FEDERAL RESERVE BANK OF DALLAS

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# Economic Review

*Reserve Requirements, the Monetary Base, and Economic Activity*

Joseph H. Haslag and Scott E. Hein

*The Stock Market and Inflation: A Synthesis of the Theory and Evidence*

David P. Ely and Kenneth J. Robinson

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# Reserve Requirements, the Monetary Base, and Economic Activity

The search for the right target for U.S. monetary policy remains a focal point of debate among monetary economists and policymakers. Although unanimity has proven elusive, sentiment favoring the monetary base has grown. For many years, the Shadow Open Market Committee has recommended targeting the growth rate of the monetary base.[1] Recently, McCallum (1988) has provided empirical evidence that suggests a monetary base rule would have resulted in more stable growth of nominal GNP (gross national product) over the period 1954–85.[2] Even Congress has recently gotten into the act. The House Subcommittee on Domestic Monetary Policy, for example, has suggested that the Federal Reserve "give serious consideration to reporting target ranges for the monetary base."[3]

Apart from the question of conviction to targeting the monetary base, there remains the issue of **which** base measure to use. Although not a generally recognized fact, two different measures of base money exist—source base and adjusted monetary base.[4] The fundamental difference between these two measures is the treatment of changes in reserve requirement ratios. The source base measure comes directly from the Federal Reserve's balance sheet and ignores the role of reserve requirement ratios. The adjusted monetary base combines the source base with a term that accounts for changes in reserve requirement ratios.

Choosing between the source base and the adjusted monetary base as prospective policy targets amounts to making suppositions about the importance of changes in reserve requirement ratios. If changes in reserve requirement ratios are important for economic stabilization purposes, then the adjusted monetary base would be the better target for monetary policy. If, on the other hand, reserve requirement ratio changes are negligible and unimportant, then the source base would serve equally well as a target.

The purpose of the present article is twofold. First, the aim is to make clear the difference between the source base and the adjusted monetary base. A complete description of the two measures is provided, including a discussion of the methodology adopted to account for changes in reserve requirement ratios.

*The authors wish to thank W. Michael Cox, R. Alton Gilbert, Evan F. Koenig, and Kenneth J. Robinson for helpful comments. Of course, any remaining errors are solely our responsibility.*

[1] *In addition, Andersen (1975) and Andersen and Karnosky (1977) find evidence that supports the monetary base as the appropriate monetary aggregate to control nominal GNP.*

[2] *See McCallum for a complete discussion of the merits of the proposed "base" rule.*

[3] *In* Report on the Conduct of Monetary Policy, *prepared for the use of the House Committee on Banking, Finance and Urban Affairs, 100th Cong., 2d sess., 1988, Committee Print 100-5, 32.*

[4] *Actually, there are four base measures. In addition to the source base and adjusted monetary base calculated by the Federal Reserve Bank of St. Louis, two are calculated by the Federal Reserve Board of Governors—a monetary base that is adjusted for reserve requirement ratio changes and one that is not.*

The second aim is to examine the question, Which base measure bears the strongest relationship to economic activity? Such a question highlights the role that reserve requirement ratios have played in economic stabilization over the past 30 years. The evidence in this article supports the notion that changes in reserve requirement ratios have been large and important enough that ignoring them gives a distorted impression of monetary policy. Based on the evidence presented here, the adjusted monetary base is judged a better gauge of monetary policy than the source base, which is a simple balance sheet relationship.

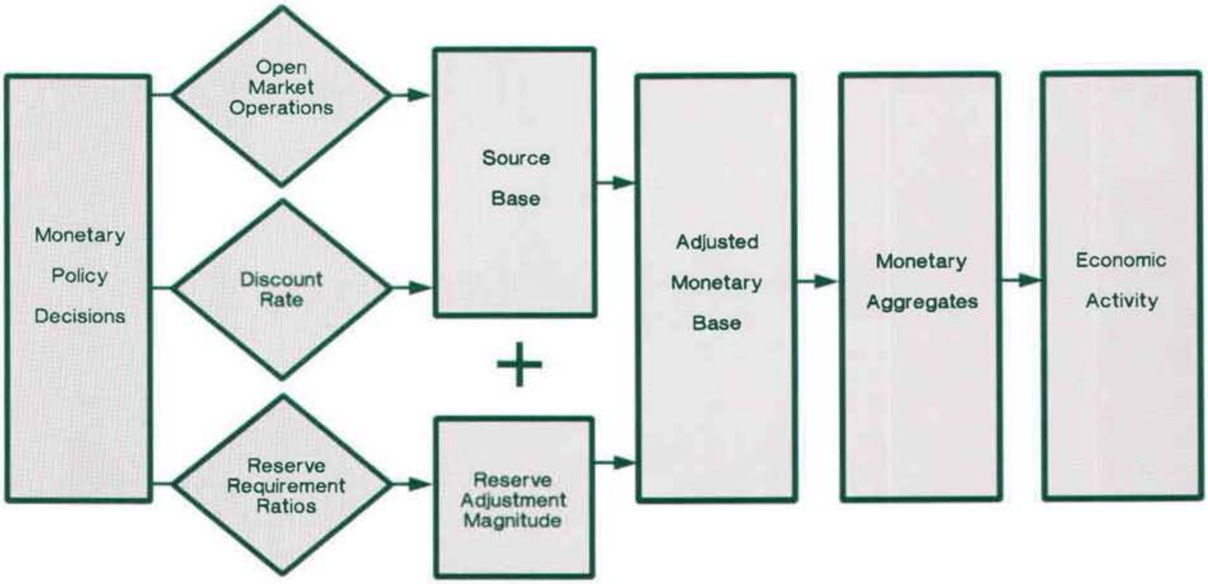
## Conducting monetary policy: an overview

Chart 1 broadly characterizes the monetary policy process originating at the policymaker's decision stage and leading ultimately to economic activity. The chain of events begins with a decision to alter monetary policy, which is implemented through the three tools of the Federal Reserve—open market operations, the discount rate, and reserve requirement ratios. These tools directly affect the operating targets—the source base, the reserve adjustment magnitude, and the adjusted monetary base—which, in turn, influence the monetary aggregates and, finally, the ultimate goals of policy.

As Chart 1 shows, the monetary policy decision can be implemented through one or more of three tools; moreover, these tools can be coordinated to achieve a desired policy outcome. From the standpoint of the operating targets, transactions in the open market and changes in the discount rate both lead to changes in the source base. Changes in reserve requirements, on the other hand, do *not* lead to changes in the source base but show up as changes in the reserve adjustment magnitude, referred to as RAM. Because the source base and RAM sum to the adjusted monetary base, changes in any of the three tools will be captured in this broader base measure.

The sequence laid out in Chart 1 indicates some of the problems associated with selecting the appropriate gauge of monetary policy. The source base is considered important by monetary policy experts but omits the effects of changes in reserve requirement ratios. Though generally less well understood, the adjusted monetary base reflects all policy actions undertaken. It is important, therefore, to describe and understand both the source base and the adjusted monetary base. By doing so, analysts will be better able to judge

Chart 1
Monetary Policy Overview



the merits of each as an indicator of monetary policy.

## Describing the source base

Calculation of the source base follows directly from the Federal Reserve System's consolidated balance sheet. Assets are identified as "sources" of the base because the Federal Reserve System generally creates base money in acquiring Federal Reserve assets. Liabilities other than Federal Reserve notes outstanding and accounts held at the Federal Reserve by depository institutions are labeled "uses" of the base because these other liabilities absorb base money. The major monetary liabilities of the Federal Reserve System are Federal Reserve notes outstanding and accounts held at the Federal Reserve by depository institutions. In sum, these two liabilities represent the public's claims against the Federal Reserve, otherwise known as Federal Reserve credit, and make up the source base.

Table 1 breaks the Federal Reserve balance sheet into its two components—sources and uses—as of February 1, 1989. Operationally, the sum of Federal Reserve assets less the value of the nonmonetary liabilities of the Federal Reserve System is sources less uses and is equal to the source base. As of February 1, 1989, the source base totaled $272.82 billion.

Table 1
**Sources and Uses of Source Base, February 1, 1989**

(Billions of dollars)

| | |
|---|---|
| Sources | |
| Holdings of securities | $240.97 |
| Loans | .96 |
| Float | .33 |
| Gold stock | 11.06 |
| Special drawing rights | 5.02 |
| Treasury currency outstanding | 18.86 |
| Other Federal Reserve assets | 19.91 |
| Total sources | $297.11 |
| Uses | |
| Treasury deposits at Federal Reserve Banks | $ 13.30 |
| Treasury cash holdings | .41 |
| Foreign deposits with Federal Reserve Banks | .22 |
| Other liabilities and capital accounts | 7.84 |
| Other Federal Reserve deposits | .51 |
| Service-related balances and adjustments | 1.99 |
| Total uses | $ 24.27 |
| Source base = total sources – total uses | $272.82 |

NOTE: Totals may not add because of rounding.
SOURCE: Federal Reserve Bank of St. Louis.

## Implementing monetary policy through the source base

What actions can the Federal Reserve undertake to change the source base? Traditionally, the most important asset alterations have occurred through open market operations—the buying and selling of U.S. government securities. As the Federal Reserve buys, for example, U.S. government securities, it generally pays for these assets by creating liabilities against itself, called financial institution deposits at the Fed. In short, the open market purchase results in an increase in Federal Reserve assets (sources of the base) without an offsetting decrease in other Federal Reserve liabilities (uses of the base). Thus, this action increases the source base. (Of course, selling government securities corresponds to the Federal Reserve buying deposits back from financial institutions. Such action results in a contraction of the source base.)

The Federal Reserve maintains a fairly large stock of U.S. government securities (roughly $233 billion as of November 1988), and it is primarily through open market operations that the source base is managed. In addition to open market operations, though, the source base may be altered through raising or lowering the discount rate. A reduction in the discount rate means lower borrowing costs for financial institutions, which, in turn, induce greater borrowings at the discount window. The increase in discount loans ("loans" in Table 1) will result in an increase in depository institutions' account balances at the Federal Reserve. Provided such loans do not directly generate offsetting reductions in other Federal Reserve assets or expansions in nonmonetary liabilities, the increase in loans results in an increase in the source base.

