Inflation Uncertainty And Inflation Hedging

By Laurence G. Kantor

Increased inflation in the United States over the past ten years has been accompanied by increased volatility in inflation that has probably made inflation harder to predict. Many analysts have identified uncertainty about inflation as a major cost of inflation.[1]

Inflation uncertainty is said to affect the economy several ways. One is by increasing the riskiness of the real rate of return on savings. Since consumers are generally risk averse, this riskiness imposes costs on households and should, therefore, encourage households to rearrange their portfolios in an effort to protect the real rate of return on their savings from unexpected changes in inflation. The resulting increase in the demand for savings instruments with a real return better protected from unexpected changes in inflation should increase the supply of such assets. To the extent that these efforts to hedge against inflation succeed, they offset the costs that inflation uncertainty inflicts on households.

Previous research on the effects of inflation uncertainty on households and other economic agents has ignored the potentially neutralizing effect of inflation hedging. This article reexamines the effect of inflation uncertainty on households by explicitly considering the role of inflation hedging.

The first section documents trends in inflation, inflation volatility, and inflation uncertainty and examines the theoretical relationships between them. The second section explains how inflation uncertainty can impose costs on households and examines how inflation hedging can offset these costs. The third section discusses the ways households might hedge inflation and provides evidence of the

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1 See, for example, Milton Friedman, "Nobel Lecture: Inflation and Unemployment," *Journal of Political Economy,* June 1977, pp. 451-72; Dean Hughes, "The Costs of Inflation: An Analytical Overview," *Economic Review,* Federal Reserve Bank of Kansas City, November 1982, pp. 3-14; Burton Malkiel, "The Capital Formation Problem in the United States," *Journal of Finance,* May 1979, pp. 291-306; Donald Mullineaux, "Unemployment, Industrial Production, and Inflation Uncertainty in the United States," *Review of Economics and Statistics,* May 1980, pp. 163-69; Maurice Levi and John Makin, "Inflation Uncertainty and the Phillips Curve: Some Empirical Evidence," *American Economic Review,* December 1980, pp. 1022-27; and John Makin, "Anticipated Money, Inflation Uncertainty, and Real Economic Activity," *Review of Economics and Statistics,* February 1982, pp. 126-34.

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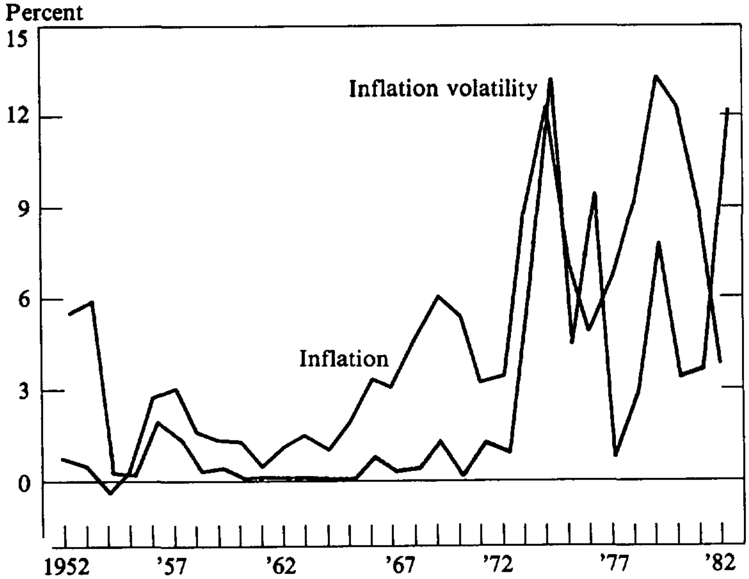
CHART 1
Inflation and inflation volatility



Note: Inflation is the yearly (December to December) percentage change in the Consumer Price Index. Inflation volatility is the variance of inflation, plotted as a three-year moving average.

nature of this hedging and the extent to which it has been successful. The results are then used to draw inferences about how inflation uncertainty has affected households and the extent to which inflation hedging has neutralized these effects. Particular attention is given to changes since 1973, when inflation became significantly greater and more volatile and uncertain. The final section presents conclusions that can be drawn from this analysis, including implications for the effect of inflation uncertainty on other economic variables.

Recent experience with inflation volatility and uncertainty

Several economists have noted positive associations between inflation, inflation volatility, and inflation uncertainty. This section examines the empirical and theoretical relationships between these variables.

Inflation and inflation volatility

Common measures of inflation and inflation volatility are employed here. To measure inflation, percentage changes in the Consumer Price Index (CPI) are used. To measure inflation volatility, the variance of inflation is used, which is the average squared deviation of values from the mean.[2]

Chart 1 shows the rate of inflation and the volatility of inflation from 1952 through 1982.

