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Financial Markets and Uncertainty

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Financial Markets and Uncertainty

"Financiers live in a world of illusion," said George Bernard Shaw, and never has this been truer than in the past decade, when everything has had to be viewed through the prism of inflation. But financiers also deal with the very real world of the marketplace, and the resulting conflicts between reality and inflationary illusions have led to serious distortions in various segments of the market and in broad monetary relationships. The 1970's thus have developed into a decade of financial uncertainty, unlike any decade since the 1930's.

The four papers in this issue discuss the responses to increased uncertainty occurring in four separate financial markets—the mortgage market, the debt market, the equity market, and the money market. The responses may differ in each case—for example, an institutional response in the mortgage market and a market response in the debt market—but all represent aspects of a general attempt to compensate for uncertainty in financial markets.

George Kaufman examines some of the structural changes brought about by inflationary uncertainty in the imperfectly functioning mortgage market. He compares the conventional fixed interest rate mortgage (FRM) with an alternative mortgage plan containing a variable rate (VRM), and shows how the latter has developed as a response to the uncertainty facing lenders and borrowers of long-term mortgage credit.

The industry, faced with an inflationary environment, has created the VRM in order to reduce the financial pressures on mortgage-lending intermediaries, to increase the flow of funds through the mortgage market, and to stimulate the purchase of additional housing. Kaufman describes how the VRM breaks the link between long maturity and high risk associated with uncertainty regarding future interest rates—two characteristics which the traditional FRM mortgage contract combines. By decoupling the current interest charge from the future interest rate, the risks surrounding future interest cost are transferred—all or in part—from the lender to the borrower. With lenders feeling a lower risk they will be more willing to undertake mortgage financing. The lowered risk should also mean that a VRM will have a lower expected cost to the borrower over the life of the mortgage than an equivalent FRM.

In Kaufman's view, "The VRM is a complex instrument, much more complex than first analysis would suggest, and there is good evidence that it is not yet fully understood by any of the parties concerned—borrowers, lenders or regulators." The recent experience of seven California financial institutions suggests that the VRM can operate successfully, but only under certain specific conditions. "The California experience to date suggests that it may not be easy to realize the full potential of this mortgage instrument."

Joseph Bisignano, in a second paper, analyzes the bond market's response to the uncertainty created by unanticipated inflation. The market has experienced not only a dramatic rise in yields on long-term debt securities, but also a change in the spreads between different grades of corporate and municipal bonds, and in the spreads between yields on prime-grade corporates and yields on long-term Government securities. This raises the question whether the market has been "efficient" in establishing yield differentials of this type.

Bisignano's response is that the market has been efficient in removing any systematic profits

available by arbitraging across different grades of securities—for example, between Aaa and Baa bonds—but that it has not been efficient in establishing the differential between prime-grade corporates and long-term Government bonds. "The difficulty in determining this spread appears to be related to the unprecedented rise in unanticipated inflation experienced since the late 1960's." Unanticipated inflation has caused the market to demand much greater premiums for prime corporates over Governments than the underlying risk would have justified. Long-term Governments apparently have lost some of their role as a "safe asset" in long-term portfolios, and this has impaired the market's ability to determine the appropriate spread between the two types of bonds.

Herbert Runyon analyzes the shifting relationships of debt and equity in corporate balance sheets, under the spur of inflation and increased uncertainty. These changes, he says, can be viewed as a matter of corporate treasurers trying to find the best mix of equity and debt in response to the uncertainty of the past decade.

Manufacturing corporations financed themselves rather conservatively until about the mid-1960's, but then began to expand the debt in their balance sheets in an attempt to increase the rate of return on equity shares. For a while they were successful, widening the spread between the return on equity and the return on assets. "This was altogether in tune with the temper of the Sixties, when performance was the name of the game and the bottom line took precedence." But then a day of reckoning came in the 1970's, when highly leveraged firms became increasingly exposed to higher market interest rates and to cyclical fluctuations in corporate earnings.

Corporate treasurers seem now to have rethought the virtues of high leverage ratios. There have been no increases in leverage in recent years, following a period of steady rise toward more risky financing in the late 1960's. Recent emphasis on cash flow suggests a return to a lower mixture of debt to equity finance. To the extent that external financing is required in the future, it is likely to be met with greater stock market financing and less reliance on bonds and and on bank borrowing.

Rose McElhattan's paper considers the puzzling overforecast of money growth which economists' money demand relationships have produced since mid-1974, thus demonstrating how a useful money-market equation can go astray in an era of uncertainty. She points out that forecast money growth was about twice as great as actual money growth for the first year of the current recovery—a finding which throws doubt on the ability of standard models of the U.S. economy to forecast GNP. But after examining the GNP forecast errors developed in a large quarterly econometric model, she concludes that the current relation between money and income has remained similar to its past behavior.

McElhattan examines several alternative explanations for this situation, the most persuasive one being that the public's demand for money has not really changed. In other words, the observed errors may be the fault of the misspecification of the equation used to predict the public's actual demand for money. But although this provides a plausible explanation of the equation's erratic behavior, a good portion of the overforecast remains unexplained. Uncertainty appears to be at the root of the problem. In the real economy, for example, the recent business decline—the steepest of the past generation—was much worse than expected, and thus generated enough uncertainty to destabilize traditional money-demand relationships.