While open market operations and discount rate changes are two of the Federal Reserve's most visible means of altering the source base, in essence, *any* increase in asset holdings of the Federal Reserve (or any reduction in nonmonetary liabilities) matched by a change in Federal Reserve credit will necessarily alter the source base. If, for example, the Federal Reserve were to make a $500 million purchase of new computer equipment, this action alone would have the same effect on the source base as a $500 million purchase of U.S. government securities, provided these assets were purchased with monetary liabilities.

In short, the source base is a summary of all the monetary policy actions that the Federal Reserve may take concerning its own balance sheet. An important use of the source base, therefore, is to enumerate in one comprehensive measure all policy actions as they pertain to the balance sheet of the Federal Reserve.

## Implementing monetary policy through reserve requirements

In addition to having the authority to undertake open market operations and change the discount rate, the Federal Reserve System may also vary, for specified deposit classifications, the proportion of funds that depository institutions must hold as required reserves. These proportions are commonly referred to as reserve requirement ratios. Required reserves must be held either as vault cash or as deposits at a Federal Reserve Bank, and they earn no interest for depository institutions.

Suppose, for example, that the Federal Reserve were to lower reserve requirement ratios for all depository institutions. For a given amount of deposits, lower reserve requirement ratios would call for smaller holdings of reserve balances by depository institutions. Because this action is not itself a Federal Reserve balance sheet transaction, it would not result in a change in the source base.[5] The reduction in reserve requirement ratios, however, would allow depository institutions to increase their deposit liabilities. And the money stock would grow, even though the source base did not change. The increase in the money stock, in turn, would presumably allow an increase in total spending in the economy. This action is not captured by the source base; therefore, the source base is not a perfect indicator of all the methods by which monetary policy may be implemented in order to affect economic activity.

Hence, while the source base reflects two of the Federal Reserve's three monetary policy tools—open market operations and the discount rate—it does not reflect the third policy tool—reserve requirements. There is, thus, one potential shortcoming of the source base as a measure of monetary policy. Namely, the source base does not capture the effects on the money supply and on economic activity that occur when the Federal Reserve changes reserve requirement ratios.

[5] *Changes in reserve requirements are likely to affect the lending behavior of depository institutions and, therefore, cause further changes in the money supply. Such portfolio actions of depository institutions, however, do not affect the source base (because the Federal Reserve's balance sheet is not affected), but, instead, allow a given level of the source base to support a higher level of the money supply. Source base movements will occur only when coordinated with open market operations, discount rate changes, or some other Federal Reserve portfolio adjustment.*

## Describing the adjusted monetary base

The potential shortcoming of ignoring reserve requirement ratios in calculating the source base has long been recognized by monetary policy analysts. For many years, both the Federal Reserve Board of Governors ("Board") and the Federal Reserve Bank of St. Louis ("St. Louis") have estimated base measures that correct for this shortcoming. The essence of each correction procedure is to adjust the source base to account for changes in reserve requirement ratios. Both the Board's "monetary base adjusted for changes in reserve requirements" and St. Louis' "adjusted monetary base" are measures that summarize all three tools of monetary policy. The aim of the following discussion is to provide a basic understanding of the adjustment procedure adopted by St. Louis. Readers who want more detail or wish to understand the Board's measure are referred to Gilbert (1983).[6]

## Adjusting for changes in reserve requirements

How is the source base adjusted to account for changes in reserve requirement ratios? Formally, the St. Louis adjusted monetary base (AMB) is calculated as

$$(1) \qquad AMB = SB + RAM,$$

where $SB$ is the source base and $RAM$ is the reserve adjustment magnitude. For comparison with the source base calculation presented in Table 1, Table 2 presents the AMB calculation for February 1, 1989. As this table shows, AMB as of that date was roughly $8.5 billion larger than the source base. Two questions must now be answered: How is this $8.5 billion adjustment determined, and what factors affect RAM? In order to answer these questions, it is helpful to understand the reserve adjustment procedure.

Consider a simple example where there is only one deposit classification against which depository institutions must hold reserves.[7] Suppose that the reserve requirement ratio is reduced from some original-period value, $r_0$, to a new lower level, $r_1$, so that $r_0 - r_1 > 0$. Given this reduction in the reserve requirement ratio, the St. Louis RAM is defined as

$$(2) \qquad RAM_1 = (r_0 - r_1)\, D_1,$$

where $D_1$ is the level of reservable deposits in the later period.[8]

Note that with $r_1$ less than $r_0$, $RAM_1$ is positive. The interpretation of this calculation is that a decrease in the reserve requirement ratio "frees" reserves. In other words, the reduction is viewed as having the same effect on the liquidity of depository institutions as would an injection of reserves through open market operations.

Table 2
**Components of Adjusted Monetary Base, February 1, 1989**

(Billions of dollars)

| | |
|---|---|
| Source base | $272.82 |
| Reserve adjustment magnitude (RAM) | 8.54 |
| Adjusted monetary base (AMB) | $281.36 |

SOURCE: Federal Reserve Bank of St. Louis.

[6] *See Gilbert (1983) and Haslag and Hein (1988) for a comparison of these two measures.*

[7] *In the discussion in the text, only one reservable deposit classification is considered. In reality, there is more than one reservable classification. The appropriate procedure requires separate adjustment, as in equation 2, for each deposit classification. As a result, RAM will be affected by deposit shifts when these moves are between deposits with different reserve requirement ratios. Thus, RAM can change even though all reserve requirement ratios remain unchanged. In this circumstance, RAM changes reflect the amount of reserves absorbed or freed by such deposit shifts. The RAM still attempts to summarize monetary policy concerns—not spending relationships, as the monetary aggregates attempt to capture.*

[8] *Gilbert (1980) and Tatom (1980) discuss some of the issues involved in selecting a base period. Specifically, both authors point to problems introduced by the sweeping reforms of the Monetary Control Act of 1980.*

As equation 2 indicates, the reduction in the reserve requirement ratio results in an increase in RAM and, hence, an increase in AMB relative to the source base. With an increase in the reserve requirement ratio, however, RAM would decrease, thus indicating an "absorption" of reserves. The decrease in RAM would cause AMB to be less than the source base.

In short, the RAM component of AMB quantifies the amount of reserves that are freed or absorbed when reserve requirement ratios are lowered or raised, respectively. In this sense, RAM "dollarizes" changes in reserve requirement ratios.

One important assumption implicit in the RAM adjustment should also be noted here. As equation 1 indicates, RAM is simply *added* to the source base to obtain AMB. That is, the adjustment treats $1 freed through reductions in reserve requirement ratios as having the same effect on the banking system and economy as a $1 increase in the source base. Constructing AMB in this manner presumes that a single number is sufficient to summarize all monetary policy actions; therefore, separating the effects is not helpful.

## Are changes in reserve requirements empirically important?

As the previous section indicates, monetary policy analysts have two summary measures of actions taken by the Federal Reserve—the source base and AMB. The only difference between the two measures is that the source base ignores changes in reserve requirement ratios, while AMB quantifies such changes and adjusts for them through the RAM component. But is this adjustment to the source base really important? Or could analysts get by with looking at the source base only?

It is noteworthy that, when viewed in terms of levels, RAM is estimated to be only about 3 percent of AMB, so RAM is dwarfed by the source base.[9] One might be led to conclude from this comparison that reserve requirements are relatively unimportant and could be ignored. Whether such a conclusion is, in fact, proper can be seen by examining and comparing the behavior of RAM and AMB both in terms of absolute levels and in terms of growth rates. This additional comparison, based on percentage rates of change, is justified because the Federal Reserve announces its targets for the monetary aggregates (annually) in terms of growth rates.

Chart 2 sheds some light on the differences between comparing the *levels* and the *growth rates* of RAM. The upper portion of the chart portrays the level of the RAM over the period 1960:Q1–1988:Q2. Two points can be made from this chart. First, the level of RAM has generally been comparatively small. Second, however, the level of RAM is far from constant. Indeed, RAM is highly variable, indicating that despite its relatively small absolute magnitude, RAM may play a potentially critical role in gauging the true posture of monetary policy.

The bottom portion of Chart 2 details the quarterly weighted-average growth rate of the RAM component.[10] The quarterly growth rates are highly variable, ranging from a low of –2 percent to a high of +5 percent. Thus, while the absolute level of RAM is generally small relative to that of the total adjusted monetary base, there have been substantial changes in the RAM variable over time.

A sizable portion of AMB growth, therefore, has historically come about through the RAM component, so it is far from obvious that RAM can be neglected. Judging the importance of reserve requirement ratios on the basis of the level of RAM relative to AMB is not sound.

## What if reserve requirement changes are ignored?

Reserve requirements have obviously changed substantially through time, but whether the implied changes in RAM have been empirically important in judging monetary policy is yet to be determined. One way of examining this issue is to investigate the relationship between

