# Economic Review

FEDERAL RESERVE BANK OF KANSAS CITY

November 1982

The *Economic Review* (USPS 417-850) is published by the Federal Reserve Bank of Kansas City monthly except for the July-August and September-October issues. Subscriptions and additional copies are available to the public without charge by writing the Research Division, Federal Reserve Bank of Kansas City, 925 Grand Avenue, Kansas City, Missouri 64198. If any material is reproduced from this publication, please credit the source. Controlled circulation postage paid at Kansas City, Missouri.

# The Costs of Inflation: An Analytical Overview

*By Dean W. Hughes*

Production of goods and services in the United States has fallen progressively below the economy's potential output for the past three years. The subpar economic performance has been associated with increased unemployment and rising business failures. The causes of this poor performance are varied and complex. Undoubtedly both the rapid oil price increases in 1979-80 and the prospect of increasing budget deficits have contributed to the poor economic performance. Nevertheless, it is generally believed that policy actions intended to reduce inflation have been a contributing factor. Even when the economy recovers from the current recession, growth in output is expected to be moderate for the next year. Thus, the country has paid and will continue to pay a high price for reducing inflation.

The question thus arises as to whether the costs of achieving greater price stability are justified. A first step toward answering this question is to identify the costs of inflation itself. Many of the adverse consequences of inflation, such as increased social friction, cannot be easily measured. Even the economic costs of inflation—which are defined in this article as reductions in current or future economic welfare resulting from distortions caused by inflation—are not easily quantified. Moreover, the magnitudes of these costs are constantly changing as the economy adapts to inflation. As a result, a definitive answer to the question of whether the costs of reducing inflation are outweighed by the costs of allowing inflation to continue is not feasible. However, the major costs of inflation and the ways these costs are changing can be identified.

This article reviews the economic costs of inflation on a theoretical level. The extent to which means have been devised to reduce the costs by adapting laws, regulations, and contractual procedures of the economy to an inflationary environment is also considered. The first section of the article defines inflation, evaluates measures of inflation, and presents a brief history of the debate over the costs of inflation. The next two sections distinguish between the costs resulting from anticipated and unanticipated inflation. And finally, recent economic adaptations to inflation are discussed, along with their limitations in eliminating the costs of inflation.

Dean W. Hughes is an economist in the Economic Research Department at the Federal Reserve Bank of Kansas City. The author would like to thank Dale Allman for research support and Bryon Higgins and Charles Webster for numerous comments and suggestions.

## INFLATION AND THE ECONOMY

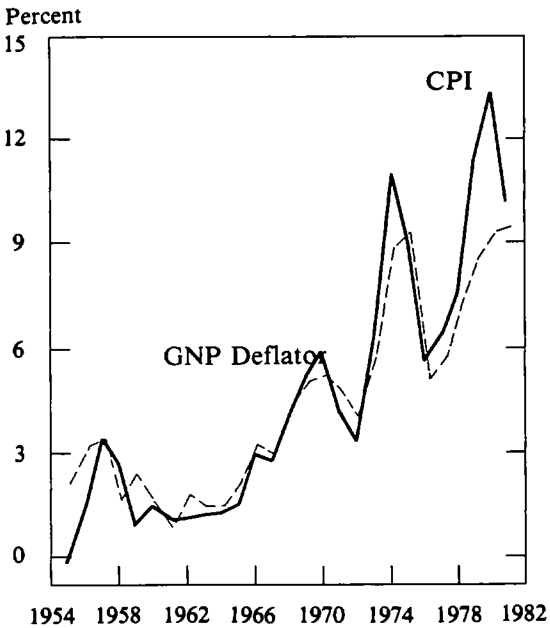
Before examining specific costs of inflation, it is useful to specify the general framework in which the costs of inflation are analyzed. This section lays the groundwork for subsequent analysis by discussing how inflation is defined and measured, documenting the increased level and variability of inflation, and tracing changes in attitudes regarding the costs of inflation.

## Measuring Inflation

Inflation can be defined as a sustained rise in the average dollar prices of goods and services. Stated another way, it is a continued decline in the amount of goods and services a dollar will buy and, therefore, a decline in the purchasing power of the dollar. As simple as the definition of inflation seems, constructing an empirical measure of prices that corresponds precisely to the price level used in defining inflation entails several complicated problems.

The Consumer Price Index (CPI) and the implicit GNP deflator are the two most commonly used measures of the price level. Correspondingly, annualized percentage changes in these two indexes are the most frequently cited measures of the inflation rate. There are several conceptual differences between the CPI and GNP deflator, including the comprehensiveness of the goods and services that they cover and the method of assigning weights to prices. Both have strengths and weaknesses, but most economists consider the GNP deflator preferable in most respects.[1]

**Chart 1**
**MEASURES OF INFLATION**




Despite conceptual differences, both the CPI and the GNP deflator show that inflation has been on an upward trend in the United States since 1955, as is shown in Chart 1. For example, inflation in the 1960s averaged only 2.5 percent as measured by the GNP deflator or 2.6 percent as measured by the CPI, but accelerated to an average rate of 6.5 percent in the 1970s according to the GNP deflator or 7.5 percent according to the CPI. Chart 1 also shows that the variability of inflation tends to increase as the level of inflation rises.[2] The range of inflation rates and other statistical measures of variability increased substantially from the 1960s to the 1970s. As will be shown, increases in the level and variability of inflation lead to increases in the costs of anticipated and unanticipated inflation.

## Changing Attitudes About the Costs of Inflation

It was traditionally thought that the economic costs of inflation were negligible.

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1 For further discussion, see Henry J. Levinson, "Some Problems of Price Indexes and Gains and Losses from Inflation," Staff Report on *Employment Growth and Price Levels*, Joint Economic Committee, 86th Cong., 1st sess., 1959.

2 For a more rigorous treatment of this relationship, see John Taylor, "On the Relation Between the Variability of Inflation and the Average Inflation Rate," Carnegie-Rochester Conference Series on Public Policy, *The Costs and Consequences of Inflation*, Karl Brunner and Allan Meltzer, eds., North-Holland Publishers, Vol. 15, 1981, pp. 57-85.

Although admitting the possibility that inflation has adverse social consequences, such as arbitrary redistribution of income and wealth, traditional economic analysis did not imply that inflation reduces aggregate economic welfare.[3] For example, microeconomic theory as developed by neoclassical economists in the 19th century suggests that economic welfare depends on the optimal allocation of resources, which in turn depends only on relative prices of commodities and productive resources.[4] Since there is nothing inherent in the theory to suggest that relative prices are affected by the average level of prices, these economists inferred that neither the price level nor its rate of change would adversely affect economic welfare, as measured by the total output of goods and services.[5]

As recently as the 1960s, most economists still thought the economic costs of inflation were small. Economic costs were thought to be limited to the use of resources required to economize on cash balances and were described as consisting of only a few extra trips to the bank.[6] Moreover, the social consequences of inflation were considered manageable.[7] Indeed, many economists argued that the meager economic costs and limited social consequences of inflation were more than offset by the reduction in unemployment and increases in output that could be achieved by accepting inflation.[8] Some economists went so far as to suggest that a small amount of inflation might actually improve economic performance by facilitating relative price adjustments.

As inflation accelerated and economic performance deteriorated in the 1970s, however, economists began to reexamine earlier views regarding the costs of inflation.[9] Two primary conclusions emerged as the result of this reexamination.

The first conclusion is that previous estimates overstated the benefits of inflation. The current view is that the benefits of inflation are tem-

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3 See Henry C. Wallich, "Honest Money," *Federal Reserve Readings on Inflation,* Federal Reserve Bank of New York, February 1979, pp. 1-12, for a discussion of some of the social consequences of inflation.

4 See R. B. Ekelund, Jr., and R. F. Hebert, *A History of Economic Theory and Method,* McGraw-Hill, 1975, pp. 387-408, for a discussion of different economists' points of view on this subject.

5 There does not have to be a reduction in gross national product for inflation to have costs. Even if resources were fully employed during an inflation, some of the resources might be "wasted" in the production of goods and services that would not be required in a noninflationary economy. If inflation were controlled, wasted resources could be used to increase economic welfare. This article, however, is not a restatement of the work done by John A. Tatom, "The Welfare Cost of Inflation," *Review,* Federal Reserve Bank of St. Louis, November 1976, pp. 9-21. Tatom focuses on measuring the welfare loss on real money balances and disregards the other rigidities of the economy that form the basis of this analysis. He estimated the annual costs at $5 to $7 billion in 1975. So, while the problems of measuring all the costs of inflation make it almost impossible to assign a specific number, the costs are not trivial. Martin S. Feldstein, "The Welfare Cost of Permanent Inflation and Optimal Short-Run Economic Policy," *Journal of the Political Economy,* Vol. 87, 1979, pp. 749-68, suggests that the discounted present value of these costs might be infinite.

6 See William H. Branson, *Macroeconomic Theory and Policy,* Harper and Row, 1972, p. 247.

7 See Paul A. Samuelson, *Economics,* McGraw-Hill, 1967, p. 20.

8 See A. W. Phillips, "The Relationship Between Unemployment and the Rate of Change in Money Wage Rates in the United Kingdom 1862-1957," *Economica,* November 1958, for the original reasoning behind the Phillips curve. See Saul Hymans, "The Trade-Off Between Unemployment and Inflation: Theory and Measurements," *Readings in Money, National Income and Stabilization Policy,* Warren L. Smith and Ronald L. Teigen, eds., 1970, pp. 152-60, for support of the Phillips curve in the late 1960s.

9 Clearly not all of the economic problems of the 1970s can be blamed on inflation. There were supply shocks to the economy in agriculture and energy, and the war in Vietnam ended. These changes, and more, make it difficult to identify the effects of any one factor.

porary and small rather than permanent and large as had been thought in the 1960s. Increases in output above the economy's full employment or "potential" output can be caused by inflation only to the extent that it is unanticipated.[10] Once the economy adjusts to a higher level of inflation, economic output returns to the more natural level, thereby offsetting to some extent the benefits of inflation. In addition, temporary increases in output that might be gained through unanticipated inflation are offset by losses in output if inflation is returned to its original level. These losses, the costs of fighting inflation, offset the original benefits of inflation.

The second conclusion of the current view is that the costs of inflation were understated in the 1960s. In large part, this understatement resulted from failure to recognize many of the adverse effects of inflation on potential output. Whereas fluctuations around the potential level of output caused by unexpected changes in inflation affect only the time path of production and income, reduction in the economy's potential to produce goods and services imposes lasting economic costs. To the extent that inflation results in a misallocation of resources that reduces potential output, economic welfare is impaired. These reductions in potential output are identified in the remainder of this article as the costs of inflation. Reductions in potential output can be caused either by anticipated or unanticipated inflation.