Variable Rate Residential Mortgages: The Early Experience from California

George G. Kaufman*

Housing has been one of the most volatile and, over the last ten years, most troubled of industries. The causes of housing's problems are varied and complex, but one of them deserves special mention—the imperfect functioning of the mortgage market. Because most new residential housing acquisition is financed by mortgage debt, conditions in the mortgage market are important to the housing industry. This paper examines one special aspect of the mortgage market, the mortgage instrument. It considers, first, whether the characteristics of the conventional fixed interest rate mortgage (FRM) may have both limited and destabilized the supply of mortgage funds and, second, whether an alternative mortgage plan containing a variable rate may increase and smooth the supply without reducing demand.[1]

In this paper, we analyze the implications of variable rate mortgages (VRMs) for both lenders and borrowers. We pay particular emphasis to the experiences resulting from the use of VRMs by six large savings and loan associations and one large bank in California which have been offering these mortgages since 1975.[2] The California experience is the most widespread use of VRMs in the country, and thus should provide useful insights for other areas. Because many VRM characteristics are stipulated by law, we examine the implications of these constraints and recommend specific changes in those features which appear to reduce the efficiency of the instrument.

FRM and VRM: Theoretical Issues

Most mortgage funds are supplied by private financial institutions. At year-end 1975, savings and loan associations had extended 51 percent of all residential mortgages outstanding, commercial banks 17 percent, mutual savings banks 10 percent, and life insurance companies 4 percent. Government supported agencies extended 13 percent and other private lenders 5 percent. Although they are the largest lenders of mortgage loans, thrift institutions (savings and loan associations and mutual savings banks) and commercial banks have complained of the relative lack of profitability of mortgage lending, and have at times appealed to the Federal government for assistance. In response, the government has introduced a host of mortgage subsidy programs and has limited the costs of depository mortgage-lending institutions by imposing ceilings on the rates they may pay on savings and time deposits. The latter restriction, popularly referred to as Regulation Q, not only limits cost increases for the bulk of the funds available to depository institutions, but also provides thrift institutions with a slight deposit rate edge over commercial banks as a means of encouraging savings flows into the thrifts. Evidence suggests, however, that these restrictions have not improved the operation of the mortgage market. At times market rates of interest have risen sharply above the Q ceilings, and

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funds have been redirected away from institutions not offering competitive rates. This has exacerbated the volatility of mortgage flows. The growing evidence of the unsatisfactory performance of these government programs has stimulated a search for other ways of assisting mortgage lending institutions which would have fewer side effects on the mortgage market.

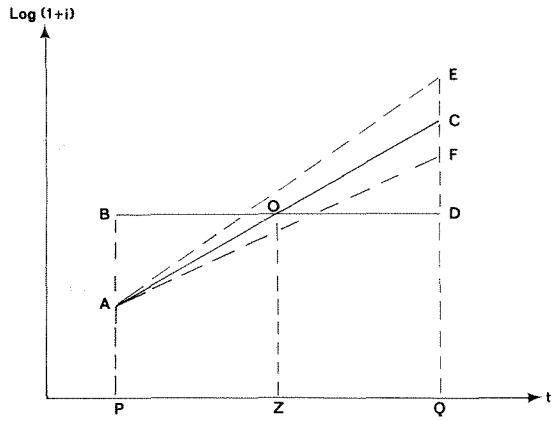
Maturity and interest-rate intermediation

Because residential dwellings are both big-ticket items and long-lived assets, they are financed primarily by long-term mortgage loans collateralized by the dwelling purchased. Many of the institutions extending such loans raise their funds by selling securities in the form of deposits with considerably shorter maturities, so that they engage in maturity intermediation. In addition, to the extent that the mortgages have a fixed rate of interest over their life, while rates on deposits may vary through time, the institutions also engage in interest-rate intermediation. Although these two activities in the past have been identical, they do not necessarily have to be so. In fact, the VRM represents a device for separating the two types of intermediation.

Economic theory tells us that the relationship between a long-term rate and a short-term rate on securities which are similar in all respects but term to maturity is determined largely by the expected course of short-term rates during the remaining life of the longer-term security. If we assume a world of perfect certainty in which the values of all future short-term interest rates are known, the long-term rate is a geometric average of the current short-term rate and future short-term rates on out to the maturity of the long-term security. This implies that, if a depository mortgage-lending institution is to break even, abstracting from costs of operations other than interest rates, the rate it charges on a fixed rate mortgage should be the geometric average of the current deposit rate and the deposit rates it expects to pay until the mortgage matures.

This relationship is illustrated in Figure 1. Time is measured on the horizontal axis and interest rates on the vertical axis.[3] Consider a loan starting in period P and maturing in period

Figure 1



Q. Assume that there is no prepayment provision, and that the current deposit rate at P is A and that deposit rates are expected to rise steadily through the period C in Q. Again, abstracting from operating costs and a competitive return on capital, the appropriate fixed rate on the loan would be B. At the rate B, the expected total return on the loan would equal the expected total of deposits over the life of the loan, so that the institution would break even on its intermediation operations. The dollar gain in the triangle ABO would be exactly equal to the loss in the triangle OCD.