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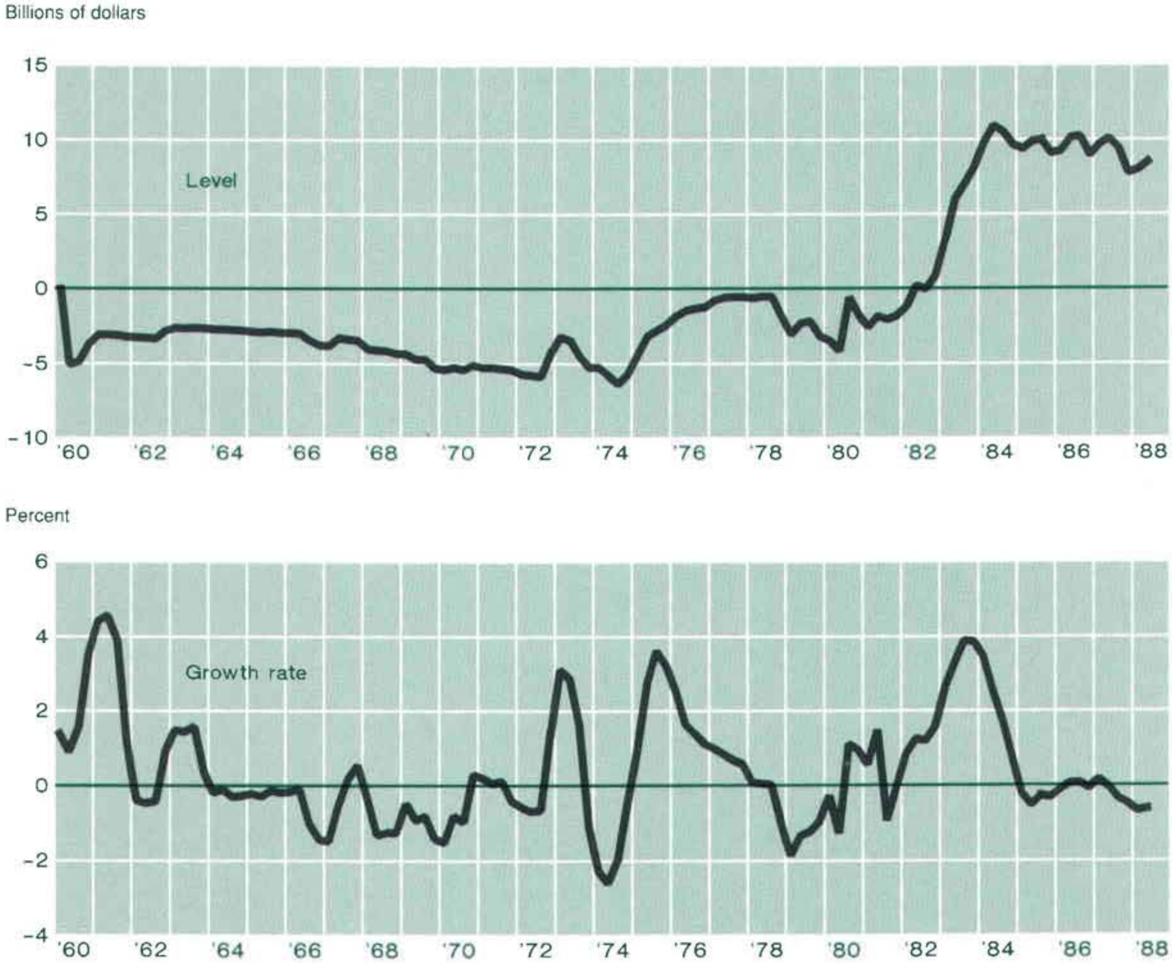
*[9] In calculating this ratio, we use data from February 1, 1989.*

*[10] The RAM component of AMB is calculated as*

$$RAM_t - RAM_{t-1} / [(AMB_t + AMB_{t-1})/2].$$

*Thus, it is the year-over-year growth rate of RAM relative to the total AMB that is presented in the bottom panel.*

Chart 2
Level and Growth Rate of Reserve Adjustment Magnitude



monetary policy and nominal GNP, using only the source base as the gauge. Interestingly enough, analysts who totally ignored RAM over the period 1960–88 would have concluded that monetary policy actions have *no* systematic relationship to nominal GNP. Statistical tests show, for example, that there is no correlation between nominal GNP growth and source base growth over this 29-year period.[11] Therefore, analysts using the source base to gauge the thrust of monetary policy would conclude that policy is powerless to affect nominal GNP.

## Why is the source base a poor policy indicator?

To see why source base growth may bear no statistical relationship to nominal GNP growth, consider three separate scenarios. First, consider a simple case in which the Federal Reserve has determined that the economy is growing too rapidly and decides to use open market operations to restrict the growth rate of nominal GNP. Policymakers reduce the rate of purchases of government securities, decreasing the growth rate of the source base. Presumably, this decrease in base growth is associated with a slower rate of growth of the monetary aggregates and, subsequently, a slower rate of growth of nominal GNP.

In Chart 3, Scenario 1 illustrates this chain of events, which follows closely the linkage laid out in Chart 1. Note that the reduction in source base growth is associated with a reduction in nominal GNP growth. That is, this scenario involves a positive association between source base growth and growth of nominal GNP. Monetary policy has been successful in slowing the pace of economic activity.

Consider next a second scenario, in which the Federal Reserve believes that the economy is growing too slowly and determines that the needed pickup in economic activity could be set in place by reducing reserve requirements. Although reserve requirements could, in theory, be lowered by an amount that would exactly achieve the desired goals for GNP growth, (for reasons that will be discussed later) the Federal Reserve reduces reserve requirements by an amount that would overstimulate economic activity.[12] Thus, the Federal Reserve decides to offset partially the reduction in required reserves by slowing the rate of growth of the source base. What is the observed association between source base growth and nominal GNP growth in Scenario 2? As the second panel of Chart 3 indicates, the association is now negative. Slower source base growth is accompanied by faster nominal GNP growth.

Consider finally a scenario in which the Federal Reserve believes that the present rate of economic growth is acceptable and that no change in monetary policy is called for. By other criteria, however, the Federal Reserve judges reserve requirements to be "too high."[13] A decrease in reserve requirements alone would be associated with higher growth rates of the monetary aggregates and, ultimately, faster nominal GNP growth. Consequently, the Federal Reserve must offset the expansionary effects of the reduction in reserve requirements. This offset can be accomplished by simultaneously decreasing the rate of growth of the source base. By design, the net effect of both actions is no change in the growth rate of the adjusted monetary base and no change in the growth rate of nominal GNP.

Note that, in this case, there is an apparent absence of association between the rate of growth

[11] *The estimated regression for the source base was*

$$Y_t = .011 + .849\,Y_{t-1} + .025\,SB_{t-1},$$
$$(.004)\quad(.055)\qquad(.055)$$

Durbin's $h = 2.93$.

*where Y is the rate of growth of nominal GNP. (Figures in parentheses are standard errors.) The results indicate that the coefficient on source base growth is not significantly different from zero. In another test, the hypothesis that the long-run effect is equal to zero was not rejected. Thus, the results suggest that there is no statistical association between changes in source base growth and nominal GNP growth.*

[12] *Mishkin (1986) points out that extremely small reserve requirement ratio changes are costly to administer. He proceeds to point out that "using reserve requirements to engineer 'fine-tuning' adjustments to the money supply is like trying to use a jackhammer to cut a diamond" (p. 371).*

[13] *For example, the Federal Reserve observes banks taking more of their operations overseas, where reserve requirement ratios are nonexistent. To offset this outflow of banking activity, the Federal Reserve lowers reserve requirement ratios, at the same time not wanting to affect economic activity directly.*

Chart 3
Three Scenarious Relating the Growth Rate of the Source Base to the Growth Rate of Nominal GNP

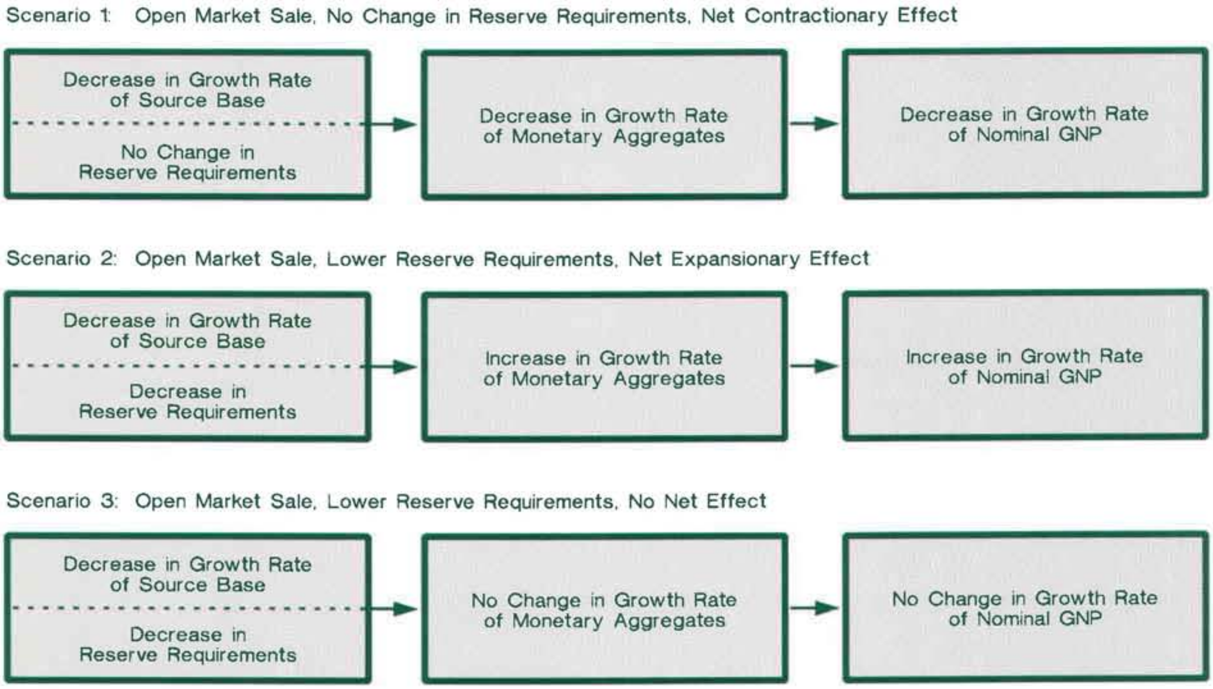
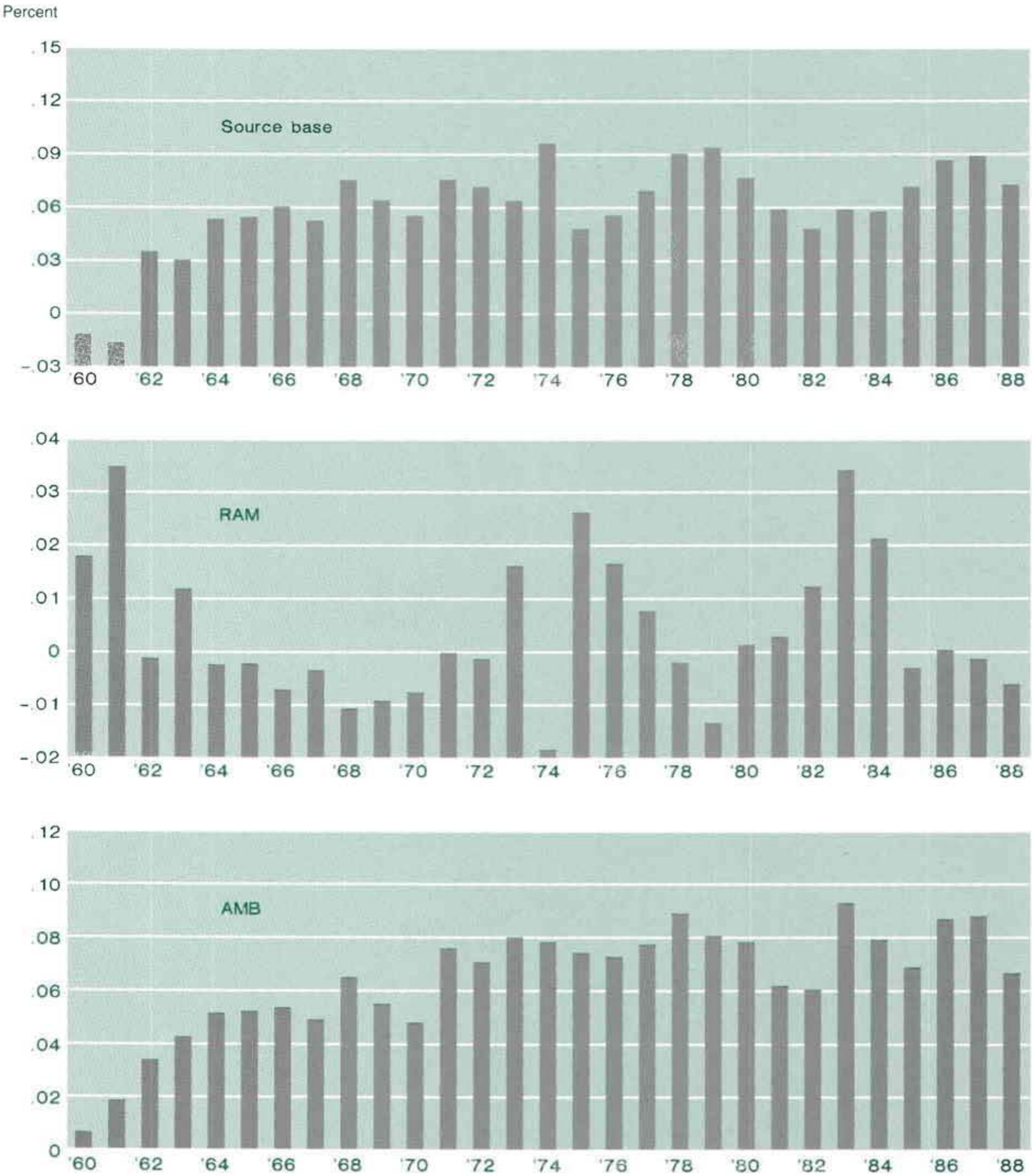