## COSTS OF ANTICIPATED INFLATION

Businesses and individuals can adjust their actions to take account of inflation to the extent that they can predict the rate of inflation in advance. It might be concluded, therefore, that anticipated inflation does not lead to misallocation of resources and therefore does not impose economic costs. However, several institutional, legal, and regulatory rigidities make it difficult to adjust entirely to anticipated inflation.[11] As a result, even inflation that is generally anticipated can lead to distortions that reduce potential output. While some of the costs of anticipated inflation are primarily short run, others have more persistent effects on economic welfare.

### Short-Run Costs

Short-run costs of anticipated inflation are those that could be quickly eliminated if price stability were restored. For example, the reductions in output resulting from the diversion of labor would be reversed soon after firms and individuals became convinced that lasting progress was being made in reducing inflation.[12] Because current decisions regarding the supply of labor by individuals and the demand for labor by firms primarily affect the current level of potential output, distortions in the labor

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10 A typical definition of potential output is the level of output where resources are used to the extent that there are no pressures for inflation to increase or decrease. Some additional resources can be made available to production but only at the expense of accelerating inflation. Potential output is used here in a broader sense than is typical. The term is used in this article to refer to maximum welfare developed subject to the preferences of consumers, production technology, and the current rules and regulations of society. A measure of this concept would have to include the value of leisure and work done outside of the market system as well as the value of goods and services incorporated in the GNP. See Paul A. Samuelson, *Economics*, McGraw-Hill, 1967, pp. 183-85, for a discussion of measuring economic welfare.

11 These costs are a joint product of both inflation and regulation. Without inflation, the cost of regulation would be less. Without regulation, the cost of inflation would be less. In this article, the rules and regulations of society are taken as given. Thus, the queston is what are the costs of inflation given the current set of laws governing the economy.

12 For a more detailed description of these costs, see Stanley Fischer and Franco Modigliani, "Towards an Understanding of the Real Effects and Costs of Inflation," NBER Working Paper No. 303, November 1978, pp. 8-10.

market caused by inflation have only a limited impact on future levels of potential output. It is in this sense that these costs can be described as short-run costs of anticipated inflation.

A reduction in output resulting from the diversion of resources to change published prices is one of the most obvious costs of anticipated inflation. For example, labor and other variable inputs used to reprint catalogs and restaurant menus to reflect increases in pricing resulting solely from inflation could better be used to increase production of goods and services that increase economic welfare. Of course, not all resources devoted to changing posted prices can be attributed to inflation. Changes in the relative prices of goods and services necessary for the efficient functioning of the economic system require that some resources be devoted to changing published prices even in the absence of inflation. However, to the extent that such changes must be made more frequently in an inflationary environment, some of the resources used are wasted and thus reduce economic welfare.

Additional labor used to economize on cash balances because of inflation also results in economic costs. As inflation is by definition a decline in the purchasing power of money, households and businesses have an incentive to devote resources to hold cash balances at a minimum. This distortion could be alleviated by paying a market interest rate on monetary assets. However, paying interest on currency would be difficult or impossible, and interest on demand deposits is prohibited by law.[13] As a result, individuals and businesses must devote time and other resources to maintaining the purchasing power of their assets by minimizing cash balances. For example, individuals make more frequent trips to the bank to transfer funds between money balances and interest-earning assets, and businesses expend time and energy developing sophisticated cash management programs, such as lockboxes and remote disbursement. These resources could be used in production of other goods and services were it not for the artificial costs of holding down cash balances created by inflation.

The time businesses devote to developing nontaxable benefits for employees because of higher marginal tax rates resulting from inflation must also be included as a cost of inflation. Income tax schedules are specified in nominal terms. Because of the progressive nature of the tax system, higher nominal incomes resulting from inflation cause an increase in the proportion of income paid in taxes.[14] The decline in the after-tax wage rate resulting from "bracket creep" may reduce the amount of labor supplied, thereby reducing potential output. To attract workers at the lowest costs, employers have developed nontaxable employee benefits. Additional resources devoted by businesses to development of these nontaxable benefits, as

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13 Efforts have been made to provide some compensation to individuals and businesses holding demand deposits and other monetary assets. Charges on checking accounts that are lower than the costs of processing checks are one example of what could be called implicit interest. Another example would be lower interest rates on loans to businesses that leave compensating balances on deposit. See Bryon Higgins, "Interest Payments on Demand Deposits: Historical Evaluation and the Currency Controversy," *Monthly Review*, Federal Reserve Bank of Kansas City, July-August 1977, pp. 3-11, for a more complete analysis of this topic.

14 Some economists would argue that the level of real taxes is independent of the inflation rate over long periods of time. They suggest tax cuts are made by the government to offset increases in real tax rates caused by inflation. See "The Inflation Tax: The Case for Indexing Federal and State Income Taxes," *An Information Report*, Washington, D.C.: Advisory Commission on Intergovernmental Relations, January 1980, for more information on the subject. Clearly, though, there are long delays in government actions to realign real tax rates after inflation has occurred. Thus, personal planning must be made on the basis of current laws, which imply real tax rate increases for any positive expected inflation rate.

well as the inefficiencies in the labor market created by the need to compare the effective compensation of jobs with different benefits packages, can be included as a cost of inflation.

### Long-Run Costs

Long-run costs of anticipated inflation would persist even if inflation were to abate. Most of these costs result from reductions in the level of business investment in plant and equipment. By reducing current incentives to save and invest, the interaction of inflation and the tax system reduce future potential output. The resulting slowdown in the rate of economic growth has a persistent negative effect on economic welfare. These long-run costs are more serious that the short-run costs because of their continuing impact on the economy's productive capacity.

The reduction in personal saving caused by declines in real returns is one aspect of the long-run cost of anticipated inflation.[15] Savers must pay taxes on the nominal interest income received on financial assets that serve as stores of value. With inflation, this interest income includes an inflation premium required to compensate for the decline in the purchasing power of savings. Nevertheless, tax laws do not distinguish between the real interest rate component of interest income and the inflation premium component of interest income. As a result, the component of the return to saving that corresponds to the maintenance of purchasing power of assets in an inflationary environment is taxed even though it represents compensation for loss in the value of principal rather than a true return to principal. Empirical evidence suggests that nominal interest rates rise somewhat more than inflation but less than would be required to keep the real after-tax rate of return on savings as high as it would be without inflation.[16] As a result, inflation reduces incentives to save, and the consequent decline in funds available to finance capital investment reduces economic growth.

Capital investment is also adversely affected by tax laws relating to the depreciation of capital goods in an inflationary environment.[17] In principle, profit taxes apply only to business income above that necessary to replace existing capital goods. But the tax laws base depreciation allowances on original purchase price. In an inflationary environment, the cost of replacing capital goods exceeds the initial purchase price. As a result, tax laws provide an inadequate shield for this cost of doing business, and profits as defined for purposes of calculating business taxes exceed true profits. Calculation of depreciation allowances on the basis of historical costs rather than the economically sounder basis of replacement costs encourages businesses to use more inputs that are fully deductible in calculating profits and discourages investment in capital goods. Since future productive capacity depends on previous investment in capital goods, this bias tends to slow economic growth.

Tax treatment of inventories and other business assets may also create economic costs when inflation causes an artificial rise in the

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15 See Gregory V. Jump, "Interest Rates, Inflationary Expectations, and Spurious Elements in Measuring Real Income and Savings," *American Economic Review*, Vol. 70, 1980, pp. 990-1004, for a more in-depth analysis.

16 See Richard Startz, "Unemployment and Real Interest Rates: Econometric Testing of Inflation Neutrality," *American Economic Review*, Vol. 71, December 1981, pp. 969-77, and Eugene F. Fama, "Short-Term Interest Rates as Predictors of Inflation," *American Economic Review*, Vol. 65, June 1975, pp. 269-82, for discussions of the size of the rise of interest rates with inflation. This interaction between inflation and interest rates is called the Fisher effect.

17 See Martin Feldstein and Lawrence H. Summers, "Inflation and Taxation of Capital Income in the Corporate Sector," *National Tax Journal*, Vol. 32, December 1979, pp. 445-70.

value of the assets.[18] Businesses must pay taxes on capital gains resulting from increases in the nominal value of inventories or from the sale of other assets at a price higher than the original purchase price. To the extent that these nominal capital gains result from a general rise in the price level rather than an increase in the relative prices of goods held in inventories or of other business assets, the resulting tax liability reduces the real net worth of firms and creates cash flow problems for them. Both effects may impair businesses' willingness and ability to invest in capital goods.[19]

## COSTS OF UNANTICIPATED INFLATION

Although the costs of anticipated inflation are significant, most could be reduced appreciably by adjusting tax laws, regulations, and other institutional arrangements. This is not true for the costs of unanticipated inflation.

Unanticipated inflation is defined as the portion of inflation that firms and households cannot predict. For the most part, unanticipated inflation results from changes in inflation from the rate that has come to be expected and incorporated in economic decisions. Because these changes are unpredictable, the costs of unanticipated inflation cannot be easily eliminated by institutional changes that reduce market imperfections.

The costs of unanticipated inflation are more fundamental in that they occur as a result of long-term contracts and other long-run economic decisions based on a future expected price level. To the extent that the actual price level differs from the expected price level, previous economic decisions prove to be suboptimal. As a result, resource allocation is distorted in a variety of ways, and potential output is reduced. The costs of unanticipated inflation, like the costs of anticipated inflation, can be divided into two classes—short run and long run.

### Short-Run Costs

Short-run costs of unanticipated inflation result from temporary distortions in relative prices caused by unexpected changes in inflation. Because businesses and individuals base economic decisions on their predictions of the future rate of inflation, any deviation in the rate of inflation from expectations can cause relative prices to diverge in the future from what was assumed when the original commitments were made. Moreover, the timing of the impact of inflation on the prices of various commodities depends on numerous factors,

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18 See Phillip Cagen and Robert E. Lipsey, *The Financial Effects of Inflation,* Ballinger Book Co., 1978, and D. Pearce, "The Impact of Inflation on Stock Prices," *Economic Review,* Federal Reserve Bank of Kansas City, March 1982, pp. 3-18, for more details. Nominal accounting at historical cost also misstates the government's financial condition leading to an overstatement of the deficit. See Stanley Fischer and Franco Modigliani, "Towards an Understanding of the Real Effects and Costs of Inflation," NBER Working Paper No. 303, December 1978, pp. 14-15, for further discussion of this topic.