Although the intermediary breaks even over the life of the mortgage, in any arbitrary shorter period, e.g., one year, it may be incurring either a profit or a loss. In our example, with deposit rates expected to increase, the loan rate will be above the initial deposit rate, so that the intermediary will be generating a profit. Through time, as deposit rates increase, the profit becomes progressively smaller until at Z the deposit rate is equal to the loan rate. Thereafter, the deposit rate rises above the loan rate and the institution experiences progressively larger losses. Thus the appropriate accounting period for evaluating the performance of the intermediary is the life of the loan and not any shorter period.

Under some circumstances the losses may precede the gains, with the loss and gain triangles reversed. In such a case, short-term loans from another financial institution or from

a government agency may be needed to ease the institution's resulting liquidity problem. It should be noted, however, that the problem is one of liquidity and not of solvency.

Our analysis demonstrates that in a world of certainty the return on any successive combination of shorter term investments summing to the maturity of the mortgage loan will be the same as for the mortgage loan itself. This is true because the long-term rate is an average of any combination of composite shorter-term rates and the latter, in turn, are averages of their composite shorter-term rates. Thus, the return on a 10-period loan is equal to that of two comparable five-period loans—and the latter return, in turn, is equal to that of 10 comparable one-period loans. In a world of certainty, long-term maturity and long-term interest-rate intermediation are just as advantageous as similar shorter-term intermediation.

Figure 1 also shows that, if the loan rate changes in synchronization with the deposit rate, the gain and loss periods are eliminated and the institution breaks even at all times. In this instance, the institution engages only in maturity intermediation without interest-rate intermediation.

Effect of uncertainty

We can now remove the assumption of perfect certainty so that future rates are only expected rates. If the intermediary's deposit rate expectations are realized, the analysis is unaltered. The institution breaks even on its fixed rate mortgage lending but experiences subperiods of gains and losses. If expectations are not realized, then it no longer breaks even. If deposit rates rise slower than anticipated, say along line AF in Figure 1, the gain triangle will be enlarged and the loss triangle reduced. The institution earns greater profits than expected. Conversely, if deposit rates rise faster than anticipated, say, along line AE, the loss triangle will be greater than the gain triangle. The institution will generate lasting losses and experience a solvency problem. Because it is lasting,

GLOSSARY

A number of the terms used in this article are subject to different meanings in common usage. To avoid confusion the terms will have the following definitions:

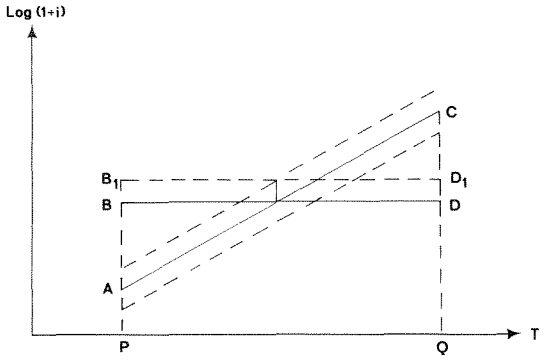
1. A *fixed-rate mortgage* (FRM) is one whose interest rate does not vary over the life of the mortgage. This is the standard form of mortgage in the United States.
2. A *variable-rate mortgage* (VRM) is one whose interest rate varies with movement in short-term interest rates. In California, where VRM's were introduced in 1975, the amount of movement is tied by law to an index of the cost of funds to mortgage lenders.
3. *Maturity intermediation* consists of borrowing at short-term and lending the funds obtained at longer-term.
4. *Rate intermediation* consists of borrowing at short-term *rates* and lending the funds obtained at longer-term *fixed* rates. Thus, the VRM is an attempt to break the link that has existed between maturity and rate intermediation by tying a long-maturity mortgage to a short-term interest rate.
5. The rate on an FRM consists basically of two parts:
   a. The *expectational* portion is the average of expected short-term rates over the life of the mortgage.
   b. The *insurance* portion is a premium which the borrower pays as protection against higher-than-expected future short-term rates. Thus, the VRM is an attempt to share the risk of such higher-than-expected rates between borrower and lender and should carry a lower (or zero) insurance premium. That is, the advantage to the borrower of a VRM should be a lower expected interest cost on a VRM over the life of the mortgage compared with a FRM of the same maturity to offset the increase in risk he must bear with the VRM.

a solvency problem requires a different solution than a short-term liquidity problem.

