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Federal Reserve Bank of St. Louis
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In This Issue . . .

In the first article in this *Review*, Dallas S. Batten and R. W. Hafer assess the empirical validity of the "currency substitution" hypothesis for five major industrial countries. This argument challenges the notion that flexible exchange rates insulate a domestic economy from foreign monetary shocks. In particular, if two currencies are considered to be substitutes in demand, then foreign monetary shocks will be transmitted across nations, even under a flexible exchange rate regime.

Because these foreign monetary shocks are hypothesized to be transmitted through the domestic demand for money, Batten and Hafer examine the effects of changes in the opportunity cost of holding foreign-currency-denominated money balances on a standard specification of the domestic demand for money equation to test for the impact of currency substitution. The evidence indicates that currency substitution's impact generally is statistically insignificant and of no economic importance. Consequently, the authors conclude that currency substitution does not appear to jeopardize the insulating properties of a flexible exchange rate system.

In the second article, "Interest Rate Risk and the Stock Prices of Financial Institutions," G. J. Santoni argues that the stock prices of financial institutions, particularly savings and loan associations, are more sensitive to interest rate changes than the stock prices of industrial firms. This is, in large part, due to the greater degree of leverage employed by financial institutions. Moreover, savings and loan associations operate under legal constraints that require them to maintain portfolios of financial assets that are relatively long-lived compared with their financial liabilities, which further contributes to the interest rate sensitivity of their stock prices.

In addition to discussing various measures of this interest rate risk exposure, Santoni estimates the sensitivity of the stock prices of banks, savings and loan associations, and industrial firms to changes in the interest rate over the period 1961–82. His results suggest that the stock prices of savings and loan associations are about two-and-a-half times more sensitive to interest rate changes than are stock prices of banks, and about five times more sensitive to such changes than are the stock prices of industrial firms.

Economists have long hypothesized that greater uncertainty about future inflation leads to misallocation of productive resources. In the third article in this issue, "The Impact of Inflation Uncertainty on the Labor Market," A. Steven Holland examines the effects of inflation uncertainty on the allocative efficiency of one particular market: the market for labor resources.

The author shows that greater inflation uncertainty produces reduced employment and output growth, higher unemployment and more complex wage negotiations. These results occur even though the labor market adapts over time to inflation uncertainty in ways that reduce its impact, specifically, by shortening the duration of labor contracts and increasing the prevalence of indexation. Furthermore, these labor market adaptations reduce both the short-run impact of monetary policy on output and the ability of the economy to adjust to real supply shocks (such as an energy crisis).

In the fourth article of this *Review*, "Examining the Recent Behavior of Inflation," R. W. Hafer explains that the recent decline in inflation is the result of declining relative prices of energy and food and a concomitant drop in the trend rate of transactions money growth.

Hafer notes that inflation, a persistent rise in the general level of prices, is related directly to the average long-run rate of money growth. He points out, however, that random shocks affecting individual prices (which are unrelated to money growth) cause the observed inflation rate to temporarily rise above or fall below the underlying, monetary-induced inflation rate. Hafer demonstrates that, after accounting for the effects of food and energy prices, which have risen more slowly than the rest of the prices making up the consumer price index (CPI), the inflation rate thus far in 1984 is running close to 5 percent.

The actual rate of inflation, however, is below that predicted by monetarist models that rely on past growth of M1, even after taking account of the effects of slower relative food and energy price increases. This problem, Hafer suggests, may be due to the fact that, since 1981, the definition of M1 has been altered with the inclusion of several interest-bearing components that have significant savings-type characteristics. Using an alternative transactions money measure that weighs each of its components according to its use in transactions, Hafer finds that the recent divergence between inflation and trend money growth is reduced significantly.

Currency Substitution: A Test of Its Importance

Dallas S. Batten and R. W. Hafer

A COMMON defense of flexible exchange rates is that they insulate the domestic economy and money supply from foreign monetary disturbances.[1] This view has been challenged by a number of critics who question the assumption behind the monetary independence argument that domestic and foreign currencies are not considered substitutes in demand by domestic residents.[2] A rational holder of money balances, these critics argue, would seek to diversify his portfolio of currencies for the same reasons that investors typically hold diversified portfolios of interest-earning assets. If currency substitution exists, domestic money demand should be sensitive to changes in both domestic and foreign influences. Consequently, even with flexible exchange rates, the existence of currency substitution exposes the domestic economy to monetary shocks from both home and abroad.

The purpose of this article is to assess empirically the importance of currency substitution in five major industrial countries by examining the significance of changes in the opportunity costs of holding foreign-currency-denominated money balances on the demand for domestic money. If currency substitution exists, changes in the opportunity costs of holding foreign money balances should generate a reallocation of money holdings and, consequently, influence domestic money demand. The evidence presented here, however, indicates that the impact of changes in the opportunity cost of holding foreign money balances on domestic money demand is statistically insignificant for almost every country analyzed. Thus, it does not appear that currency substitution jeopardizes the insular properties of a flexible exchange rate system.[3]

EXCHANGE RATE SYSTEMS AND MONETARY INDEPENDENCE

Under the Bretton Woods system of fixed exchange rates, each monetary authority was obligated to maintain the foreign exchange value of its currency within a specified range by intervening directly in the foreign exchange market. When the foreign exchange value of its currency rose to the upper bound of this range, the monetary authority sold its currency for foreign exchange in the foreign exchange market. This action increased the supply of "home" currency relative to its demand and lowered its foreign exchange value. The monetary authority continued increasing the supply of currency until its value declined. If the foreign exchange value of its currency fell to the bottom of the permissible range, the central bank would purchase its own currency with its foreign exchange reserves, thereby increasing its own currency's value in the foreign exchange market.

No Monetary Independence Under Fixed Exchange Rates

The obligation to maintain its currency's foreign exchange value reduces the domestic monetary author-

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[1]The case for flexible exchange rates is made forcefully in Friedman (1953). In this analysis, we ignore the possibility that monetary disturbances in a flexible exchange rate world may have real consequences as goods prices change more slowly than do exchange rates. For a discussion of this, see Dornbusch (1976).

[2]For a discussion of these arguments, known collectively as currency substitution, see, among others, Miles (1978a, b), Boyer (1978) and McKinnon (1982). Alternative viewpoints are presented in Chrystal (1977) and Spinelli (1983).

[3]It should be noted that, even under a flexible exchange rate regime, monetary independence may be lessened by the existence of international capital mobility. For a discussion of the effects of capital mobility on the insular properties of flexible exchange rates, see Tower and Willett (1976). It also should be noted that central banks' attempts to maintain a desired exchange rate by intervention may thwart the advantages of a flexible rate system.

ity's ability to conduct a policy independent of those conducted by other countries. To see this, first assume that the domestic and foreign economies initially are in equilibrium. If the domestic monetary authority increases its money supply, the immediate result will be an excess domestic supply of money. Consequently, domestic residents will attempt to reduce their excess holdings of money by purchasing more goods, services and securities, both domestic and foreign. Such actions impart upward pressure on the general level of domestic prices and, concurrently, downward pressure on the foreign exchange value of the domestic currency.[4]

Since the monetary authority is obligated to defend its currency's foreign exchange value under a fixed exchange rate system, the resultant downward pressure on the exchange value requires it to purchase its own currency in the foreign exchange market with foreign currency. Obviously, this operation results in a decrease in the domestic money supply, reversing the initial expansion. In other words, having to maintain its exchange rate precludes the domestic monetary authority from independently changing its own money supply.

It is also the case that monetary shocks can be transmitted from one economy to another. Consider, for example, the impact of an increase in the money supply of country A on country B in a two-country world of fixed exchange rates. As described above, the initial excess supply of money in A causes the exchange value of A's currency to fall relative to B's. When A's monetary authority intervenes, it buys its own currency, using its holdings of B's currency to pay for the transaction. Consequently, B's money supply must rise as B sells its holdings of country A's currency for more of its own. This, in turn, generates an excess supply of money in country B. Thus, the original monetary expansion in A has been transmitted to B because each country is obligated to maintain exchange rates within a prescribed range.

Monetary Independence Under Flexible Exchange Rates

Under a system of flexible exchange rates, however, this inability to control the domestic money supply need not exist. With no obligation to maintain its exchange rate, the monetary authority can increase its domestic money supply and allow the exchange rate to fall. A system of flexible exchange rates also provides an environment in which monetary disturbances need not be transmitted from economy to economy; the exchange rate simply fluctuates freely in response to relative movements in money supplies. Thus, as long as the monetary authority is willing to let the exchange rate move as the market dictates, it can follow any domestic monetary policy that it desires.

What If Currency Substitution Exists?

The currency substitution argument suggests that this analysis mistakenly ignores the possibility that foreign currency is a substitute in demand for domestic currency.[5] That is, residents demand both domestic and foreign currencies. Advocates of this argument point to certain evidence of the existence of currency substitution.[6] For example, multinationals, among others, hold various currencies simultaneously in order to reduce the costs of foreign transactions and to provide certain risk-decreasing benefits typically associated with asset diversification.[7] As Miles has noted recently,

> significant currency substitution does not require every little old lady on Main Street to hold foreign money. All that is required is a significant subset of individuals and enterprises which on the margin are indifferent between holding another dollar of their money portfolio in domestic versus foreign money.[8]

[4]For a more detailed discussion of exchange rate movements, central banks' exchange rate objectives and their impact on domestic monetary policy, see Batten and Ott (1983, 1984).

[5]See, for example, McKinnon.

[6]Our analysis focuses only on "onshore" substitution, that is, the substitution of foreign for domestic money balances by domestic agents. A second type, which we do not address directly, is "offshore" substitution — the substitution of one foreign-currency-denominated asset for another by domestic agents. Chrystal, and Chrystal, Wilson and Quinn (1983) analyze this second type and find significant offshore currency substitution. Most of this substitution involves interest-earning assets; consequently, its primary impact is on interest rates. Since we analyze onshore substitution within the framework of money demand (see below), whatever indirect impact offshore substitution may have should be captured by the inclusion of the domestic interest rate in equation 1. (See discussion on p. 8.)

[7]Miles (1978a) has argued this. One may question the transactions motive as a significant reason for holding foreign currencies in a non-interest-earning form, especially since many highly liquid, interest-earning assets are available in the Eurocurrency market. An argument may be made for holding these balances for speculative purposes, however; nonetheless, given the availability and easy access to the Eurocurrency market, one may discount the currency substitution argument on a priori grounds alone.

[8]Miles (1984), p. 1203.

The mere holding of a diversified portfolio of currencies, however, is not sufficient for currency substitution to be meaningful. These holdings must also change in response to changes in the relative opportunity costs of holding foreign money balances. That is, if individuals actually hold a diversified portfolio of currencies, then they will respond to changes in the cost of holding one currency relative to another by changing the relative amount of each currency held. This readjustment of currency holdings (that is, currency substitution) enables monetary shocks to be transmitted (via money demand) from one economy to another even in a world of flexible exchange rates.

To illustrate this possibility, assume that country B's monetary authority strives to maintain a targeted growth path for a narrow, transactions-oriented, monetary aggregate. In a world of currency substitution, residents in both countries hold both B's currency and A's currency. Now suppose that country A's monetary authority increases its domestic money supply while B's money supply remains unchanged. Immediately, money holders (individuals and firms) expect A's currency to depreciate relative to B's. With a flexible exchange rate system in effect, the central banks do not intervene to maintain the prevailing exchange rate. The expected depreciation of A's currency increases the opportunity cost of holding it relative to B's currency. Consequently, residents of both countries will desire to hold less of A's currency and relatively more of B's; that is, both the domestic and the foreign demand for B's currency will increase because of a change in country A's monetary policy. Thus, failure by policymakers in B to recognize the external effects on domestic money demand may lead to inappropriate policy actions. As McKinnon argues, ". . . currency substitution destabilizes the demand for individual national monies so that one can't make much sense out of year-to-year changes in purely national monetary aggregates. . . ."[9]

For another illustration of how currency substitution may affect domestic policy actions, assume that the domestic monetary authority in country B is attempting to peg some domestic interest rate. As before, assume that country A unilaterally expands the growth of its money stock. This again produces an expected depreciation of A's currency relative to B's and, for a given level of income and interest rates, increases the domestic and foreign demand for B's currency. For a fixed (in the short run) supply of money, the increase in B's money demand leads to an increase in market interest rates. Since the assumed policy of the monetary authority in country B is to peg a domestic interest rate, it must offset this increase in rates by increasing its money supply. Thus, the policy action taken by country A leads to a similar action by country B if there is currency substitution and if the monetary authority attempts to target on a market interest rate.

In summary, the most important problem with currency substitution is that it may destabilize the domestic demand for money, thus hobbling a monetary authority's attempt to determine policy independent of foreign influences. Consequently, the impact of any particular monetary policy stance on the domestic economy may not be the desired one even in a world of flexible exchange rates.

THE EMPIRICAL SIGNIFICANCE OF CURRENCY SUBSTITUTION

That currency substitution *may* exist and that it *may* reduce the insulating properties of flexible exchange rates are not sufficient reasons to conclude that it significantly lessens the degree of monetary independence among countries under a flexible exchange rate regime. Whether currency substitution is sizable enough to have the impact described above is an empirical issue.

The Test

A commonly used procedure to test for the importance of currency substitution is to estimate a domestic demand for money equation and determine if changes in the opportunity cost of holding a foreign currency significantly influence holdings of domestic real money balances. More formally, the following equation is estimated:

$$(1)\quad \ln (M/P)_t = \alpha_0 + \beta_1 \ln y_t + \beta_2 R_t + \beta_3 \hat{E}_t + \beta_4 \ln(M/P)_{t-1} + \varepsilon_t,$$

where M = the domestic nominal money stock,
P = the domestic price level,
(M/P) = the domestic real money stock,
y = a measure of domestic real income or wealth,
R = a domestic nominal interest rate,

[9]McKinnon, p. 320.

$\hat{E}$ = the expected return from holding foreign money balances, and
ln = the natural logarithm.[10]

We measure the expected return from holding foreign money balances with the expected rate of appreciation/depreciation of the exchange rate as approximated by the three-month forward premium/discount.

$$(2)\quad \hat{E}^* = [(F/S)^4 - 1] \times 100,$$

where F is the three-month forward exchange rate between a specific foreign currency and the U.S. dollar, and S is the spot (current) exchange rate between the same two currencies.

Equation 1 allows for a relatively broad test of the currency substitution hypothesis. If domestic residents consider foreign currency balances and foreign-currency-denominated, interest-earning assets (for example, Eurocurrency assets) to be substitutes, the domestic interest rate variable (R) in equation 1 will capture this behavior; the relatively uninhibited international mobility of capital requires that interest rates worldwide (adjusted for expected exchange rate changes) be equal. Consequently, foreign interest rate changes not totally compensated for by expected changes in the exchange rate will produce concomitant movements in domestic interest rates and, subsequently, the normal money demand response.