Chart 4
Contributions of Growth of the Source Base and the Reserve Adjustment Magnitude to Growth of the Adjusted Monetary Base




NOTE: The weighted-average growth rates for the source base and for RAM are calculated as described in footnote 14.

of the source base and that of nominal GNP. In short, as shown by Chart 3, the source base and nominal GNP appear independent.

What primary inference can be drawn from reviewing these three scenarios? In each case, the rate of growth of the source base has declined. Yet in each case, the final implication for nominal GNP growth is quite different. For this reason, the source base is potentially a poor indicator of monetary policy.

## Are monetary policy tools coordinated?

Has the source base historically been used to offset changes in reserve requirement ratios? To answer this question, Chart 4 presents information on the annual growth rates of the source base, RAM, and AMB over the 1960–88 period. Consider first the top and middle portions of Chart 4, which plot the weighted-average growth rate of the source base and that of RAM.[14] In general, the higher the RAM contribution to AMB growth, the lower is the source base contribution to AMB growth. This tendency suggests that movements in source base growth *are* coordinated with reserve requirement changes.

The bottom portion of Chart 4 presents the annual average growth rate of the adjusted monetary base. As such, it reveals the bottom-line movement in AMB growth as a composite of growth of the source base and that of RAM. Growth of the adjusted monetary base shows far less volatility than growth of either component (source base or RAM) individually. Thus, this chart further suggests a coordination of the tools of monetary policy and underscores the potential fallacy in using the source base alone as a gauge of monetary policy.

The coordination of source base and RAM is further indicated by simple correlation of the growth rates of the two AMB components.[15] Over the 1960–88 period, the estimated correlation coefficient for the growth rate of the source base component and that of the RAM component is –0.61 and is statistically significant.[16] This is strong evidence of a negative association between the growth rates of the source base and RAM. The implication is that when the Federal Reserve lowers reserve requirement ratios, a simultaneous contraction in the growth rate of the source base is typically undertaken.

## Why is the source base used to offset changes in reserve requirements?

As discussed previously, the Federal Reserve has historically used the source base to offset movements in reserve requirements. At first, this practice may seem counterproductive, but there are basically two reasons why policymakers might choose to pursue this strategy.

The first reason concerns the costs to depository institutions of changes in reserve requirements. Reserve requirement ratios play a direct and important role in portfolio management by depository institutions. Even when small in magnitude, increases in reserve requirement ratios oblige depository institutions to liquidate a portion of their interest-bearing assets, alter the maturity structure of existing loans, and pursue other investment strategies. Decreases in reserve requirements similarly involve "fixed" loan-production and other costs that depository institutions must bear. The portfolio management problem historically has been further complicated by variation in the structure of deposit classifications against which reserve requirements apply. As Table 3 shows, a variety of reserve requirement structures and deposit categories have been administered over the past 10 years.

Given these considerations, periodic and repeated changes in reserve requirements unduly complicate the task of portfolio management.

[14] *The source base and RAM components are defined as*

$$SB_t - SB_{t-1} / [(AMB_t + AMB_{t-1})/2]$$

*and*

$$RAM_t - RAM_{t-1} / [(AMB_t + AMB_{t-1})/2],$$

*respectively. Thus, the growth rates of both components are measured relative to the total adjusted monetary base.*

[15] *This coefficient ranges in value from –1.0 to +1.0. A negative coefficient indicates that the two variables move in opposite directions, and a positive coefficient indicates that the two variables move in the same direction.*

[16] *The correlation between growth rates of the source base and RAM components over the 1960:Q1–1979:Q4 subperiod is estimated to be –0.71. This correlation is also significantly different from zero at the 5-percent level.*

Consequently, the Federal Reserve has altered reserve requirements sparingly. And when changes in reserve requirements have been administered, the Federal Reserve has often done so without regard to the objective of fine-tuning the economy.

The second reason why the Federal Reserve has historically used the source base to offset movements in reserve requirements pertains, broadly speaking, to the "other" factors behind reserve requirement decisions. An example of these considerations is pointed out by McNeill (1980). Referring to the intentions of the Monetary Control Act of 1980, McNeill stated, "the Board has emphasized the need for universal reserve requirements in order to meet the problem of attrition in membership and weakening of the Board's monetary reserve base" (p. 444).[17] This argument reflects a concern during the late 1970s that the exodus of banks from membership in the Federal Reserve System (and to the jurisdiction of state banking authorities) due to lower reserve requirements elsewhere might continue.[18] The Federal Reserve reacted by altering reserve requirement ratios to retain deposits and to bring the depository institutions back to the System. Thus, for reasons other than ultimately affecting economic activity, the Federal Reserve may choose to raise or lower reserve requirements.

## Are economic activity and the adjusted monetary base empirically related?

In a previous section, it was established that nominal GNP bears no significant relationship to the source base. Having uncovered the negative correlation between the source base and the reserve adjustment magnitude, the evidence suggests that this lack of significance is due chiefly to the coordination of monetary policy tools. This

Table 3
**Reserve Requirements of Depository Institutions as of Selected Dates**

(Dollar amounts in millions)

**January 31, 1989**
**All Depository Institutions**

| Type of deposit, deposit interval | Percent of deposits[1] |
|---|---|
| *Net transaction accounts* | |
| $0–$41.5 | 3 |
| More than $41.5 | 12 |
| *Nonpersonal time deposits* | |
| By original maturity | |
| Less than 1 1/2 years | 3 |
| 1 1/2 years or more | 0 |
| *Eurocurrency liabilities* | |
| All types | 3 |

**January 31, 1979**
**All Member Banks**

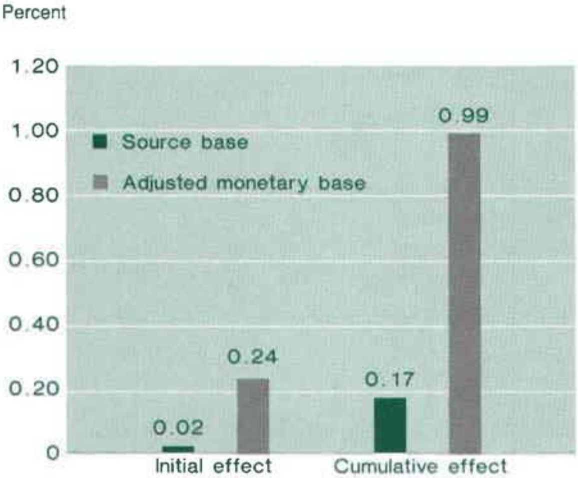
| Type of deposit, deposit interval | Percent of deposits |
|---|---|
| *Net demand deposits* | |
| $0–$2 | 7 |
| $2–$10 | 9 1/2 |
| $10–$100 | 11 3/4 |
| $100–$400 | 12 3/4 |
| Over $400 | 16 1/4 |
| *Time deposits* | |
| Savings deposits | 3 |
| Other time deposits | |
| $0–$5, maturing in— | |
| 30 to 179 days | 3 |
| 180 days to 4 years | 2 1/2 |
| 4 years or more | 1 |
| Over $5, maturing in— | |
| 30 to 179 days | 6 |
| 180 days to 4 years | 2 1/2 |
| 4 years or more | 1 |

[1] A zero-percent reserve requirement applies to total reservable liabilities not in excess of $3.4 million.
SOURCE: Board of Governors, Federal Reserve System.