When an intermediary extends a long-term loan at a fixed interest rate, it accepts the risk that the underlying expected short-term interest rates may not be realized. Although this may result in gains or losses, many market participants are risk averse and assign greater weight to an extra dollar loss than to an extra dollar gain. A fixed rate mortgage contains two components for the borrower: (1) a long-term financing commitment and (2) insurance against loss from higher than expected short-term interest rates. Like any insurance seller, the lender will charge a premium for the interest rate insurance. The premium would be related to the expected loss, or the probability of losses from greater than expected interest rate increases multiplied by the magnitude of the associated loss. This premium is added to the long-term rate obtained by averaging the relevant expected short-term rates. If this is done and deposit rates are realized, the gain triangle will exceed the loss triangle. In Figure 2 the solid line AC is now the *expected* path of short-term rates, and the dotted lines above and below AC represent the degree of uncertainty about that path. The rate BB_1 is purely *expectational,* based on expected future short-term rates. This is the standard explanation of the mortgage interest rate without risk. BD is the *insurance premium* payable by the borrower and is proportional to the amount of risk. With the total market interest rate at PB_1 there is neither a profit to the intermediary nor a net loss to the fixed rate mortgage borrower, because the cost of providing insurance for the former and the cost of purchasing insurance for the latter are the same. If short rates turned out below expectations, long rates would fall and the borrower would wish to refinance. With no prepayment penalty an underpriced premium would imply that realized losses exceeded expected losses, and the intermediary would incur net losses on its lending.

The analysis also indicates that the profitability of fixed rate mortgage lending is dependent only upon whether expected future interest

Figure 2



rate changes are realized, and not on the shape of the yield curve. Financial intermediaries can operate as profitably under descending or flat, as under "normal" ascending yield curves. Thrift institutions, in fact, expanded as rapidly as commercial banks between 1905 and 1930, though the yield curve was downward sloping throughout almost all of that period. Except where the yield curve is flat, realization of expected interest rates shifts the yield curve, and consequently, the level of profitability reflects the extent to which changes in the yield curve are greater or less than those consistent with the realization of expected rates. Fixed rate mortgage lending can be profitable to intermediaries even if short-term rates rise more than long-term rates, provided that the increases do not exceed expectations.

Implications of VRM

Variable rate mortgages are long-term mortgage contracts in which the interest rate changes at prearranged periods, in sympathy with changes in some designated market interest rate that is referred to as the standard index.[4] Unlike a series of consecutive short-term loans, a VRM avoids the transactions costs that accompany a new mortgage note. As Figure 1 indicates, a VRM would simplify the operations of the intermediary by eliminating or greatly reducing interest rate intermediation. Under the assumptions that VRM interest rates 1) change concurrently with deposit rates and 2) are translated into changes in the dollar amount (rather than in the number) of monthly payments, the institution's interest receipts and payments are

perfectly synchronized and no interest rate risk arises.

What happens to the interest rate risk? If there are no constraints on VRM interest rate changes, all the risk is shifted to the borrower. The latter knows the amount of the first monthly payment and the length of the mortgage, but not the amount of the subsequent payments or of the total payments. In contrast, on a fixed rate mortgage he would know the amount of all payments and the length of the payments. If interest rates over the life of the mortgage changed in line with market expectations, the borrower would pay the same average rate on the VRM as on the FRM (less the FRM interest rate insurance premium), although the time pattern of the payments would be different. If short-term interest rates increased more than expected, the VRM would be costlier to the borrower than the FRM, while if short-term interest rates increased less than expected, the VRM would be cheaper.

A compromise between an FRM and a full VRM would involve a risk-sharing arrangement between the lender and borrower.[5] This could be accomplished by placing a symmetrical maximum interest rate band on either side of the rate on a new mortgage. Within the band, the borrower assumes the risk; outside the band, the lender assumes the risk. The wider the band, the greater the risk assumed by the borrower. The two polar cases are represented by an infinitely wide band, which is a pure VRM, and an infinitesimally narrow band, which is a pure FRM.

The California Experience

Six large state chartered savings and loan associations in California began offering VRMs in early or mid-1975. Five of these associations rank in the top ten in the country. (Their example was followed at year end by the Wells Fargo National Bank, the eleventh largest commercial bank in the nation.) These six savings and loan associations together extended some $1.7 million of VRMs between April and December 1975—about two-thirds of the total mortgages they made in this period. Although this experience is too brief to develop meaningful conclusions, some tentative impressions can be expressed. On the whole, the VRM is a much more complex instrument than either lenders or regulators generally realize. As a result, regulations and pricing practices could limit the value of the instrument to both lenders and borrowers. In addition, difficulties could arise under seven different headings, as described below.

Standard index

Regulations of the California Savings and Loan Commissioner tie the rate on VRMs to a standard index, defined as the last published weighted average cost of savings, borrowings, and Federal Home Loan Bank advances to California member associations of the Federal Home Loan Bank of San Francisco. Commercial banks offering VRMs also use this S&L cost of funds index. However, the index presents three problems, two economic and one political.

First, when individual lenders are forced to use an all-lender index, those institutions in capital-short areas may be discouraged from bidding more aggressively for deposits by offering higher interest rates, knowing as they do that the rates on their outstanding mortgages will not be increased correspondingly. Because a lender's decisions on the deposit rates it pays will not greatly affect the index value, some individual institutions could bid less aggressively for funds by offering lower rates and still benefit from higher mortgage rates. This reduces competition among individual lenders.