On the other hand, if people are holding non-interest-earning foreign money balances for whatever purpose (transactions or speculative), the expected change in the exchange rate represents the opportunity cost of holding these foreign balances. Testing for this type of currency substitution requires determining whether the addition of $\hat{E}^*$ to a standard domestic money demand equation significantly improves the explanatory power of the equation. For currency substitution to have an impact, the estimated coefficient on $\hat{E}^*$ should be statistically significant and negative; as the expected return from holding foreign money balances rises, other things equal, individuals will hold relatively smaller domestic real money balances. If these two conditions are not met, the currency substitution hypothesis will have been rejected by the statistical tests.

[10]This specification is taken from Bordo and Choudhri (1982). For other studies employing the money demand function as the tool of analysis, see Cuddington (1983), Daniel and Fried (1983) and Spinelli.

Empirical Results

We investigate the existence of currency substitution in five countries: Canada, France, Germany, the Netherlands and the United Kingdom.[11] In each instance, the U.S. dollar is assumed to be the foreign currency that substitutes for the relevant domestic currency.[12] The data used are quarterly observations and are seasonally adjusted at the source. For each country, the income measure is real GNP or real GDP, depending on availability; the price level is measured by the relevant GNP or GDP deflator; and the interest rate is a short-term one.[13] The money stock used is always the narrowly defined aggregate (M1), enabling us to focus on the possible impact of currency substitution on the ability to control the money stock held for transaction purposes — the measure most closely associated with changes in economic activity.[14]

Because the sample periods extend back to the mid-1960s, estimating equation 1 without regard to the possible effects of the change in exchange rate regimes that occurred in the early 1970s would cloud the interpretation of the $\hat{E}^*$ variable. To circumvent this problem without reducing the number of observations, we estimate the effects of currency substitution using (0, 1) interactive terms to separate the fixed and flexible exchange rate periods. Thus, $\hat{E}1$ equals the value of $\hat{E}^*$ for the fixed exchange rate period and zero elsewhere; $\hat{E}2$ equals the value of $\hat{E}^*$ for the flexible exchange rate period and zero elsewhere. In this manner, the differential effects of currency substitution, if they exist, can be contrasted under the two exchange rate regimes.

Estimates of equation 1 first were obtained excluding $\hat{E}^*$ as an explanatory variable. The individual country estimates (and their respective sample periods) are

[11]Cuddington also has investigated this issue for several countries. Unfortunately, he fails to recognize changes in exchange rate regimes and their possible effects on the estimated parameters.

[12]Tests also were conducted using the German DM forward premium to calculate $\hat{E}^*$. These results are consistent with those reported in the paper.

[13]The countries using GNP are Canada, Germany and the Netherlands. GDP is used for France and the United Kingdom. The interest rates used are: the three-month interbank deposit rate for Germany, the Netherlands and the United Kingdom; the three-month prime finance company paper rate for Canada; and the three-month interbank money rate against private paper for France.

[14]For an analysis of the relationship between M1 and economic activity in the countries examined here (excluding the Netherlands), see Batten and Hafer (1983).

Table 1
Standard Money Demand Estimation

Country/Sample Period	Constant	y	$R(\times 10^{-2})$	$(M/P)_{t-1}$	$\bar{R}^2$	SE	h(ρ)
CANADA	−0.026	0.048	−0.456	0.934	0.971	0.0165	−0.65
(I/1966–IV/1983)	(0.44)	(2.63)	(5.92)	(34.03)			
FRANCE	0.749	0.081	−0.200	0.789	0.897	0.0196	−0.94
(IV/1966–III/1983)	(2.19)	(2.83)	(2.16)	(10.19)			
GERMANY	−0.350	0.144	−0.449	0.880	0.997	0.0094	0.21
(I/1966–I/1984)	(4.11)	(4.76)	(10.11)	(33.35)			
NETHERLANDS	−0.034	0.194	−0.358	0.743	0.983	0.0167	0.44
(I/1966–IV/1982)	(0.33)	(3.44)	(4.33)	(10.38)			(0.34)
UNITED KINGDOM	0.028	0.057	−0.545	0.923	0.961	0.0192	−0.63
(I/1966–IV/1983)	(0.10)	(1.61)	(6.33)	(27.98)			

NOTE: Absolute value of t-statistics appear in parentheses. $\bar{R}^2$ is the coefficient of determination adjusted for degrees of freedom, SE is the regression standard error, h is the Durbin-h statistic and ρ is the estimated first-order serial correlation correction coefficient.

presented in table 1.[15] The estimated coefficients generally have the theoretically expected sign and are significant at acceptable statistical levels. The overall explanatory power of each equation is quite high; the $\bar{R}^2$s indicate that the right-hand-side variables explain at least 90 percent of the variance of real money holdings. Moreover, except for the Netherlands, the Durbin h-statistics indicate that the ordinary least squares estimates are not plagued by first-order autocorrelation. In the case of the Netherlands, a first-order correction adequately solves the problem.

With respect to available money demand estimates, the estimated coefficients in table 1 seem quite reasonable.[16] For instance, the estimated average speed of adjustment of actual real balances to desired $(1-\hat{\beta}_4)$ is about 15 percent per quarter. The average long-run income elasticity $(\hat{\beta}_1/(1-\hat{\beta}_4))$ is estimated to be 0.76, with only the German estimate (1.20) appearing out of line. The interest elasticities also appear reasonable; the average short-run elasticity is −0.034, although there is a wide range of point estimates.

To examine the extent of currency substitution, the variables Ê1 and Ê2 are added to the equations in table 1; these results are presented in table 2. As indicated earlier, if currency substitution between a particular foreign currency and the U.S. dollar is relevant, the estimated coefficients on these variables should be negative and statistically significant. The results in table 2, however, indicate that there is little statistical support for currency substitution in our sample of countries. The estimated coefficients on the Ê* terms generally are not statistically significant. Moreover, the estimated parameters do not always have the predicted negative sign.[17]

Only for Canada and Germany during the flexible exchange rate period is there a statistically significant (at the 5 percent level) effect.[18] Although the effect is

[15]Following Bordo and Choudhri, the domestic interest rate and the expected change in the exchange rate variables are estimated in nonlogarithmic form.

[16]See Boughton (1981) and references therein.

[17]We tested for the impact that exchange controls in the United Kingdom may have had on the reported results. Our evidence indicated that accounting for these controls and their abolition in 1979 did not alter the results reported in the text. Furthermore, we also estimated the set of equations using a seemingly unrelated regression procedure. These results were not qualitatively different from those presented.

[18]The Canadian result is contrary to that found by Bordo and Choudhri, and Cuddington. The difference in the results stems from the different sample periods used: Bordo and Choudhri, and Cuddington both ended their sample period in 1979, whereas our sample extends into 1983. When we estimated our equations through 1979, we also found no statistical effect of currency substitution: the estimated coefficient on Ê2 is -0.202 $(\times 10^{-2})$ with a t-statistic of −1.50. Adding the post-1979 observations provides the statistical significance of the Ê2 variable, because the variance of the Ê2 variable during the post-1979 period is much larger than before. For instance, the mean value of the absolute change in the forward premium is 0.83 for the period III/1970 to IV/1979. The variance during this period is 0.32. In contrast, from I/1980 to IV/1983, the mean value increases sharply to 1.30, and the variance also rises to 1.47. Thus, the statistical significance in our study relative to earlier works results from including more recent data.

Table 2

Money Demand Estimates Using U.S. Forward Premium

Country/Sample Period	Constant	y	$R(\times 10^{-2})$	$\hat{E}1(\times 10^{-2})$	$\hat{E}2(\times 10^{-2})$	$(M/P)_{t-1}$	$\bar{R}^2$	SE	$h(\rho)$
CANADA	−0.041	0.052	−0.452	0.018	−0.301	0.932	0.972	0.0162	−0.42
(I/1966–IV/1983)	(0.70)	(2.88)	(5.96)	(0.04)	(2.06)	(34.50)			
FRANCE	0.796	0.085	−0.205	−0.087	0.088	0.776	0.895	0.0198	−0.97
(IV/1966–III/1983)	(2.25)	(2.86)	(2.15)	(0.32)	(0.73)	(9.61)			
GERMANY	−0.312	0.161	−0.453	−0.062	−0.166	0.848	0.997	0.0092	−0.39
(I/1966–I/1984)	(3.53)	(5.23)	(10.29)	(0.81)	(2.07)	(28.07)			
NETHERLANDS	0.011	0.177	−0.276	−0.290	−0.126	0.753	0.983	0.0166	0.41
(I/1966–IV/1982)	(0.10)	(2.99)	(2.96)	(1.59)	(1.22)	(10.32)			(0.36)
UNITED KINGDOM	−0.077	0.072	−0.538	0.133	−0.043	0.929	0.960	0.0194	−0.98
(I/1966–IV/1983)	(0.26)	(1.84)	(5.83)	(0.67)	(0.51)	(25.76)			

NOTE: Absolute value of t-statistics appear in parentheses. $\bar{R}^2$ is the coefficient of determination adjusted for degrees of freedom, SE is the regression standard error, h is the Durbin-h statistic and ρ is the estimated first-order serial correlation correction coefficient.

statistically significant, the *economic* significance of currency substitution for each country is quite small. For example, a 1 percent increase in the forward premium/discount ($\hat{E}^*$) during the flexible-rate period induces Canadians to lower their holdings of Canadian real money balances by only 0.0007 percent, on average. Furthermore, since the largest quarterly change in $\hat{E}^*$ during the flexible exchange rate period was 4 percentage points, the largest quarterly change in Canadian real money holdings motivated by a change in the expected appreciation/depreciation of the U.S. dollar was 0.012 percent.[19] Likewise, a 1 percent increase in $\hat{E}^*$ for Germany during the flexible-rate period induces a 0.003 percent decline in real money holdings, on average, and the largest quarterly change in real money holdings caused by a change in $\hat{E}^*$ was 0.015 percent.

SUMMARY AND CONCLUSION

Theoretical discussions suggest that the presence of currency substitution may defeat the policy-insulating properties of a flexible exchange rate regime. Under a system of fixed exchange rates, monetary authorities must maintain the exchange rate within some fixed range. Consequently, policy actions taken by a foreign central bank that upset the prescribed exchange rate between domestic and foreign money require domestic monetary authorities to increase or decrease their money stock to stabilize the exchange rate. Under a flexible exchange regime, however, the rate is allowed to move with market forces. In this way, prices — that is, the exchange rate — adjust to clear the market for currencies without the need for intervention.

In a world of flexible exchange rates with currency substitution, policy responses may regress to those more common to a fixed exchange rate regime. This is because domestic holdings of money are influenced by changes in the opportunity costs of holding domestic and foreign currencies. When the possible impact of such currency substitution was subjected to empirical investigation, it generally was found to be statistically insignificant. In the two countries (Canada and Germany) where currency substitution was found to have a statistically significant effect, the magnitude of the effect on real money holdings was minimal. Thus, contrary to recent arguments, it does not appear that currency substitution significantly compromises monetary independence in a system of flexible exchange rates.

[19]The economic significance of currency substitution also is questioned by Laney, Radcliffe and Willett (1984). Based on estimates for the United States, they find that a 100 basis-point increase in the foreign opportunity cost of holding domestic dollar balances reduces holdings of domestic currency by only 0.025 percent. It should be noted, however, that the model from which this estimate is derived (based on Miles (1978a)) has been criticized by Bordo and Choudhri, and Spinelli.

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Interest Rate Risk and the Stock Prices of Financial Institutions

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MOST discussions of the effects of interest rate movements on the portfolios of financial institutions typically conclude that the relatively high and volatile interest rates of the past 15 years have placed many of these institutions in jeopardy of failing. The consensus of many of these discussions is that institutions with "unbalanced" portfolios and low capital are particularly susceptible to interest rate movements.[1]

The purpose of this paper is to analyze the effect of interest rate changes on the relative value of financial institutions.[2] This issue is important not only to the owners, managers and employees of financial institutions but to monetary policymakers as well. Monetary policy actions affect interest rates. If the viability of financial institutions is particularly sensitive to interest rate changes, monetary policymakers will want to take this effect into account.

FINANCIAL INSTITUTIONS AND INTERMEDIATION

Financial institutions intermediate many transactions between borrowers and lenders. In doing so, banks and savings and loans do not act merely as credit brokers, negotiating credit transactions between borrowers and lenders. Rather, they borrow directly from some individuals and lend directly to others. These transactions make up the portfolio of the financial firm. In large part, the market value of the firm is determined by the net present value of its portfolio of assets and liabilities. Changes in the interest rate affect the firm's market value because they influence the present value of the assets and liabilities in the firm's portfolio.

INTEREST RATE CHANGES AND THE RELATIVE PRICE OF FINANCIAL INSTRUMENTS

Since the interest rate is the price of the earlier availability of dollars, a change in the interest rate means that this price has changed.[3] For example, if the

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[1]See, for example, Maisel and Jacobson (1978), p. 688; Kaufman (1984); Bierwag, Kaufman, and Toevs (1983); Hopewell and Kaufman (1973); Flannery (1981); and Samuelson (1945).

[2]More correctly, it is *unexpected* changes in the interest rate that affect relative values. Any future change that is expected is reflected in current prices. Long-term interest rates are important determinants of stock prices, and changes in these interest rates can be characterized as unexpected (see footnote 15).

[3]Since this paper is mainly concerned with changes in the whole complex of interest rates (i.e., changes that leave the term structure unaltered), "the" interest rate is used as a shorthand method of referring to the complex of interest rates.

Table 1
Present Values and Interest Rate Changes

Date of Payment (Receipt) in Years	Payment (Receipt)	Present Value if i=10%[1]	Present Value if i=11%[1]	Percentage Change in Present Value
Now	$100.00	$100.00	$100.00	0.00%
1	110.00	100.00	99.10	−0.90
2	121.00	100.00	98.21	−1.79
3	133.10	100.00	97.32	−2.68

[1]These amounts are calculated by applying the present value formula for a single receipt (payment):

$PV = \frac{A}{(1+i)^n}$, where PV = present value
A = dollar amount to be received (paid)
i = interest rate in decimal form
n = number of years prior to the receipt (payment) of A

interest rate rises from a level of 10 percent to 12 percent, the price (or value) of present dollars rises in terms of future dollars. Before the change in the interest rate, borrowing a dollar today necessarily meant giving up 1.10 dollars one year from now or 1.21 dollars two years from now, etc. After the increase in the interest rate, borrowing a dollar today requires the sacrifice of 1.12 dollars one year from now or 1.25 dollars two years from now, etc.

Since financial instruments represent claims to dollars at different points in the future, changes in the interest rate affect the relative values of financial assets and liabilities. A rise in the interest rate has two important effects on financial claims. First, it reduces the present value of all such instruments in terms of present dollars. Second, and equally important, the present values of various instruments will change *in terms of each other;* the prices of claims to dollars in the more distant future will fall relative to the prices of claims to dollars in the near future.

Table 1 presents an example that illustrates the effect of an interest rate change on the present values of four different financial instruments. The instruments are similar in that each promises a single future dollar receipt (payment) of a given amount; they differ in both the amount to be received (paid) and timing of the receipt (payment). The first column of the table indicates when each receipt will occur. The second column shows the amount to be received. Columns three and four give the present values of the various instruments at two different interest rates. The last column shows the percentage change in present value that occurs when the interest rate rises.