19 The adverse consequences for investment spending of the interaction between inflation and the tax system are offset to some extent by the deductibility of interest expenses in computing income for tax purposes. The same inflationary premium in nominal interest rates that serves to reduce the after-tax return to lenders also reduces the after-tax cost of borrowing. Because both the inflation premium and real interest rate components of nominal interest rates can be deducted from income in computing tax liabilities, anticipated inflation reduces the real after-tax cost of borrowed funds. This reduction in the cost of borrowing has two primary effects. First, it encourages use of debt financing relative to equity financing. By adding to businesses' fixed costs, this increased use of debt increases risk and reduces the ability of firms to adapt to changing business conditions, thereby slowing the response to changes in relative prices and impairing efficiency in the allocation of resources. Second, the reduced cost of borrowing lowers the average cost of capital, which is a weighted average of the cost of debt and the cost of equity. By so doing, the deductibility of nominal interest expenses taken by itself tends to encourage business investment.

such as the market structure of the industry producing the commodities. Thus, unanticipated inflation affects the prices of some commodities sooner than others. As a result, even a one-time increase in inflation that was not anticipated leads to a temporary misallocation of resources. However, businesses and households can adjust to the higher level of inflation if it persists long enough to become considered "normal." Thus, the initial reduction in potential output caused by misallocation of resources resulting from an unexpected change in the inflation rate can be reversed as long as the surprise in the inflation rate does not recur.

Unanticipated inflation can create economic costs by changing the relative prices of alternative factors of production. An unexpected decline in inflation can increase the cost of factors of production purchased under long-term contracts relative to factors of production purchased in the spot market. For example, union labor may become more expensive relative to other factors of production. Long-term contracts are common for labor unions. Such contracts can benefit both employers and employees by reducing costs of negotiating wage rates and other terms of employment. A certain level of anticipated inflation is typically incorporated into wage increases over the term of the contract. A decline in the rate of inflation below that built into union wages tends to raise the real wage rate for employees covered by the contract. As a result, employers have an incentive to substitute other resources for union labor even though doing so reduces productivity somewhat. For instance, businesses may hire additional management personnel rather than union members merely because the relative wage rates have been distorted by unanticipated inflation. If so, economic efficiency, which requires an optimal combination of the various factors of production, would be impaired, thereby reducing economic welfare.

Unanticipated inflation may also lead to misallocation of resources by distorting relative prices of products because of different speeds of adjustment to the aggregate inflation rate. The prices of commodities produced in a competitive industry may respond more rapidly to unexpected changes in the inflation rate than do prices of goods produced in oligopolistic industries. A competitive environment forces producers to react more quickly to changing conditions of supply and demand. In addition, speeds of adjustment to the aggregate inflation rate may differ between industries because of differences in the extent to which long-term contracts for materials are used.[20] Regardless of the nature of the frictions that prevent businesses from fully adjusting to unanticipated inflation, however, resulting distortions in the choice of inputs cause economic inefficiency.

## Long-Run Costs

Long-run costs of unanticipated inflation result primarily from the uncertainty caused by recurring surprises in the rate of inflation.[21] Occasional divergences from the expected rate of inflation on which economic decisions are based may be insufficient to cause fundamental changes in the basis for ordering economic relationships. However, recurrent bouts of unan-

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20 See Michael Mussa, "Sticky Individual Prices and the Dynamics of the General Price Level," *The Costs and Consequences of Inflation,* Carnegie-Rochester Conference Series on Public Policy, Karl Brunner and Alan Meltzer, eds., North-Holland Publishers, 1981, pp. 261-96, and Dennis Carlton, "The Disruptive Effect of Inflation on the Organization of Markets," paper presented at an NBER conference on inflation, Washington, D.C., February 1981.

21 See Hayne E. Lehland, "The Theory of the Firm Facing Random Demand," *American Economic Review,* Vol. 62, 1972, pp. 278-91, and Stephen L. Able, "Inflation Uncertainty, Investment Spending, and Fiscal Policy," *Economic Review,* Federal Reserve Bank of Kansas City, February 1980, pp. 3-13.

ticipated inflation can increase uncertainty to the extent that fundamental changes are made in the conduct of economic affairs. Moreover, these changes will persist, even after unanticipated inflation is eliminated. Economic agents adjust their expectation slowly. Thus, risks resulting from continuously unanticipated inflation can be eliminated only after a prolonged period in which there have been no surprises about inflation.

One major long-run cost of unanticipated inflation results from the reluctance of savers to buy long-term assets. As savers have been repeatedly surprised by the acceleration of inflation, they have increased the liquidity premium required to invest in long-term financial assets. By investing in short-term assets, savers are protected from the large capital losses that result from declines in the purchasing power of long-term financial assets when inflation accelerates unexpectedly. However, reluctance of savers to commit funds on a long-term basis impairs the ability of businesses to finance long-term investment projects. Borrowing short-term funds to finance long-term real investment creates a risk that the real cost of the project will increase if unexpected inflation causes an unanticipated increase in the short-term interest rates required to refinance debt. Therefore, savers' reluctance to invest in long-term assets increases the riskiness of business fixed investment and thereby reduces the growth of potential output.

Costs are also incurred because of reluctance to enter into long-term nonfinancial contracts. Long-term contracts between workers and firms, suppliers and producers, and other economic units reduce transactions costs and risks for both parties. However, the usefulness of long-term contracts is premised on the predictability of prices over the term of the contract. Thus, by destroying confidence in the ability to predict future prices, recurrent bouts of unanticipated inflation undercut the economic rationale for long-term commitments. The resulting loss of efficiency in the conduct of economic affairs persists until confidence in the predictability of prices is restored and is therefore a long-run cost of unanticipated inflation.

Reductions in international trade resulting from unanticipated inflation in one country also impose long-run economic costs. It has been recognized for centuries that world economic welfare is enhanced by every country specializing in the production of goods in which it has a comparative advantage. Yet, historically, unanticipated inflation in one country has caused the prices of the goods it exports to rise unexpectedly and prices of the goods it imports to fall unexpectedly. Under the fixed exchange rate system that existed until 1973, governments bore the risks of unanticipated inflation in that variation in government's foreign exchange reserves was used to preserve the international value of its currency. Since the floating exchange rate system was introduced, however, importers and exporters have borne the risks of unanticipated changes in exchange rates resulting from unexpected inflation. To the extent that these risks have discouraged international trade, the potential output of all countries has been reduced.

## RECENT ADAPTATIONS TO INFLATION

The increase in the level and variability of inflation in the 1970s led individuals, businesses, and the government to develop methods of alleviating the costs of inflation. As these costs became more evident, laws, regulations, and private contracts governing economic relationships have been altered to adapt to an inflationary environment. Although the adaptations have reduced the costs of both anticipated and unanticipated inflation, they have not eliminated the costs altogether.

A number of developments have alleviated the cost of holding money balances. Several new financial instruments yielding a market rate of interest—including money market mutual funds, corporate repurchase agreements, and money market CD's—have emerged as very close substitutes for traditional forms of transactions balances. Moreover, the Depository Institutions Deregulation and Monetary Control Act of 1980 authorized nationwide NOW accounts for individuals. Although initially subject to a 5.25 percent interest rate ceiling, interest rates on NOW accounts and all other time and savings deposits will be deregulated altogether by 1986. Thus, consumers will eventually be able to earn a market rate of return on transactions deposits, thereby reducing the incentives to economize on cash balances resulting from inflation.

Despite recent and prospective developments expanding the range of options for holding liquid assets, inflation will continue to impose costs by creating incentives to economize on cash balances for several reasons. NOW accounts cannot be offered to business firms. Moreover, there is no prospect of paying interest on currency held by the public or on reserves held by depository institutions. Finally, even for financial assets that earn competitive yields, after-tax real returns will be low or negative in an inflationary environment due to the taxation of nominal interest income. For all of these reasons, incentives will continue for businesses, financial institutions, and individuals to economize on cash balances. Economic costs associated with resources wasted on cash management will therefore continue if inflation persists.

Adaptation of tax laws will also reduce the costs of inflation. The Economic Recovery Tax Act of 1981 (ERTA) provides for indexing of personal income tax rates beginning in 1985. By eliminating bracket creep, tax indexation will reduce the misallocation of resources caused by distortions in labor markets due to the interaction of tax laws and inflation.

Indexing of income tax rates is not adequate in itself for the elimination of all the costs brought about by the failure of the tax laws to allow for the effects of inflation. For example, the ERTA does not change the tax treatment of real and financial capital. Distortions arising from taxation of nominal interest income and nominal capital gains will continue to impose economic costs if inflation persists. Although the ERTA provides incentives for investment in the form of more liberal depreciation allowances, the incentives are not directly geared to the problems inflation creates. As a result, incentives to invest in plant and equipment will continue to be distorted by high and variable inflation rates.

Indexation of private contracts, like indexation of the tax code, has alleviated some of the costs of inflation. For example, an increasing number of labor contracts contain escalator clauses involving automatic cost of living allowances (COLA's). By automatically adjusting nominal wage rates by a percentage that depends on the overall rate of inflation, COLA's reduce the misallocation of resources resulting from inflation distorting real wage rates. In addition, indexed contracts for labor and for goods and services reduce the need for incurring the economic costs of renegotiating contracts and alleviate the risk of entering into long-term contracts.

Nonetheless, indexation of some private contracts has not eliminated the entire cost of inflation associated with long-term economic agreements. Comparatively few contracts include COLA's, and many of the COLA's are constrained by maximum allowable increases in wage rates. While the real prices of commodities covered by indexed contracts are less affected by inflation, these prices still vary relative to prices of commodities covered by nonindexed contracts.[22] Thus, inflation will continue to distort prices and cause misallocation of resources as long as some economic agreements are not fully indexed.

Adjustable rate loans represent the indexation of financial contracts. The interest rate on a variable rate loan is indexed to the cost of funds to the lender or some other measure of current interest rates that varies with inflation. As such, rates on variable rate loans are effectively indexed to current inflation rather than to the inflation expected when the loan was made. Consequently, variable rate loans reduce interest rate risk for borrowers and lenders caused by unexpected capital gains or losses. The introduction of this type of loan, therefore, alleviates some of the costs of inflation caused by reluctance to commit funds for long periods in the face of unanticipated inflation.

However, variable rate loans do not eliminate the problems unpredictable inflation poses for long-term loan agreements. For example, variable rate loans force borrowers to accept substantially higher cash flow risks than conventional fixed rate loans. Interest payments on a variable rate loan can increase sharply when interest rates rise, as would occur when expectations of future inflation rise. Moreover, even if the increase in interest rates results from an increase in current rather than expected future inflation, the borrower's income might not keep pace with inflation. If not, the disparity between the borrower's income and the timing or magnitude of the effect of inflation on interest expenses can create severe cash flow risks for the borrower. In the extreme case, the borrower's inability to make loan payments could result in default. Thus, instead of eliminating the risk of loan agreements associated with unanticipated inflation, variable rate loans transfer risk from one category to another. As a result, unanticipated changes in inflation continue to impose costs in the form of risk accompanying long-term loan agreements.

Development of financial futures markets is a recent innovation for reducing the cost of inflation. In these markets, individuals or businesses can enter agreements that effectively lock in a given interest rate regardless of what happens to market interest rates. Consequently, these agreements can be used to hedge against the adverse effects for borrowers or lenders of future interest rate movements, thereby reducing the economic costs of inflation.

