

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.

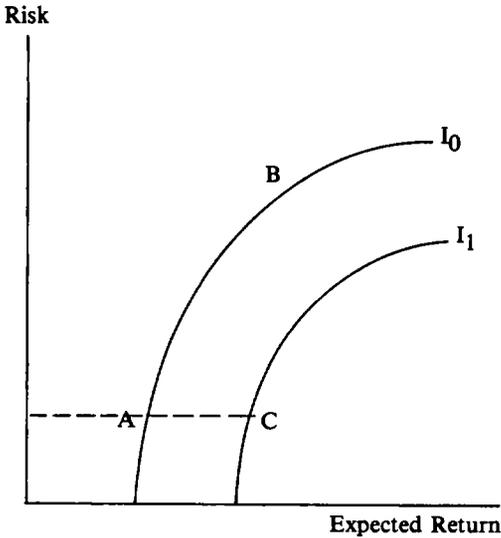
A graphic presentation clarifies the utility function concept. A bank measures profits by the expected net spread of its portfolio—the difference between its asset earnings and liability costs. Risk is measured by the variability associated with this expected return. Measured in these terms, the utility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

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.

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.

Figure 1
BANK OWNER INDIFFERENCE CURVES

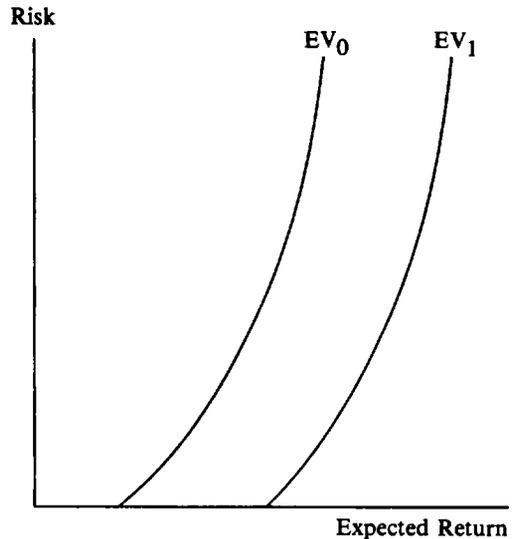


Bank Performance

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,

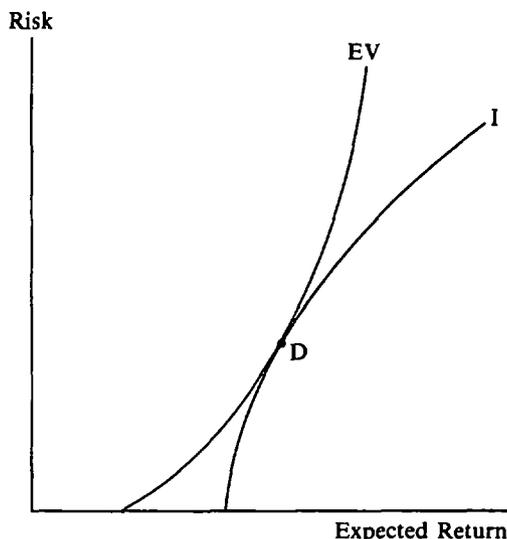
Figure 2
BANK EV FRONTIERS



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

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.

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

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

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 ap-

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

plication 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

MODEL RESULTS

This section discusses the model results dealing with how bank performance is affected by hedging the cost of issuing money market cer-

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.

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.

tificates. 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

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-

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.