[17] *See McNeill (1980) for a complete description of the principal elements of the Monetary Control Act.*

[18] *The reserve requirement ratio is also considered a "tax" on depository institutions. Because reserves are non-interest-bearing, reserve requirements impose a portfolio restriction. See Santoni (1985) for a complete discussion of how reserve requirements act as a tax on depository institutions.*

Chart 5
Estimated Initial and Cumulative Effects on Nominal GNP Growth of a 1-Percentage-Point Change in Source Base and Adjusted Monetary Base




section focuses on the question, Is the *adjusted* monetary base helpful in explaining movements in nominal GNP?

Chart 5 illustrates the initial (one-quarter-ahead) expansion in nominal GNP growth estimated from a 1-percentage-point increase in the source base and, separately, from a 1-percentage-point increase in the adjusted monetary base.[19] With a 1-percentage-point increase in the source base, nominal GNP growth is estimated to remain essentially unchanged. With a 1-percentage-point increase in the adjusted monetary base, however, GNP growth is higher.

Chart 5 also illustrates the cumulative, or long-run, effect on nominal GNP growth of a 1-percentage-point increase in both the source base and AMB.[20] Again, the long-run effect of a 1-percentage-point increase in the source base is not statistically different from zero. On the other hand, a 1-percentage-point increase in AMB growth yields a significantly positive increase in nominal GNP growth. In fact, the estimated cumulative effect is not different from unity; a permanent 1-percentage-point increase in the growth rate of the adjusted monetary base generally results in a permanent 1-percentage-point increase in the nominal GNP growth rate.[21] Thus, an analyst using the adjusted monetary base, instead of the source base, to gauge monetary policy intent would conclude that monetary policy does affect economic activity.

## Summary

This article outlines the distinction between two measures of the monetary base—the source base and the adjusted monetary base—and focuses on which is more helpful in explaining movements in aggregate economic activity. As shown, the adjusted monetary base is essentially the source base plus a second component—the reserve adjustment magnitude. That magnitude (RAM) is designed to account for changes in reserve requirement ratios.

Evidence is provided that over the past 30 years, changes in reserve requirements have been large and important enough to have significant effects on economic activity. By ignoring the role of reserve requirements, then, the source base ap-

[19] *The estimated regression for the adjusted monetary base was*

$$Y_t = .004 + .759\, Y_{t-1} + .238\, AMB_{t-1},$$
$$(.004)\quad(.054)\qquad(.067)$$

Durbin's $h = 3.35$.

*(Figures in parentheses are standard errors.) The results suggest that changes in the growth rate of the adjusted monetary base are related to changes in nominal GNP growth. The coefficient on the adjusted monetary base variable is statistically significant. Moreover, the hypothesis that the long-run multiplier is equal to 1 is not rejected. (See the Appendix for a detailed discussion of the GNP specifications.)*

[20] *The estimated long-run elasticity of a 1-percentage-point increase in the source base is calculated as 0.025/(1–0.849), which equals 0.166. For AMB, the estimated cumulative effect is calculated as 0.238/(1 – 0.759), which equals 0.988.*

[21] *The result that the long-run multiplier for the adjusted monetary base is equal to unity is essentially the notion conveyed by Dwyer and Hafer (1988) in their Proposition Ia. These results are also in line with our findings reported in Haslag and Hein (1988), where a more general model was used in the investigation.*

pears to give a distorted picture of monetary policy over this period. The primary reason is that Federal Reserve changes in the reserve requirement ratio over the past 30 years have typically been coordinated with offsetting balance sheet operations affecting the source base. Looking at source base alone, therefore, is misleading because the source base does not capture the full intent of monetary policy. By combining both the source base and RAM, on the other hand, the adjusted monetary base *does* appear quite adequate in gauging the full thrust of monetary policy. Our conclusion is supported by a variety of tests showing essentially no relationship between the source base and nominal GNP but a strong positive relationship—indeed, a proportionate one—between the adjusted monetary base and aggregate nominal GNP.

## Appendix

### Alternative Nominal GNP Specifications

The time paths of the effects of source base growth and adjusted monetary base growth on nominal GNP growth are derived from the results reported in footnotes 11 and 19, respectively. The sample period was 1960:Q1–1988:Q2. Furthermore, to allow for seasonal variation in all the variables, we calculated year-over-year changes using quarterly observations, as follows:

$$\dot{x}_t = \frac{x_t - x_{t-4}}{(x_t + x_{t-4})/2}.$$

Taking four-quarter differences with quarterly observations appears to allow for much of the common quarterly seasonal pattern, as indicated by the sample autocorrelation functions provided in Haslag and Hein (1988).

Presenting the results from only one specification (correctly) piques a researcher's interest. How robust are these findings to alternative model specifications? The primary justification for adopting this regression form is the simple dynamic structure. McCallum (1988) also used a model with only one lag of monetary base growth to explain nominal GNP behavior.

Two criticisms of the simple model were considered and addressed. First, the Durbin's $h$ statistics reported for both regressions suggest that the residuals are autocorrelated. This evidence, of course, violates the classical regression assumption that errors are independent. Using ordinary least squares to estimate a regression when the residuals are not white noise renders the statistical inferences questionable.

Second, the lag structure warrants further consideration. For example, do the results change if additional lags, or perhaps even contemporaneous values, are included in the regression? Misspecification bias may also stem from having too few lags. The final prediction error is used to determine the "optimal" lag length. Similarly, omitting a fiscal policy measure may also affect the outcomes of the regression analysis.

To address both issues—autocorrelated errors and potential misspecification bias—simultaneously, a more general model was estimated. Testing the hypothesis that the long-run effect of a change in adjusted monetary base growth on nominal GNP growth equals unity fails to be rejected using the results from the general model. But the hypothesis that the total multiplier for the effect of a change in source base growth on nominal GNP growth is unity is rejected. Thus, the evidence suggesting that reserve requirement ratio changes affect nominal GNP behavior is left intact when a more general model specification is considered.

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# The Stock Market and Inflation: A Synthesis of the Theory and Evidence

One of the more puzzling anomalies found in financial markets is the poor performance of the stock market during periods of inflation. The failure of equities to maintain their value during inflationary time periods is considered anomalous as stocks, representing claims to *real* assets, should provide a good hedge against inflation. Moreover, if the so-called "Fisher" effect holds, stocks should be positively related to measures of expected inflation as well.

As shown in Chart 1, during the rapid inflation years of the 1970s, movements in U.S. stock prices failed to keep pace with movements in the general level of prices. This pattern has also been found in a number of other countries. Table 1 contains correlation coefficients between real stock returns and inflation for the Group of Seven countries using monthly data over the period 1950–1986. As that table shows, a significant negative relationship holds during at least one extended subperiod for all except one of the countries listed. And a significant negative relationship is found in four of the seven countries for the overall period of 1950–1986. Against this backdrop, it is not surprising that "inflation fears" were cited as a possible contributing factor to the stock market crash of October 1987.[1]

A number of studies have documented the inverse relationship between real common stock returns and various measures of both actual and expected inflation.[2] The literature is generally divided, however, over the reasons why equities might fail to maintain their value during periods of inflation. This paper surveys the two main arguments that have been advanced as possible explanations for this observed anomaly in the U.S. stock market. First, the so-called "tax-effect" hypothesis is examined. This hypothesis focuses on the treatment of depreciation and the valuation of inventories in periods of inflation. Particularly, share prices fail to keep pace with inflation because inflation increases corporate tax liabilities and thus reduces after-tax earnings. Here, inflation can be said, in an econometric sense, to "cause"—or more precisely to temporally precede—movements in stock prices.

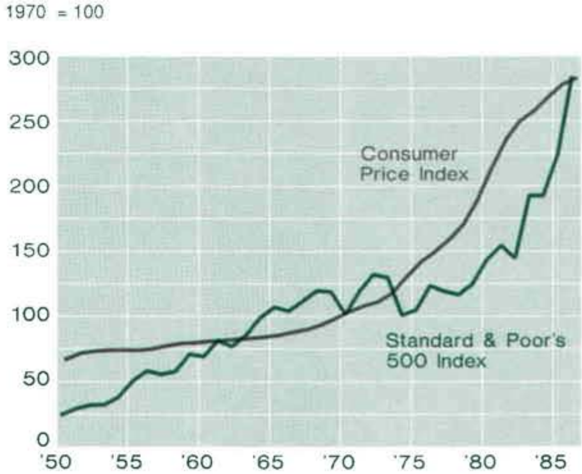
The "proxy-effect" hypothesis is the alternative explanation for why real stock returns are negatively correlated with inflation. In its current form, this hypothesis involves two assumptions—one that cyclical variations in output and earnings growth are positively correlated, and the other that monetary policy is countercyclical. The central tenet here is that lower stock returns signal lower expected future output and earnings growth, which, in turn, initiates a countercyclical policy response by the central bank. Individuals anticipate the expansion in the money supply and thus anticipate future inflation, which leads to an increase in *current* inflation. So, when stock re-

*The authors would like to thank Mike Cox, Joe Haslag and Scott Hein for helpful comments without implicating them in our conclusions.*

[1] The Report of the Presidential Task Force on Market Mechanisms *(1988, p. I-13) states that "It is meaningless whether or not these inflation fears were justified, for it is clear that for as long as financial authorities were responding to the inflation threat—whether real or imagined..." the equity market might suffer.*

[2] *See Bodie (1976), Nelson (1976), and Fama and Schwert (1977).*

Chart 1
Annual CPI and S&P 500
Common Stock Price Index




Sources of Primary Data: Standard & Poor's Corporation.
U.S. Bureau of Labor Statistics.

