues.

In addition, there were steady net capital inflows, although that is not obvious from the published balance-of-payments data. As in Korea, Taiwan's major commercial banks are government-owned and operate under the central bank's direction. At times (e.g., 1973 and 1977), the central bank reduced its foreign-asset holdings, but the commercial banks increased their holdings by much larger amounts. These increases by convention are considered as private capital outflows, so that published balance-of-payments data show a substantial net capital outflow in both years (Table 4). However, the data are misleading since the balance sheet of the consolidated banking system shows large increases in the banking system's foreign assets in both years.

Thus, from 1968 to 1973, Taiwan attempted to maintain a fixed exchange rate under mounting upward exchange-market pressure. At first, the pressure was relatively small, so that the money supply increased at 10.5 percent a year during 1968-70—remarkably low considering that real output increased almost as fast during that period. The relatively low money-growth rate of 1968-70 helps to account for the sustained low inflation rate, averaging 1.2 percent a year, during 1970-72 (Chart 2). However, from 1970 on, the money-growth rate accelerated steadily and steeply to reach 49 percent a year in 1973. During the four years 1970-73, foreign assets accounted for 38 percent of the total credits extended by the consolidated banking system; even more remarkably, from 1969 to 1972, foreign assets accounted for more than the total credits extended by the central bank. After considerable lag, the accelerating money growth finally hit the economy, and the consumer price index jumped 24 percent in 1973. The 1973 revaluation of 5.3 percent was apparently too small to be effectual, as foreign assets continued to accumulate in the banking system and money growth continued to accelerate throughout that year.

The oil shock and the world recession in 1974-75 saved Taiwan from the need for further currency revaluations, by bringing to an end the steady string of current-account surpluses. The $1.1 billion current-account deficit in 1974 helped the money-growth rate to drop precipitously from 49 percent in 1973 to only 7 percent in 1974. But the rapid money growth of prior years continued to exert its toll, as the inflation rate rose to 35 percent in 1974. Nevertheless, the monetary contraction of 1974 helped bring about a sharp deceleration in inflation, with the inflation rate declining to only 2.2 percent a year in 1975.

But with the subsequent world economic recovery, Taiwan resumed its steady export growth, so that its current account swung from a deficit of $0.6 billion in 1975 to a $1.7-billion surplus in 1978. As reserve accumulation resumed and the money-growth rate accelerated to 23 percent in 1978, the stage was set for a re-run of the scenario that had precipitated the currency revaluation of February 1973

In July 1978, the central bank again responded with a small currency appreciation of 5.5 percent, but this time also announced a decision to abandon the fixed rate. The decision was officially implemented on February 1, 1979, although *de facto* changes in the exchange rate have since been very small. A replay of the earlier story remained a distinct possibility, until the 1979 oil-price increases again disrupted the upward trend in the current-account surplus.

IV. Conclusion

The exchange-rate and inflation experiences of the four Pacific Basin countries during the 1968-78 period provide a wide range of cases for testing the validity and relevance of the model presented in this paper. Even though we have not attempted a formal statistical testing, we have obtained several useful insights from this survey.

First, in a number of episodes, exchange-rate policies affected domestic price levels in an important way. In particular, all four countries experienced rapid monetary growth during 1971-73—the exact years varying from country to country—as a result of their resistance to currency appreciation during a period of strong upward exchange-market pressures. In all cases except Korea, reserve accumulation apparently

accounted for most of the rapid monetary growth. (Korea's monetary growth was dominated by domestic credit expansion, although foreign-asset accumulation was also an important factor.) Given the lags between money-growth changes and their impact on the price level, it appears reasonable to infer that the 1971-73 exchange-rate policies of the four Pacific Basin countries aggravated their inflation problem in 1974-75.

Second, in the case of downward exchange-market pressures, our analysis suggests resisting depreciation and using reserve depletion to help bring about a monetary contraction. All four countries experienced strong downward pressures during 1974-75; but all except Taiwan responded by letting their currencies depreciate. Taiwan, in contrast, relied on a heavy reserve drain to effect a sharp drop in its money-growth rate, from 49 percent in 1973 to 7 percent in 1974. It paid dearly for the monetary contraction, as real output grew only 2.2 percent in 1975, compared to its 10.4-percent average growth during the 1963-73 period.[13] But on the other hand, Taiwan's inflation rate dropped precipitously from 35 percent in 1974 to only 2 percent in 1975.

Third, the evidence suggests that our policy rule is not a necessary condition for domestic price stabilization. Japan intervened heavily in the exchange market to moderate yen appreciation in 1968-78. Nevertheless, Japan also managed to hold down the money-growth rate, and thus successfully wound down inflation over a several-year period. Korea similarly was unwilling to appreciate its currency in the face of mounting exchange-market pressure; but through drastic trade-liberalization measures, it was able to reduce its payments surplus in 1978 and win at least a temporary respite from the exchange-market pressure. Thus, our policy rule is by no means absolute. The same anti-inflation policy objective could be achieved through measures other than an appropriate exchange-rate policy.