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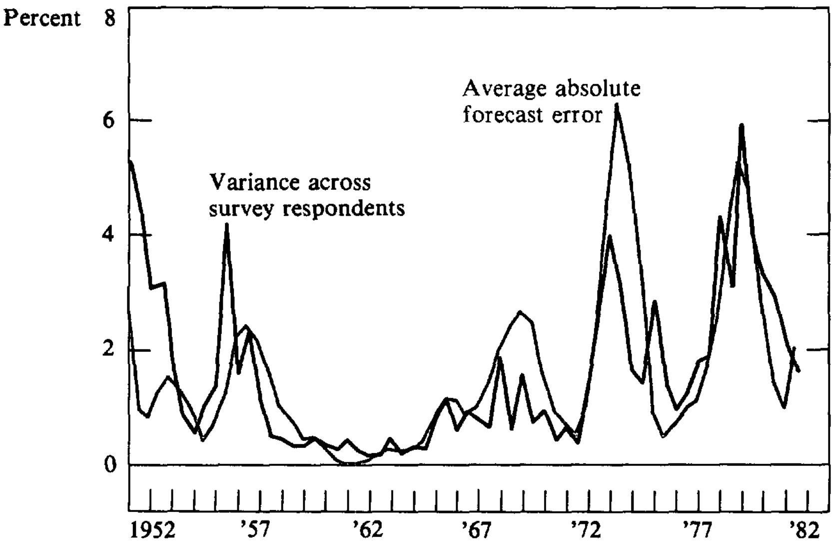
2 The variance of the inflation rate over n periods would be equal to:

$$\mathrm{Var}(P) = \frac{1}{n} \sum_{i=1}^{n} (P_i - \overline{P})^2,$$

where P_i = the rate of inflation in period i, and

$\overline{P}$ = the average rate of inflation $= \frac{1}{n} \sum_{i=1}^{n} P_i$.

CHART 2
Inflation uncertainty proxies



Note: Variance is the variance of 12-month inflation forecasts across respondents to the Livingston survey at each of the June and December survey dates. Average forecast error is the three-period moving average of the absolute value of 12-month inflaton forecast errors, measured as the actual rate of inflation minus the mean expected rate of inflation across respondents to the Livingston survey.

The chart shows that when inflation increased dramatically beginning in 1973, so did inflation volatility. Several researchers have found further evidence of a positive association between inflation and inflation volatility, for both the United States and other countries.[3]

[3] The strongest evidence of a positive relationship between inflation and inflation volatility consists of a significantly positive relationship between average inflation and the variance of inflation across countries. Such evidence has been presented by John Taylor, "On the Relation Between the Variability of Inflation and the Average Rate of Inflation," *Carnegie-Rochester Series on Public Policy,* Autumn 1981, pp. 57-86; Stanley Fischer, "Towards an Understanding of the Costs of Inflation: II," *Carnegie-Rochester Series on Public Policy,* Autumn 1981, pp. 5-42; Arthur Okun, "The Mirage of Steady Inflation," *Brookings Papers on Economic Activity,* 1971:2, pp. 435-498; and Denis Logue and Thomas Willett, "A Note on the Relationship Between the Rate and Variability of Inflation," *Economica,* May 1976, pp. 151-158. Taylor, "On the Relation . . . ," also presents evidence of a positive association between inflation and inflation volatility over time for various countries.

Inflation volatility and inflation uncertainty

Inflation volatility and inflation uncertainty have much the same elements, but they are not identical.[4] If inflation could be predicted, increased inflation volatility would not necessarily be associated with increased inflation uncertainty. This, however, has not been the case in the past ten years. Increased inflation volatility has coincided with a reduction in inflation predictability. The major cause of the increased inflation and inflation volatility in the 1970s, sharp increases in the price of crude oil, was generally unexpected.

[4] See I. Ibrahim and Raburn Williams, "Price Unpredictability and Monetary Standards: A Comment on Klein's Measure of Price Uncertainty," *Economic Inquiry,* July 1978, pp. 431-437, for a more formal analysis of the differences between inflation volatility and uncertainty than presented here.

Researchers have also shown a positive association between inflation volatility and various proxies for inflation uncertainty.[5] Chart 2 traces two proxies for inflation uncertainty. One is the variance of inflation forecasts across respondents to the Livingston expected-inflation survey.[6] The other is the three-period moving average of the absolute value of inflation-forecast errors—that is, the actual rate of inflation less the expected rate of inflation—based on inflation forecasts from the Livingston data. The evidence suggests that inflation uncertainty, like inflation volatility, has increased since the early 1970s, particularly during and after the two main energy-induced inflation shocks in 1973-74 and 1979.

Inflation uncertainty and hedging: theoretical considerations

This section examines the theoretical basis for the effect of inflation uncertainty on households and shows how inflation hedging can offset this effect. Inflation uncertainty affects households by making the real rate of return on household savings more risky. The real rate of return on savings is defined approximately as the nominal (stated) rate of return minus the actual rate of inflation:

$$r_t = R_t - P_t, \qquad (1)$$

where r_t is the actual (ex post) real rate of return over holding period t, R_t is the nominal rate of return over period t, and P_t is the rate of inflation over the same period.[7] Since households save for future consumption, they are concerned with the goods and services their savings will buy in the future. It is assumed, therefore, that they are concerned with real rates of return on their savings rather than nominal rates because real returns account for changes in purchasing power.[8]

Inflation uncertainty increases risk

Equation 1 can be modified to show that greater uncertainty about inflation implies greater uncertainty about the real return on savings.[9] Whether the nominal rate of return is