Table 1
**Real Stock Returns and Inflation: Various Periods**

| Country | 1950-1959 | 1960-1969 | 1970-1979 | 1980-1986 | 1950-1986 |
|---|---|---|---|---|---|
| United States | –0.05 | –0.28* | –0.24* | –0.34* | –0.25* |
| Japan | –0.08 | –0.21* | –0.33* | –0.26* | –0.20* |
| West Germany | –0.05 | –0.19* | –0.02 | –0.12 | –0.09 |
| France | –0.24* | –0.12 | –0.005 | –0.15 | –0.13* |
| United Kingdom | –0.02 | –0.16 | –0.06 | –0.08 | –0.04 |
| Italy | –0.26* | –0.16 | –0.29* | –0.09 | –0.20* |
| Canada | –0.06 | –0.12 | –0.04 | –0.26* | –0.03 |

* Significant at the 1-percent level.

turns fall, inflation increases. Although inflation in this case, is negatively correlated with stock returns, more precisely, stock returns temporally precede inflation. Thus, in an econometric sense, they are said to "cause" inflation.[3]

In the following analysis, a simple model of stock-price determination is offered. (*See the accompanying box for a description.*) This model can be used to highlight the role that inflation has played in determining both stock prices and stock returns in the U.S. economy. In the context of this model, the tax-effect hypothesis is first examined, with emphasis on particular features of the U.S. Tax Code that may have given rise to inflation's adverse effect on equity markets. This is followed by an exposition of the proxy-effect hypothesis, which shows how monetary policy may have historically contributed to the anomalous relationship between stock returns and inflation.

### Tax-effect hypothesis: the firm's perspective

Adherents of the tax-effect hypothesis argue that the adverse effect of inflation on share prices stems primarily from two sources—inflation's effect on after-tax earnings of firms and inflation's effect on individuals' portfolio allocation. This section considers the first of these two sources.

From the standpoint of firms, inflation has a detrimental effect due primarily to two features of the U.S. Tax Code. The first of these features is the treatment of depreciation. Traditionally, the value of the depreciation deduction allowed for firms has been based on the original or "historic cost" of an asset, and *not* on its full replacement value. In a period of rising prices, then, the value of the depreciation allowance becomes inadequate and real corporate tax liabilities increase. In this way, inflation leads to a reduction in real after-tax earnings of firms and a consequent reduction in real dividends and stock prices.

Also contributing to the adverse effect of inflation on the firm is the treatment of inventory valuation under U.S. tax laws. When inventories are valued under FIFO (or first-in-first-out) accounting, inflation leads to an understatement of the costs of replacing these inventories. As is the case under the use of historic-cost accounting for depreciation charges, inflation raises the effective corporate tax burden, thus depressing net earnings. Each of the above two factors—depreciation allowances and inventory valuation—acts to make inflation a penalty to firm profitability; consequently, inflation penalizes a firm's dividends and share prices.

There is, however, one potential *benefit* to firm profitability from rising prices. Namely, at higher rates of inflation, nominal interest rates are higher. And, since firms are allowed to deduct the full nominal interest payments on debt, accounting profits are in this regard reduced by inflation.

The net corporate tax burden caused by inflation thus depends on a comparison of the *penalty* arising from historic-cost accounting methods to the *benefit* arising from the deductibility of nominal interest payments on debt. Using simulation analysis, Hasbrouck (1983) finds that, under tax laws in effect through 1980, the loss due to historic-cost accounting outweighs the leverage gain at low inflation rates. Hasbrouck estimates that the corporate tax-maximizing inflation rate is in the range of 7–9 percent. Beyond these rates, inflation actually reduces the corporate tax burden since gains resulting from the use of debt financing outweigh the effects of historic-cost accounting.[4] It is worth noting that from 1973 to 1980, when real stock prices tended to fall, the rate of inflation averaged 9.2 percent per year. Interpreted in light of Hasbrouck's esti-

[3] *Modigliani and Cohn (1979) offer a third explanation. Investors commit two "major errors" in evaluating stocks during periods of inflation. First, investors are said to be unable to distinguish between real and nominal rates of return in the valuation of equities. Second, market participants fail to realize the gain that flows from a depreciation in the value of corporate debt outstanding in a time of inflation. In essence, Modigliani and Cohn argue that investors suffer from a form of "money illusion." This framework is ignored in the current analysis as it is outside the generally accepted paradigm of market efficiency and thus has not generated much interest.*

[4] *Maher and Nantell (1983) argue that there is no offset possible from debt usage as the premium that must be paid to bondholders in the face of inflation exceeds the tax advantages of debt financing. The crucial assumption for this result to hold is that the bondholder's marginal tax rate must exceed the corporate tax rate.*

### A Model of Share Price Determination

This box outlines a simple model of stock-price determination helpful for illustrating the relationship between stock prices and inflation. In order to focus attention on the issues considered in this article—specifically, on the tax-effect hypothesis and on the proxy-effect hypothesis—certain simplifying assumptions are made.

In general, the price of a firm's stock today can be expressed as the present discounted value of expected future dividends (Brealey and Myers 1984, Chap. 4). That is,

$$(1) \qquad V_t = \sum_{i=1}^{\infty} \frac{DIV^e_{t+i}}{(1+R)^i}$$

where $V_t$ equals the dollar price of the firm's stock today, $DIV^e_{t+i}$ equals the firm's nominal expected future dividend (dividend in period $t+i$), and $R$ represents the nominal rate (presumed constant over time) at which market participants discount these expected future cash flows (or the rate of return required by investors).

Consider first the numerator of this expression. There are essentially two ways that expected dividends can grow over time. One of these is through growth in expected *real* earnings, and the other is through inflation. That is, $DIV^e_{t+i} = div^e_{t+i} {}^* P^e_{t+i}$ where $div^e_{t+i}$ represents real earnings of the firm in period $t+i$ and $P^e_{t+i}$ is the expected price level in period $t+i$. Since the purpose of this paper is to investigate the relationship between *inflation* and the stock market, both actual and expected real earnings will be provisionally treated as constant over time. This allows $div^e_{t+i}$ to be expressed simply as $div$ in all periods.

For simplicity, it is also assumed that inflation, $\pi$, is constant over time and fully anticipated. Under these assumptions, $P^e_{t+i}$ can be rewritten simply as $P_t(1+\pi)^i$. This allows expected nominal dividends to be separated into its two components, real dividends and the general level of prices, so $DIV^e_{t+i} = div^* P_t(1+\pi)^i$.

Turning now to the denominator of this expression, the nominal rate of discount can be separated into its two components—inflation and the (constant) real rate of discount ($r$)—by making use of the Fisher relationship. That is, $1+R$ equals $(1+r)(1+\pi)$.

With these simplifications, the value of the firm's stock can then be expressed as:

$$(2) \qquad V_t = \sum_{i=1}^{\infty} \frac{div^* P_t \ (1+\Pi)^i}{(1+r)^i \ (1+\Pi)^i},$$

which, upon simplification, reduces to:

$$(3) \qquad V_t = \frac{div \cdot P_t}{r}$$

As equation 3 makes clear, stock prices will not increase proportionately with an increase in the general price level if inflation is associated with either (1) a reduction in real dividends of the firm, or (2) an increase in individuals' discount rate. Equation 3 is thus helpful in explaining both the tax-effect hypothesis and the proxy-effect hypothesis. The tax-effect hypothesis, for example, is represented in equation 3 as the case where either (1) $div$ is reduced, or (2) $r$ is increased due to an increase in $P_t$. The proxy-effect hypothesis, on the other hand, is represented as the case where an anticipated reduction in GNP growth causes a reduction in $div$ and $V_t$, which is associated with an increase in $P_t$. In the text we will discuss more fully the underlying bases for each of these hypotheses.

mates, stock prices fell during a period in which inflation had risen to roughly its corporate tax-maximizing rate, indicating the possibility of an adverse tax-effect at work.

### Tax-effect hypothesis: individuals' perspective

The foregoing discussion pertains to the adverse effect that inflation can have on stock prices due solely to its direct effect on firms' profitability. Inflation was shown to potentially lower firms' real dividends which, as seen from Equation 3, prevents stock prices from keeping pace with the general level of prices. Chart 2 illustrates this hypothesized link between inflation and stock prices.

There are, however, other methods by which taxes and inflation can interact to lower firms' stock prices. One of these methods, as outlined by Martin Feldstein (1980 a & b), pertains to the manner in which tax rules and inflation interact to raise individuals' effective rate of discount. Feldstein's argument relies principally on the assumption that individuals invest in a wide range of alternative assets (stocks, bonds, land, gold, owner-occupied housing, tax-free instruments, etc.). Furthermore, although inflation generally reduces firm profitability and thus reduces the rate of return on stocks, it tends to raise the relative return offered on a variety of other assets. (In fact, as Feldstein points out, individuals may actually experience an increase in their net real yield on some assets during inflation).

Therefore, since they: (1) must pay income tax on both dividends and capital gains; (2) must pay taxes on nominal interest income from corporate bonds; and (3) may invest in a much wider range of alternative investments, individuals will substitute out of corporate stocks and bonds in times of rising prices. The effect of this substitution is to increase the real cost to firms of raising capital or, viewed alternatively, to increase the real rate at which individuals discount their before-tax dividends received from firms ($r$). As seen in equation (3), this effect of inflation on individuals' rate of discount reinforces that outlined previously on firms' dividends, so that real stock prices would be further depressed in periods of inflation.[5] Chart 2 illustrates this added effect of inflation on stock prices.

### Tax-effect hypothesis: empirical evidence

While the theoretical justification for the tax-effect hypothesis is generally acknowledged, formal empirical evidence is more problematic. As shown previously, when firms' computation of taxes is based on historic-cost accounting methods for both depreciation and cost of goods sold, tax-deductible firm costs differ from the current costs of factors of production. It follows that real *aggregate* corporate tax liabilities, then, should vary directly with the rate of inflation. Following this line of reasoning, Gonedes (1981) attempts to assess the impact of both expected and unexpected inflation on various measures of the aggregate real corporate tax burden over the period 1929–1974. Contrary to expectations, Gonedes presents evidence that appears to be inconsistent with the tax-effect hypothesis.[6] Specifically, aggregate corporate tax liabilities over the period from 1929–1974 are found to be unrelated to various measures of inflation—rather than positively affected by inflation—and thus not in support of the tax-effect hypothesis.