The example is constructed so that the present value of each instrument is $100 at an interest rate of 10 percent. Because each is worth $100 at this interest rate, each will exchange one-for-one in the market. An increase in the interest rate, however, will completely alter this set of relative prices.

The increase in the interest rate from 10 percent to 11 percent causes the present value of each instrument that promises future dollars to fall. Those that represent earlier claims to dollars, however, become relatively more valuable compared with those that promise dollars in the more distant future as indicated by the smaller percentage reductions in the present values of these instruments.

Interest Elasticity: A Fundamental Measure of Interest Rate Risk

Discussions of the impact of an interest rate change on the prices of financial assets have a long history in economic literature and are typically referred to as the "elasticity of capital value with respect to the interest rate."[4]

This "elasticity" is simply the percentage change in the present value of an asset (liability) divided by the percentage change in the interest rate. The number that results approximates the percentage change in

[4]See Hicks (1939), pp. 184–88, and, more recently, Alchian (1955).

Table 2
Interest Rate Elasticities Calculated from Table 1

Date of Payment (Receipt) in Years	Percentage Change in Present Value	Percentage Change in Interest Rate	Approximate Elasticity
Now	0.00%	10%	0.000
1	−0.90	10	−0.090
2	−1.79	10	−0.179
3	−2.68	10	−0.268

the present value that will occur for a 1 percent change in the interest rate.[5]

Interest elasticity measures the sensitivity of the present value of an asset (liability) to interest rate changes. The larger the absolute value of the elasticity, the greater is the percentage change in present value for a given percentage change in the interest rate and, consequently, the more sensitive is the value of the asset to interest rate changes.[6]

Table 2 uses the data in table 1 to calculate the approximate interest elasticities of the various instruments. The larger elasticity (in absolute value) for the more distant receipts indicates that their present values are more sensitive to interest rate changes.

The examples in tables 1 and 2 consider only assets that consist of single receipts at different dates in the future. The same procedure, however, works for assets that yield any conceivable stream of future receipts. All that is required to calculate an interest elasticity is the ability to calculate present values at different interest rates. This is comparatively easy, provided that present value tables and a hand calculator are readily available. For example, table 3 shows how to use the present value table (shown at the bottom of table 3) to compute the interest elasticity of an asset yielding a varying stream of receipts (one of which is negative) over a five-year period when the interest rate is around 10 percent. The elasticity is −.275, indicating that a 1 percent increase in the interest rate reduces the present value of the asset by slightly more than .27 percent.

Duration: Another Measure of Interest Rate Risk

More recently, the concept of interest rate elasticity has been applied in the area of financial management where it has appeared in the guise of the "duration of the financial portfolio and interest rate risk."[7] Usually, different names are used to identify different things. In this case, however, there seems to be a distinction with no real difference.

Like elasticity, duration is a number that ranks the interest rate sensitivity of various assets. Unlike elasticity, however, which is a "pure" number (i.e., is not dimensioned in any particular unit), duration is expressed in units of time. The duration of an asset is the "average" length of time that receipts are deferred from the present. In calculating the average, the time period that each receipt is deferred is weighted by the discounted value of the receipt.[8] As the duration of an asset increases (as the average length of time one must wait for payment rises), the interest rate sensitivity of the asset also increases.

Interest rate elasticity and duration are closely related concepts. In fact, for given interest rates, the duration of *any* asset is simply its interest elasticity

[5] It is an approximation because the calculation holds only for *small* changes in the interest rate.

[6] Since present values and interest rates are inversely related, the elasticity measure will always be negative.

[7] "Duration has now emerged as an important tool for measuring and managing interest rate risk." Bierwag, Kaufman, and Toevs, p. 15. See, as well, Hopewell and Kaufman.

[8] Hicks, p. 186.

Table 3

The Interest Elasticity of a Stream of Payments: An Example

Date of Receipt in Years[1]	Amount Received	Present Value if i=10%	Present Value if i=11%
Now	$ 0.00	$ 0.00	$ 0.00
1	40.50	36.82	36.49
2	523.20	432.69	424.84
3	−15.40	−11.57	−11.26
4	782.00	534.11	515.34
5	60.30	37.45	35.82
Net Present Value		$1,029.50	$1,001.23

Elasticity = {(1001.23 − 1029.50)/1029.50}/{(.11 − .10)/.10} = −.275

Sample Present Value Table: Present Value of a Future $1.00 at End of Specified Year at Various Interest Rates

Year	10%	11%
1	.909	.901
2	.827	.812
3	.751	.731
4	.683	.659
5	.621	.594

[1]Payments are assumed to occur at the end of the year indicated.

multiplied by the factor $-(1+i)/i$.[9] Consequently, the duration and interest rate elasticity produce identical rankings of assets and liabilities in terms of their interest rate sensitivity or risk.

If the interest rate elasticity of an asset is known (and it is always relatively simple to estimate), its duration can be immediately obtained. For the examples used in table 1, the approximate durations of the various assets are 0.00, 0.99, 1.97 and 2.95 years, respectively. The

[9]The elasticities of the present values of various types of assets (liabilities) with respect to the interest rate are given by:

A. In the case of a single receipt (payment) of A dollars n years in the future, the present value is:

$$P = \frac{An}{(1+i)^n} \quad \text{and}$$

$$\frac{dP}{di}\frac{i}{P} = -n\frac{i}{(1+i)}. \quad \text{Duration} = \frac{dP}{di}\frac{i}{P}\left[-\frac{(1+i)}{i}\right] = n.$$

In this case, duration is equal to n, the number of years one must wait before receipt (payment) of A.

B. In the case of a stream of receipts (payments) of various expected amounts, A_t, at the end of each year for n years, the present value is:

$$P = \sum_{t=1}^{n} \frac{A_t}{(1+i)^t}$$

$$\frac{dP}{di}\frac{i}{P} = -\left[\sum_{t=1}^{n}\frac{t\,A_t}{(1+i)^t} \Bigg/ \sum_{t=1}^{n}\frac{A_t}{(1+i)^t}\right]\frac{i}{(1+i)}$$

$$\text{and Duration} = \frac{dP}{di}\frac{i}{P}\left[-\frac{(1+i)}{i}\right].$$

The duration of this instrument is measured by the term in brackets, i.e., the "*average length of time for which the various payments are deferred from the present, when the times of deferment are weighted by the discounted values of the payments* (emphasis in the original)." Hicks, p. 186.

C. In the case of a perpetual stream of receipts (payments) of equal annual amounts, A, present value is:

$$P = \frac{A}{i} \text{ and}$$

$$\frac{dP}{di}\frac{i}{P} = -\frac{(1+i)}{i}\frac{i}{(1+i)} = -1 \text{ or } \frac{(1+i)}{i} = \frac{dP}{di}\frac{i}{P}\left[-\frac{(1+i)}{i}\right].$$

The duration of this instrument is $(1+i)/i$ and the percentage change in its price is equal to the percentage change in the interest rate. Note that in each of the three cases duration is always equal to interest rate elasticity, $\frac{dP}{di}\frac{i}{P}$, multiplied by $-(1+i)/i$.

approximate duration of the asset shown in table 3 is 3.02 years.[10]

The Effect of Interest Rate Changes on "Unbalanced" Portfolios

Changes in the rate of interest generally will change the present value of a firm's assets relative to its liabilities. When this occurs, the market value of the firm will change. If the firm's shares are publicly traded, the change in the firm's value will be reflected by a change in the price of its shares. Thus, the market value of a firm is sensitive to interest rate changes, and this sensitivity generally will differ across firms.

As in the case of particular assets or liabilities, the sensitivity of the value of the firm to interest rate changes can be measured by the elasticity of the present (market) value of the firm with respect to the interest rate.[11] Unlike the case for a particular asset or liability, however, the interest rate elasticity of the present value of the firm may be positive, negative or equal to zero. If positive, the market value of the firm will rise as interest rates rise and fall as interest rates fall. If negative, the reverse is true; if zero, the net present value of the firm is unaffected by interest rate changes.

Table 4 presents an example of each possibility. In panel A, the interest elasticity of net present value is negative. Interest elasticity is positive in panel B and equal to zero in panel C. The example is constructed so that the net present values are identical when the interest rate is 10 percent. In addition, the construction is such that the ratio of assets to liabilities (leverage) is initially the same for each firm.

An increase in the interest rate from 10 percent to 11 percent causes the net present value of the firm in panel A to fall by \$3.62, rise by \$1.19 in panel B and remain unchanged in panel C. The explanation for this differential effect is that the increase in the interest rate lowers the present value of firm A's assets relative to the present value of its liabilities, causing its net worth to fall. The reverse is true for firm B, while for firm C the present values of assets and liabilities fall proportionally, leaving its net worth unchanged.

DURATION: SOME COUNTERINTUITIVE ANOMALIES

Since the duration of an asset or liability is in terms of units of time, it may appear to be a more intuitively appealing measure of interest rate sensitivity than elasticity, which is a pure number. However, duration has some counterintuitive qualities that emerge when it is applied directly to the net flow of receipts generated by the firm (i.e., when the firm is treated as a single asset).

There Is Less in Duration Than Meets the Eye

While duration presumably measures the average length of time that receipts and payments are deferred from the present, the measurement can produce some unusual results. This is apparent in panel A where the duration of the portfolio is approximately 8.76 years, while the durations of the asset and liability are only 5.0 and 1.0 years, respectively. Intuitively, it would seem that the duration of the portfolio should be no more than 5.0 years. The asset will mature after five years, so a measured duration of 8.76 years is somewhat unusual in terms of the way averages (even weighted averages) are normally computed. This odd result occurs because duration employs an unusual method in weighting the streams of receipts and payments (see footnotes 9 and 11).

As a further illustration, notice that the duration of the portfolio in panel B is negative. In a mechanical sense, this result is not surprising. Duration is always equal to interest elasticity multiplied by $-(1+i)/i$. For the firm in panel B, interest elasticity is positive and $-(1+i)/i$ is negative. So duration, the product of the positive and negative numbers, is negative. However, a portfolio with a negative average life is surely counterintuitive. This result indicates that duration is more appropriately thought of as a proxy for the interest rate

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[10] These are approximate durations because the elasticities computed in the tables are estimates of the true elasticity (see footnote 6). The exact durations are 0.00, 1.00, 2.00, 3.00 and 3.10 years (see footnote 9).

[11] Let A_t and C_t be, respectively, the dollar value of the firm's receipts and the dollar value of its payments in period t. If the life of the firm is n years, the market value of the firm in period t, M_t is:

$$M_t = \sum_{t=1}^{n} \frac{A_t}{(1+i)^t} - \sum_{t=1}^{n} \frac{C_t}{(1+i)^t}$$

$$\frac{dM_t}{di}\frac{i}{M_t} = -\frac{i}{(1+i)}\left[\frac{\Sigma \frac{t \cdot A_t}{(1+i)^t} - \Sigma \frac{t \cdot C_t}{(1+i)^t}}{\Sigma \frac{A_t}{(1+i)^t} - \Sigma \frac{C_t}{(1+i)^t}}\right]$$

As long as the market value of the firm is positive, i.e., the denominator exceeds zero,

$$\frac{dM_t}{di}\frac{i}{M_t} \gtrless 0 \text{ as } \left[\Sigma \frac{t \cdot A_t}{(1+i)^t} - \Sigma \frac{t \cdot C_t}{(1+i)^t}\right] \lesseqgtr 0$$

See Samuelson, p. 19.

Table 4

Net Present Values and Interest Rate Changes: Elasticity and Duration Measures

Panel A: Asset = Single receipt of $146.41 five years hence
Liability = Single payment of $50 one year hence
Elasticity of Net Present Value with Respect to the Interest Rate = (−3.62/45.46)/(.01/.1) = −.796
Portfolio Duration = (−.796)(−1.1/.1) = 8.76 years

i = 10%		i = 11%	
Assets:	Liabilities:	Assets:	Liabilities:
$\frac{\$146.41}{(1.1)^5} = \$90.91$	$\frac{\$50}{1.1} = \$45.45$	$\frac{\$146.41}{(1.11)^5} = \$86.89$	$\frac{\$50}{1.11} = \$45.05$
	Net Worth:		Net Worth:
	$45.46		$41.84

Change in net worth valued at market = −$3.62

Panel B: Asset = Single receipt of $100 one year hence
Liability = Single payment of $73.20 five years hence
Elasticity of Net Present Value with Respect to the Interest Rate = (1.19/45.46)/(.01/.1) = .262
Portfolio Duration = (.262)(−1.1/.1) = − 2.88 years

i = 10%		i = 11%	
Assets:	Liabilities:	Assets:	Liabilities:
$\frac{\$100.00}{1.1} = 90.91$	$\frac{\$73.20}{(1.1)^5} = \$45.45$	$\frac{\$100.00}{1.11} = \$90.09$	$\frac{\$73.20}{(1.11)^5} = \$43.44$
	Net Worth:		Net Worth:
	$45.46		$46.65

Change in net worth valued at market = +$1.19

Panel C: Asset = Single receipt of $100 one year hence
Liability = Single payment of $55 two years hence
Elasticity of Net Present Value with Respect to the Interest Rate = (0.00/45.46)/(.01/.1) = 0.00
Portfolio Duration = (0.00)(−1.1/.1) = 0.00

i = 10%		i = 11%	
Assets:	Liabilities:	Assets:	Liabilities:
$\frac{\$100}{1.1} = \$90.91$	$\frac{\$55}{(1.1)^2} = \$45.45$	$\frac{\$100}{1.11} = \$90.09$	$\frac{\$55}{(1.11)^2} = \$44.63$
	Net Worth:		Net Worth:
	$45.46		$45.46

Change in net worth valued at market = 0.0

elasticity of the portfolio rather than an indicator of the portfolio's average life.

Thus, at best, duration produces a consistent ranking of assets, liabilities and portfolios in terms of interest rate risk. The ranking is identical to the one that would be obtained by calculating interest rate elasticities. Calculating duration, however, requires an extra computational step and produces a result that reveals very little intuitive information about the average life of the portfolio.

Leverage Affects Portfolio Duration

An increase in the firm's leverage (an increase in liabilities relative to assets) affects the duration of the portfolio. Again, consider panel A of table 4. Suppose that the present values of these particular assets and liabilities were increased by equal amounts so that the firm's net worth remained constant. This increase in the leverage of the firm would also increase the interest elasticity of the portfolio. Since duration is simply the interest elasticity multiplied by $-(1+i)/i$ and, in this case, interest elasticity is negative, the duration of the portfolio will increase even though the average lives of the assets and liabilities were not changed.

Matching Asset/Liability Duration Does Not Eliminate Interest Rate Risk

Matching asset and liability durations will *not* insulate the net worth of the firm (valued at market) against interest rate changes. This is particularly apparent in panel C of table 4. The duration of the firm's asset is one year, while the duration of its liability is two years. Although the firm has a mismatch of asset/liability durations, a change in the interest rate leaves its net present value unaffected.