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5 Alex Cukierman and Paul Wachtel, "Inflationary Expectations: Reply and Further Thoughts on Inflation Uncertainty," *American Economic Review,* June 1982, pp. 508-12, show that the variance of inflation-forecast errors, a common proxy for inflation uncertainty, and the variance of inflation are both increasing functions of the variance of the rate of change in nominal income. In that paper and their paper, "Differential Inflationary Expectations and the Variability of the Rate of Inflation," *American Economic Review,* September 1979, pp. 595-609, they also show that the variance of inflation is significantly and positively correlated with the variance of inflation forecasts across survey respondents, another proxy for inflation uncertainty. Taylor, "On the Relation Between . . . ," demonstrates that the variance of inflation-forecast errors from an inflation-forecasting equation is positively related to both the variance and mean of inflation across seven countries. Inflation volatility has often been used as a proxy for inflation uncertainty. See, for example, Mullineaux, "Unemployment, Industrial Production . . . ," and Benjamin Klein, "Our New Monetary Standard: The Measurement and Effects of Price Uncertainty, 1880-1973," *Economic Inquiry,* December 1975, pp. 461-484.

6 The Livingston data refer to a survey of economists and leading financial market participants compiled every June and December by Joseph Livingston, a financial columnist for the *Philadelphia Inquirer.* The data used here were revised by John Carlson, "A Study of Price Forecasts," *Annals of Economic and Social Measurement,* Winter 1977, pp. 27-56.

7 A more precise definition would include an interaction term representing the depreciation of real interest. However, this term is very small and usually ignored.

8 Households are also concerned with after-tax rather than before-tax rates of return. That issue is ignored in this article, however, to focus on the effect of changes in inflation.

9 No distinction is made in this article between risk and uncertainty. These terms are used interchangeably. See Frank Knight, *Risk, Uncertainty and Profit,* London School of Economics and Political Science, 1948, for an explanation of the distinction.

known in advance or not, the real rate is always uncertain. This is because future inflation is always uncertain and fully inflation-indexed savings instruments are not available.[10] With the assumption that the nominal rate of return is known at the beginning of the holding per iod, the expected real rate of return is defined approximately as:

$$r_t^e = R_t - P_t^e, \qquad (2)$$

where r_t^e is the expected real rate of return for period t and P_t^e is the expected rate of inflation for period t. By subtracting equation 2 from equation 1, equation 3 is obtained:

$$r_t - r_t^e = P_t^e - P_t. \qquad (3)$$

This equation shows that when inflation is different from expected, that is, when $P_t^e - P_t$ is not zero, the real rate of return is also different from what was expected, that is, $r_t - r_t^e$ is not zero. This means that more uncertainty about inflation implies more uncertainty about the real rate of return on savings.

Inflation hedging reduces risk

Equation 1 can be further modified to show that inflation hedging, which results in a more positive association between the nominal rate of return on savings and the rate of inflation, may reduce uncertainty about the real rate of return on savings caused by inflation uncertainty. Equation 2 assumes that a fixed nominal rate of return is known at the beginning of the holding period. If the nominal rate is uncertain, as it usually is, equation 2 becomes:[11]

$$r_t^e = R_t^e - P_t^e. \qquad (4)$$

Subtracting equation 4 from equation 1, the following is obtained:

$$r_t - r_t^e = (R_t - R_t^e) + (P_t^e - P_t). \qquad (5)$$

Inflation hedging, as indicated above, causes R_t and P_t to move together. In the case of complete inflation hedging, any change in R_t is accompanied by an equal change in P_t. Thus, any difference between expected and actual inflation, that is, any nonzero value for $P_t^e - P_t$, is offset exactly by a divergence between the actual and expected nominal rate of return, that is, by a nonzero value for $R_t - R_t^e$. This offsetting effect eliminates any divergence between the actual real rate of return and the expected real rate—that is, it means $r_t^e - r_t = 0$. In general, then, a more positive association between R_t and P_t implies that unexpected inflation has less effect on the difference between the actual real rate of return on savings and the expected real rate. Hence, the effect of inflation uncertainty on the uncertainty about the real rate of return on savings is reduced.

The incentive to hedge inflation

The analysis so far has established that, other factors held constant, an increase in inflation

[10] If a household's savings consisted only of Treasury bills held until maturity, the nominal return on its savings would be known in advance but not the real return. Alternatively, neither the nominal nor the real return on common stock is known in advance. The unavailability of fully inflation-indexed savings instruments is discussed in Stuart Weiner, "Why Are So Few Financial Assets Indexed to Inflation?" *Economic Review,* Federal Reserve Bank of Kansas City, May 1983, pp. 3-18.

[11] In practice, the only assets with nominal rates of return known and fixed at the beginning of the holding period are assets that are default-risk free, have a fixed maturity, no coupon, and are held until maturity. Many assets used by households as savings instruments do not satisfy all of these conditions, as for example, real estate, common stock, and bonds sold before maturity.

uncertainty increases the riskiness of the real rate of return on savings, which makes consumers worse off.[12] This being the case, an increase in inflation uncertainty creates an incentive for households to rearrange their portfolios toward assets that are better inflation hedges and to demand assets that better hedge inflation.[13] To the extent that households succeed in changing their portfolios so that the real rate of return on their savings is better protected from changes in inflation—or so that the nominal rate is more positively associated with the rate of inflation—they can offset the increase in risk and, hence, offset the cost associated with increased inflation uncertainty.[14]

Empirical evidence of inflation hedging by households

The previous section indicates that households have a greater incentive to hedge inflation when it becomes more uncertain because hedging can offset increases in the riskiness of the real rate of return on savings that result from increases in inflation uncertainty. This section investigates the nature of inflation hedging by households and the extent to which households have succeeded in hedging inflation. Results of the investigation are then used to estimate the effects of inflation uncertainty and inflation hedging on the riskiness of the real rate of return on household savings. Particular emphasis is placed on the period since 1973, when inflation became significantly greater and more uncertain. Finally, a comment is offered on the changes in consumer welfare that accompanied changes in inflation and inflation uncertainty.