Secondly, the index is published semi-annually with a lag of two to eight months, and thus does not reflect current market rates. If market dates decline in any period, the drop will not be reflected in the index until later. Yet to be competitive with FRM lenders, VRM lenders must lower their rates in the current period. In the absence of a decline in the standard index, they can remain competitive only by reducing the differential between the market rate and the standard index. This spread, which remains constant over the life of the mortgage, is designed to compensate the intermediary for the

costs and risks of operations, which remain unchanged. A lower spread than necessary to cover the costs would, of course, lead to unprofitable operations over the life of the mortgage. It would appear at first that lower than required spreads when the standard index lags a decline in market rates would be offset by higher than required spreads when the index lags an increase in market rates. But because of the combined impact of prepayment provisions and limits on maximum interest rate changes, borrowers are encouraged to switch from higher spread mortgages to lower spread mortgages, reducing the profitability of lending institutions. A more appropriate solution would be the use of an up-to-date index, such as a two-month moving average of the cost of funds for individual institutions.

Lastly, a political problem arises because the cost of funds index is greatly affected by Regulation Q. Major increases have occurred in the cost of funds index in past periods when Regulation Q ceilings were increased. Because increases in Reg Q ceilings would lead to increases in rates on all outstanding VRM mortgages, and not only on new mortgages, it is reasonable to predict that all homeowners would exert significant political pressure to maintain—or even reduce—Reg Q ceilings as market rates rose. If financial intermediaries could not offer competitive deposit rates, depositors would transfer their funds away from these institutions into private capital markets, depriving the mortgage market of funds.

Maximum interest rate limit

A limit on the maximum VRM interest rate change causes the risk of unexpected interest rate changes to be shared between lender and borrower. Two difficulties exist with the current California regulations regarding this limit. First, they make possible asymmetrical rate changes for the affected savings and loan associations. The rate cannot be increased more than 2½ percentage points above the initial rate, but there is no limit on the amount it can decline as the standard index falls below the initial rate. This regulation places a greater share of the risk on the lender, increasing the rate that he is likely to charge on each new loan. Also, because borrowers are allowed to prepay without penalty within 90 days of any announced increase in loan rates, they have an incentive to shift into new VRMs during any later period of declining market rates in order to take advantage of lower maximum VRM rates.

Secondly, the maximum limit is based upon the initial VRM rate rather than upon the rate on a comparable FRM extended at the same time. This feature benefits VRM borrowers who obtain their mortgages when deposit or short-term rates are high, because they can not only ride the rates down, but can also convert to new VRMs with lower maximum interest rate limits. On the other hand, lenders are unable to recoup these losses from those borrowers who obtain their mortgages when rates are low and assume only limited upside risk. As a result, lenders must charge a higher interest rate in order to be compensated for the added risk.

Limits on the maximum interest rate change also cause new VRMs to differ from comparable outstanding VRMs, either in the loan rate or in the maximum permissible loan rate. These differences, in turn, may encourage lenders and borrowers to shift from old to new mortgages, and thereby encourage the use of prepayment and assumption restrictions to compensate either party for potential losses from such transfers.

Prepayment fees

Prepayment fees on mortgages have frequently been a problem for lenders. If the prepayment penalty fees are nonexistent or too low, in periods of low interest rates the lender will experience losses from expected income and become reluctant to engage in additional lending under the same conditions. Casual inspection suggests that prepayment penalties generally have not been very severe on fixed rate mortgages, so that borrowers have been able to refinance into lower rate mortgages in periods of declining rates. On the other hand, borrowers were locked into lower rates during periods of rising market rates. This situation has helped

make FRMs unfavorable instruments for lenders.

If there were no limits on changes in VRM rates, old VRMs would yield the same rate as new VRMs of the same credit quality—and thus there would be no advantage to borrowers to refinance at lower rates, no loss to lenders, and no need for prepayment fees. However, rates are generally not free to fluctuate without limit. If the maximum interest rate limits are either asymmetrical or centered around the initial VRM rate rather than the comparable FRM rate, it may be advantageous for the borrower to refinance into a new VRM when interest rates decline sufficiently. This, of course, would be disadvantageous to the lender, so that he would be likely, if permitted by law, to impose prepayment penalties on VRMs when market rates fell below initial rates. At other times, there would be no loss to the lender, so that he would be likely to permit prepayment without charge.

The California code permits prepayment of VRMs without penalty anytime within 90 days of an announced increase in loan rates. Thus, if rates had been falling for a period, borrowers would be able to refinance into new, lower rate VRMs after the first announcement of an increase. This provision should be changed to permit prepayment without charge at any time the loan rate is at or above the initial rate. At other times, when the loan rate is below the initial rate, prepayment penalties should be permitted.

Loan assumptions

Most conventional FRMs have "due on sale" clauses, which permit the lender to demand repayment of the outstanding balance (plus prepayment fees) at the time the mortgaged property is sold. This feature permits the lender to extend a new mortgage at a higher loan rate if market rates have risen since the initial mortgage contract. Restrictions on the assumption of an existing mortgage by the property buyer are analogous to unrestricted prepayment, with two differences: the option to terminate the loan rests with the lender rather than the borrower, and the injured party is the borrower when interest rates are above the initial rate (rather than the lender when interest rates are below the initial rate).