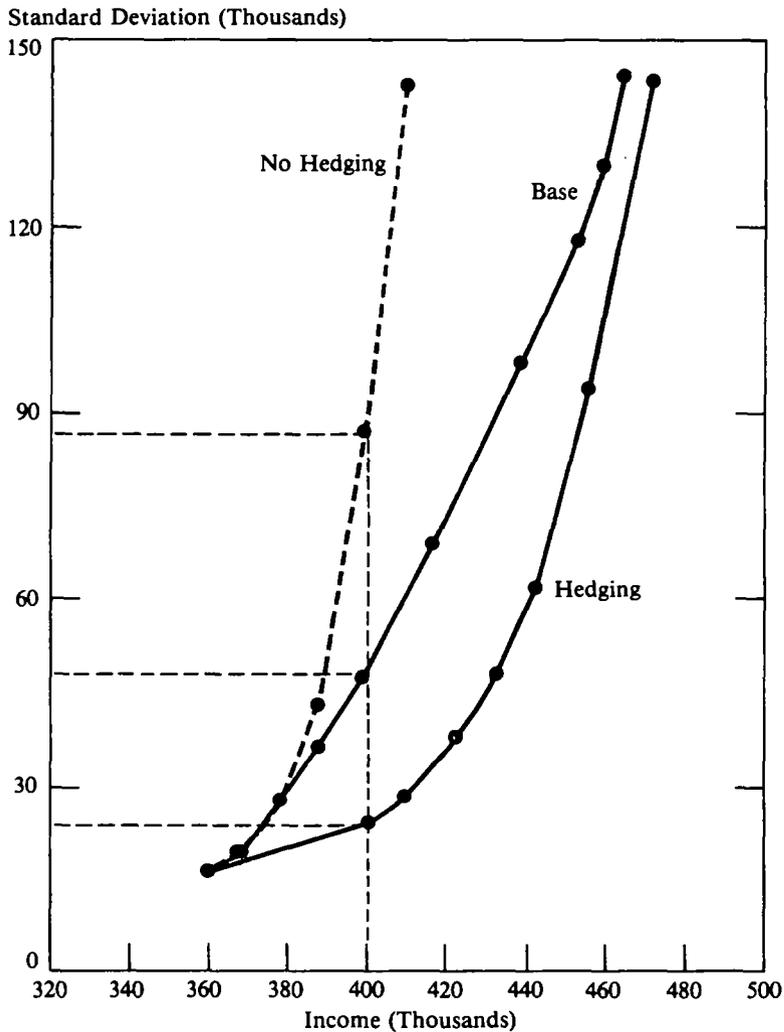
mance for an arbitrary point, they cannot be interpreted as precise measures of the effects of hedging. Rather, they provide an indication of whether the effects are positive or negative.

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

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 $\$400,000 \pm \$47,000$ if it was aiming at a \$400,000 earnings target.

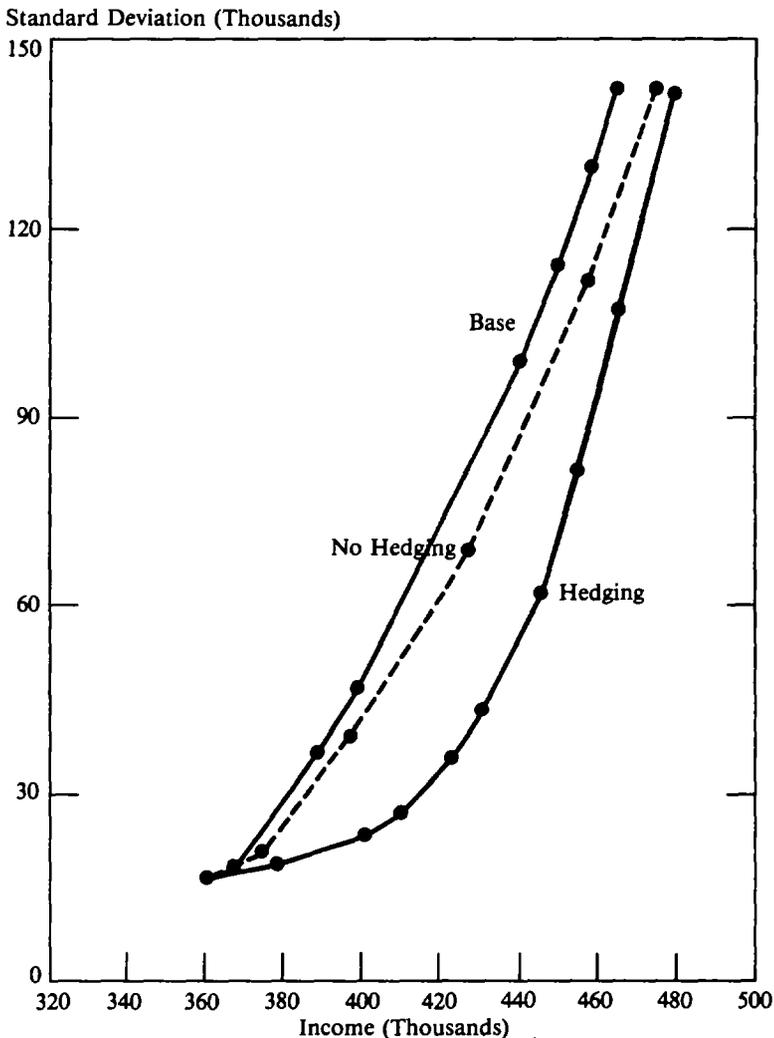
bank is encouraged to expand its loan portfolio, providing returns from increased lending that outweigh the relatively higher cost of borrowing. Thus, model results suggest that hedging borrowing costs when interest rates are falling may improve bank performance. For some greater decline in interest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