Nature of hedging by households

Households try to insulate the real rate of return on their savings from changes in infla-

12 It is generally assumed that economic agents, including consumers, are risk averse. With regard to savings, risk aversion implies that, given two investments offering the same rate of return but different degrees of risk, consumers will prefer the investment with less risk.

13 Increased uncertainty regarding the real rate of return on savings might also affect households' income allocation between spending and saving, but the direction of the effect is theoretically ambiguous. One response to increased uncertainty about the real rate of return on savings would be to save more to make sure of a minimum purchasing power in the future. There is also a motive to substitute spending for saving, however, because the real return to saving has become more risky relative to consumption. The net effect depends on the precise nature of savers' attitudes toward risk. For a more formal theoretical analysis of the effect of uncertainty (not specifically inflation uncertainty) on total saving, see J. Stiglitz, "A Consumption-Oriented Theory of the Demand for Financial Assets and the Term Structure of Interest Rates," *Review of Economic Studies,* April 1970, pp. 345-351, and A. Sandmo, "The Effect of Uncertainty on Saving Decisions," *Review of Economic Studies,* April 1970, pp. 353-360. Not surprisingly, empirical tests of the effect of inflation uncertainty on saving yield ambiguous results and are sensitive to the definition of saving used and to the specification of the test. For examples, see Paul Wachtel, "Inflation Uncertainty and Saving Behavior Since the Mid-1950's," *Explorations in Economic Research,* Fall 1977, pp. 558-578, and Philip Howrey and Saul Hymans, "The Measurement and Determination of Loanable Funds Savings," *Brookings Papers on Economic Activity,* 1978:3, pp. 655-685.

Households can also protect themselves from inflation by adjusting their liabilities. However, this article does not address those adjustments.

14 While the focus here is on the effect of inflation uncertainty on the riskiness of the real rate of return on savings, it is also important to consider any effects on the level of the real rate of return. An increase in the riskiness of the real rate of return on savings leaves households worse off, but an increase in the level of the real rate of return on savings makes them better off. Inflation hedging has been broadly defined as including adjustments that protect the real rate of return on savings from changes in inflation. While hedging offsets the effect of inflation uncertainty on the riskiness of the real rate of return on savings, it also offsets declines in the level of the real rate of return resulting from increases in inflation. Since the level of inflation has been positively correlated with inflation uncertainty, it is not always possible to distinguish between inflation hedging designed to protect the level of the real rate of return on savings from increases in the level of inflation and inflation hedging intended to protect against increases in the riskiness of the real rate due to increases in inflation uncertainty.

tion by reallocating wealth among existing assets in their portfolios and demanding new financial assets that are better inflation hedges. This demand for inflation hedges has been one of the factors, along with financial deregulation, that has encouraged an increased supply of such assets. Some of this inflation hedging is designed to protect the level of the real rate of return on savings from falling due to higher levels of inflation. Some is also designed to protect against an increase in the riskiness of the real rate caused by increased inflation uncertainty.

Financial futures contracts are examples of financial assets that can be used to offset increases in the riskiness of the real rate of return due to increased inflation uncertainty. Their development reflects growth in the demand for such assets. New assets with more flexible nominal rates of return that adjust more easily to changes in inflation protect both the level of the real rate of return on savings from higher inflation and the riskiness of the real rate from greater inflation uncertainty. Examples of such assets that came about as a result of deregulation include Super NOW accounts, money market certificates, money market deposit accounts, and all savers certificates. Some of these assets were supplied by nondepository institutions. They include money market mutual funds, universal and variable life insurance, and floating rate notes. These new, more inflation-hedged assets began to appear in the mid-1970s, just after inflation became significantly greater and more uncertain.[15]

An examination of the changes in the relative proportions of the household sector's portfolio allocated to various classes of assets provides some indication of how households have responded to the increase in inflation and inflation uncertainty since 1973.[16] Chart 3 shows the changes in the three classes of assets with weights that have changed the most since 1973. The proportion that households have allocated to equity (including mutual funds) has declined significantly since 1973. At the same time, the allocation to real estate (including both farm and residential real estate) has increased considerably, as has the allocation to short-term securities (which includes Treasury bills, money market mutual funds, large CD's, and commercial paper). The increase in the household sector's portfolio allocation to short-term assets is underestimated, though, because the estimates do not include the new short-term assets with more flexible nominal rates of return that resulted from financial deregulation.