Because of these general similarities, loan assumption provisions may be analyzed best relative to prepayment provisions. If there are no prepayment penalties to compensate the lender when interest rates decline, equity suggests that assumption should be restricted so as not to compensate the borrower when interest rates increase. (Although the burden of higher rates falls directly on the buyer, the new mortgage rate affects the price at which property can be sold and thus indirectly affects the seller.) On the other hand, if sufficient prepayment penalties are permitted to compensate the lender for any loss he may experience, restrictions on assumption would not appear to be warranted.

Unlike prepayment penalties, only part of the assumption penalties—the part made up of the higher rate on the new mortgage—accrues to the lender. The remainder is absorbed in the process of obtaining a new promissory note, in the form of search loss, title insurance costs, recording costs, and legal costs. Thus, the effective assumption costs to the borrower are greater than the benefits to the lender.

As in the case of prepayment provisions, if there were no restrictions on VRM maximum interest rate changes, there would be no need for assumption restrictions. The rate on a new mortgage would be the same as on the old mortgage. However, as already noted, restrictions on interest rate changes may at times not make the two mortgages equivalent, so that either the borrower or the lender can find some advantage at such times in choosing between a new and an old mortgage. As a result, some VRM lenders have imposed assumption restrictions similar to those on FRMs, even though unrestricted assumption has often been cited as an advantage of VRMs.

Because only part of the benefit from restricted assumption goes to the lender, it would help both sides if these restrictions were modified. One alternative is to reset the maximum interest rate band each time the property were sold. (This could be done without having to

write a new promissory note.) The band on the existing mortgage would then be equivalent to that on a comparable new VRM. The necessary legal changes could be achieved with only a minor change in the California code.

Implementation of rate changes

Changes in loan rates may be implemented either as changes in the dollar amount of monthly payments or as changes in the number of unchanged monthly payments. Because deposit rate changes are reflected only in changes in the amount of interest payments, discrepancies between the time of inflows and outflows are reduced if loan rate changes are implemented in the same fashion, making interest receipts match interest payments. However, VRM loan rates can increase sharply, increasing monthly payments sharply, while most borrowers' incomes increase only slowly. As a result, borrowers may occasionally experience payments difficulties.

To ease the burden of such rate changes, lenders frequently permit increases in loan rates to be implemented, at the option of the borrower, as increases in the number of monthly payments rather than in the dollar amount. This eliminates interest rate risk, but because cash inflows and outflows are not snychronized, liquidity problems may still arise. The lender may need to meet deposit rate payments before receiving his loan rate payments. Thus, whenever a lender increases the length of a mortgage in response to loan rate increases, he should reserve the right to shorten the length again to the original maturity in the event rates decline.

California regulations permit VRM rate increases to be translated into increases in the number of monthly payments, provided that the remaining life of the mortgage does not exceed 40 years. Although this is reasonable for a mortgage with 20 or more years left to maturity, it appears to be an unnecessarily long extension for shorter mortgages. If rates increased over time, some mortgages might never be completely repaid. A change in the regulations, permitting mortgage maturities to be lengthened by no more than, say, 10 years in response to loan rate increases, could help lenders without creating any undue problems for borrowers.

Complexity of mortgage contract

Because a VRM is a complex instrument, the VRM contract or promissory note is also complex—much more so than an FRM contract. Like the FRM note, the VRM note must specify the initial interest rate, the amount of the monthly payments, and the length of the mortgage. But in addition, the VRM note must also stipulate the conditions under which the interest rate can change, the methods by which an interest rate change may be implemented, the options available to either side for implementing rate changes, the maximum and minimum limits on interest rate changes, the frequency of possible rate changes, and the maximum limits on the total interest rate change over the life of the mortgage. VRM prepayment provisions are also more complicated, since they can shift with the relationship of the current market rate with the initial rate. Lastly, the legal provisions applicable to VRMs are numerous, complex, and subject to frequent changes.

As a result, it is easy for errors to appear in the promissory note. An analysis of the notes used by the seven major users of VRMs in mid-January, 1976, revealed that many contained errors of nonconformity with the state laws and regulations then in effect. The largest number of errors pertained to the alternative procedures by which loan rate changes could be implemented. Such errors are not binding on the borrower, but they do reduce the amount of information provided and thereby lower the borrower's ability to evaluate the contract.

In addition, almost all of the promissory notes omitted information that was materially relevant to the ability of the borrower to understand the provisions and the value of the standard index at the time the loan was originated. Because of the complexities of the instrument, lenders and borrowers alike should benefit from the development of a model VRM contract. This would be of considerable use to lenders in preparing their own promissory notes and to borrowers in becoming knowledgable about the information that is material to them.

Consumer protection

The intrinsic complexity of the VRM makes it more important to protect borrowers against errors resulting from incorrect or omitted material information. One source of error unique to VRMs arises from the computation of the change in monthly payments resulting from changing loan rates.