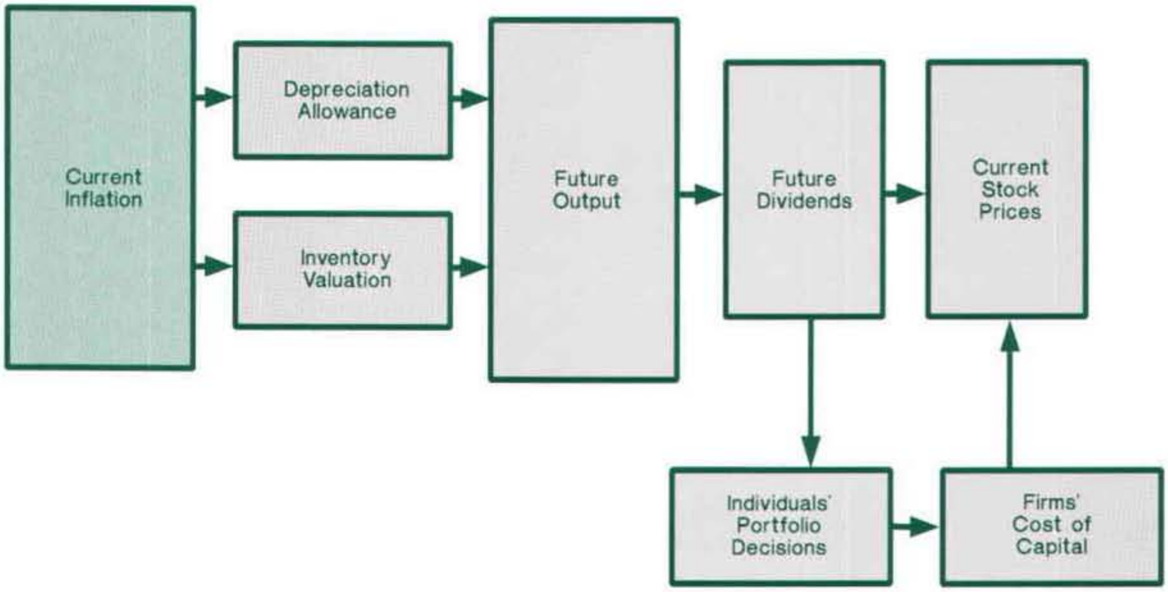
Gonedes attributes the lack of empirical verification of a tax effect at work to an implicit "indexing" that has occurred over the period 1929–1974. Indexing the tax code with respect to both depreciation and inventory charges would eliminate the effect of inflation on share prices. Gonedes argues that de facto indexation has been

*[5] Friend and Hasbrouck (1982) criticize the ad hoc nature of Feldstein's approach to share-price determination. Using a model based on expected utility maximization, along with different values of the tax and risk parameters, Friend and Hasbrouck arrive at the same qualitative conclusions as Feldstein. That is, inflation places downward pressure on share prices due to tax effects, but the magnitude of the effect is discovered to be much smaller than what follows from Feldstein's model. Feldstein (1982) acknowledges the usefulness of deriving the price investors are willing to pay per share on the basis of expected utility maximization, but rejects as "implausible" some of the parameter values assumed by Friend and Hasbrouck.*

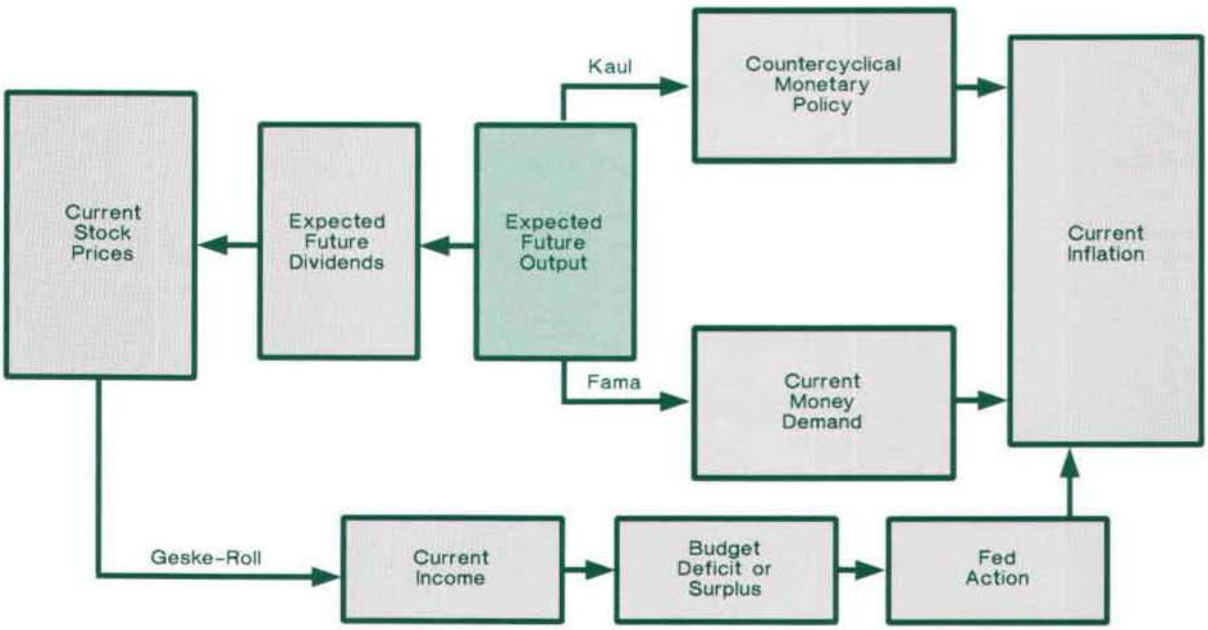
*[6] Gordon (1983) also finds little evidence in support of a tax effect at work.*

Chart 2

Tax-Effect Hypothesis




Proxy-Effect Hypothesis



achieved through such factors as: (1) The implementation of accelerated depreciation schedules; (2) Various subsidies, such as the Investment Tax Credit; and (3) Decreasing the service lives on depreciable assets, all of which occurred simultaneously over the period 1929-1974.

Recall that, during times of inflation, the *net* corporate tax burden depends on both a penalty arising from historic-cost accounting methods and a benefit arising from the deductibility of nominal interest payments on corporate debt. If inflation is unanticipated, an additional benefit is available from the unforeseen decline in the real value of a firms'outstanding debt. Over the time period November 1977 through December 1982, Pearce and Roley (1988) examine the impact of unanticipated inflation on firms' share prices by considering these potential penalties and benefits. Historic-cost accounting of inventories is found to adversely affect stock prices. But, depreciation expenses are not a significant factor in explaining movements in share prices. Finally, the magnitude of a firms' outstanding debt is found to have a positive affect on share prices, indicating that inflation, in part, reduced the real value of firms' liabilities.

## Tax-effects hypothesis: recapitulation of theory and evidence

The failure of changes in share prices to keep pace with movements in the overall level of prices could be attributed to certain features of the tax system. Particularly, the use of historic-cost accounting drives a wedge between tax-deductible costs and current costs of the factors of production. As a result, taxable profits increase at a faster pace than inflation, which puts downward pressure on equity prices. Empirical evidence of a tax effect at work is mixed and does not generally come out in support of the tax-effects hypothesis. Also, evidence that relies on simulation analysis is usually quite sensitive to the assumptions regarding the *effective* corporate tax burden.[7] Further, if it *is* the tax structure which is the driving force behind the seemingly anomalous relationship between inflation and stock prices in the U.S., then it is puzzling to observe (*see Table 1*) basically the same phenomenon across countries despite variation in tax laws.

## An alternative framework: the proxy-effect hypothesis

In view of the criticisms of the tax-effect hypothesis, an alternative framework has developed to explain why inflation and stock values are inversely related. This explanation—known as the proxy-effect hypothesis—argues that expected future output growth and current inflation are inversely correlated. Inflation is said to be merely "proxying" for expected output or earnings growth in statistical tests of the relationship between stock returns and inflation. According to the proxy-effect hypothesis, any significant inverse relationship between these two variables is spurious, because it is induced by a *direct* relationship between stock returns and expected output growth together with an *inverse* relationship between expected future output growth and inflation. In contrast to the tax-effect hypothesis, the proxy-effect hypothesis claims that inflation has not been a causal factor in the performance of real stock prices but, rather, the relationship between inflation and stock prices is spurious.

Understanding the proxy-effect hypothesis requires exposition of the purported links in two contemporaneous chains of causality. Each chain begins with an increase or decrease in the rate of growth of expected future output. In one case this chain runs to expected future dividends and thus to current stock returns and in the other case, to expected future inflation and thus to current inflation. The link between expected future output growth and current stock returns is straightforward and requires little explanation. The purported link between expected future output growth and current inflation is not commonly acknowledged and requires further elaboration. In what follows, three explanations are reviewed to show how movements in expected future output may be related to current inflation.

*[7] See the discussion in Friend and Hasbrouck (1982) and Feldstein (1982) for an example of the importance of assumed parameter values.*

## The proxy-effect hypothesis: linkage through money demand

The proxy-effect hypothesis was first introduced by Eugene Fama (1981). Fama's explanation for the inverse relationship between expected economic activity and current inflation follows from two key assumptions—(1) that individuals are "rational" in the sense of making use of all available current information relevant to their money and financial decisions, and (2) that individuals' current demand for money is related to future real economic activity and current interest rates.[8] Then, assuming that the money supply, real economic activity, and interest rates are exogenous, this demand for money, in effect, becomes a vehicle for the transmission of expected future inflation to current inflation.

In order to explain this more fully, consider the case where individuals' expectations of future output growth are revised downward. The lowering in expected future output growth leads to a lowering in expected future dividends and has the direct and immediate effect of reducing current stock returns. But also, the decline in expected future output growth leads to a decrease in money demand currently and thus an excess supply of money. Following Fama's assumption that interest rates and the money supply are exogenous, the excess supply of money is accompanied by an increase in the price level to restore monetary equilibrium. Essentially, the forward-looking nature of individuals' money demand generates an inverse relationship between current inflation and expected future growth in GNP. This enables a decrease in future output growth to cause *both* a decline in current stock returns and an increase in current inflation.