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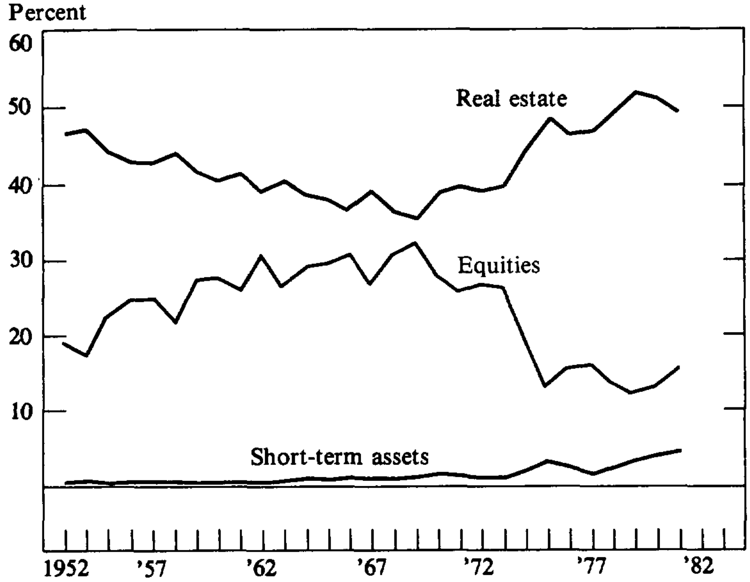
15 See Weiner for a more detailed discussion of these assets as well as the exact dates of their appearance.

16 Note that the changes in weights reflect some supply and demand factors other than those resulting from changes in portfolio allocations by households. In the long run, however, households will readjust their portfolios in response to undesired changes in weights induced by changes in outstanding market values that originate from sources other than household portfolio reallocation—that is, from supply sources and portfolio reallocations by other sectors.

These weights are calculated from outstanding values held by households at the beginning of the year (or, the end of the previous year). The data are obtained from the Federal Reserve's Flow of Funds for all assets other than life insurance reserves and real estate. Values for life insurance reserves are obtained from various issues of the *Life Insurance Fact Book.* Market values for residential real estate are from John Musgrave, "Fixed Non-Residential Business and Residential Capital in the United States, 1925-79," *Survey of Current Business,* February 1981. The value of land beneath the structures was assumed to be 20 percent of the value of the structures. (See Roger Ibbotson and Laurence Siegel, "The World Market Wealth Portfolio," *Journal of Portfolio Management,* Winter 1983, pp. 5-17, for a further explanation of these real estate values.) Market values for farm real estate were from Ibbotson and Carol Fall, "The Unites States Market Wealth Portfolio," *Journal of Portfolio Management,* Fall 1979, pp. 82-92, and Ibbotson and Siegel, "The World . . . ."

CHART 3
Portfolio allocation by households



Note: Real estate includes residential and farm real estate. Equities include common stock and mutual funds, other than money market mutual funds. Short-term assets include U.S. Treasury bills, money market mutual funds, large certificates of deposit, and commercial paper.

These trends in the allocation of household assets suggest a reallocation from less inflation-hedged assets to assets that are more inflation hedged. Several studies show that nominal stock returns have been negatively related to inflation.[17] Real estate, however, has been one of the best inflation hedges available to households. Short-term financial assets are better inflation hedges than long-term financial assets. Returns on short-term assets are better at capturing short-term changes in the expected rate of inflation. Furthermore, unexpected inflation results in less capital loss on short-term securities than on long-term securities.[18]

Inflation hedging performance of households

While it appears that households may have tried to hedge inflation, it is useful to examine the extent to which they succeeded. Their success should be reflected in a positive association between the nominal rate of return on their savings and the rate of inflation.

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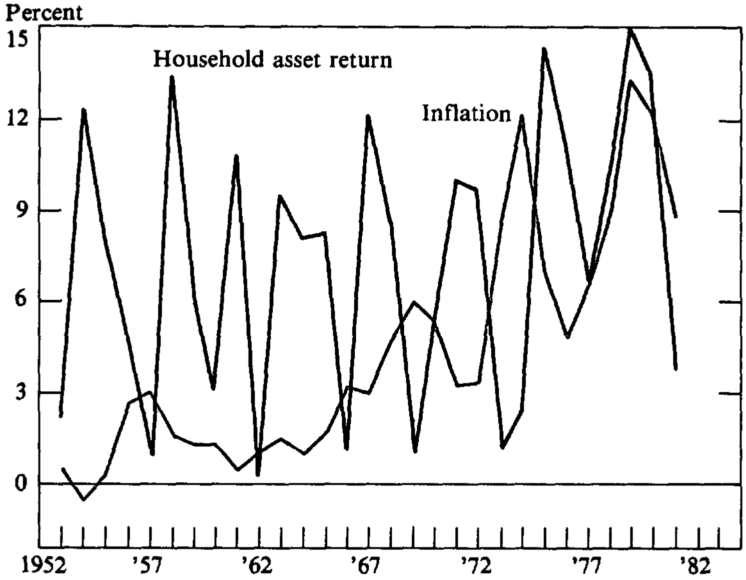
17 See, for example, Zvi Bodie, "Common Stocks as a Hedge Against Inflation," *Journal of Finance,* May 1976, pp. 459-470; Eugene Fama and G. William Schwert, "Asset Returns and Inflation," *Journal of Financial Economics,* 1977, pp. 115-146; and Charles Nelson, "Inflation and Rates of Return on Common Stocks," *Journal of Finance,* May 1976, pp. 471-482. One hypothesis that has been offered to explain why stocks have not been a good inflation hedge is that inflation increases the real tax burden of corporations because of inventory and depreciation accounting methods that are based on historic costs.