Interest rates on almost all new residential mortgages of any type are denominated in multiples of 0.25 percent, e.g. 9¼ percent. Borrowers can check the monthly payments that are consistent with this rate and the loan maturity by using a standard mortgage payments table. (Computations of these amounts without the assistance of a calculator or computer is not recommended.) However, as interest rates change, the loan rate on outstanding VRMs can be in multiples smaller than 0.25 percent. Interest rate fractions in these smaller multiples are not included in standard mortgage tables. Thus there is no easy way for a borrower to check the monthly payment stipulated by the lender and obtained through the use of a computer. To remove doubts about the accuracy of such figures, all VRM lenders should make available at their offices a monthly mortgage payments table, perhaps in computer printout form, for all interest rate fractions and maturities in which their mortgages are outstanding.

California law requires lenders to provide borrowers with at least 30 days' written notice before the effective date of a change in VRM loan rates. When the economy is stable, with only small changes in market interest rates, there may be no changes in VRM loan rates for extended periods of time. But some borrowers may forget that these rates can actually change, and be both surprised and upset when an increase in monthly payments finally occurs. Lenders would be well advised to send borrowers a brief notice on every mortgage anniversary, possibly describing interest rate developments in the mortgage market since the last notice and reminding them that their loan rates could change if market rates change sufficiently. At least one smaller California savings and loan association, which has used VRMs for some years, has found such a program successful in defusing borrower animosity to rate increases.

Evaluation of VRM

The mortgage industry has developed the VRM as an alternative and/or supplement to the FRM in order to reduce the financial pressures on mortgage-lending financial intermediaries, to increase the flow of funds through the mortgage market, and to stimulate the purchase of additional housing. Hence, the usefulness of the VRM as a mortgage instrument can be evaluated by examining its actual and potential impacts on the mortgage and housing markets. This, in turn, requires a determination of the advantages and disadvantages of VRMs, relative to FRMs, for mortgage borrowers and lenders. These advantages and disadvantages can be set forth in tabular form, based in part on theoretical considerations, and in part on our observation of California's limited experience with this instrument.

Mortgage Borrowers

Advantages

1. Possible gain from lower than currently expected interest rates over the life of the mortgage.
2. Possible gain from lower prepayment fees.[6]
3. Possible gain from more liberal assumption provisions.[6]
4. Greater availability in periods of great interest rate uncertainty.

Disadvantages

1. Possible loss from higher than expected short-term interest rates and need to predict interest rates.
2. Possible risk of financial strain if mortgage rate increases sharply but family income remains unchanged.
3. Greater complexity of mortgage contract.
4. Difficulty of ascertaining accuracy of changes in monthly payments as a result of changes in standard index.

Mortgage Lenders

Advantages

1. Reduced solvency problem from risk of

higher than expected cost of funds through shifting of part or all of risk to borrower.
2. Reduced liquidity problem through increased synchronization of interest payments and receipts, whenever changes in loan rates are translated into corresponding changes in dollar amount of monthly payments.

Disadvantages

1. Difficulty in pricing of new VRMs and potential inability to compete for new mortgages in periods of declining rates because of standard index lagging behind market rate changes.
2. Reduction in potential gains from lower than expected cost of funds.
3. Elimination of potential profit from sale of "interest rate insurance."
4. Lack of synchronization of monthly payments and receipts, and possible liquidity problems, whenever changes in standard index are translated into changes in number of monthly payments.
5. Necessity of educating borrowers in complexities of mortgage contract, and possible borrower animosity whenever rates are raised on outstanding mortgages.
6. Difficulty in designing features of mortgage contract and simple promissory note.

Mortgage Market

Advantages

1. Possible increase in supply of funds from lenders.
2. Possible smoother supply of funds over the cycle.
3. Protection of solvency of thrift institutions, provided that new contracts are priced correctly.

Disadvantages

1. Possible decrease in demand for funds by borrowers because of greater risk.
2. Possible pressure on government from mortgagors to prevent increases in standard index, particularly through use of Regulation Q to hold down cost of funds and thus level of index.

Housing Market

Advantages

1. Possible greater demand for new and improved housing from greater availability of mortgage funds.
2. Possible smoother demand for new and improved housing over cycle from smoother flow of mortgage funds.
3. Possible greater demand for new and improved housing from increased ability of home owners to sell, as a result of more liberal prepayment and assumption provisions.

Disadvantages

1. Possible reduced housing demand from reduced demand for mortgages.
2. Possible reduced housing demand from (a) increased disintermediation if free movement of standard index is restricted; and (b) mispricing of mortgage if standard index is not sufficiently current.

Conclusion

The VRM is a complex instrument, much more complex than first analysis would suggest, and there is good evidence that it is not yet fully understood by any of the parties concerned—borrowers, lenders, or regulators. The potential success or harm of the VRM is heavily dependent upon the regulations and practices defining its characteristics. The California experience highlights a number of requirements that must be met for the VRM to operate successfully:

1) the need to select an appropriate standard index;
2) the need for thrift institutions to understand fully the complexities of maturity and term structure intermediation;
3) the need to offset political pressures for greater government interference with interest rates;
4) the need to determine loan rate changes in the light of the desired degree of risk sharing and the implications for prepayment and assumption provisions;
5) the need to "educate" borrowers;

6) the need to design the promissory note to provide complete, accurate, and understandable disclosure of all material information;
7) the need to provide proper protection to borrowers; and
8) the need for careful marketing of both the initial contract and subsequent changes in interest rates.