Finally, the suggested policy rule must be taken in its proper context. For analytical purposes, we assume that reducing domestic inflation is the only policy objective, that adequate foreign reserves or international credits are available on reasonable terms for financing temporary payments deficits, and that policymakers can permit an effective adjustment process (including monetary contraction) to correct a sustained payments imbalance. But in reality, not all of these conditions can be satisfied. For example, Korea probably had no choice but currency depreciation in 1968-71 and again in 1974, given the small size of her foreign reserves and a credit policy which was designed to promote domestic investment. Moreover, all four countries exhibited a strong aversion to currency appreciation and a strong preference for currency depreciation—an attitude exactly opposite to what our policy rule would prescribe. Presumably, their policy attitudes stemmed from other objectives, such as export competitiveness and income growth. Whether such an attitude is rational or not is a separate issue. What is relevant is that a "sub-optimal" exchange-rate policy incurs a cost in terms of a higher-than-necessary inflation rate.

FOOTNOTES

1. See International Monetary Fund, **Annual Report 1977,** Appendix II, "Surveillance Over Exchange Rate Policies," pp. 107-109.

2. See Lance Girton and Don Roper, "A Monetary Model of Exchange Market Pressure Applied to the Postwar Canadian Experience," **American Economic Review,** September 1977, pp. 537-548.

3. See Peter Quirk, "Exchange Rate Policy in Japan: Leaning Against the Wind," **International Monetary Fund Staff Papers,** November 1977, pp. 642-664.

4. Robert A. Mundell, "The International Disequilibrium System," **Kyklos,** 1962, pp. 153-170, reprinted in his **International Economics,** 1968, Ch. 15, pp. 217-232; and his "The Appropriate Use of Monetary and Fiscal Policy for Internal and External Stability," **International Monetary Fund Staff Papers,** March 1962, reprinted in his **International Economics,** 1968, Ch. 16, pp. 233-239.

Marcus J. Fleming, "Domestic Financial Policies Under Fixed and Under Floating Exchange Rates," **International Monetary Fund Staff Papers,** November 1962, pp. 369-380.

For a survey of the early contributions, see Marina v.N. Whitman, **Policies for Internal and External Balance,** Special Papers in International Economics, No. 9, Princeton University, December 1970.

For a recent study that also deals with the relationship between the exchange-rate policy and the domest-

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ic price level, see Stanley W. Black, **Exchange Policies for Less Developed Countries in a World of Floating Rates,** Essays in International Finance, No. 119, Princeton University, December 1976.

5. The analysis is comparative-static and thus does not consider any short-run effect of monetary changes on real output.

6. See Don Patinkin, **Money, Interest, and Prices,** 1956, p. 59 and Mathematical Appendix 4:b-c, pp. 309-311.

7. The proof in terms of money-market analysis is quite simple. Although the money market is not expressly considered, it is nevertheless subsumed in the model involving the goods markets only. By Walras' Law, in the absence of a bond market, the goods markets are a mirror image of the money market; whatever holds for the goods markets must also hold for the money market, and vice versa. In the present case, the output expansion in the tradable-good sector corresponds to a rise in the demand for money balances in the money market as a result of increased real income or wealth. Given the unchanged money supply, equilibrium in the money market can be restored only through a decline in the aggregate price level.

8. According to unpublished regression results obtained by Michael Bazdarich, the average lag between money expansion and price inflation in Japan was about eight quarters on the basis of 1958-1977 data.

9. A complete explanation of Japan's inflation of 1973-74 lies outside the scope of this paper. That inflation can be considered as part of the world inflation phenomenon which was analyzed in four articles in this **Review,** Spring 1975, by Edward S. Shaw, Michael W. Keran, Hang-Sheng Cheng and Nicholas P. Sargen, and Joseph Bisignano.

10. International Monetary Fund, **International Financial Statistics Yearbook,** 1979.

11. At the end of 1974, the Bank of Korea held only $277 million in foreign reserves, while other domestic banks had $774 million in foreign assets against $1,073 million in foreign liabilities. The current-account deficit amounted to $2.0 billion in 1974. International Monetary Fund, **International Financial Statistics,** September 1979.

12. For a study of the role of the 1974 won devaluation in the improvement of Korea's trade balance, see Hang-Sheng Cheng, "Alternative Balance-of-Payments Adjustment Experiences: Korea and Taiwan, 1973-77," this **Review,** Summer 1978, pp. 37-48.

13. Ibid., p. 44.