18 For the same reason, households should allocate less of their wealth to long-term assets in response to increased inflation volatility and uncertainty. The relative weight allocated by households to long-term assets (which included Treasury notes, Treasury bonds, municipal bonds, corporate and foreign bonds, and government agency

CHART 4
Nominal rate of return on household assets



Note: Return on assets is the value weighted annual nominal rate of return on assets held by the household sector, other than consumer durables. Inflation is yearly (December to December) percentage changes in the Consumer Price Index.

Chart 4 plots the nominal rates of return on the aggregate portfolio of assets held by households and the inflation rate from 1953 through 1981.[19] The aggregate portfolio includes financial assets and real estate but not consumer durables. The rates of return are before taxes, since after-tax data are not available.[20]

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securities) was approximately the same in 1981 as it was in 1973. However, the weights for these long-term securities were calculated by using outstanding par values instead of market values. Since there was considerable unexpected inflation over this period and interest rates generally rose, the market values of many bonds fell below their par values. Thus, the relative weight of household portfolios allocated to long-term securities, with respect to outstanding market values, probably declined over this period.

19 This rate-of-return series consists of the weighted rate of return on the assets held by households. The beginning-of-year weights are described in footnote 16. All rates of return are calculated on a calendar-year basis. Thus, the results presented in this section implicitly assume a one-year holding period. Assets included in the portfolio are demand deposits and currency, savings and small time deposits (under $100,000) at all depository institutions, certificates of deposit, money market mutual funds, Treasury bills, notes, and bonds, municipal bonds, corporate and foreign bonds, commercial paper, mutual funds, equities, life insurance reserves, U.S. savings bonds, residential real estate, farm real estate, and government agency securities. Rates of return are obtained from Ibbotson and Fall, "The United States . . . ," Ibbotson and Siegel, "The World Market . . . ,"; The *Mutual Fund Fact Book,* 1978 and 1982 editions; Federal Reserve Flow of Funds data; the *Life Insurance Fact Book,* various issues; the U.S. Savings Bond Division of the Treasury; the *Federal Reserve Bulletin;* Chase Econometrics, Inc.; the Federal Home Loan Bank Board *Journal;* the Federal Home Loan Bank Board *Sourcebook;* and Scott Winningham and Donald Hagan, "Regulation Q: An Historical Perspective," *Economic Review,* Federal Reserve Bank of Kansas City, pp. 3-17. The precise methods used in calculating the various rates of return are available from the author.

20 Thus, this examination does not consider the extent to which households were able to avoid inflation-induced increases in taxes. The reallocation of household assets toward real estate, illustrated in Chart 3, suggests that households adjusted to avoid these tax increases to some extent. The implicit rental return on residential real estate is not taxed and taxes on capital gains can be largely avoided through deferral options and exemptions.

Over the 1953-72 period, before inflation became considerably greater and more uncertain, there seems to have been a negative relationship between the nominal rate of return on household savings and the rate of inflation.[21] Beginning with the huge increase in inflation in 1973, the rate of return on household assets appears to have begun to follow inflation with a lag that made their contemporaneous association negative. Beginning in 1977, however, the nominal rate of return of household savings and the rate of inflation were closely and positively associated.

Correlation coefficients between the nominal rate of return on household assets and the rate of inflation generally support these observations.[22] This standardized measure of association indicates that inflation and the nominal rate of return on the aggregate portfolio of household assets were positively but not significantly related over the entire 1953-81 period at 0.12. The results also indicate, however, that the associations between the nominal rate and the rate of inflation changed markedly over the 1953-72, 1973-76, and 1977-81 subperiods. The relationship was negative for 1953-72 (−0.24) but turned more negative over the 1973-76 period (−0.74) and significantly positive over the 1977-81 period (0.83).

The evidence presented so far indicates that the 1953-72, 1973-76, and 1977-81 periods were distinctly different in levels of inflation and inflation uncertainty and in the extent of inflation hedging by households. The 1953-72 period was characterized by low inflation and inflation uncertainty and little apparent inflation hedging by households. During the 1973-76 period, the economy was beset by high inflation and inflation uncertainty precipitated by the unexpected large increase in energy prices and the removal of price controls. Households, however, apparently did not hedge the inflation over this period. Another major oil shock occurred in 1979, and inflation remained high and uncertain over the 1977-81 period. Unlike the 1973-76 period, however, households did hedge inflation.

The evidence suggests that when inflation became greater and more uncertain, households hedged inflation after an adjustment period. It takes time for households to adjust their portfolios, for new financial assets to be developed, and for financial deregulation to be legislated and implemented. An adjustment period of several years is not surprising, given the previous 20 years of relatively low and predictable inflation. In sum, the evidence is consistent with the hypothesis that when inflation becomes greater and more uncertain, the benefits of inflation hedging increase relative to the costs.

Contribution of inflation hedging to risk reduction

The results presented above indicate that the nominal rate of return on household savings and the rate of inflation were negatively related over the 1953-72 period and became more negatively associated over the 1973-76 period. The implication of a negative association between the nominal rate of return on household savings and the rate of inflation is that increases in inflation are associated with decreases in the nominal rate and, thus, even bigger decreases in the real rate of return on savings. Similarly, increased inflation volatility would imply even

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21 Household savings is loosely defined as consisting of the financial assets held by the household sector plus residential and farm real estate.