As with variable rate loans, however, financial futures contracts merely redistribute the risks associated with interest rate changes caused by unanticipated inflation. To the extent that futures markets facilitate the transfer of risk to those better able or more willing to accept it, the economic costs resulting from unanticipated inflation are reduced. Nevertheless, it is unlikely that those accepting risk are totally indifferent to it. Rather, they are probably only less risk adverse than others that use futures markets to hedge. In addition, there are transactions costs of transferring risk in financial futures markets, and futures contracts are currently available on only a limited range of financial assets. Thus, financial futures markets provide a means for some individuals to limit the prospective costs of unanticipated inflation to themselves but do not allow the economy as a whole to avoid the costs.

## SUMMARY AND CONCLUSION

The costs of inflation discussed in this article are defined as the losses in potential output that occur during periods of increases in the average

22 See Stanley Fischer, "Adapting to Inflation in the United States Economy," paper presented at an NBER conference on inflation, Washington, D.C., October 1980.

dollar prices of goods and services. Economic theory suggests that temporary gains and losses in the actual level of economic output occur over a business cycle as inflation first increases unexpectedly and then declines. Since these short-run changes in output substantially offset each other, this article focuses on the reductions in potential output caused by inflation.

Some of the costs are incurred even if inflation is fully anticipated, since resources can be misallocated when relative prices change due to the interaction of inflation and various rules and regulations that do not adequately account for inflation. The costs of anticipated inflation can be further categorized into short-run costs that price stability would quickly eliminate and long-run impacts on the growth in potential output that occur when investment is reduced. Short-run costs of anticipated inflation include reductions in potential output resulting from resources being wasted on repricing goods, minimizing cash balances, and developing nontaxable employee benefits. Long-run costs of anticipated inflation are caused by the interaction of inflation with tax laws that reduce the incentives for consumers to save and for businesses to invest.

Other costs of inflation are incurred when unanticipated changes in the inflation rate cause temporary changes in relative prices and increase risks. Both unexpectedly high and low rates of inflation change the relative prices of factors of production and final products. The resulting redirections of resources into production activities that would not otherwise be warranted diminish potential output. In addition, the increase in risks associated with a fluctuating rate of inflation can lead to lower domestic and international levels of output.

Increases in the level and variability of inflation during the 1970s led to many adaptations made in an effort to reduce the costs of inflation. Many of the recent innovations in financial instruments can be traced to the need to compensate holders of cash balances for the losses they suffer when inflation is rapid and interest rates are high. Income taxes are scheduled to be indexed in 1985 to keep tax rates from increasing simply because of inflation. Many long-term contracts for goods and services have been indexed to a measure of inflation to protect both buyer and seller from unanticipated inflation. Finally, financial markets are adjusting to unanticipated inflation through use of adjustable rate loans and financial futures. These adaptations have not eliminated the costs of inflation entirely, however, either because they are not in all contracts or because risks cannot be totally eliminated.

There are continuing costs of inflation, and therefore, the costs are not likely to be eliminated until inflation is eliminated. The imperfect adaptations that have evolved already resulted from more than a decade of historically high inflation. No one can be certain how long it would take for a more complete transition to an indexed economy where inflation imposes no costs. The result of continuing inflation or a return to even higher inflation would, therefore, be further reductions in current output and cumulative losses in future production. These costs are a principal reason for the Federal Reserve System's commitment to reducing inflation.

# The Effect of Financial Futures on Small Bank Performance

*By Mark Drabenstott and Anne O'Mara McDonley*

Commercial banks have always encountered risks in their normal course of business. However, the volatility of interest rates in recent years has increased the risk of mismatching interest-sensitive assets and liabilities. Small community and agricultural banks, it has been found, have felt the effects of this risk more than their larger urban counterparts.[1] As a result, many small banks might use financial futures to reduce the risks of interest rate volatility if they knew how such use would affect their performance.

This article employs an economic model of a representative rural bank to demonstrate the possible effects that the use of financial futures can have on bank performance. The first section discusses a conceptual framework for the small banking firm and introduces financial futures to the framework. The second section presents an empirical economic model of a bank based on this conceptual framework. The model is then used to show how the representative bank performs when futures are used in various situations. The final section draws some implications for potential users of financial futures and summarizes the findings of the article.

## THE SMALL BANKING FIRM

The ownership of small banks usually differs significantly from the ownership of large banks. Most small banks are closely held corporations, often with only one major stockholder. The major owners of small banks, therefore, exert considerable influence over the management of the bank. Large banks, by contrast, are normally publicly held corporations with many stockholders, none usually holding a strong majority position. Thus, a separation of ownership and management is characteristic of large banks.[2]

Because of these differences in ownership, the operating objectives of large and small banks are usually different. A large bank tries to maximize the total value of bank stock holdings. This objective is consistent with the goals of both stockholders and management. The operating objective of a small bank, however, more directly reflects the goals of a small

[1] For a fuller discussion of financial futures and their applications for agricultural banks, see Drabenstott and McDonley, "The Impact of Financial Futures on Agricultural Banks," *Economic Review*, Federal Reserve Bank of Kansas City, May 1982, pp. 19-30.

Mark Drabenstott is an economist and Anne O'Mara McDonley is a research associate, both with the Economic Research Department at the Federal Reserve Bank of Kansas City. The authors gratefully acknowledge the assistance of Freddie Barnard of Purdue University and Peter Barry of the University of Illinois in developing the economic model used for this research.

[2] Another important distinction is that, unlike the shares of stock of large banks that trade on major exchanges, shares of small banks typically trade in local imperfect markets.

group of owners. Their goals tend to include greater risk avoidance along with profit maximization. Thus, the operating objective of a small bank can be defined as simultaneously satisfying the goals of profit maximization and risk avoidance.

Utility maximization is another way of describing the operating objective of a small bank. In this context, utility can be defined as the satisfaction owners receive from achieving profits and avoiding risk. The choice of an operating strategy that maximizes utility depends on the owners' preferences between risk and profit and the bank's feasible performance—the various portfolio combinations of profit and risk that the bank can achieve.[3]

A small bank that follows a utility maximization objective faces one danger. If the owners are too cautious and bank earnings fall low enough, the bank may be bought by someone that perceives that the bank's profit performance can be improved. In effect, this amounts to the bank being operated at a value below market expectations. For a large bank, low performance would be reflected directly in a drop in the price of its stock. But for a small bank, because its stock is not actively traded, a utility maximizing course that drives down earnings will be revealed eventually when a buyer offers to take over the bank at a premium price. This premium will be determined by the difference between current value and the perceived value that could be achieved under a value maximization objective.

### Bank Utility Functions

The utility function combines the satisfaction gained from achieving all the bank's goals into one calculation and reflects the bank owners' preferences among these goals. Given a bank's goals of profits and risk avoidance, a utility function quantifies the bank's risk aversion. In other words, the utility function indicates the amount by which earnings must increase for the bank to accept additional risk.

A graphic presentation clarifies the utility function concept. A bank measures profits by the expected net spread of its portfolio—the difference between its asset earnings and liability costs. Risk is measured by the variability associated with this expected return. Measured in these terms, the utility function depicts combinations of profit and risk that provide the bank with a constant level of utility.

Because the bank does not prefer any one combination, the locus of points that represents the complete set of risk-return combinations is called an indifference curve. Thus, curve $I_0$ in Figure 1 represents one indifference curve. The bank receives the same utility from either combination A or B. The bank shows its risk aversion by being willing to accept the higher risk at B only by gaining a higher rate of return.[4] The bank receives more satisfaction when it can operate on curve $I_1$ since combination C provides a higher rate of return than combination A, but with the same level of risk.

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[3] The distinction between a value maximizing objective for publicly held banks and a utility maximizing objective for closely held banks is discussed extensively in economic literature. For a discussion of alternative theories of the banking firm, see E. Baltensperger, "Alternative Approaches to the Theory of the Banking Firm," *Journal of Monetary Economics*, 6 (1980), pp. 1-27. For an example of a model that deals with a value maximizing bank, see M. Flannery, "Market Interest Rates and Commercial Bank Profitability: An Empirical Investigation," *Journal of Finance*, 36 (1981), pp. 1085-1101. For an example of a model that deals with a utility maximizing bank, see L. Robison and P. Barry, "Portfolio Adjustments: An Application to Rural Banking," *American Journal of Agricultural Economics*, 59 (1977), pp. 311-20.

[4] The utility function illustrated in Figure 1 is a quadratic function that exhibits the property of increasing relative risk aversion. Alternative utility functions would, of course, imply different graphic representations.

**Figure 1**
**BANK OWNER INDIFFERENCE CURVES**

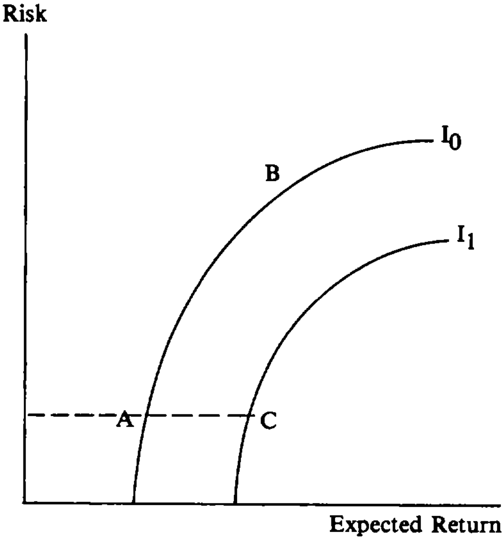
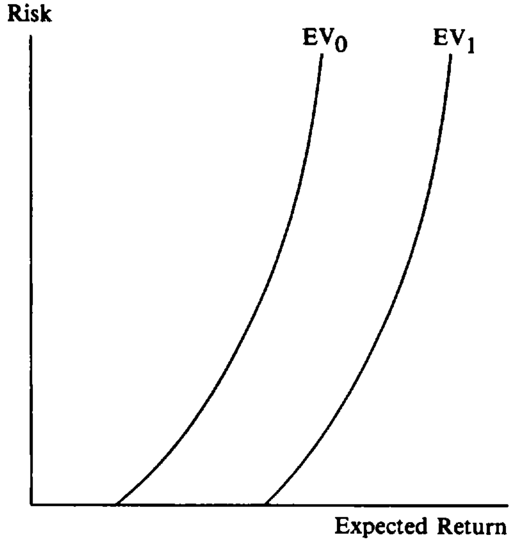



**Figure 2**
**BANK EV FRONTIERS**



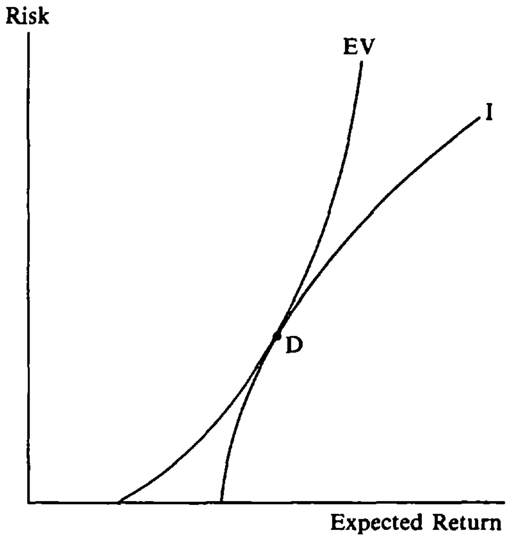

## Bank Performance

Feasible bank performance determines the utility a bank can achieve. In the context of this article, bank performance is defined as the maximum profit a bank can earn for a given level of risk. Conversely, it is the lowest level of risk that can be achieved for a given profit level. Improved performance, by the first definition, means the bank has increased profits without increasing the level of risk. Decreased performance means profits have declined from the same level of risk. These definitions differ from more traditional financial measures of performance, such as return on equity, that do not account for risk. A bank's utility, therefore, depends on its feasible performance.