Insulating the firm against changes in the interest rate requires that the interest elasticity of the portfolio be zero. If the firm's net worth is positive, as must be the case for any viable firm, achieving this result requires that the duration of the firm's liabilities must exceed the duration of its assets. That is, the weighted average length of time for which payments are deferred from the present must exceed the weighted average length of time for which receipts are deferred from the present.[12]

INTEREST RATE RISK AND FINANCIAL INSTITUTIONS

There is reason to believe that financial firms are best characterized by the firm shown in panel A of table 4. Notice that in examples B and C, the firm's asset matures in one year, while its liabilities extend beyond one year. Once the asset matures, the net present value of the firm is negative (and will continue negative throughout its remaining life) unless the owners reinvest the proceeds of the matured asset.

What are the incentives for the owners to reinvest? If the firm is a corporation and, hence, creditors have no claim on the personal assets of the owners, there is relatively little incentive. The wealth of the owners will be greater if they simply take the proceeds of the matured asset ($100) as a dividend and declare the firm bankrupt. Their wealth will rise by the present value of the liabilities. The incentive to behave in this fashion is greater the larger the liabilities are relative to assets, that is, the greater the firm's leverage.

Financial institutions tend to be highly levered.[13] On average, net worth represents about 5 percent of total assets for these firms. Under these conditions, it is unlikely that financial institutions could attract many depositors if they maintained maturity structures of assets and liabilities similar to those shown in panels B and C. Public trust makes up much of the capital of financial institutions, both literally and figuratively. These institutions provide assurance against the kind of behavior discussed above by maintaining asset/liability maturity structures similar to that shown in panel A rather than those shown in panels B and C.

This implies that the interest elasticity of the present value of financial institutions will be negative. Positive changes in the interest rate will be associated with reductions in their market values, while negative changes in the interest rate will be associated with increases in their market values. Moreover, the absolute value of the interest rate elasticity should be larger for savings and loan associations than for banks, because they lend on a much longer-term basis than do

[12] The above example considers only a single receipt and payment, only a single interest rate, and only one type of asset and liability. The real world, of course, is considerably more complicated and, hence, the example used here may appear to be unrealistic. However, the same results would be obtained if a more realistic example were employed; all that would be gained by more realism is more complexity.

[13] For example, the ratio of capital to total assets averaged .042 for the 35 banks listed in Salomon Brothers (1983), p. 54, over the most recent five-year period. The ratio for all savings and loans is .053 over the same period (Savings and Loan Sourcebook, various years). In contrast, the ratio of capital to total assets for all manufacturing firms averaged .500 over the same period.

banks while both borrow on a short-term basis.[14]

The highly levered portfolios of all financial institutions, as well as the maturity structures of savings and loan portfolios, suggest that the share prices of financial institutions will not only decline, but decline relative to the share prices of other firms when the interest rate rises and, conversely, when the interest rate falls. Because of this, the stock prices of financial institutions should exhibit greater variation around their mean levels than firms that are less highly levered and that maintain more balanced portfolios.

SOME ESTIMATES OF INTEREST RATE ELASTICITIES

The above discussion implies that, other things equal, the owners of financial institutions accept more interest rate risk than the owners of nonfinancial firms. To what extent does an analysis of share prices for publicly traded firms support this implication?

To investigate this issue, quarterly data on the percentage change in various indexes of share prices were regressed on the percentage change in the corporate Aaa bond rate over the period from 1961 to 1983 to produce estimates of the interest rate elasticities confronting different types of firms.[15] The share price indexes used are the Standard and Poor's indexes of share prices of 400 industrial companies, banks outside of New York City, New York City banks, and savings and loan holding companies. The regressions also include the growth rate of real GNP to control for cyclical factors. The results are shown in table 5.[16]

Table 5
Estimates of Interest Rate Elasticity Sample Period: I/1961–IV/1983

Estimate 1:

$$\Delta LnIND = 1.68 + 1.46\,\Delta Lny - .41\,\Delta LnRL$$
$$(.44)\quad (2.37)^{*}\quad (2.78)^{*}$$

RSQ = .13

Rho 1 = −.26
(2.56)*

Estimate 2:

$$\Delta LnBK = .25 + 1.98\,\Delta Lny - .94\,\Delta LnRL$$
$$(.06)\quad (2.61)^{*}\quad (4.98)^{*}$$

RSQ = .27

Rho 1 = −.30
(2.98)*

Rho 2 = .23
(2.32)*

Estimate 3:

$$\Delta LnBK' = 3.85 + 1.10\,\Delta Lny - .86\,\Delta LnRL$$
$$(.91)\quad (1.39)\quad (4.43)^{*}$$

RSQ = .19

DW = 1.67

Estimate 4:

$$\Delta LnSL = 10.29 + 1.32\,\Delta Lny - 2.41\,\Delta LnRL$$
$$(1.07)\quad (.87)\quad (6.70)^{*}$$

RSQ = .34

Rho 1 = −.29
(2.94)*

where:

ΔLnIND = the percentage change in an index of the share prices of industrial firms

ΔLnBK = the percentage change in an index of the share prices of banks located outside New York City

ΔLnBK′ = the percentage change in an index of the share prices of New York City banks

ΔLnSL = the percentage change in an index of savings and loan share prices

ΔLny = the growth rate of real GNP

ΔLnRL = the percentage change in the corporate Aaa bond rate

NOTE: Absolute values of t-scores appear in parentheses.
*Significantly different from zero at the 5 percent level.

[14]All federally insured savings and loan associations are required by law to hold the bulk of their assets in the form of home mortgage loans with remaining maturities of not less than eight years (Federal Home Loan Bank Act of 1932, sec. 2, p. 1). It was not until 1980 that federally insured institutions were allowed to invest up to 20 percent of their assets in shorter-term loans (Savings and Loan Sourcebook 1982, p. 54).

[15]The first differences of the corporate Aaa bond rate can be characterized as representing unexpected changes in the interest rate. The hypothesis that the series represents white noise cannot be rejected. The Chi-square statistic based on 24 lags is 30.22. In addition, three sets of initial regressions attempted to control for changes in the term structure of interest rates by including the percentage change in the three-month Treasury bill rate, the percentage change in the ratio of the three-month Treasury bill rate to the corporate Aaa bond rate and the percentage change in the difference between one plus the three-month Treasury bill rate and the corporate Aaa bond rate. However, these variables proved insignificant and were dropped from subsequent regressions.

[16]In the case of estimates 1, 2 and 4 the procedure used was generalized-least-squares regression. Estimates 1 and 4 were corrected for first-order autocorrelation. Estimate 2 was corrected for first- and second-order autocorrelation. No correction was required for estimate 3.

In each of the regressions reported, the estimated coefficient of the percentage change in the long-term interest rate (corporate Aaa bond rate) — which is an estimate of the interest elasticity of the stock prices of the firms — is both negative and statistically significant. Increases in the long-term interest rate are associated with reductions in the capital values of both industrial and financial firms.

The estimated coefficient of the growth rate in real GNP (the proxy for cyclical factors) is positive in each estimate. The positive sign of the coefficient indicates that expansions in economic activity are associated with increases in the stock prices of both industrial and financial firms. The coefficient is statistically significant, however, only in estimates 1 and 2.

Differential Interest Rate Elasticities

The results in table 5, as expected, show that a given percentage change in the long-term interest rate produces differential effects on the share prices of the different types of firms. For example, a 1 percent increase in the long-term interest rate is associated with an average reduction of 0.4 percent in the net present value of industrial firms, a 0.9 percent reduction in the net present value of banks, and a 2.41 percent reduction in the net present value of savings and loan associations.

Since the coefficients of the percentage change in the long-term interest rate are estimates of interest rate elasticity, the results indicate that, on average, the stock prices of savings and loans are about two and a half times more sensitive to changes in the long-term interest rate than are the stock prices of banks, and about five times more sensitive to such changes than are the stock prices of industrial firms. These differences are statistically significant.[17]

The relative ranking of the various types of firms indicated by these estimates of interest elasticity is consistent with that suggested by the previous discussion: financial firms are more highly levered than other firms, and savings and loans maintain asset/liability portfolios that are heavily weighted by long-term assets and short-term liabilities.

[17]When the ratio of the index of the prices of bank stock to the index of the prices of industrial stock was regressed on the same set of right-side variables as appear in table 5, the coefficient of the long-term interest rate was negative and statistically significant for both of the proxies for the price of bank stock. The test was repeated using the ratio of the indexes of the prices of savings and loan stock to the prices of bank stock with the same results. In sum, unexpected increases in the long-term interest rate cause the stock prices of savings and loan associations to decline relative to the stock prices of banks, which decline relative to the stock prices of industrial firms.

CONCLUSIONS

The share prices of financial institutions (and the wealth of their owners) are more sensitive to interest rate changes than are the share prices of industrial firms. This is true because financial institutions are highly levered relative to other firms and because the portfolios of savings and loan associations are composed of relatively long-term financial assets and relatively short-term financial liabilities. Because the market value of these institutions is particularly sensitive to changes in the long-term interest rate, financial firms (particularly savings and loan associations) are subject to greater interest rate risk.

Simply matching asset and liability durations will not insulate the firm against interest rate risk. In fact, complete insulation is probably undesirable. Interest risk can only be eliminated if these firms were to borrow long and lend short, that is, if they were to completely reverse their traditional practices. However, structuring portfolios in this way can be costly to financial institutions if, as suggested here, it reduces the credibility of the commitments these institutions make to depositors.

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The Impact of Inflation Uncertainty on the Labor Market

A. Steven Holland

As inflation rates have risen around the world over the last 20 years the impact of inflation has become a topic of widespread interest. Evidence suggests that higher inflation imposes real costs on society by leading to increased uncertainty about future inflation and, as a result, a misallocation of resources.[1] This article examines the impact of inflation uncertainty on the allocation of labor resources and shows that the economy produces less output with a given quantity of productive resources when inflation uncertainty is higher.[2]

LABOR MARKET RESPONSE TO UNANTICIPATED INFLATION

The labor market's reaction to unanticipated inflation depends upon the flexibility of nominal wages. As a general rule, both the quantity of labor services that workers supply and the quantity that business firms demand depend upon the real wage rate — the nominal wage rate adjusted for the level of prices. The interaction of the supply and demand for labor determines the equilibrium value of the real wage; the nominal wage adjusts upward or downward as inflation or deflation occurs. Figure 1 shows the labor market in equilibrium at a real wage w_1^* with employment Q_1^*, when the supply of labor is S_1 and the demand for labor is D_1. If the nominal wage were completely flexible — that is, if it adjusted instantly to keep the real wage constant in the face of changing rates of inflation — then unanticipated inflation would have no effect on the labor market. Nominal wages simply would rise or fall, maintaining equilibrium at w_1^* and Q_1^*.

Nominal Wage Rigidity

Wages are not perfectly flexible, however, because of contractual arrangements that prevent their immediate adjustment to changes in prices. For example, in a contract for union workers, the nominal wage is fixed for a specified period of time. Although less than 25 percent of the U.S. labor force is unionized, the impact of union wage contracts extends far beyond this group. If there is a threat of unionization, for example, the wage increases won for union laborers will affect the wages that nonunionized firms offer their employees.[3]

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[1] For a discussion of the relationship between inflation and inflation uncertainty, see Holland (1984). The best-known discussion of the potential adverse impacts of inflation uncertainty is by Friedman (1977).

[2] Inflation uncertainty also may affect markets other than the labor market. For a discussion of its impact on product markets, see Carlton (1982); on financial markets, see Kantor (1983). For a broad overview, see Fischer (1982). An alternative approach to that used in this paper would be to consider information a productive resource and analyze the effects of a reduction in the level of this resource.

[3] Hamermesh and Rees (1984) discuss the arguments for and against the notion that the wages of nonunion workers emulate those of union workers.

Figure 1
Initial Labor Market Equilibrium

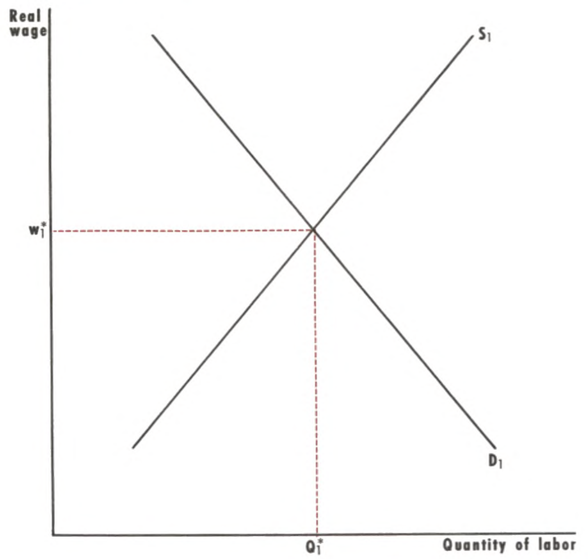
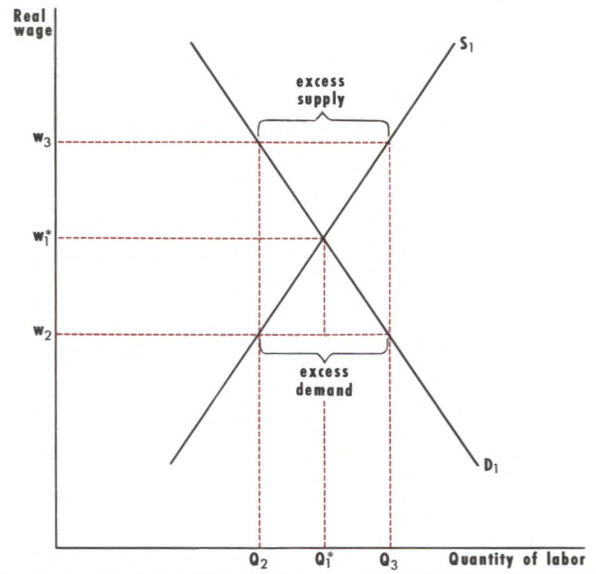


Figure 2
The Effect of Unanticipated Inflation with Rigid Nominal Wages



In addition, there are many *implicit* agreements between employers and employees that keep nominal wages fixed for a specified period.[4] Oftentimes, both employers and employees recognize that it would be too costly for nominal wages to adjust to every temporary deviation of actual events from the expected.

The contracted nominal wage is determined in essentially the same manner as in the flexible-wage case. The only difference is that w_1^* in figure 1 is now the equilibrium *expected* real wage — the nominal wage adjusted for the expected level of prices — rather than the equilibrium actual real wage.[5]

If nominal wages are rigid in the short run, the actual differs from the expected real wage when there is unanticipated inflation. If the inflationary shock is permanent, then the nominal wage contract must ultimately be renegotiated. Recontracting, however, will not occur immediately unless the shock is of sufficient magnitude (in absolute terms) for the gains from immediate recontracting to exceed the costs. Otherwise, an unanticipated short-run redistribution of wealth occurs.