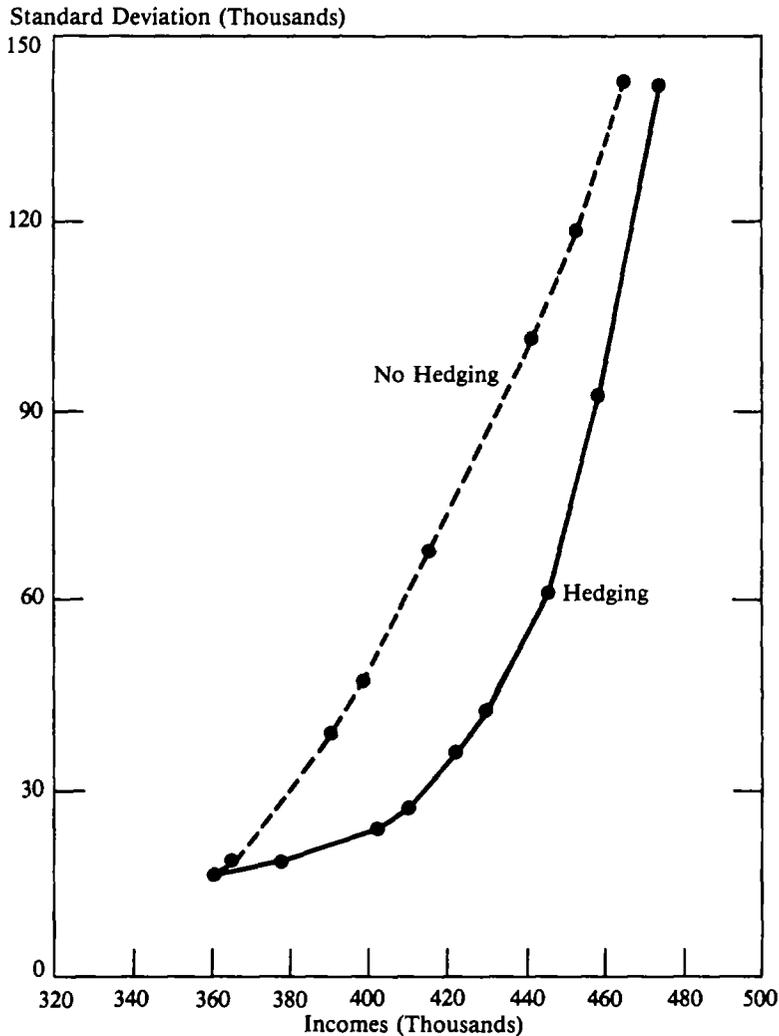
	Base	No Hedging Rising Interest Rates	Hedging MMC Rising Interest Rates	No Hedging Falling Interest Rates	Hedging MMC Constant Interest Rates
Expected Income	\$ 397,708	\$ 374,527	\$ 431,886	\$ 409,553	\$ 434,413
Standard Deviation	45,575	37,992	46,510	49,916	46,510
Return on Equity	29.5%	27.8%	32.0%	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%
<u>ASSETS</u>			
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
<u>LIABILITIES</u>			
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 portfolio 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 cer-