Two factors determine the best performance a bank can attain—operating constraints and the substitution of risk for return. The operating constraints that affect bank performance are numerous, including such things as equity capital, asset returns, liability costs, regulatory environment, and investment alternatives. For example, because a bank keeps an equity reserve proportional to its total assets, the amount of equity capital effectively constrains the size of the bank's portfolio. A bank can try to increase profits, but only if it is willing to accept greater risk. Conversely, portfolio risk can be reduced by more conservative lending and investing policies, but the portfolio return will decline as a result. Risk and return, therefore, are substitutes for each other, and the substitutions made help shape feasible bank performance.

A bank's feasible performance can be plotted graphically in an analogous manner as the utility function. Curve $EV_0$ in Figure 2 represents the best performance the bank can attain over the full range of risk-return tradeoffs available to it, given a certain set of operating constraints. Every point on the curve represents one possible portfolio combination that produces an expected return at a particular risk. Curve $EV_0$ is called an expected return-variance

**Figure 3**
**UTILITY MAXIMIZATION FOR THE SMALL BANK**




(EV) frontier because the bank cannot improve its performance any further, given its operating constraints and its possible substitutions between risk and return.[5] A relaxing of one of the operating constraints would allow the bank to improve its performance to the higher level represented by $EV_1$. This might occur, for example, if there were an infusion of additional equity capital.

To determine the one specific portfolio combination that maximizes utility, the bank combines its utility function with its EV frontier (Figure 3). By arranging its portfolio so that it is consistent with point D, the bank is able to maximize the satisfaction of its owners, given the best performance the bank can achieve. A more thorough discussion of EV frontiers and an analysis of financial futures are in the Technical Appendix.

### Volatile Interest Rates and Hedging

The effect that interest rate volatility has on small banks can be demonstrated within the framework of utility maximization. By increasing the variability of asset returns and liability costs, volatile interest rates increase the risk of bank portfolios, forcing banks to accept higher risks for the same expected returns. The result is a reduction in the best performance a bank can attain. Increased volatility, therefore, corresponds to a leftward shift of the EV frontier.[6]

Increased volatility affects a bank in two ways. First, with a loss in the performance it can attain, the bank can no longer achieve the same utility. In short, bank owners suffer a loss in satisfaction. Second, with increased portfolio risk, the bank is encouraged to reduce risk by substituting assets with less risk, resulting in a reduced rate of return on the portfolio.

A bank can use financial futures, however, to counter the effects of increased interest rate volatility. Hedging allows a bank to reduce the interest rate variability of the asset or liability being hedged.[7] Thus, hedging shifts the EV

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5 J. A. James, "Portfolio Selection with an Imperfectly Competitive Asset Market," *Journal of Finance and Quantitative Analysis*, 11 (1976), pp. 831-46, has demonstrated that an EV frontier has the shape shown in Figure 2 when one of the assets in question is bought and sold in an imperfect market. This shape has been used here because small banks typically price their loans in an imperfect local market.

6 In addition to making a bank's portfolio spread more variable, interest rate volatility can also cause the spread to widen over time. The result of decreased bank performance assumes that a bank has a mismatch in the maturities of its assets and liabilities. Banks with matched asset and liability maturity structures automatically insulate themselves from the effects of interest rate volatility.

7 Hedging substitutes basis risk for cash market interest rate risk through the purchase or sale of financial futures contracts. Hedging a particular asset or liability is referred to as microhedging, while hedging a bank's net portfolio interest rate exposure is call macrohedging. For further discussion of hedging as a risk-management tool and a comparison of macrohedging and microhedging, see Drabenstott and McDonley, "The Impact of Financial Futures on Agricultural Banks."

frontier to the right. The reduction in the interest rate variability improves the best attainable bank performance. Hedging cannot remove all the increased risk of interest rates, because basis risk is substituted for interest rate risk. The basis is the difference in price between a futures contract and the cash market value of the financial instrument on which the contract is based. Risk is involved because the price differential fluctuates in response to several market stimuli, including market expectations concerning the future course of interest rates. Because basis risk is smaller and more predictable than interest rate risk, hedging can effectively reduce the variability of portfolio returns. Thus, financial futures offer the bank an opportunity both to reduce utility loss and avoid substitutions to less profitable assets.

In summary, small banks with interdependent goals of profitability and risk avoidance seek to maximize utility. The choice of a utility maximizing portfolio combination depends on the bank's utility function and its best attainable performance. Greater volatility in interest rates leads to a loss of utility and portfolio substitutions away from assets that are higher yielding but riskier. Financial futures offer banks a strategy for reducing these effects of interest rate volatility.

## MODEL OF A REPRESENTATIVE AGRICULTURAL BANK

The economic model selected to analyze the effects of using futures on bank performance is based on the utility maximization framework discussed above.[8] The model maximizes the utility of a representative agricultural bank, given the operating constraints the bank faces. The model follows a mathematical procedure, known as quadratic programming, to find the portfolio combination that earns the bank the highest income for a given level of risk. Risk is measured in the model as the variance of bank earnings.[9] By varying the level of risk, the model determines the best tradeoff the bank can make between risk and return—that is, the EV frontier.[10]

The model is designed to capture the operating conditions of a typical small agricultural bank, assumed to have total assets of slightly less than $15 million and equity capital of slightly more than $1 million. The bank earns income from agricultural and nonagricultural loans and from investing in Treasury securities and nontaxable municipal securities. The bank is assumed to operate in an imperfect local market, which means it has some control over the interest rates it charges on loans. By comparison, the bank would have no control over its loan interest rates if it

8 The model used in this research is an adaptation of one developed by Freddie Barnard in a Ph.D. thesis at the University of Illinois (1982), "An Evaluation of the Effects of Regulation Q on Farm Lending by Agricultural Banks." His model has been extended to examine the effects of financial futures on bank performance. For an earlier application of quadratic programming models see Linden Robison and Peter Barry, "Portfolio Adjustments: An Application to Rural Banking," *American Journal of Agricultural Economics,* 59 (1977), pp. 311-20.

9 Quadratic programming models have some shortcomings. They measure risk as the variance of interest rates. Other measures of risk, such as coefficient of variation and other distributional characteristics, are not accounted for in this model. Also, the model incorporates the assumptions of expected utility theory. These assumptions include the ability to order preferences, use continuous (as opposed to discrete) utility functions and make decisions independent of others.

10 Selection of a quadratic programming model for the purpose of this article can be justified for several reasons. Quadratic programming models are used extensively for risk analysis and are well recognized in economic literature. By accounting explicitly for portfolio variability, the model can easily be extended to include hedging. Finally, the model reflects the utility maximizing theoretical framework that characterizes the management of small, closely held banks.

operated in a perfectly competitive market. Allocable funds are acquired through several sources: demand and savings deposits, $100,000 certificates of deposit (CD's), 30-month CD's, 6-month money market certificates (MMC's), federal funds, and borrowings from a Federal Reserve Bank.[11]

The bank represented in the model (the model bank) faces several operating constraints. Corporate income taxes must be paid on net taxable income, and the bank pays a 30-percent after-tax dividend. A capital to total assets ratio of 8 percent constrains the size of the asset portfolio. Reserves against deposits must be maintained in accordance with Federal Reserve requirements. Also, bank liabilities are limited by the funds available in the local market. The model accounts for limitations in the local market by constraining the distribution of liability sources to reflect the experience of average agricultural banks of comparable size (Table 1).

The model contains data reflecting financial market conditions in 1980. Asset returns and liability costs are averages for that year expressed as nominal interest rates. Corporate income taxes also represent 1980 rates. Operating costs correspond to those listed for average banks in the Federal Reserve's 1980 Functional Cost Analysis.[12]

**Table 1**
**DISTRIBUTION OF LIABILITY SOURCES FOR THE MODEL BANK**

| | Percentage of Total Liabilities |
|---|---|
| Demand Deposits | 28.99 |
| 6-Month Money Market Certificate of Deposit | 25.36 |
| Savings Deposits | 19.57 |
| Time Deposits | 12.32 |
| $100,000 Certificates of Deposit | 8.70 |
| 30-Month Certificates of Deposit | 3.62 |
| Federal Funds Purchased | .72 |
| Federal Reserve Borrowings | .72 |
| TOTAL | 100.00 |

Source: Freddie Barnard, "An Evaluation of the Effects of Changes in Regulation Q on Farm Lending by Agricultural Banks," Ph.D. thesis, University of Illinois, 1982. This distribution was derived from a sample of 67 agricultural banks.

## MODEL RESULTS

This section discusses the model results dealing with how bank performance is affected by hedging the cost of issuing money market certificates. The money market certificate was selected as the instrument to be hedged because most agricultural banks have grown increasingly dependent on MMC's as a source of funds. Their relatively short maturity, moreover, means that volatility in interest rates quickly change the bank's portfolio spread. The results that follow represent the effects of hedging this one specific liability item. Hedging strategies for other balance sheet items, however, would generate results reinforcing the conclusions reached here.

A key assumption in these results is that the bank is hedging its overall balance sheet gap. The results assume that the bank's total MMC

11 Federal Reserve borrowings are not related to the bank's hedging activity. Rather, they represent a normal source of funds for a typical agricultural bank under the Federal Reserve's seasonal borrowing privilege.