Furthermore, assuming a downward-sloping demand for labor curve and an upward-sloping supply of labor curve, a deviation in either direction of actual from anticipated inflation results in reduced employment. This is illustrated in figure 2. With inflation higher than previously expected, the actual real wage is w_2 which is less than the equilibrium expected real wage w_1^*. This results in a reduction of employment from Q_1^* to Q_2 and an excess demand for labor $(Q_3 - Q_2)$. With lower-than-expected inflation, the actual real wage is w_3 which is greater than w_1^*. This also results in a reduction of employment (again drawn at Q_2 for ease of exposition) but with excess supply of labor $(Q_3 - Q_2)$. Notice that both the supply and demand curves are more steeply sloped in figure 2 than in figure 1. This is because the elasticity of both supply and demand with respect to the actual real wage should be less in absolute value for this short-run case than it is in the long run, because both workers and firms would like to avoid immediate recontracting if possible.[6]

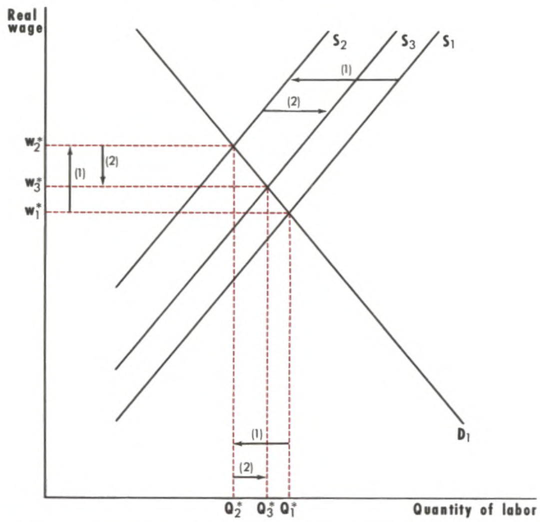
In reality, nominal wages have varying degrees of flexibility because of differences in the characteristics

[4]See Azariadis (1975) and Baily (1974).

[5]I assume that both the suppliers and demanders of labor expect the same rate of inflation to occur.

[6]Many theorists, including Gray (1976), Fischer (1977a) and Katz and Rosenberg (1983) use models in which nominal wages are determined by contract and business firms adjust employment in accordance with the realized value of the real wage. Therefore, in these models, employment is completely demand-determined, and higher-than-expected inflation results in a higher level of employment because of the lower real wage. For a critique of this type of model, see Barro (1977).

Figure 3
The Initial Impact of Greater Inflation Uncertainty and the Offsetting Effects of Labor Market Adjustments
(Risk-Averse Workers and Risk-Neutral Firms)



of wage contracts. Therefore, some combination of the flexible- and rigid-wage models describes actual labor market behavior.

INITIAL EFFECTS OF GREATER INFLATION UNCERTAINTY

Greater uncertainty about inflation increases the risk of entering into wage contracts. There is a much greater potential for error in forecasting inflation, which increases the potential deviation of actual from expected real wages. Under reasonable assumptions, this increase in risk has the effect of reducing employment and increasing the costs of negotiating a given labor contract.

This analysis assumes that workers are risk-averse, business firms are risk-neutral and nominal wages are fairly rigid.[7] As the level of inflation uncertainty increases, risk-averse workers reduce the supply of labor offered to the market.[8] They redirect their activities toward those that are affected less by unanticipated inflation. Aside from opting for greater income from more effectively hedged capital holdings, they devote more time to leisure or to labor provided outside the market — for example, labor exchanged directly for goods and services or labor for one's own benefit such as home improvements. This is illustrated in figure 3 by a movement of the supply curve from S_1 to S_2. Because the demand for labor by risk-neutral business firms is unaffected by greater inflation uncertainty, the demand curve (D_1) remains stationary. Labor contracts will be revised so that the equilibrium expected real wage rate rises from w_1^* to w_2^* and the equilibrium level of employment falls from Q_1^* to Q_2^*.[9] Reduction of employment will also reduce the level of real output and possibly increase the rate of unemployment.[10]

Greater inflation uncertainty increases the complexity of wage negotiations, because of the potential for increased loss to both the employer and employee from incorrectly choosing the nominal wage-adjustment mechanism or contract duration. If wages are not indexed, it becomes more difficult to determine the appropriate nominal wage changes to incorporate in the contract. If wages are indexed, there remain the problems of choosing the "best" index to use for nominal wage adjustments and the extent to which wages will be adjusted for changes in the index. Other potential considerations are whether to set caps on the size of cost-of-living adjustments and the conditions under which contract negotiations will be reopened before expiration of the contract. Thus, the costs of negotiating a labor contract increase with inflation uncertainty.[11]

[7]The assumption of risk-averse workers and risk-neutral firms is used frequently in the literature on labor contracting; see, for example, Azariadis. One reason, as explained by Gordon (1974), is that it is more difficult to reduce the risk associated with owning human capital than physical capital. For example, people tend to be specialized in their labor skills, whereas their other capital holdings tend to be diversified.

[8]Amihud (1981) presents a model that leads to this result.

[9]If both firms and workers are risk averse, then employment falls even more, but the effect on the equilibrium real wage is indeterminate.

[10]The measured rate of unemployment may increase despite the occurrence of equilibrium in the labor market, because of people continuing to search for a job even though they're unwilling to accept one at the prevailing wage rate. Recent studies by Mullineaux (1980), Levi and Makin (1980), Ratti (1983) and Amihud indicate that greater inflation uncertainty reduces employment and output growth and increases unemployment.

[11]One indicator of the higher costs of negotiating labor contracts would be an increase in strike activity, since the increased complexity of negotiations makes it more difficult to reach a settlement. Labor economists have known for many years that past inflation has a significant positive impact on the incidence of labor strikes. See, for example, Ashenfelter and Johnson (1969). The standard explanation is that this reflects catch-up demands on the part of labor for inflation they did not anticipate and, therefore, were not compensated for at the time of previous contract negotiations. Given the evidence that inflation uncertainty is positively related to past inflation (see Holland), this finding is consistent with the notion that greater inflation uncertainty leads to more strike activity.

Inflation uncertainty also makes it more difficult to distinguish changes in the rate of inflation from changes in relative prices: an increase in inflation uncertainty reduces the extent to which a producer alters his output in response to a change in the relative price of his product.[12] The reason is that a producer will be less likely to regard an unexpectedly higher price for his product as an increase in its relative price. Instead, he will regard it as a reflection of his own inability to accurately predict the rate of inflation. In this way, the allocative efficiency of the price system is reduced, since labor and other resources will not necessarily be directed toward their most productive uses.[13] All things equal, if the marginal product of labor declines, the demand for labor and the equilibrium real wage falls. This would imply an even greater reduction in employment than that illustrated in figure 3.

ADAPTING TO INFLATION UNCERTAINTY

There are two basic ways to reduce the risk of wage contracting in an environment of inflation uncertainty: (1) shorten the duration of contracts, thus lessening the potential loss from an incorrect prediction of inflation, or (2) index contracts, with wage adjustments linked to changes in the price level. Each of these adaptations will increase the responsiveness of nominal wages to an inflationary shock.

There is evidence that greater inflation uncertainty has served to reduce the duration of labor contracts. Using data from the unionized sector of the Canadian labor market for 1966–75, Christofides and Wilton (1983) find a significant negative relationship between inflation uncertainty and the length of contracts. Thus, greater inflation uncertainty diverts more resources to the contracting process from other (previously more valuable) uses, not only because negotiations are more complex, but also because negotiations occur more frequently.

Greater inflation uncertainty also is associated with more widespread indexation of labor contracts. Chart 1 plots a measure of inflation uncertainty — the root-mean-squared error (RMSE) of 12-month inflation forecasts from the Livingston survey — and a measure of the prevalence of indexation — the number of workers covered by cost-of-living adjustment (COLA) clauses as a percentage of the total number of workers subject to major collective bargaining agreements.[14] When viewed over the last 20 years, inflation uncertainty shows a rising trend, although with substantial variability. Over the last 10 years, however, the trend has virtually disappeared.[15] Indexation increased substantially in the 1960s and 1970s as well, before levelling off. From 1967–77, COLA coverage rose from about 25 percent to its peak of over 60 percent and has remained fairly stable since then.

Simple correlations suggest that inflation uncertainty has a lagged effect on the prevalence of indexation. The correlation coefficients are not significant between COLA coverage and RMSE in the current or previous year. The correlation of COLA coverage with RMSE two years before (0.44), however, is significant at the 10

[12]For a producer to increase output in the short run, he must be able to increase employment. This requires either some flexibility of nominal wages or demand-determined employment in the short run.

[13]See Lucas (1973) and Friedman. The confusion between relative and absolute price changes implies that the greater the inflation uncertainty, the less the effects on the firm's output, labor demand and wages of an actual change in the relative demand for its product. Therefore, greater inflation uncertainty reduces the impact of an increase in the variance of changes in relative product demands on the variance of changes in relative wages, assuming that nominal wages are flexible. To the extent that changes in relative wages assist in allocating labor in the most efficient manner, this indicates a potential loss of efficiency. This may explain Hamermesh's (1983) finding that greater inflation uncertainty reduces the variance of changes in relative wages in the United States.

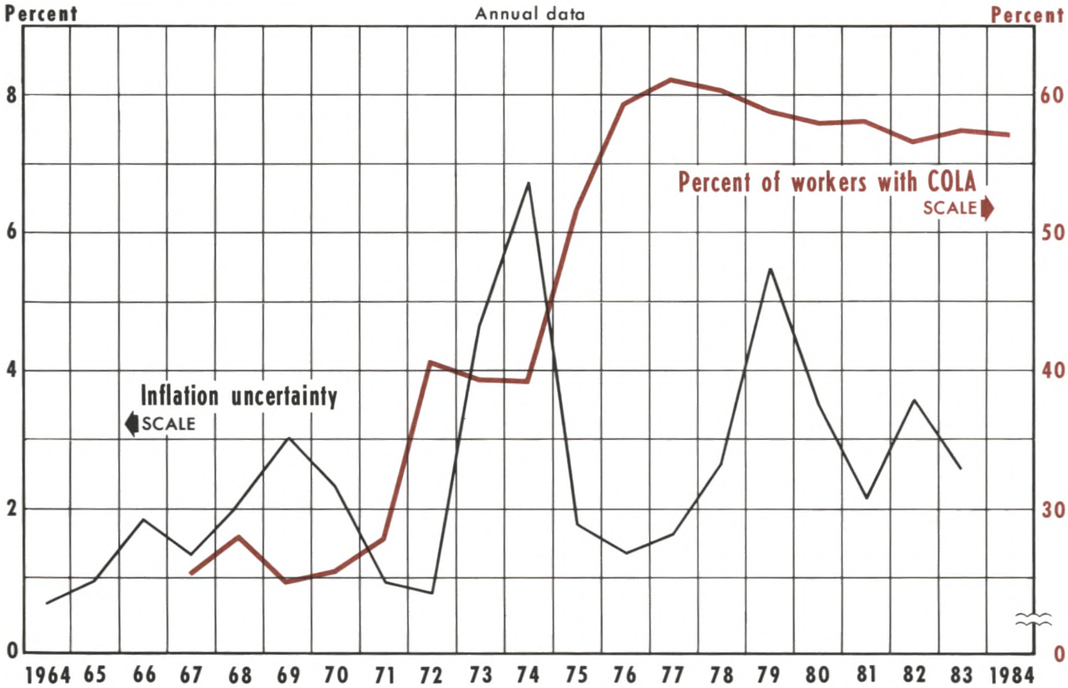
Another way that inflation uncertainty may affect the productivity of labor arises because greater inflation uncertainty should be associated with greater variance over time of unanticipated inflation. If the level of employment varies with short-term changes in the real wage due to unanticipated inflation, then the variance of employment is positively associated with inflation uncertainty. Katz and Rosenberg show that, if there are diminishing returns to the use of labor input, then the productivity of labor declines on average as the (mean-preserving) variance of employment gets higher. Therefore, greater inflation uncertainty reduces labor productivity. (This result holds even if the mean level of employment declines as a result of the uncertainty.)

[14]Joseph Livingston of *The Philadelphia Inquirer* conducts a survey each spring and fall requesting respondents to indicate their predictions about a number of economic indicators including the consumer price index (CPI). I use only the year-end to year-end forecasts in this article. The inflation forecasts are actually 14-month forecasts, since respondents are thought to know only the level of the October CPI when they turn in their predictions in December of the level of the CPI for the following December. With this in mind, Carlson (1977) has revised Livingston's data on inflation expectations, and this revised data (updated through 1983) is used here. The use of the mean-squared error of the forecasts as a measure of inflation uncertainty is advocated by Cukierman and Wachtel (1982). The data on cost-of-living adjustments come from various issues of the *Monthly Labor Review* (see U.S. Department of Labor). Major collective bargaining agreements are those that apply to 1,000 or more workers. Although this is not a comprehensive indicator of the incidence of COLA coverage, it does cover the majority of all workers covered by COLA provisions. See Sheifer (1979).

[15]Regressions of RMSE on a time trend for the periods 1964–83 and 1974–83 confirm this perception.

Chart 1

Inflation Uncertainty and the Percentage of Workers Covered by Cost-of-Living Adjustment Clauses



NOTE: Inflation uncertainty is measured as the root-mean-squared error of 12-month, year-end inflation forecasts from the Livingston survey. The percentage of workers covered by COLA clauses applies to workers under major collective bargaining agreements (1,000 or more workers).

percent level; for three years earlier (0.51), it is significant at the 5 percent level.[16]

There is evidence also that indexation offers an alternative to shortening the duration of contracts in the face of greater inflation uncertainty. Christofides and Wilton find that the response of contract duration to inflation uncertainty is less in indexed than in nonindexed contracts.

Labor Market Adjustments and the Real Effects of Inflation Uncertainty

Labor market adjustments that lead to more flexible nominal wages also should lead to a reduction in the impact of inflation uncertainty on employment and output growth. In the extreme, if all wages could be costlessly indexed to eliminate the risk arising from unanticipated inflation, inflation uncertainty would have no impact on the supply of labor.[17] However, the problems of imperfect price level measures and delays in the availability of price level data make perfect indexation impossible.[18] There are also costs of providing greater indexation, one of which is described in the next section.

Figure 3 shows what happens in the labor market as these adjustments occur. The initial effect of greater inflation uncertainty was illustrated by the movement of the labor supply curve from S_1 to S_2. As measures to reduce the risk associated with inflation uncertainty are taken, the supply curve shifts back to the right — to S_3, for instance. This "second-round" effect of inflation uncertainty moves employment and the expected real wage back toward their original levels — to Q_3^* and

[16]Hendricks and Kahn (1983) also find a positive impact of inflation uncertainty on the probability that a given wage contract is indexed.

[17]See Amihud.

[18]See Alchian and Klein (1973) for a discussion of the technical problems associated with price indexes.

w_3^*. Because indexation is imperfect, the supply curve does not shift all the way back to its original position at S_1, so there remains a net reduction of employment. Because less market output is produced with lower employment even though the same level of productive resources is available to the economy, this represents a net loss from inflation uncertainty.[19]

EFFECTS OF INCREASED RESPONSIVENESS OF WAGES TO INFLATIONARY SHOCKS

The preceding section showed that labor markets adapt to greater inflation uncertainty in ways that increase the responsiveness of nominal wages to an inflationary shock. This type of labor market adjustment has consequences on the economy beyond those illustrated above, and the implications differ depending on the source of the inflationary shock.