22 A correlation coefficient is a standardized measure of association between two variables constrained to be greater than or equal to −1 and less than or equal to 1. A correlation coefficient of 1 implies that two variables are perfectly and positively associated. A correlation coefficient of −1 implies that the two variables are perfectly and negatively associated.

greater volatility in the real rate of return on savings and increased inflation uncertainty would imply greater uncertainty about the real rate. Alternatively, as already discussed, a positive association between the nominal rate and the rate of inflation reduces—and can even eliminate—the negative effect of increased inflation on the real rate of return on savings. Such an association—which characterized the 1977-81 period—also reduces the effect of inflation uncertainty on the riskiness of the real rate.

The effect of inflation uncertainty and the counteractive effect of inflation hedging on the riskiness of the real rate of return on savings are not easy to measure because the riskiness of the real rate and inflation uncertainty cannot be observed directly. A commonly used proxy for the riskiness of financial portfolios is the variance of the real rate of return.[23] The variance of the real rate can be decomposed as follows:

$$Var(r) = Var(R) + Var(P) - 2Cov(R,P), \quad (6)$$

where Cov(R,P) is equal to the covariance (a measure of the degree of association) between the nominal rate of return and the rate of inflation. This expression shows that an increase in the variance of the inflation rate—which has been closely associated with inflation uncertainty—increases the variance of the real rate of return on savings. However, an increase in the covariance between the nominal return and inflation—a result of successful inflation hedging—reduces the variance of the real rate of return on savings.

TABLE 1
Components of variance of real rate of return on household savings

	Var(r)	=	Var(R)	+	Var(P)	−	2Cov(R,P)
1953-72	23.93	=	17.46	+	2.98	−	2[−1.75]
1973-76	80.02	=	41.07	+	9.60	−	2[−14.68]
1977-81	7.94	=	21.77	+	7.62	−	2[10.72]

Table 1 shows the components of the variance of the real rate of return on household assets for three periods: 1953-72, the period before the dramatic increase in inflation and inflation uncertainty; 1973-76, the period of adjustment; and 1977-81, the period in which households were able to adjust to high and uncertain inflation. Inflation volatility, measured by the variance in the rate of inflation, began increasing in 1973 and remained high through 1981. The variance in the real rate of return on household savings increased substantially from the first period to the second, with all three components of the variance of the real return contributing to the increase.[24]

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23 Since the variance of the real rate of return on savings is unknown at the beginning of the holding period, a more precise measure of risk would be the expected variance of the real rate of return. However, as the expected variance is not observable, the actual variance of the real rate of return is often used as a proxy. The suitability of the variance of the real rate of return on savings as a measure of its riskiness depends partly on the extent to which the length of savers' holding periods matches the length of the holding period used in calculating the variance. For example, if savers do not plan to spend out of their savings for at least a year, the monthly volatility of the real rate of return on their savings within the year might be irrelevant. However, holding periods are uncertain. Savers do not usually know beforehand exactly when they will need to spend out of their savings. Given that holding periods are uncertain and vary across households, increased volatility of the real rate of return on total household savings calculated by using any reasonable holding period can be assumed to increase risk.

24 The increase in the variance of the nominal rate of return on savings, Var(R), cannot, by itself, be interpreted as increasing risk. This is because changes in the nominal rate of return at least partly reflect changes in expected inflation. However, the substantially more negative covariance between the nominal rate of return and the rate of inflation suggests that the variance of the nominal rate of

TABLE 2

Means and variances of real rates of return on household assets before, during, and after adjustment to high and variable inflation

	Mean	Variance
1953-72	4.52	23.93
1973-76	−0.93	80.02
1977-81	−0.16	7.94

Although the variance in inflation remained high in the 1977-81 period, the variance in the real rate of return on household assets fell dramatically, below what it had been before 1973. This drop was due primarily to a large increase, to a positive value, in the covariance between the nominal return on household savings and inflation. When this covariance is positive, it subtracts from, rather than adds to, the variance of the nominal rate and the variance of inflation in the calculation of the variance of the real rate of return. While other factors could have also contributed to this increased covariance, the evidence is consistent with the premise that, after an adjustment period when the riskiness of the real rate increased substantially, inflation hedging by households offset the effect of increased inflation uncertainty on the riskiness of the real rate of return on their savings.