12 *Functional Cost Analysis*, 1980 Average Banks, Board of Governors of the Federal Reserve System, Washington, D.C.

position is not matched by an asset of equal maturity. Thus, the bank can hedge its MMC position and reduce total balance sheet risk. Regulators' guidelines, including those of the Federal Reserve System, allow banks to use financial futures only in situations that reduce total balance sheet interest rate exposure. These guidelines appear in a 1980 joint Federal Reserve-Federal Deposit Insurance Corporation-Comptroller of the Currency policy statement that states the following:

> In managing their investment portfolio, banks should evaluate the interest rate risk exposure resulting from their overall activities to insure that the positions they take in futures...markets will reduce their risk exposure. Pairing a transaction in the spot market with an offsetting position in futures...contracts can be an effective way to reduce interest rate risk. However, policy objectives should be formulated in light of the bank's entire asset and liability mix.[13]

A few assumptions underlie the model results that follow. Hedging strategies are assumed to be 75-percent effective, which means the bank can successfully offset three-fourths of the volatility in the rates it pays for MMC's. When interest rates are rising, for example, the bank can negate three-fourths of the rise in borrowing costs from the time the hedge is placed. If the hedge were perfect, it would offset 100 percent of the volatility. The 75-percent level was chosen because it seems consistent with the experience of many banks.[14]

Results are presented for the full range of market environments under which hedging can take place: when MMC rates rise, fall, and remain constant after the hedge is placed. In analyzing hedging under these alternative market situations, the sequence of events is important. The results that are presented are based on the assumption that the bank places a hedge, rearranges its portfolio accordingly, and then interest rates change. Comparisons are drawn between the bank performance that resulted from the bank hedging and what performance would have been in the absence of hedging. For the sake of comparison, all three market environment solutions are based on the same transactions costs. Results also are presented for other transaction costs.

Two types of model results are presented under each of these four headings. First, the effect of hedging on feasible bank performance is shown by comparing model generated EV frontiers. The comparison allows general conclusions to be drawn about the value of hedging. Second, the effect of hedging on bank earnings, portfolio size and selection, and return on equity are presented for one arbitrarily selected level of risk-return preference. Selecting this one level of risk-return preference amounts to choosing a point along the EV frontier where the owners' tradeoff between risk avoidance and profits is fixed. Holding this tradeoff constant for a number of model solutions provides results that demonstrate the portfolio adjustments that occur as a result of hedging. Because these results represent bank perfor-

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13 Board of Governors of the Federal Reserve System, *Policy Statement Concerning Forward Placement of Delayed Delivery Contracts and Interest Rate Futures Contracts,* January 1, 1980. For a discussion of financial futures regulation and micro vs. macrohedging, see Drabenstott and McDonley, "The Impact of Financial Futures on Agricultural Banks," *Economic Review,* Federal Reserve Bank of Kansas City, May 1982, pp. 26-29.

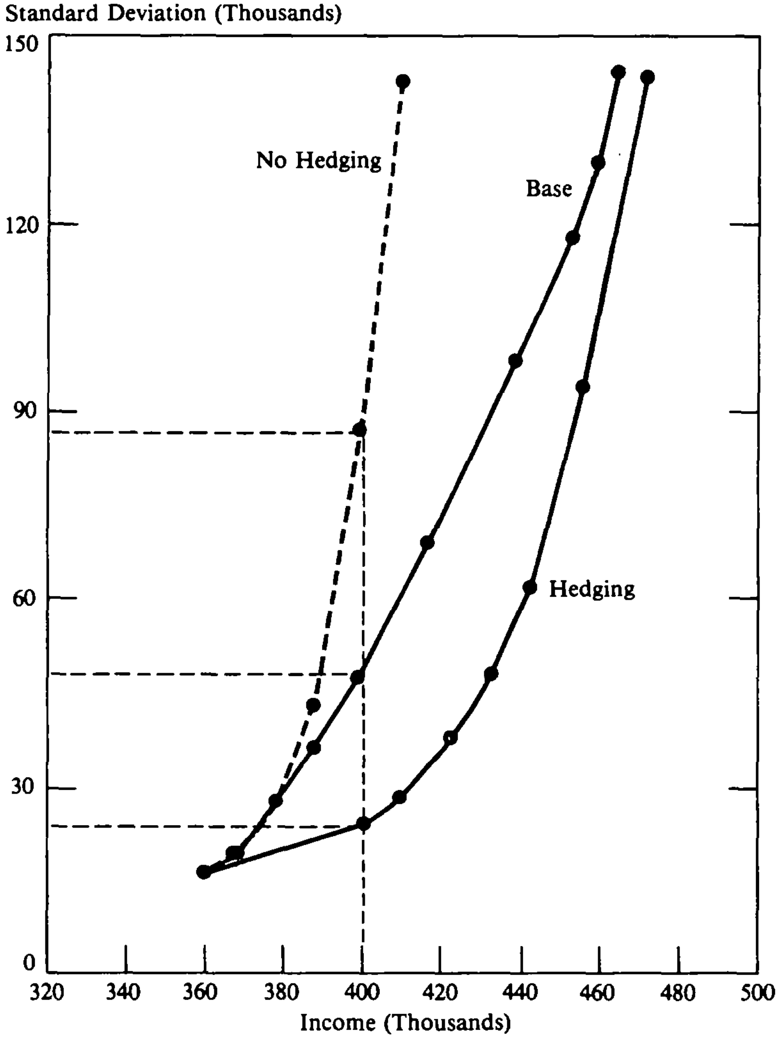
14 No written documentation of hedging effectiveness is available. The 75-percent level was determined through an informal phone survey of banks that are currently hedging and represents the midpoint of the 50 to 95-percent range determined in the survey.

mance for an arbitrary point, they cannot be interpreted as precise measures of the effects of hedging. Rather, they provide an indication of whether the effects are positive or negative.

### Interest Rates Rise

Hedging the cost of issuing MMC's benefits the bank most when MMC interest rates are rising. The interest rate for MMC's in the base solution is 12.7 percent, the actual average for 1980. This rate was increased to 13.5 percent to analyze the effects of hedging when borrowing costs subsequently rise. When the rate rises and the bank has not hedged, the bank's optimal performance declines relative to the base level because portfolio net returns fall. The higher

**Chart 1**
**HEDGING WHEN INTEREST RATES RISE**



MMC rate, therefore, shifts the bank's EV frontier to the left (Chart 1). However, if the bank hedges when interest rates are still 12.7 percent, its best attainable performance exceeds even the base level. Thus, hedging shifts the bank's EV frontier to the right and places the bank in a much better position in terms of performance and utility.

The performance benefits of hedging can be further demonstrated by comparing the different degrees of risk that result from hedging when the bank tries to maintain the same level of income. For example, if the bank wanted to earn income of $400,000 at the initial level of interest rates, it would have to accept risk equivalent to a standard deviation in earnings of $47,000 (Chart 1).[15] When interest rates rise to the new level and the bank has not hedged, earnings of $400,000 have a standard deviation of $89,000. This increase in portfolio risk occurs because to maintain earnings of $400,000, the bank must increase its lending volume to offset a narrower spread. On the other hand, if the bank hedged before interest rates rose, $400,000 in earnings implies a standard deviation of only $32,000. Risk is reduced because hedging lowers the variability of MMC rates and, consequently, allows the bank to increase loan volume without raising total portfolio risk. In short, hedging allows a bank to improve performance by achieving the same amount of earnings at a lower level of risk.

For the specific level of operation, bank performance improves substantially as a result of hedging. Both income and return on equity are higher than when the bank did not hedge (Table 2). When the bank has not hedged, it chooses to eliminate MMC's from its portfolio as interest rates rise and lending volume declines as a consequence. Hedging also allows the bank to issue more MMC's than it could at the base level, boost its loan volume, and increase earnings. Thus, hedging the cost of borrowing when rates are rising enables the bank to increase overall portfolio size over what it would have been and significantly raise its earnings.

### Interest Rates Fall

Falling interest rates mitigate some of the benefits of hedging borrowing costs. A bank might still be better off by hedging, however, even if interest rates declined. To analyze the usefulness of hedging under falling interest rates, the interest rate charged on MMC's was dropped to 12.0 percent. The bank can achieve greater performance with this lower rate than it could have in the base solution (Chart 2), but hedging interest rates at their original level still offers higher performance than not hedging when rates are falling.

The result that hedging improves performance even when interest rates fall does not seem logical for a firm earning profits. It can be explained, however, for a utility maximizing bank. Because the bank has goals of avoiding risks as well as earnings profits, the risk reducing benefits of hedging can offset the profit reducing effects. Even though hedging causes the bank to pay a higher rate for its MMC's, the reduction in the variability of portfolio returns that comes from hedging outweighs the higher liability costs. Therefore, hedging borrowing costs can improve the bank's optimal performance, even when interest rates are falling.

Results for the specific level of risk-return preference indicate that bank performance is higher when the bank hedges. Income is slightly higher as a result of hedging while the return on equity also improves (Table 2). By reducing the variability of MMC rates through hedging, the

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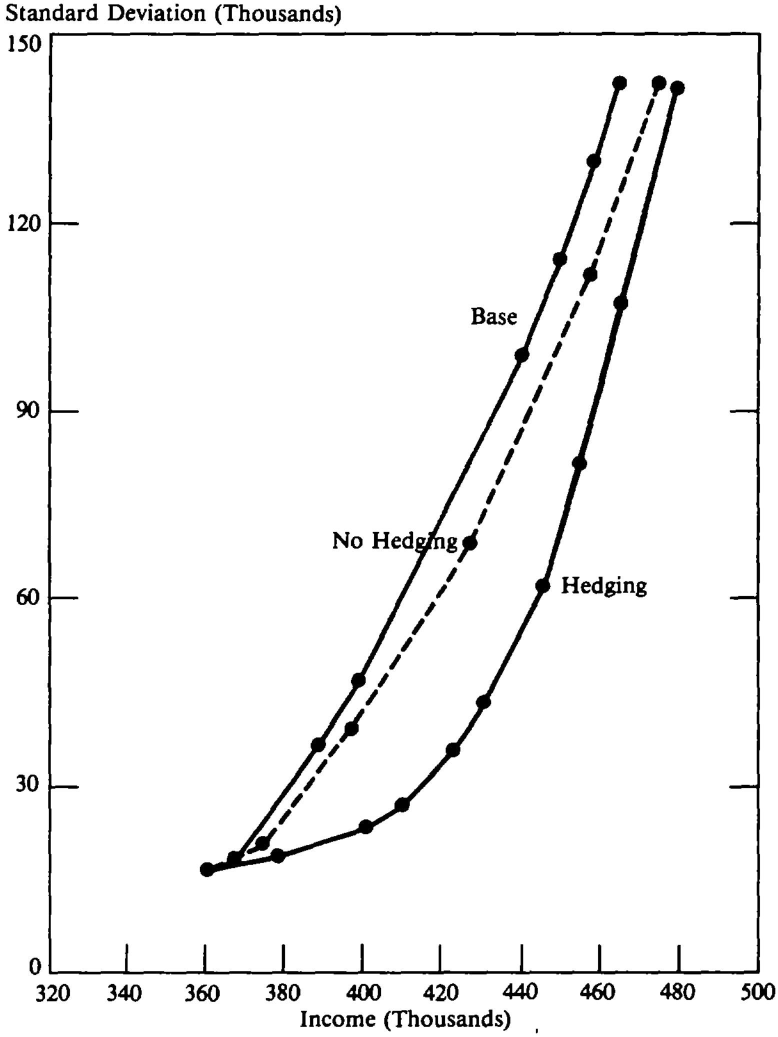
15 Standard deviation is a measure of risk that describes the tendency of individual values to differ from the mean. In this case, the bank could reasonably expect bank earnings to fall within a range of $400,000 ± $47,000 if it was aiming at a $400,000 earnings target.

bank is encouraged to expand its loan portfolio, providing returns from increased lending that outweigh the relatively higher cost of borrowing. Thus, model results suggest that hedging borrowing costs when interest rates are falling may improve bank performance. For some greater decline in interest rates, the resultant higher relative costs of borrowing could presumably negate the risk-reducing benefits of hedging.