Nominal Shocks

In the face of a purely nominal shock, such as an unanticipated change in nominal aggregate demand produced by an unexpected change in the money supply, the greater responsiveness of nominal wages increases the stability of output growth and unemployment; consequently, for nominal shocks, indexing improves the efficiency of the labor market. If nominal wages adjust slowly and if the growth rate of the money supply is reduced, the result is an eventual increase in real wages when the inflation rate falls. This occurs even if workers and firms anticipate the change in monetary policy as long as some of them are still covered by labor contracts negotiated before this expectation was formed.[20] Assuming that contracts are not renegotiated prior to their expiration, the quantity of labor demanded by business firms will be reduced and the quantity supplied by workers will be increased.

This was illustrated in figure 2 as an increase in the real wage from w_1^* to w_3 and an excess supply of labor $(Q_3 - Q_2)$. The excess supply of labor results in an increase in the rate of unemployment, and the decline in the quantity of labor demanded causes a reduction in the growth rate of real output. If, however, nominal wage growth adjusts downward more quickly in response to the contractionary monetary policy (because of indexation, for example), the impact on both the quantity of labor demanded and supplied is reduced.

Real Shocks

If the inflationary shock is due to a real disturbance, indexation makes it more difficult for the economy to adjust to the shock. This is because automatic cost-of-living adjustments prevent (at least temporarily) the changes in real wages that are required in the face of real shocks to the economy. This is an important cost of indexing. For example, a substantial increase in the relative price of energy leads to higher prices in general because of energy's role as a factor of production for many goods. Because the costs of production increase, producers are willing to supply less at any given price than they were before the shock. As a consequence, the demand for labor falls as well, thereby lowering the equilibrium real wage.[21]

In figure 4, the reduction in the demand for labor from D_1 to D_2 results in a reduction in the equilibrium real wage from w_1^* to w_2^*. As the price level increases due to the energy shock, the indexation of wages exacerbates the effect of the shock by preventing the needed decline in the real wage and causing excess supply of labor of the amount $(Q_1^* - Q_3)$. In the absence of indexation, however, nominal wages need not rise in proportion to the rise in prices, and the real wage can decline to its equilibrium level, w_2^*, with the employment level at Q_2^*. Thus, the impact of the energy shock on the economy is reduced.[22]

In the event of a positive real shock — one that results in an increase in output and the demand for

[19]It should be emphasized that this is a partial equilibrium analysis; interaction between the labor market and other markets is not considered. In particular, the results concerning the impact of inflation uncertainty on employment and wages could be altered if, for example, greater inflation uncertainty caused a reduction in investment and a lower capital-labor ratio for the economy.

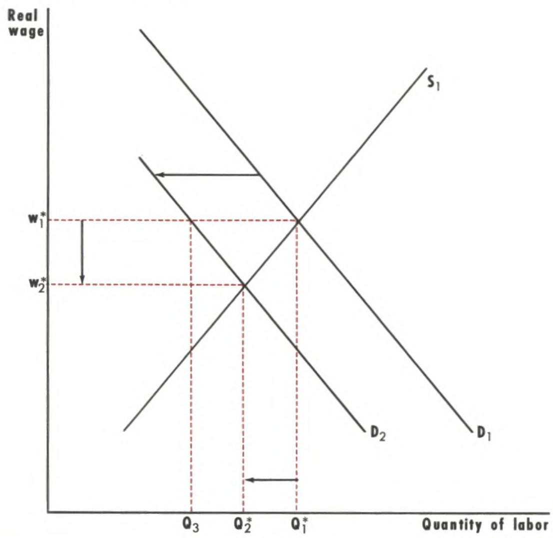
Furthermore, the analysis has not dealt with all of the implications of costly indexing. Under the assumptions of the analysis, it is the risk-averse workers who desire indexing, and the risk-neutral firms must be paid to provide it, since it is costly. At the margin, the value of a higher degree of indexing to the workers (the amount they are willing to pay) equals the cost of indexing to the firm. If, however, the marginal cost of indexing is constant while its marginal value is declining, then the firm profits from providing a higher degree of indexing. In other words, in the presence of higher risk, the risk-neutral firm profits from the risk aversion of its workers. This implies a higher demand for labor as the degree of indexation increases, though this effect should not be large enough to alter the conclusion that greater inflation uncertainty leads to reduced employment.

[20]See Fischer (1977b).

[21]The discussion assumes that labor and energy are complementary inputs, at least in the short-run — the period for which this analysis applies.

[22]See Gordon (1984) for a simple model of the effects of an aggregate supply shock on the economy.

Figure 4
The Impact of a Higher Relative Price of Energy
(Negative Supply Shock)



labor, such as increased productivity of labor — the equilibrium real wage and employment level will rise. If, however, indexation results in the maintenance of a constant real wage, there will be no increase in employment as long as the supply of labor curve slopes upward; instead, an excess demand for labor will result.[23]

Thus, in an economy subject to both real and nominal economic shocks, the optimal degree of indexing is less than 100 percent.[24] This has indeed been the case in the United States; the annual change in wages due to escalator clauses was only 57 percent of the annual change in the Consumer Price Index on average from 1968–77.[25]

CONCLUSION

Inflation uncertainty has risen with inflation rates over the last 20 years. This uncertainty affects the labor market and reduces the welfare of society. The major effect on the labor market of greater inflation uncertainty is reduced efficiency in allocating labor resources. The end result is reduced employment and output growth, higher unemployment and more complex wage contract negotiations.

The labor market has adapted to greater inflation uncertainty by reducing the duration of labor contracts and increasing the prevalence of indexation. As a result, nominal wages have exhibited a greater responsiveness to inflationary shocks. The consequences of these events on the economy include reductions in both the short-run impact of monetary policy on output and the ability of the economy to adjust to a real supply shock (such as an energy crisis). Labor market adaptations reduce but do not completely offset the impact of a given level of inflation uncertainty on the economy.

[23]The conclusion of Fischer (1977a) and Gray that indexation always destabilizes output in the face of a real disturbance arises from their assumption that employment is demand-determined. Cukierman (1980) shows that, for a *positive* supply shock, indexation actually makes employment and output more stable (but lower) under the assumptions about the determination of employment used in this article.

[24]This result from Gray's model is not affected by her assumption about the determination of employment. Maital (1984) discusses some of the consequences of nearly 100 percent indexing of payments in Israel.

[25]See Sheifer, p. 15.

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Examining the Recent Behavior of Inflation

R. W. Hafer

DURING the past few years, the rate of inflation has declined dramatically. From its peak of 16.70 percent in I/1980, inflation, as measured by changes in the consumer price index (CPI), fell to a low of 0.32 percent in I/1983. Although the inflation rate has increased somewhat to 4.34 percent in the first half of 1984, it continues to be low relative to rates for the past decade.

The actual behavior of recent inflation contrasts sharply with "monetarist" forecasts of inflation that rely heavily on the behavior of past money growth for their predictions.[1] The divergence between such inflation forecasts and actual inflation has led some analysts to question the usefulness of a narrow, transactions measure of money as an indicator of future economic activity.

The purpose of this article is to examine some of the reasons for the recent decline in the observed inflation rate. In this regard, we will investigate the impact of recent changes in food and energy prices on the observed rate of inflation. Because these two categories are most often cited as the major culprits in the 1973–74 and 1979–80 bursts of inflation, we will examine the role they have played in the recent disinflation.

In addition, we will assess the claim that the trend growth in a transactions measure of money provides a good measure of the underlying inflation rate; that is, the rate to which observed inflation would tend in the absence of exogenous shocks to individual commodity prices. To do this, we will investigate the relationship between current inflation and two measures of trend money growth: one measure based on published M1 data, the other accounting for the distorting effects of recent financial innovations.

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[1]For example, Hafer (1983) forecasted the rate of inflation for 1983, 1984 and 1985 to be 6.59 percent, 7.25 percent and 7.17 percent, respectively, based on an equation that uses only past money growth to predict inflation. These forecasts assumed that the trend in money growth, measured as a distributed lag over three years, would remain at its I/1983 rate of 7.5 percent. By II/1984, this trend rate actually had increased to 8.09 percent.

THE RATE OF INFLATION VS. CHANGES IN THE PRICE LEVEL: SOME KEY DIFFERENCES

Inflation is defined as a persistent increase in the *general level* of prices of goods and services. The crucial distinction is that the general level of prices, not just one or two individual prices, must rise over time. Of course, observed rates of inflation are measured by changes in an *index* of prices. These indexes, for example the CPI, represent a weighted average of prices covering a variety of goods and services. From month to month, some of these individual prices will be rising while others are falling. Because these relative price movements are weighted differently in the index, changes in the overall index, which are used to measure inflation, may reflect nothing more than the changes in certain individual prices that are weighted more heavily than others. Thus, such descriptions as "the jump in inflation last month stems from an increase in food prices," although commonly reported, are essentially wrong. Indeed, rather than describing a persistent increase in the general level of prices, statements of this type merely describe a temporary phenomenon — a transient increase in the price index caused by an increase in the relative price of an individual commodity that has a relatively large weight in the index.[2]

It generally is agreed that a persistent increase in the price level occurs only when aggregate demand continues to grow faster than aggregate supply. Because there is considerable evidence that the main determinant of aggregate demand growth over time is the growth of the money supply, it has become widely accepted that "Inflation is always and everywhere a monetary phenomenon."[3]

Since changes in aggregate demand over time are mainly determined by money growth, a useful measure of the underlying or monetary-induced rate of inflation is the trend, or longer-run average rate of money growth. Movements in trend money growth, while not accurate for forecasting *short-term* inflation rates, are useful because they point to the *direction* of the longer-run movement of prices that is more appropriately termed "inflation." Indeed, during the 1960–84 period, the average rate of inflation (5.34 percent) is not statistically different from the average rate of money growth (5.69 percent).[4] When the quarter-to-quarter changes in prices and money are compared, however, the simple correlation is only 0.15. Thus, even though money growth and inflation are not related closely over intervals as short as one quarter, they are related very closely over longer time periods.

Deviations of Inflation from Trend Money Growth

Deviations of observed inflation rates from trend money growth reflect the impact of transitory factors on the price index. To see this, consider the stylized world depicted in figure 1. The underlying rate of inflation consistent with the trend rate of money growth is shown in panel B of figure 1 as the slope of line AB. At time t_0, however, a random shock occurs; for example, a sharp decline in OPEC oil prices. At this point, the observed price index drops from B to C in panel A. If the economy could adjust instantaneously and costlessly to this new environment, inflation would continue from t_0 at the previous rate: the slopes of lines AB and CE are identical.

In the real world, however, adjustments to changes in relative prices are costly and the adjustment process takes time. This period of complete adjustment is depicted in figure 1 by the span between t_0 and t_1. During this time, the overall price index increases from B to D and, since the slope of BD is less than CE, *gives the appearance* that the decline in the price of oil has caused the inflation rate to decrease. In fact, this phe-

[2]As of December 1983, food prices accounted for 18.74 percent of the index. For discussions of the sensitivity of price indexes to relative price movements in general, see Blinder (1980, 1982) and Davidson (1982). For a specific investigation of the role of food prices, see Belongia (1983).

[3]Friedman (1970), p. 24. This observation stems from the relationship captured in the quantity theory equation of exchange. In growth rate form, the equation is written as:

$$\dot{M} + \dot{V} = \dot{P} + \dot{Q},$$

where M is the money stock, V is velocity, P is the price level, Q is the level of output, and the dots over the letters denote rates of change. According to the theory associated with this specification, velocity and output, in the long run, are determined independently of money growth; thus, $\dot{V}$ and $\dot{Q}$ can be viewed as constants. The consequence of this notion is that changes in the growth of money, in the long run, will be reflected directly and one-for-one in changes in the rate of inflation.

[4]The calculated t-statistic to test the null hypothesis that these mean rates are equal is 0.67. Thus, we cannot reject the null hypothesis at any reasonable level of significance. Interestingly, this relationship holds even for the 1970s. The average rate of inflation is 7.38 percent, and the average rate of M1 growth is 6.57 percent. The calculated t-statistic from this comparison is only 1.31. This suggests that the supply shocks of the 1970s did not affect the underlying rate of inflation, but merely generated substantial short-run deviations of the observed inflation rate from the trend rate of money growth.

The relationship between money growth and inflation is examined in a vast amount of research, examples of which are Friedman and Schwartz (1963, 1982), Meiselman (1970), Carlson (1980), Karnosky (1976), and Bordo and Choudhri (1982).

Figure 1
Effect of Transitory Nonmonetary Shock on the Trend Rate of Inflation

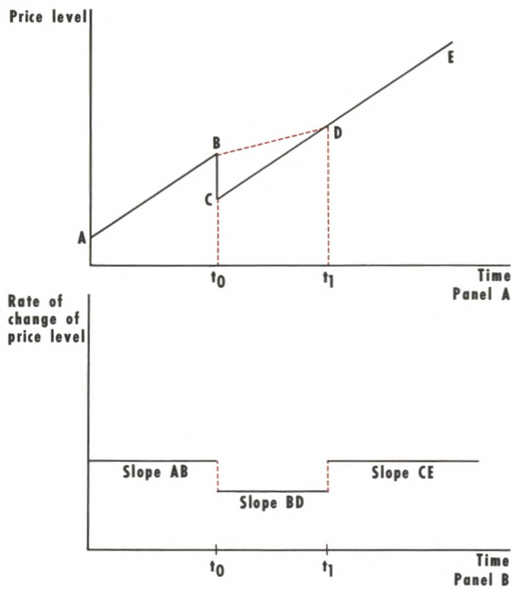
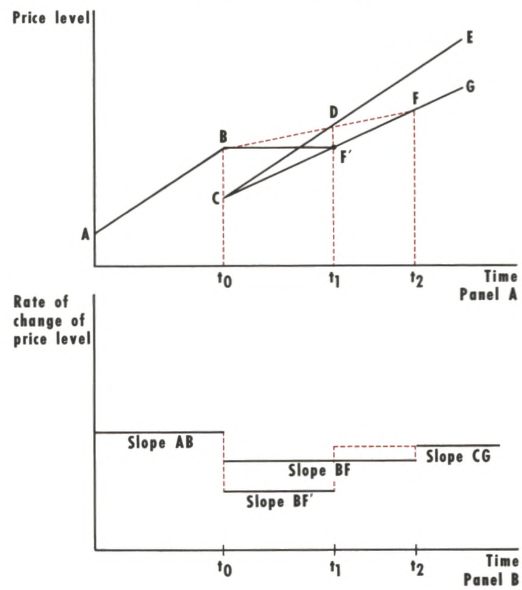


Figure 2
Effect of Transitory Nonmonetary Shock and Change in Trend Money Growth on the Trend Rate of Inflation



nomenon is only temporary and, beginning in t_1, observed inflation returns to the rate determined by the trend of money growth.