In terms of the model developed earlier, and summarized in equation 3, a reduction in expected future output and earnings growth lowers *div* with the direct effect of lowering $V_t$.[9] But also, the reduction in anticipated future output growth raises $P_t$. Chart 2 outlines this purported linkage of the proxy-effect hypothesis (identified as the Fama scenario). Any observed relation between stock returns and current or expected inflation then, according to this theory, is purely spurious, with no causal chain from inflation to stock returns.[10]

## The proxy-effect hypothesis: linkage through debt monetization

Geske and Roll (1983), who relax the assumption of an exogenous money supply, have suggested an extension of Fama's argument. These authors posit, in fact, that a "reverse causality" actually drives the inverse relationship between stock returns and inflation. In contrast to earlier work which hypothesized a causative influence of inflation on stock returns (and in contrast to Fama's model in which inflation and stock returns are spuriously related), it is stock returns which "cause" inflation.[11]

Geske and Roll weave a sequence of events by which this reverse causality comes about. In order to illustrate the Geske-Roll hypothesis, consider the case where expectations regarding future GNP growth are lowered. Stock prices decrease in response to projections of slower growth which leads to a decline in both personal and corporate income. Government tax revenues then decline which leads to a deficit in government revenue. That is, Geske and Roll suggest that a decline in expected future economic activity should be fol-

[8] *It should be pointed out that it is not common in economic models to assume that the demand for money currently is related to future economic activity, and, on this basis, Fama has been criticized. It is worth noting, however, that Fama's results could also be obtained in a more standard framework where, instead of Fama's assumption (2), current money demand is assumed to be related to current income and current interest rates, but with individuals being forward looking in decisions regarding interest rates. In this case, a decline in expected future output growth would lead to a perceived future excess supply of money and thus to a perceived increase in future inflation and interest rates (equivalently a decrease in future bond prices). Expecting such an increase in future interest rates, individuals may bid up interest rates today (bond prices fall) as they sell bonds in order to avoid a future capital loss. Again, the demand for money currently would fall leading to an excess supply of money and inflation.*

[9] *This application of the proxy-effect hypothesis assumes that the expected growth rate of future output was initially zero, so that a decline in the growth rate amounts to an anticipated contraction in GNP.*

lowed both by a decline in government revenue *and* by an increase in the federal budget deficit. The next step in the Geske-Roll model involves the central bank. When deficits begin to grow, government debt outstanding increases. The central bank chooses to monetize a portion of this debt, thus leading to inflation. Since this debt monetization is anticipated by rational individuals, a decline in the stock market will cause an increase in expected future inflation. Therefore, stock returns are inversely correlated with expected future inflation.

Geske and Roll point out that changes in expected inflation tend to be highly correlated with unexpected inflation. This explains the negative association between stock returns and unexpected inflation which Fama (1981) found puzzling. Finally, through individuals' forward-looking behavior, the increase in expected future inflation is transmitted to current inflation as well. It is through this extended chain of causality, then, that lower current stock returns cause an increase in current inflation. In terms of the model developed earlier, *div* first falls (due to an anticipated cyclical contraction in output). The reduction in *div* drives $V_t$ down, which ultimately leads to an increase in $P_t$. Chart 2 shows this hypothesized chain of events (identified as the Geske-Roll scenario).

## The proxy-effect hypothesis: linkage through countercyclical monetary policy

The Fama model excludes any response by the monetary authority while Geske and Roll stress a policy response of debt monetization. An extension of these arguments is developed by Kaul (1987) who agrees that the relationship between stock returns and inflation is spurious. Following Fama, Kaul stresses the importance of the money demand linkage in his analysis but is also willing to incorporate a response of the monetary authorities. Unlike Geske and Roll, however, this response does not hinge exclusively on the practice of debt monetization. Rather, Kaul presumes that the central bank follows a *countercyclical* money supply process.

The full sequence of events as viewed by Kaul occurs as follows. First, expected future output declines which is signaled by a fall in stock prices. The Fed then responds with a countercyclical policy which results in an increase in the money supply. This causes both an increase in current inflation and an upward revision in inflation expectations. As a result, there is an observed inverse relationship between stock returns and both actual and expected inflation.

Kaul's version of the proxy effect hypothesis thus incorporates two commonly accepted effects of a perceived reduction in future GNP growth. For one, the anticipated slowing lowers current stock returns. For another, the anticipated slowing causes a current monetary expansion, and thus inflation. These two alone are sufficient to generate the inverse relationship often found between stock returns and inflation. The inverse relationship between expected future GNP growth and current inflation now is the result of the equilibrium process in the monetary sector. In terms of the model developed earlier, *div* first declines (due to an anticipated decline in GNP) which lowers $V_t$. But also, the decline in *div* stimulates a countercyclical response on the part of the monetary authorities which raises $P_t$. Chart 2 shows this hypothesized connection between stock prices and inflation (identified as the Kaul scenario).

*[10] Benderly and Zwick (1985) agree with Fama that the relationship between stock returns and inflation is spurious. Unlike Fama though, Benderly and Zwick argue that the relationship runs from inflation to expected output growth. These authors base their conclusion on a real balance model of output in which changes in aggregate demand are related to lagged changes in real money balances.*

*[11] One should take note of the subtle distinction in Geske and Roll's use of the term "cause" here. Really, there is not reverse causality in the sense previously described for the tax-effect hypothesis because the sequence of events does not begin with stock prices. It begins with movements in expected future output. Actually, then, the relationship between current inflation and stock returns is here, too, spurious because both inflation and stock returns are ultimately driven by a decline in expectations of future GNP growth. Movements in stock prices, however, do precede movements in inflation and in this sense can be said to cause inflation.*

## Proxy-effect hypothesis: the empirical evidence

Empirical evidence on the proxy-effect hypothesis is extensive and generally may be delineated into the categories outlined above in reviewing the theoretical linkages between stock returns and inflation. In what follows, we will review the empirical evidence on the proxy-effect hypothesis beginning with the evidence on the linkage through money demand, as theorized by Fama.

Recall that the key to the spurious relationship between inflation and stock returns in Fama's hypothesis is that movements in expected future economic activity cause movements in both expected and current inflation. Empirical evidence relating real stock returns to both expected and unexpected inflation reveal a significant negative relationship. However, in multiple tests which also include real expected output growth, expected inflation looses its significance in explaining stock returns. This evidence suggests a spurious relationship between expected future inflation and current stock returns. Note also that *unexpected* inflation remains significant in nearly all of Fama's tests (all but those using annual data), and the expected inflation term looses significance in explaining real stock returns only when the growth rate of the monetary base is added to the set of explanatory variables. Fama points out that his measure of expected inflation is highly correlated with monetary base growth. Therefore, it is possible that one proxy for expected inflation has simply replaced another and the puzzling relationship between stock returns and inflation remains.

Turning now to empirical evidence on other views of the proxy-effect hypothesis, recall that Geske and Roll view current stock prices as driving current inflation through a practice of debt monetization by the central bank. Geske and Roll offer as empirical evidence a series of "transfer-functions" which purport to establish the linkage between stock prices and inflation in their model. For the most crucial element of this linkage, however—the practice of debt monetization—Geske and Roll do not offer compelling evidence. Empirical verification of the existence of debt monetization by the Federal Reserve is mixed, at best.[12] Geske and Roll point out that "...the detectable effect of Federal Reserve System Treasury debt holdings on the Fed's issuance of base money is very small in estimated magnitude; however, it *is* significant." The failure to discover a very substantial degree of debt monetization is blamed on "the incredible short-term churning of the Fed's asset portfolio."[13]

Kaul (1987) presents empirical evidence for the United States, as well as for Canada, the United Kingdom and Germany, consistent with the central tenets of the proxy-effect hypothesis. Regression results indicate a positive relationship between stock returns and expected real activity. Inflation and expected real activity are found to be negatively related, Kaul argues, due to both a countercyclical monetary policy response and to the practice of debt monetization.

Just as Geske and Roll's results hinge on the practice of debt monetization, Kaul's conclusions rely on a consistent countercyclical policy response which is anticipated by individuals. In estimates of both base-growth and monetary-aggregate growth equations, Kaul includes the unemployment rate to capture this policy response. In the four countries analyzed, however, the unemployment rate is generally insignificant in explaining money growth.

Evidence of central bank behavior from reaction functions casts doubt about the consistency of Federal Reserve policymaking, making it difficult to derive a generally accepted model of central-bank behavior.[14] Moreover, throughout most of the 1970's, the Fed engaged in federal funds rate targeting, which tends to result in a *procyclical* policy. Also, the current procedure of targeting on borrowed reserves, in effect since the fall of 1982, represents a return to funds rate targeting.[15] Clearly, a procyclical policy results in either a *positive* relationship between stock re-

[12] *See Allen and McCrickard (1988) and Joines (1988). For additional support of the inconclusive evidence of debt monetization, see the references in McMillin (1986).*

[13] *Geske and Roll (1983, p. 22)*

[14] *For a summary of the reaction function literature, see Barth Sickles and Wiest (1982).*

[15] *See Gilbert (1985) and Thornton (1988).*

turns and inflation or, at best, no relationship. Yet there has been an inverse relationship between stock returns and inflation in the United States during the 1970's and 1980's, as Table 1 shows, despite evidence of a procyclical policy stance by the central bank. These findings cast further doubt on the validity of Kaul's hypothesis.

## Summary and conclusions

Equities, representing claims to real assets, should prove to be good hedges against inflation. Moreover, if future inflation can be at all foreseen, stock-market returns should be positively related to expected inflation as well. During much of the post-war time period, however, a well-documented tendency exists for equities to perform poorly during periods of inflation. Two main schools of thought have arisen to explain this anomaly.

The first of these appeals to particular features of the tax code in the United States as the primary factor behind the failure of equities to maintain their value during inflation. Historic-cost accounting for both depreciation and inventories results in an overstatement of corporate profits during periods of inflation. As a result, real corporate tax liabilities increase, which decreases net earnings. A simple model of share price determination then predicts downward pressures on real equity values during periods of inflation. While theoretically valid, empirical evidence for a tax effect at work is inconclusive.

The second school of thought appeals to the monetary sector as a vehicle through which the inverse stock return-inflation relationship occurs. A combination of money demand effects, along with both the practice of debt monetization and countercyclical monetary policy responses by the central bank is said to give rise to an inverse relationship between stock returns and inflation. Again, empirical evidence for this model is problematic.

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