### Interest Rates Remain Constant

Hedging the cost of issuing MMC's has pronounced benefits for the model bank, even when MMC rates do not change after the hedge has been placed. A comparison of model

**Chart 2**
**HEDGING WHEN INTEREST RATES FALL**



generated EV frontier shows the bank can increase its utility by hedging. Hedging reduces the variations in the interest rates that must be paid on MMC's and shifts the bank's EV frontier to the right (Chart 3). By hedging, the bank improves on the best performance it had been able to achieve, earning more at the same risk.

Comparisons of bank performance for a specific risk-return preference further demonstrate the benefits of using financial futures. Hedging boosts the bank's performance by increasing income, return on equity, and the total size of the portfolio (Table 2). The improvement in earnings comes from increased lending, because with less variability in interest rates, the bank is encouraged to issue more

**Table 2**
**BANK PERFORMANCE UNDER ALTERNATIVE INTEREST RATE LEVELS**

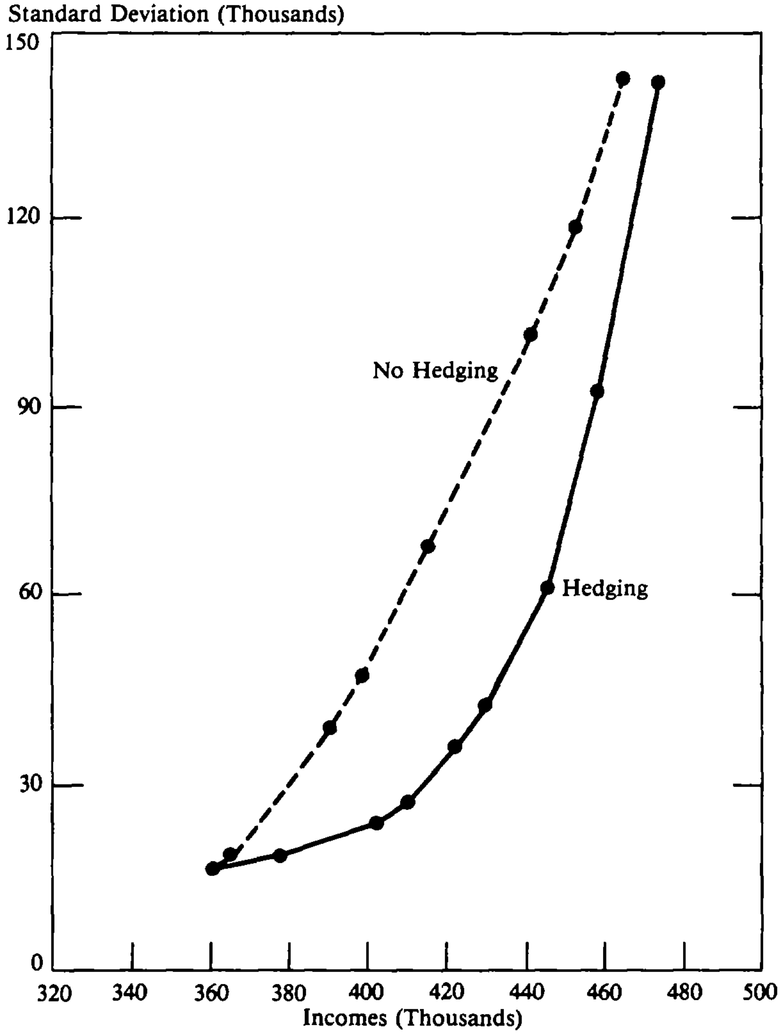
| | Base | No Hedging Rising Interest Rates | Hedging MMC Rising Interest Rates | No Hedging Falling Interest Rates | Hedging MMC Constant Interest Rates |
|---|---|---|---|---|---|
| Expected Income | $ 397,708 | $ 374,527 | $ 431,886 | $ 409,553 | $ 434,413 |
| Standard Deviation | 45,575 | 37,992 | 46,510 | 49,916 | 46,510 |
| Return on Equity | 29.5% | 27.8% | 32.0% | 30.4% | 32.2% |
| ASSETS | | | | | |
| Federal Funds Sold | $ 502,121 | $ 227,727 | $ 564,926 | $ 614,246 | $ 564,926 |
| 1-Year Treasury Bill | 0 | 0 | 0 | 0 | 0 |
| Nontaxable Securities | 0 | 0 | 0 | 0 | 0 |
| Agricultural Loans | 6,462,031 | 5,989,573 | 7,518,470 | 6,599,321 | 7,418,470 |
| Reserves | 554,681 | 525,001 | 565,392 | 565,392 | 629,999 |
| TOTAL ASSETS | $11,548,943 | $10,300,000 | $13,800,000 | $11,946,410 | $13,800,000 |
| LIABILITIES | | | | | |
| Federal Funds Purchased | $ 0 | $ 100,000 | $ 100,000 | $ 0 | $ 100,000 |
| Demand Deposits | 4,000,000 | 4,000,000 | 4,000,000 | 4,000,000 | 4,000,000 |
| Savings Deposits | 2,700,000 | 2,700,000 | 2,700,000 | 2,700,000 | 2,700,000 |
| Time Deposits | 1,700,000 | 1,700,000 | 1,700,000 | 1,700,000 | 1,700,000 |
| $100,000 CD's | 116,220 | 1,200,000 | 1,200,000 | 0 | 1,200,000 |
| 6-Month MMC | 2,432,723 | 0 | 3,500,000 | 2,946,410 | 3,500,000 |
| 30-Month CD's | 500,000 | 500,000 | 500,000 | 500,000 | 500,000 |
| Federal Reserve Borrowings | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 |
| TOTAL LIABILITIES | $11,548,943 | $10,300,000 | $13,800,000 | $11,946,410 | $13,800,000 |

MMC's—a primary source of loanable funds. Moreover, the size of the bank's portfolio expands as much as available equity capital allows. In summary, model results indicate that hedging the borrowing costs during a period of constant interest rates can improve all measures of bank performance.

## Alternative Transaction Costs

The transaction costs of hedging are important to banks that use financial futures, especially small banks that may not hedge often. Transaction costs for such banks may not be confined to trading costs alone. Because many small banks do not have the resources to

**Chart 3**
**HEDGING WHEN INTEREST RATES REMAIN CONSTANT**



manage their own hedging program, they may employ an advisory service to help develop hedging strategies. Total transaction costs for hedging may then include not only the actual trading costs but also a consulting fee for advice used in implementing the hedge and other aids in analysis.

The results discussed in previous sections were based on transaction costs of $40 per contract. That figure, which includes placing and lifting the hedge—a complete futures contract turn—represents an average of current trading costs for futures contracts. To analyze the extent that higher transaction costs might reduce

**Table 3**
**BANK PERFORMANCE UNDER ALTERNATIVE TRANSACTION COSTS**

| | $40 Transaction Cost | $100 Transaction Cost | $200 Transaction Cost |
|---|---|---|---|
| Expected Income | $ 434,413 | $ 434,360 | $ 434,227 |
| Standard Deviation | 46,510 | 46,510 | 46,510 |
| Return on Equity | 32.2% | 32.2% | 32.2% |
| ASSETS | | | |
| Federal Funds Sold | $ 564,926 | $ 564,926 | $ 564,926 |
| 1-Year Treasury Bill | 0 | 0 | 0 |
| Nontaxable Securities | 0 | 0 | 0 |
| Agricultural Loans | 7,518,470 | 7,518,470 | 7,518,470 |
| Nonagricultural Loans | 5,986,605 | 5,986,605 | 5,986,605 |
| Reserves | 629,999 | 629,999 | 629,999 |
| TOTAL ASSETS | $13,800,000 | $13,800,000 | $13,800,000 |
| LIABILITIES | | | |
| Federal Funds Purchased | $ 100,000 | $ 100,000 | 100,000 |
| Demand Deposits | 4,000,000 | 4,000,000 | 4,000,000 |
| Savings Deposits | 2,700,000 | 2,700,000 | 2,700,000 |
| Time Deposits | 1,700,000 | 1,700,000 | 1,700,000 |
| $100,000 CD's | 1,200,000 | 1,200,000 | 1,200,000 |
| 6-Month MMC | 3,500,000 | 3,500,000 | 3,500,000 |
| 30-Month CD's | 500,000 | 500,000 | 500,000 |
| Federal Reserve Borrowings | 100,000 | 100,000 | 100,000 |
| TOTAL LIABILITIES | $13,800,000 | $13,800,000 | $13,800,000 |

the benefits of hedging, other model solutions were derived using different transaction costs. The model bank was forced to pay first $100 and then $200 per futures contract. All these model solutions were based on the assumption that MMC interest rates remained constant after the hedge was placed. Because the higher transaction costs had minimal effect on bank performance, only the results for the specific risk-return preference are discussed.

Model results suggest that the advantages of hedging far outweigh the cost, even when the costs are substantial. Higher levels of transaction costs did not discourage the bank from continuing to hedge. Nor did they force the bank to reduce its portfolio or cut back on the MMC's it issued, even when they reached a substantial $200 per contract (Table 3). The only noticeable effect of the higher hedging costs is a modest reduction in bank income. These results indicate that the benefits that come from a reduction in portfolio variability more than counterbalance even high transaction costs.

## IMPLICATIONS OF HEDGING

Model results provide an empirical framework for testing whether hedging improves bank performance. The model used in this analysis shows financial futures can make significant improvements in several measures of bank performance. Hedging the risk involved in issuing MMC's clearly placed the model bank in a better position both when interest rates remained unchanged and when they rose. When borrowing costs fell, optimal performance was greater with hedging than without it, except when interest rates had declined significantly. Results indicate, therefore, that under most market conditions hedging offers substantial rewards.

Although the results of this study apply to a small rural bank, the general conclusions can be extended to other closely held banks. Adapting the model to another such bank would require changing portfolio size and income, but the bank's feasible set of portfolio combinations would show similar risk-return tradeoffs. Thus, model results demonstrating the effect of financial futures on the performance of a larger bank would show more absolute changes in measures of bank performance, but the direction of the changes would be the same as for the size of bank modeled in this study.