A look at changes in the welfare of households

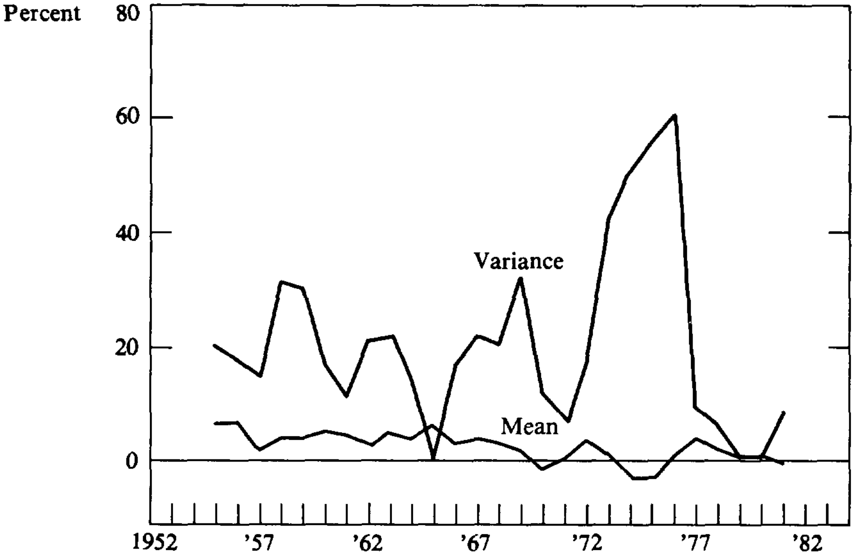
The riskiness of the real rate of return on household savings appears to have risen from the 1953-72 period to the 1973-76 period and then, because of inflation hedging, to have fallen from the latter period to the 1977-81 period. Given these changes in risk, it is useful to assess the changes in consumer welfare that occurred. To do that, changes in the level of the real rate of return on household savings also have to be examined. It is assumed that consumers' welfare is a positive function of the real rate of return on their savings and a negative function of the variance of the real rate of return.

Chart 5 shows the three-year mean and variance of the real rate of return on household savings for 1955-81. Table 2 reports the average real rate of return and the variance of the real rate of return for 1953-72, 1973-76, and 1977-81. The high and unpredictable rates of inflation that began in 1973 were accompanied by a decline in the average real rate of return on household savings and an increase in the variance of the real rate of return for the 1973-76 period. Households were clearly worse off during this adjustment period in terms of the real return and the riskiness of their savings. Beginning in 1977, however, the average real rate of return rose—although not generally as high as before 1966—and the variance of the real rate of return fell to levels generally below those before 1973. Thus, in terms of the real return and riskiness of their investment assets, it appears that the welfare of households improved once they could adjust to inflation.

It is difficult, however, to compare their welfare in the 1953-72 and 1977-81 periods. Both the average real return and the variance of the real return seem to have fallen. Households appear to have recently been earning a negative real rate of return on their savings, but a more certain rate. It is also difficult to assess the extent to which inflation and inflation uncertainty have contributed to these changes in welfare. Other factors also affect risk and return. Higher oil prices, for example—the major source of increased inflation and inflation

return contributed to the increase in the riskiness of the real rate of return on savings over this period.

CHART 5
Mean and variance of real return on household assets



Note: Variance is the variance of the real rate of return on household assets, shown as a three-year moving average. Mean is the mean of the real rate of return on household assets, shown as a three-year moving average.

uncertainty—may have contributed significantly to the reduction in consumer welfare by lowering the real rate of return on capital.[25] The evidence strongly suggests, however, that after a period of adjustment, at least some of the adverse effects of increased inflation uncertainty have been offset by inflation hedging.

Summary and implications

This article reexamines the effect of inflation uncertainty on households by considering the potential for neutralizing this effect by hedging. In theory, inflation uncertainty affects households by making the real rate of return on their savings more risky. This effect depends on a less than perfect positive association between the nominal rate of return on household savings and the rate of inflation.

By increasing the association between the nominal return on household savings and inflation through hedging, the effect of inflation uncertainty on the riskiness of the real return on household savings is reduced. The implication, since consumers are risk averse, is that an increase in inflation uncertainty creates an incentive for inflation hedging by increasing the benefits of hedging relative to the costs.

Inflation hedging—its nature and extent—was examined to see if hedging increases with inflation and inflation uncertainty. It was found that households were largely unhedged before inflation became significantly higher and more uncertain in 1973 and that they remained unhedged for several years after. Evidence indicates that households suffered welfare losses during the period immediately

25 See James Wilcox, "Why Real Interest Rates Were So Low in the 1970's," *American Economic Review,* March 1983, pp. 44-53.

following the first episode of high and volatile inflation, 1973-76.

It appears, however, that the nominal rate of return on household savings and the rate of inflation became highly correlated after 1976. This apparent success in hedging was accompanied by a reallocation of household savings away from equity and long-term assets and toward real estate and short-term assets and toward the new financial assets that allowed households to better hedge against inflation. Moreover, this inflation hedging appears to have substantially improved consumer welfare. In brief, the evidence is consistent with the hypothesis that increased inflation and inflation uncertainty encourage inflation hedging which reduces the associated costs to households.

The arguments presented here can be applied to the analysis of the effects of inflation uncertainty on other economic variables. Empirical and theoretical research indicates that inflation uncertainty lowers investment spending, real output, and employment. This literature, however, has ignored the potentially offsetting effects of inflation hedging. For example, if inflation uncertainty makes profits more uncertain, thus lowering investment spending, businesses would presumably try to insulate their profits from changes in inflation.

This does not imply that the costs of inflation uncertainty can be eliminated entirely. Even if households and firms could adjust to the extent that changes in inflation did not affect real rates of return on saving and investment, the adjustments themselves would likely incur transactions and efficiency costs. Efficiency costs to the economy could result from the reallocation of resources that these adjustments involved. On the other hand, financial deregulation, which has contributed to the success of inflation hedging, might increase efficiency by eliminating artificial market barriers to the optimal allocation of resources. The consideration of inflation hedging for the analysis of the effects of inflation uncertainty on the economy suggests instead that if economic agents were to hedge inflation completely, the only costs associated with inflation uncertainty would be the transactions and efficiency costs incurred by hedging.