What happens if this type of relative price decline occurs simultaneously with a decline in the underlying inflation rate? These joint effects are captured in figure 2. As in figure 1, the underlying inflation rate equals the slope of AB until, at time t_0, there occurs a relative price-induced decline in the price index. Also at time t_0, the trend of money growth is reduced. This latter development, other things equal, lowers the underlying inflation rate to the slope of the line CG, which is less than the slope of AB. Note that the rate of inflation is lower than before, when there was only a relative price decline (slope BDF is less than slope AB).

Suppose that the adjustment is completed by time t_1, indicated by line segment BF′. This possibility suggests a much sharper decline in observed inflation (see panel B) and a shorter period of adjustment ($t_2 - t_0 > t_1 - t_0$). The impact of a lower trend in money growth also is reflected by the fact that, once the new underlying rate of inflation is reached at time t_2, prices rise at a slower rate than before the shock (slope CG is less than slope AB).

To summarize, inflation is a persistent increase in the overall price level. This persistence is associated directly with the average long-run rate of money growth. As discussed above, however, random shocks that affect individual prices (and which are unrelated to money growth) may cause the observed inflation rate to temporarily rise above or fall below the underlying inflation rate which corresponds to trend money growth.

THE EFFECTS OF RELATIVE PRICE CHANGES IN THE 1970s: SOME EVIDENCE

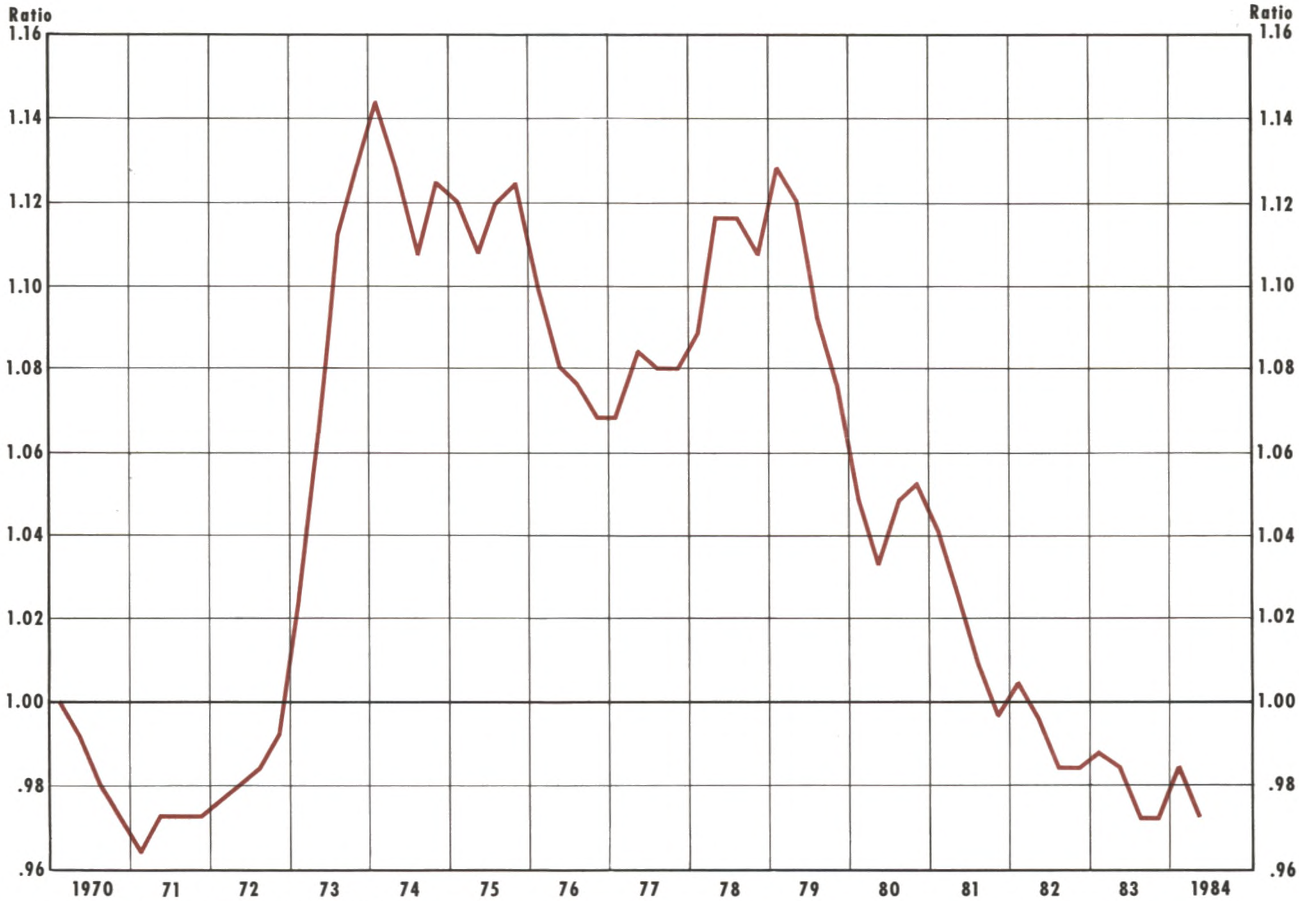
A substantial literature has evolved to explain the behavior of inflation during the 1970s.[5] It generally is agreed that exogenous supply shocks to the economy accounted for a substantial amount of the observed inflation phenomenon. The two most widely discussed supply-side factors have been the behavior of food prices and, perhaps better known, the impact of oil price changes.[6]

[5]See Blinder (1982), Rasche and Tatom (1981), Tatom (1981), Fischer (1981) and Gordon (1977).

[6]The Nixon price controls of 1971–74 also had the effect of artificially reducing the observed rate of inflation. Indeed, Blinder (1982), p. 267, demonstrates that the imposition and removal of wage and price controls altered the time path of price changes: "lowering inflation when it would otherwise have been low (especially in 1972) and raising inflation when it would otherwise have been high (especially in 1974)." See Blinder and Newton (1981) for a more detailed analysis of the wage and price controls' effect on inflation.

Chart 1

Relative Price of Food [1]



[1] Measured as ratio of CPI food to CPI less food component.

Food Prices

The behavior of the food price component of the CPI during the past decade is shown in the second column of table 1. Note the dramatic rise in food prices in 1973, increasing at a 19.4 percent rate compared with a 5.0 percent rate only a year earlier. This jump in food prices accounts for a sizable portion of the observed increase in the CPI between 1972 and 1973. Estimates by Blinder (1982), for example, suggest that increases in food prices alone accounted for nearly 5 percentage points of the measured inflation rate between mid-1973 and mid-1975.

During the period 1977–78, food prices again increased rapidly, rising faster than the price index for all items except food. Excluding food prices from the CPI, for instance, yields an inflation rate of 6.38 percent in 1977 and 8.43 percent in 1978, compared with rates of inflation of 6.65 percent in 1977 and 8.94 percent in 1978 using the overall CPI. This comparison suggests that increases in the relative price of food directly accounted for about one half of one percentage point of the observed inflation rate by 1978.

To see the change in food prices relative to all other goods during these periods, chart 1 plots the ratio of the index of food prices to the index of all other prices in the CPI from I/1970 to II/1984. Note that, beginning in late 1972, the price of food items began to rise more

[6]The Nixon price controls of 1971–74 had the effect of artificially reducing the observed rate of inflation. Indeed, Blinder (1982), p. 267, demonstrates that the imposition and removal of wage and price controls altered the time path of price changes: "lowering inflation when it would otherwise have been low (especially in 1972) and raising inflation when it would otherwise have been high (especially in 1974)." See Blinder and Newton (1981) for a more detailed analysis of the wage and price controls' effect on inflation.

Table 1
Rates of Inflation

Year	CPI	Food	Energy	CPI less Food/Energy
1970	5.67%	3.45%	4.00%	6.46%
1971	3.51	3.65	3.54	3.41
1972	3.42	5.02	3.15	2.97
1973	8.35	19.36	12.94	4.55
1974	12.14	12.02	25.49	10.90
1975	7.37	7.25	11.25	6.96
1976	5.07	1.16	6.76	6.44
1977	6.65	7.43	9.21	6.21
1978	8.94	11.42	7.52	8.44
1979	12.66	9.93	36.47	10.66
1980	12.51	10.27	18.86	12.15
1981	9.57	4.93	12.59	10.24
1982	4.48	3.26	1.92	5.19
1983	3.30	2.26	−1.25	4.26
1984	4.34	4.80	0.11	4.96

NOTE: All rates measured as fourth quarter to fourth quarter, except 1984 which is measured to second quarter.

rapidly than all other items in the CPI: from IV/1972 to I/1974, this ratio increased from 0.99 to 1.14. During the 1974–76 period, food prices increased more slowly than the prices of other goods and services, as reflected in the decline in the ratio to a value of 1.07 in IV/1976. Again in 1977 through 1979, food prices relative to all others increased more rapidly. This is shown by the rise in the ratio from 1.07 in I/1977 to 1.13 in I/1979.

Energy Prices

The most often discussed culprit for the temporary bursts of inflation during the past decade has been the increase in the relative price of energy. To provide some perspective, energy prices increased at an average annual rate of only 1.20 percent during the 1960s. The average annual increase in the energy price component of the CPI has been almost 11 percent since 1970.

The effects of the two surges in energy prices on the observed rate of inflation have been well documented.[7] As shown in table 1, the energy price component of the CPI rose dramatically from 1973 through 1975, with the major boost coming in 1974 when energy prices increased at a 25.49 percent rate. Indeed, researchers have found that the direct and indirect effects of the energy price increase in 1974 raised the observed rate of inflation by 2 to 4 percentage points in 1974 and by a slightly smaller amount in 1975, depending on the price index used.[8]

Energy prices rose sharply again in 1979 and continued to increase through 1981: the 36.47 percent increase in 1979 was substantially larger than the increase in 1974. And, because the relative weight on energy items in the CPI has increased since the early 1970s, increases in energy prices today have a relatively more important effect on the overall change in the level of the CPI.[9]

To illustrate how the relative energy price increases affected inflation, chart 2 plots the ratio of the index of energy prices to the index of all other items in the CPI. The rapid increases in the relative price of energy in 1973–74 and again in 1979–80 are clearly noticeable in the chart. Furthermore, as was the case for the relative food price increases, these relative price changes are of short duration. Indeed, from 1975 through 1978, the relative price of energy showed little change, indicating that energy prices were increasing no faster than other prices.

The combined effects of the food and energy price shocks can be seen by stripping the CPI of these components and recalculating the inflation rate. This rate of inflation is reported in the final column of table 1.[10] Increases in the food and energy components of the CPI directly accounted for almost 4 percentage points of the observed inflation rate in 1973. In 1974 and 1975, these two components directly raised the CPI inflation rate by 1.24 percentage points and 0.4 percentage points, respectively. Of course, these figures do not capture the indirec. influence of these components as higher energy prices influenced manufacturing, transportation, heating and other costs of production.

[7]See references cited in footnote 4.

[8]Blinder (1979), using the personal consumption expenditure (PCE) deflator reports that the direct effect of the increased energy prices in 1973–74 was to raise the PCE deflator's inflation rate by 2.4 percent. Tatom (1981) reports that energy price changes in 1974 contributed almost 4 percentage points to the inflation rate using the GNP deflator.

[9]Blinder notes that the relative importance of the energy component of the CPI has increased since 1973. The "relative importance" of the energy component increased from 0.065 in 1973 to 0.10 during the 1979–80 energy price shock. See Blinder (1982), footnote 8 for a useful discussion.

[10]This rate of inflation is sometimes referred to as the "base" rate of inflation.

Chart 2
Relative Price of Energy [1]

[1] Measured as ratio of CPI energy to CPI less energy component.

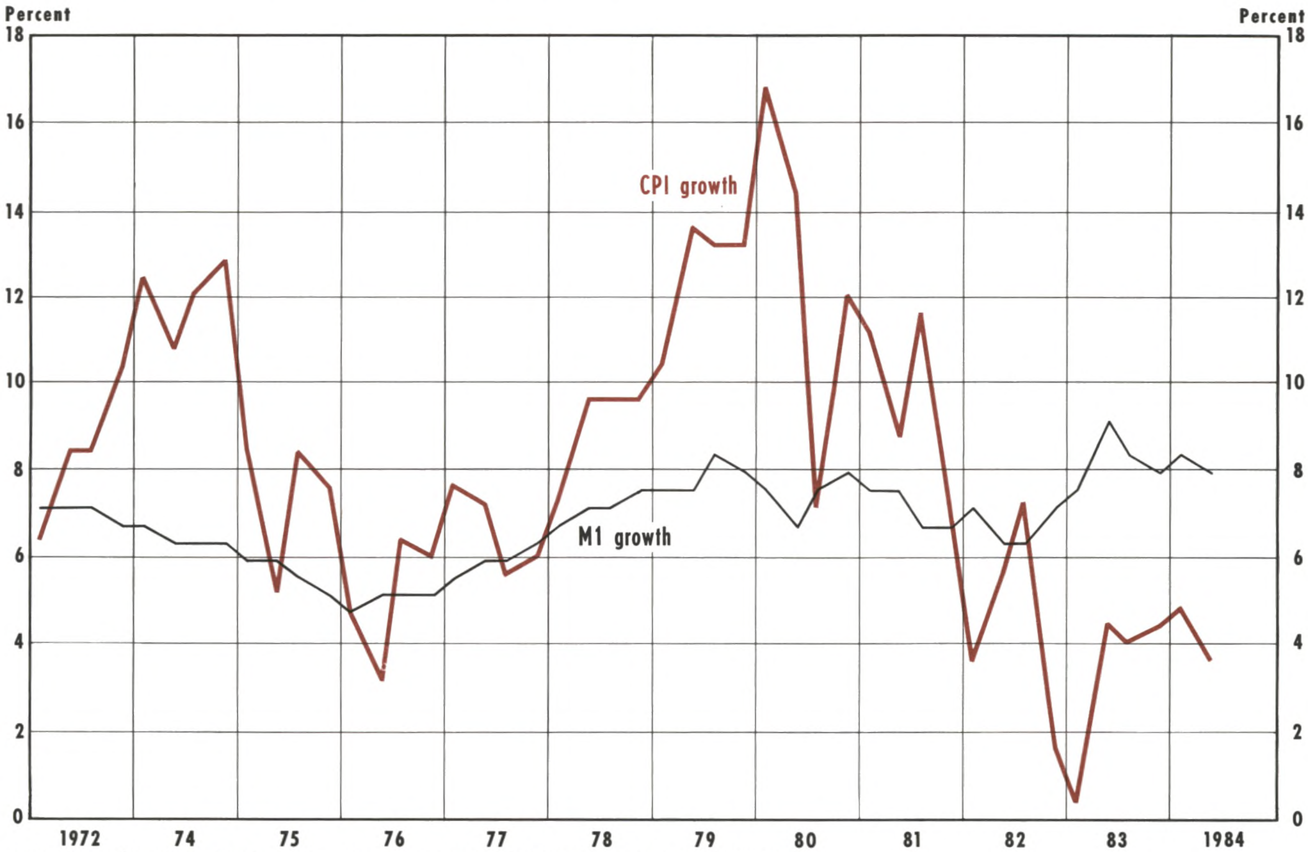
To see the degree to which food and energy price developments influenced the measured rate of inflation in 1979–80, look again at the inflation rate measured using the CPI less food and energy index. This inflation rate, compared with the overall CPI rate, suggests that food and energy price rises in 1979 directly accounted for 2 percentage points of the increase, and the indirect effects continued to work through the price system in 1980 and 1981.