tificates 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.

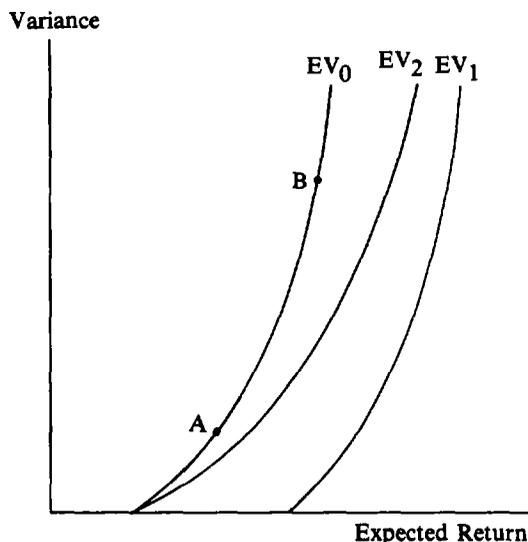
The advantageous effects demonstrated in this article raise the question of why more banks are not using financial futures as a risk-management tool. The likely answer is that many banks, especially small banks, lack the expertise to carry out an effective hedging program. As banks become more aware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

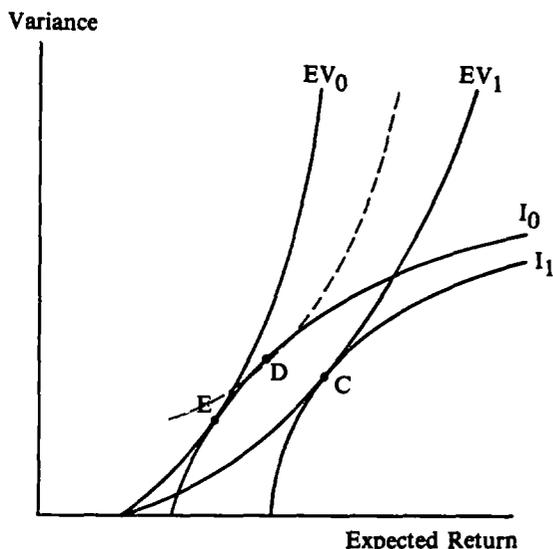
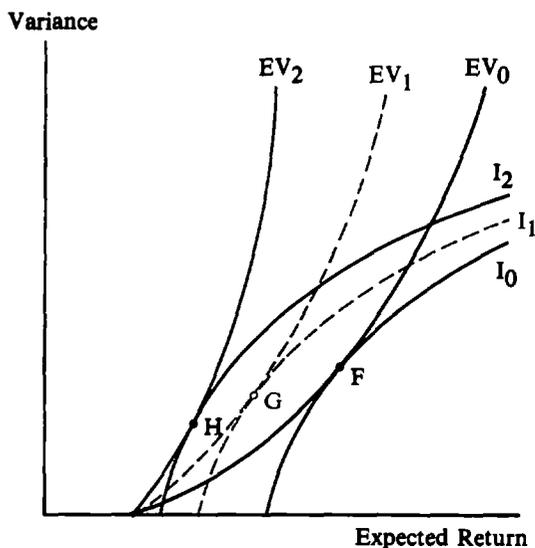


Figure A3
THE EFFECT OF HEDGING



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.

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