One implication of the results is that when interest rates are volatile hedging gives banks more flexibility in selecting their optimal portfolio. By hedging, the model bank could enlarge its porfolio and maintain or even increase the MMC's it issued. Without hedging, the interest rate risk associated with MMC's forced the bank to cut back on this liability and lending volume was curtailed as a result. Thus, hedging largely offsets the risk of volatile interest rates and gives a bank more freedom in selecting a higher yielding portfolio. Hedging also gives the bank another management tool for reducing risk.

Another implication to be drawn from the results is that transaction costs are probably a comparatively minor consideration for small banks. Even when transaction costs are raised to a high level, hedging still improves bank performance. This suggests that small banks that lack the resources to manage their own hedging programs might be able to achieve higher levels of performance by employing capable advisory services to carry out hedging programs than by not hedging at all.

The implications of hedging go well beyond the benefits that accrue to a small bank and its owners. To the extent that use of financial futures reduces bank risks, hedging has implications for depositors, borrowers, and the general economy. Not only do depositors face less risk of loss when overall bank risk has been reduced, but with less risk the cost of insuring deposits may decline for a bank that successfully hedges. Model results also indicate that hedging encourages increased lending, with the result that farmers and other rural borrowers benefit from the greater availability of loan funds. Finally, by allowing banks to transform risks in the economy more efficiently, hedging benefits society in general.

## SUMMARY AND CONCLUSIONS

This article has examined the effects of financial futures on bank performance. Beginning with a conceptual framework of the banking firm, the article presented an economic model to test the effect of hedging money market certificates on the performance of a representative small agricultural bank. The results suggest that hedging significantly improves bank performance whether measured by income, return on equity or portfolio size. Furthermore, these beneficial effects hold even under some adverse financial market conditions.

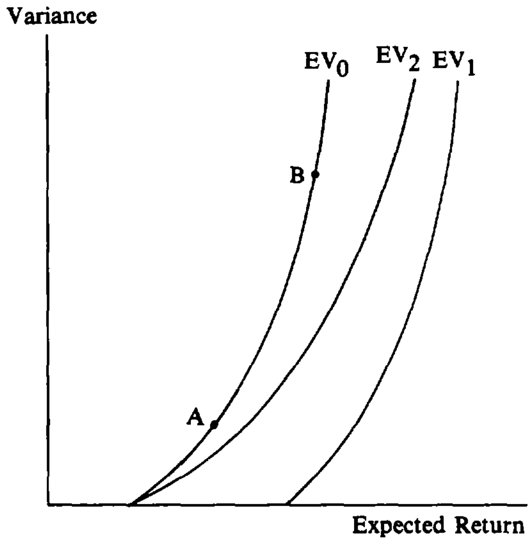
The advantageous effects demonstrated in this article raise the question of why more banks are not using financial futures as a risk-management tool. The likely answer is that many banks, especially small banks, lack the expertise to carry out an effective hedging program. As banks become more aware of the benefits of hedging, increased use of financial futures markets might be expected.

## TECHNICAL APPENDIX

The expected return-variance (EV) frontier traces out the most efficient tradeoffs a bank can make between risk and return (Figure A1). The EV frontier is efficient in that the expected return on the bank's portfolio cannot be improved for a given level of expected return.[1] Every point along curve $EV_0$ represents a different portfolio combination. Point A, for example, represents total investment in such almost riskless investments as Treasury bills. Point B represents more aggressive commercial lending with limited investment in securities.

The frontier shifts in response to changes in the bank's operating parameters. Equity

**Figure A1**
**BANK EV FRONTIERS**




[1] Portfolio analysis for an individual has its theoretical roots in the work first pioneered by James Tobin, "Liquidity Preference as Behavior Towards Risk," *Review of Economic Studies*, 25 (1958), pp. 65-86 and Harry Markowitz, "Portfolio Selection," *Journal of Finance*, 7 (1952), pp. 71-91. For a further discussion of portfolio theory as applied to the bank firm, see J. M. Mason, *Financial Mangement of Commercial Banks*, New York: Warren, Gorham, and Lamont, 1979.

capital, for example, affects the size of the bank's asset portfolio. By allowing more lending and investing, an infusion of more equity causes the EV frontier to shift in parallel to the right from $EV_0$ to $EV_1$. If the bank suddenly has an increase in the return on one of its risk assets, the EV frontier also shifts to the right, but as shown in the movement from $EV_0$ to $EV_2$, the shift is not parallel.

## Interest Rate Volatility

The impact that interest rate volatility has on commercial banks can be demonstrated within a utility maximization framework. Volatile interest rates increase the variability of both asset returns and liability costs. The result for most banks has been more variability in their net portfolio spread. This corresponds to a leftward, nonparallel shift in the EV frontier, shown in Figure A2 as the movement from $EV_1$

**Figure A2**
**THE EFFECT OF INTEREST RATE VOLATILITY**

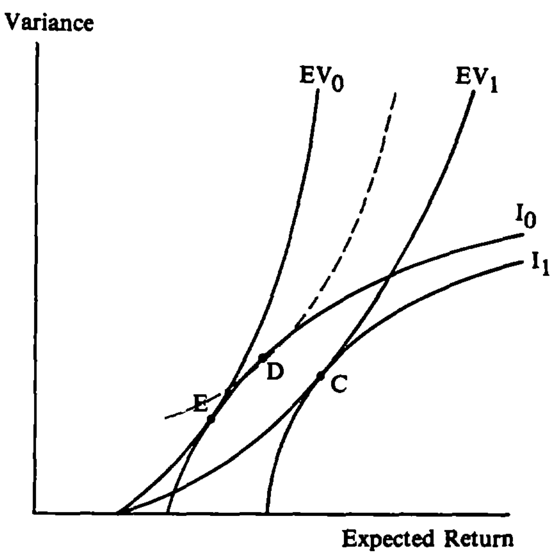
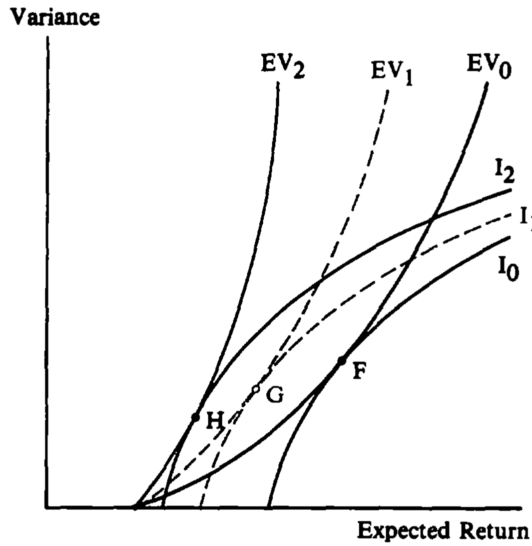



**Figure A3**
**THE EFFECT OF HEDGING**




to $EV_0$. The bank then adjusts its portfolio combination to be consistent with point E instead of point C.

The total impact of increased volatility on the bank's operation can be divided into two components—the income and substitution effects. The income effect is the net loss in utility that results from greater volatility. This is shown in Figure A2 as a move from point C to point D. The shift to $EV_0$ also causes the bank to hold fewer risky assets that it had. This substitution for assets with lower risks corresponds to the movement from point D to point E. An increase in the volatility of interest rates, then, not only reduces utility but also encourages banks to reduce their holdings of risky assets.

## Using Financial Futures

The same framework can be used to demonstrate the effect of financial futures. If interest rates become more volatile, a bank's

EV frontier effectively shifts to the left. This corresponds to the movement from $EV_0$ to $EV_2$ (Figure A3). If the bank keeps the new portfolio arrangement, point C, utility drops from $I_0$ to $I_2$ and the bank readjusts its portfolio to include fewer risky assets.

Both the utility loss and the portfolio adjustments can be mitigated by use of financial futures. Suppose that instead of accepting point C as its new point of operation, the bank anticipates the increased volatility in interest rates and places a macrohedge in an effort to keep the portfolio variability associated with point F. This hedge, if properly placed, will shift the EV frontier back to the right, to some new value, $EV_1$. The frontier shifts to the right because portfolio variance has been reduced and the bank can earn a higher return for any given level of risk. The exact location of $EV_1$ will depend on the effectiveness of the hedge—how well basis risk is managed—and transaction costs. The more effective the hedge, the closer $EV_1$ will lie to the initial frontier, $EV_0$. The net effect of using financial futures, then, is that the bank now operates at point G instead of point H, providing the bank with more utility and fewer portfolio adjustments than it could have achieved without hedging.

## Research Working Papers

Research Working Papers published by the Federal Reserve Bank of Kansas City through September 1982 are listed below. Copies may be obtained by writing the Public Affairs Department, Federal Reserve Bank of Kansas City, 925 Grand Avenue, Kansas City, Missouri 64198.

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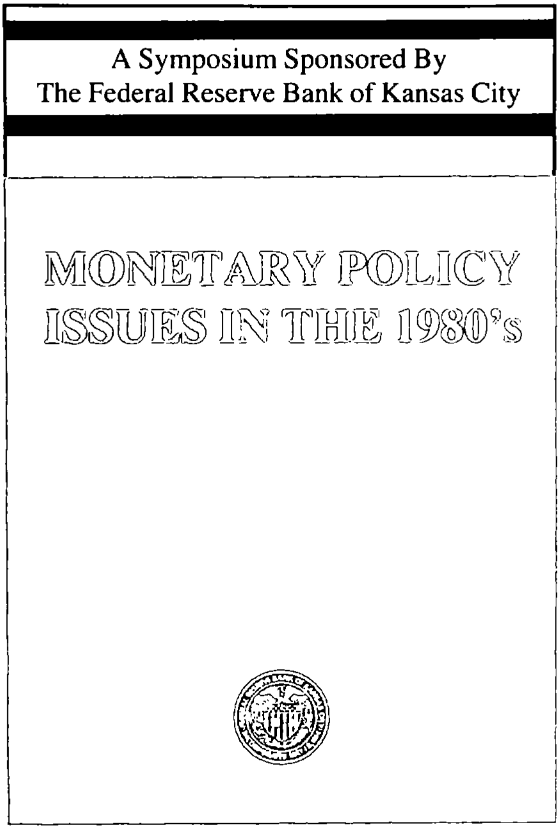


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As an outgrowth of these complications in monetary policymaking—and the need for the Federal Reserve to understand alternative points of view—in August 1982 the Federal Reserve Bank of Kansas City sponsored a two-day symposium on *Monetary Policy Issues in the 1980s.* The proceedings of the symposium, which include papers and comments by academicians and central bankers, are now available.

Proceedings also are available from other symposiums sponsored by the Bank, including:

*Modeling Agriculture for Policy Analysis in the 1980s*—1981, 222 pp.

*Future Sources of Loanable Funds for Agricultural Banks*—1980, 244 pp.

*Western Water Resources: Coming Problems and the Policy Alternatives*—1979, 324 pp.

Economic Review
Federal Reserve Bank of Kansas City
November 1982, Vol. 67, No. 9