RELATIVE PRICE EFFECTS AND THE RECENT DISINFLATION

Food price increases recently have declined from the lofty rates registered from 1977 through 1980. During the past few years, food prices have increased at a slower rate than that of all other items. This is evident in table 1 and in the decline in the ratio of food prices to other CPI items plotted in chart 1. For example, food prices increased at an average rate of 3.70 percent for the period 1981–84. The average rate of inflation for the CPI less food during the same period is 6.00 percent. Thus, the recent decline in the relative price of food has contributed to the drop in the observed rate of inflation, just as increases in the relative price of food helped raise the observed inflation rate during the 1970s.

In contrast to the behavior of energy prices during the 1970s, energy prices also have increased much less rapidly in the past few years. In fact, relative to all other prices, energy prices have fallen since mid-1981 (see chart 2). For example, after increasing at a 12.59 percent rate in 1981, the energy price component of the CPI increased at only a 1.92 percent rate in 1982 and, in 1983, actually *declined* at a 1.25 percent rate. Indeed, this recent decline in energy prices is the first since 1964.

Chart 3
Trend Growth Rate of M1 and Inflation [1]



[1] Trend growth rate calculated as 12-quarter moving average. Inflation based on growth rate of CPI.

These declines in the relative prices of energy and food help explain some of the recent reduction in measured inflation. As shown in table 1, during 1981–84, deleting food and energy prices from the CPI results in an inflation rate that is *greater* than that measured with the CPI. In other words, during 1981–84 the direct effects of declines in the relative prices of food and energy were to reduce the observed rate of inflation by an average of 0.74 percentage points. Thus, in contrast to the 1973–74 and 1979–80 episodes when food and energy prices temporarily pushed the observed rate of price increase upward, large declines in these relative prices during the past few years have helped reduce the observed rate of inflation. Consequently, just as commentators in the 1970s sought to measure a lower "baseline" rate of inflation by removing the effects of food and energy, recent observed rates of inflation have been understated partly because of food and energy price behavior.

MONEY AND INFLATION

The previous discussion suggested that the trend rate of money growth and the underlying rate of inflation are related directly. It is useful, therefore, to compare the observed rate of inflation over time with the trend rate of money growth. This comparison is shown in chart 3 where the CPI inflation rate is plotted along with the trend of M1 growth for the period 1973–84.[11]

The major supply shocks discussed above again are evident in this chart as the inflation rate soars above trend money in the mid- and late-1970s. These episodes reflect the fact that trend money approximates the underlying rate of inflation and cannot be used to explain short-run movements of the inflation rate. That is, trend money growth provides a reference point from

[11] Trend money growth is measured as a 12-quarter moving average.

which inflationary developments can be judged; the inflation rate presumably moves back toward the trend money growth once temporary supply shocks have dissipated. This is apparent in the drops of measured inflation during 1975–77 and again following the 1979–80 inflation bulge.

Recently, however, concern has been voiced about the large divergence between trend money and the inflation rate. In 1981, trend money averaged about 7.17 percent and the quarterly inflation rate averaged 9.59 percent. Since 1982, however, the situation has reversed with the trend of money growth substantially above the inflation rate: inflation averaged 4.48 percent in 1982 and trend money growth averaged 6.81 percent. In 1983, the difference widened with trend money growth averaging 8.35 percent while the average inflation rate was only 3.30 percent. And, thus far in 1984, trend money growth has averaged 8.16 percent, compared with an average inflation rate of 4.34 percent. Some argue that these divergences support the arguments against using a narrow monetary measure as a primary variable in formulating economic policy. Others argue that the recent divergence is a function purely of recent relative price distortions and that the inflation rate will soon return to the level of trend money growth, about 8 percent.

Trend Money Growth and Inflation: A Closer Look at the Recent Data

To examine the foregoing arguments, chart 3 is altered in two ways. The first change is somewhat controversial: it amounts to plotting a trend money growth line based not on published M1 figures, but on a measure (called MQ) that weights the components of M1 plus money market deposit accounts and money market mutual funds according to their use in transactions. In this measure, M1 components that have savings characeristics are given less weight in calculating the growth of money while some of the M2 components with transactions characteristics are added in. In other words, this alternative measure attempts to account for the "transactionsness" of these components.[12]

[12]The measure used here is constructed in Spindt (1984). In developing his measure, Spindt compares the ability of M1 and MQ to explain economic activity. He notes that, "In general, MQ and the conventional aggregate M1 exhibit strikingly similar behavior. However, during episodes when the behavior of M1 is 'abnormal' relative to income and interest rates, MQ behaves differently from M1. During these periods, shifts in the velocity of MQ are not detectable." For another attempt to remove the effects of financial innovations on M1 and examine the resultant measure's relationship to GNP during the recent period, see Hafer (1984).

Table 2
Money Growth Rates: M1 and MQ

Period	M1	MQ
I/1980	7.35%	8.31%
II	−4.32	−4.07
III	16.87	15.31
IV	10.87	9.18
I/1981	4.66	−7.58
II	8.19	4.74
III	3.14	2.65
IV	4.67	4.65
I/1982	10.67	7.80
II	2.19	0.79
III	6.26	5.79
IV	16.28	14.92
I/1983	13.38	9.78
II	12.14	8.76
III	9.79	7.58
IV	4.91	3.71
I/1984	7.35	6.08
II	6.35	6.06

NOTE: Rates are compounded annual rates of change.

This change is very important in calculating the trend of money growth, because it significantly reduces the rate of M1 growth during periods when new transactions accounts that pay explicit interest and which appear to have some savings-type characteristics were introduced into M1. To illustrate the differences between these series, table 2 presents the quarterly growth rates of M1 and MQ for the period I/1980 to II/1984.

As table 2 reveals, there is a substantial increase in the growth of M1 in early 1981 and in late-1982 and early-1983. For example, during the first two quarters of 1981 when NOW accounts were made available nationwide, M1 growth averaged 6.42 percent. The average of MQ growth during that period, in contrast, was a negative 1.42 percent. This difference is due to the fact that much of the inflow of funds into NOW accounts was not used actively in transactions but held more for savings purposes.[13]

[13]This conclusion is supported by evidence presented in Radecki and Wenninger (1983), Johannes (1981) and Johannes and Rasche (1981). See also the discussion in Hafer (1984).

Chart 4

Trend Growth Rate of MQ and Inflation [1]

[1] Trend growth rate calculated as 12-quarter moving average. Inflation based on growth rate of CPI.

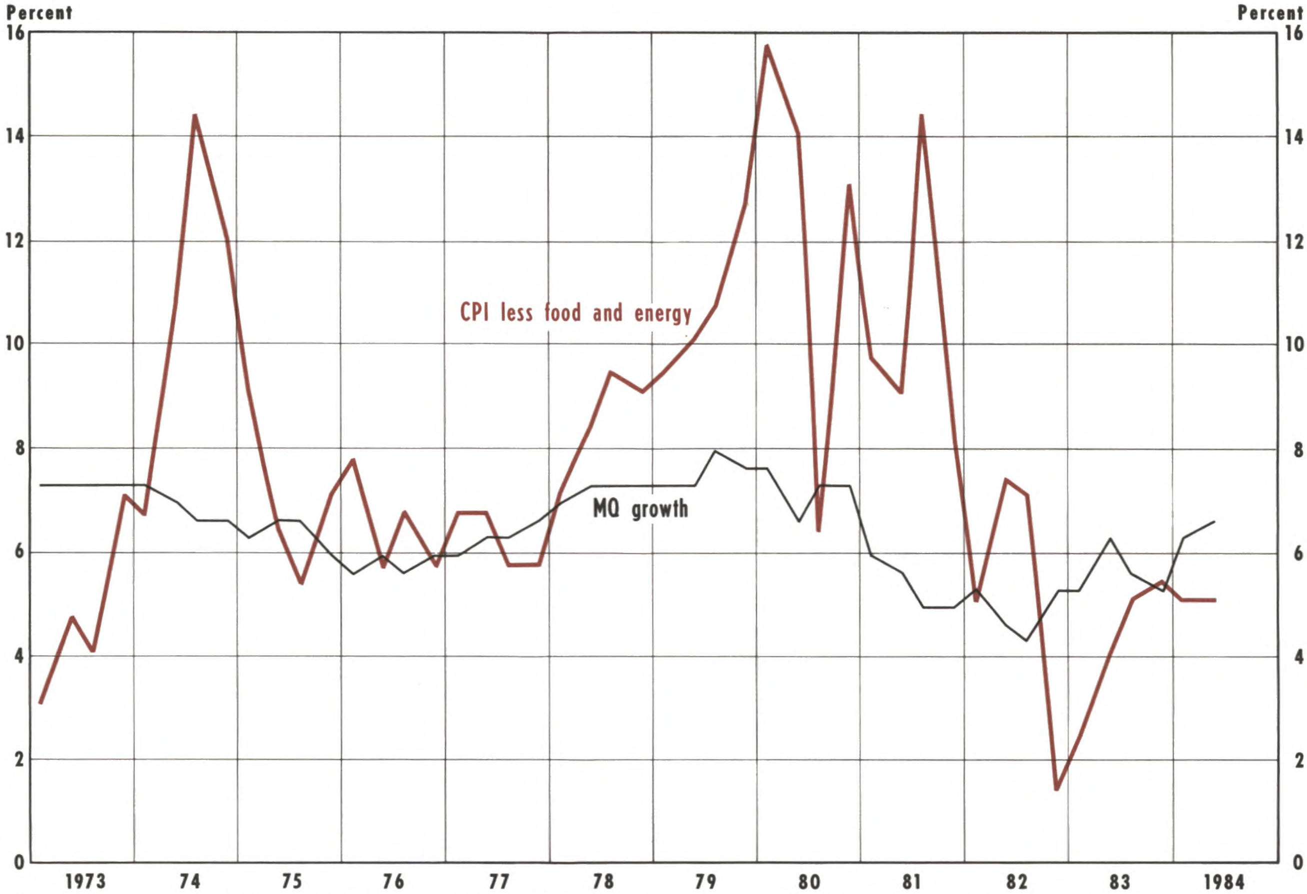
The two money growth rates differ substantially again in IV/1982 and I/1983, the time when the maturing of all-savers certificates and the introduction of Super-NOW accounts are thought to have imparted an upward bias to M1 growth.[14] During IV/1982, the growth of MQ is 1.36 percentage points less than M1. In both the first and second quarters of 1983, however, MQ growth is less than that of M1 by over 3 percentage points. Thus, these data suggest that the actual M1 figures may overstate the inflationary impact of recent trend money growth rates.

The outcome of using the MQ measure instead of M1 to construct trend money growth is illustrated in chart 4. There the MQ money growth trend is plotted with the CPI inflation rate. Note how the trend growth of MQ is lower than that of M1 since late 1980. Indeed, since 1980, the trend growth of MQ has averaged about 2 percentage points below that of M1. This lower trend is reflected in the closer relationship between recent inflation and trend MQ growth. For example, during the period I/1981 to II/1984, the trend rate of MQ growth was, on average, below the inflation rate by only 0.1 percentage points. Over the same time period, M1 trend money growth exceeded the inflation rate by an average of 2 percentage points. More recently, since the beginning of 1983, M1 trend money growth has been, on average, over 4.5 percentage points above the inflation rate; MQ trend money growth, in contrast, has averaged about 2 percentage points above the inflation rate. Thus, the evidence in chart 4 suggests that the recent divergence of inflation from trend money growth may be due to the overstatement of M1 growth stemming from recent financial innovations.

[14] The possibility of this occurring was given as one reason for temporarily abandoning M1 as the primary intermediate target variable in setting policy in October 1982.

Chart 5

Trend Growth Rate of MQ and an Alternative Measure of Inflation [1]



[1] Trend growth rate calculated as 12-quarter moving average. Inflation based on growth rate of CPI less food and energy components.

The second change to chart 3 is to plot the inflation rate measured by the CPI less food and energy components. This alteration allows us to illustrate the effects of recent relative energy and food price developments on the observed inflation rate and the relationship between inflation and trend money growth. Chart 5 combines the result of using MQ to measure trend money growth and measuring the inflation rate as the change in the CPI less food and energy components. The chart helps to illustrate how these factors explain the recently observed low rates of inflation.

First, the inflation rate based on all items in the CPI is less than the rate calculated using the CPI less food and energy from mid-1981 onward. During the past two years, this difference was as great as 2.18 percentage points (in I/1983). As of II/1984, the CPI less food and energy increased at an annual rate of 4.91 percent compared with a value of 3.70 percent using the complete CPI. Thus, the direct effect of recent energy price reductions along with slowing increases in food prices has been to lower the observed rate of inflation by more than 1 percentage point by the middle of 1984.

Second, as noted above, trend money growth based on the MQ measure is substantially lower than that for M1 since 1981. The importance of measuring trend money growth with the MQ measure is revealed by the fact that, once the recent relative price shocks have been accounted for, the rate of inflation is much more closely aligned with the MQ trend than with the trend of M1 growth. To the extent that the recent decline in inflation reflects the economic consequences of slow money growth, the recent recovery of inflation back toward the level of trend money growth (MQ) supports the belief that trend growth of transactions money affects the temporal behavior of aggregate demand and, hence, has an important influence on inflation.[15]

CONCLUSION

Two conclusions emerge from this study. First, the recent decline in the observed rate of inflation measured by changes in the CPI is due, in part, to the decline in the relative price of food and energy. When these components are omitted from the overall measure of prices, the recalculated rate of inflation is almost 1 percentage point higher during the past two years. In other words, food and energy price developments during the past few years have served to temporarily lower the observed rate of inflation.

The second important finding is that trend M1 growth currently may be overstating the inflationary impact of recent monetary policy actions. An alternative transactions money measure, one that reduces the impacts of recent financial innovations, indicates the trend rate of money growth currently may be about 6.5 percent, instead of the 8 percent rate shown by the trend growth of M1. Thus, our results again indicate the importance of achieving and maintaining a low trend of money growth if the current low rates of inflation are to be maintained.

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[15]Others have sought to explain the decline in inflation as a function of lower wage demands, high rates of unemployment, excess capacity and a host of other "causes." While these forces, in fact, may account for some of the short-term behavior of observed inflation rates, these causes, like observed changes in the price index, are affected directly by aggregate demand and supply conditions in the economy. As such, they also reflect the underlying forces of monetary expansion or contraction. Thus, to cite these factors as "causes" of inflation is misleading. For recent examples of such analyses, see Englander and Los (1983), Kowalewski and Bryan (1984) or Stockton (1984). A critical discussion of this analytical approach is presented in Batten (1981).

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