Inappropriate decisions in any of these areas could greatly reduce the potential contribution of VRMs. The California experience to date suggests that it may not be easy to realize the full potential of this mortgage instrument.

APPENDIX

How a VRM Works

The VRM is a long term mortgage contract in which the loan rate may change periodically, concurrently with changes in some predetermined market rate of interest, referred to as the standard index. The provisions governing the relationship between the loan rate and the standard index are stipulated in the promissory note and, in part, are established by state statute or regulation. These provisions generally include the fixed differential between the standard index and the loan rate, the frequency at which the loan rate may be changed, the amount by which the loan rate may be changed (at any single time and over the life of the note), and the method by which changes in the loan rate are translated into changes in the monthly payments (and at whose option). In California, many of these provisions are stipulated either in the State Civil Code or regulations of the Savings and Loan Commissioner.

The operation of a VRM may be illustrated with a hypothetical example developed in Table A-1. The standard index is the actual current value of the average cost of funds of insured savings and loan associations in the San Francisco Federal Home Loan Bank District.[1] The loan rate is assumed to be 1½ percentage points (150 basis points) above the standard index, to compensate the lender for all costs of operation and provide him with a competitive return. Changes in the loan rate are subject to the following restrictions:

1. Limit per change:
   maximum = 25 basis points
   minimum = 10 basis points
2. Carryover: changes in the standard index greater than 25 basis points or less than 10 basis points are carried over to the next and, if necessary, subsequent periods and added to the change in the index at that time.
3. Number of changes: no more than one per six month period.
4. Overall limit: 250 basis points from the rate on a comparable fixed rate mortgage extended on the same date.

The carryover (or cumulative) provision requires the computation of two numbers:

$$\text{Total loan rate carryover (TC)} = UC_{-1} + \Delta SI$$

$$\text{Unused loan rate carryover (UC)} = UC_{-1} + \Delta SI - P\Delta = TC - P\Delta$$

where:

SI = change in standard index

$P\Delta$ = permissible change in loan rate

UC_{-1} = unused carryover in previous period

A $20,000, 30-year VRM is assumed to be extended on January 1, 1967, at 6.85 percent, based on a standard index of 5.35 percent. (A comparable FRM is assumed to cost 7 percent.) In the second semiannual period, the standard index declines by 32 basis points. As a result, the loan rate is reduced by the maximum 25 basis points to 6.60 percent. The remaining 7 basis points are included in the unused carryover and are applied to the change in the next period. By the end of the first half of 1975, the standard index had climbed to 6.41 percent, or 106 basis points over its initial value. The loan rate had increased by 105 basis points to 7.90 percent. In the 16 semiannual periods following the origination of the mortgage, the standard index had declined five times and increased 11 times, while the loan rate had declined twice and increased seven times.

The monthly payments, as the table shows, are $131.06 in the first six months when the interest rate is at the initial 6.85 percent level. The payments then decline to $127.77 in the next six month period when the loan rate declines to 6.60 percent. (This assumes that all changes in the loan rate are translated into changes in the dollar amount of monthly payments.) In the first six months of 1975, the last semiannual period shown, the monthly mortgage payments have increased to $143.24.

[1]This rate is not published until some months after the close of the respective semiannual period. Nevertheless, we assume here that it is available at the beginning of the period, in order to have a current index that permits lenders to price their new mortgages at the current market loan rate without changing the rate differential.

The unpaid balance at the end of this period is $17,754.10.

In contrast, a FRM extended on January 1, 1967 at a 7-percent fixed rate would call for constant monthly payments of $133.20. At the end of the period, the unpaid balance would be $17,703.20, only $50 less than on the VRM. Of course, if interest rates had increased faster, the difference would have been greater, but the initial rate on the FRM may also have been higher.

FOOTNOTES

1. For a discussion of alternative changes in mortgage plans, see D. Lessard and F. Modigliani, **New Mortgage Designs for Stable Housing in an Inflationary Environment** (Boston: Federal Reserve Bank of Boston, 1975).
2. Another large commercial bank began offering VRMs after the conclusion of the study.
3. The interest rate on the vertical axis is scaled in terms of the logarithm of 1 plus the interest rate, to reflect reinvestment of the interest on both the mortgage and the deposit, as is required by the definition of compound interest.
4. The operation of a typical VRM is shown in Appendix (A).
5. The risk could also be shared or assumed totally by the Federal government as a third party. For such suggestions see George G. Kaufman, "The Case for Mortgage Rate Insurance," **Journal of Money, Credit, and Banking,** November 1975, and James L. Pierce, "A Program to Protect Mortgage Lenders Against Rate Increases," in **Financial Institutions and the Nation's Economy (FINE),** Committee on Banking and Currency, U.S. House of Representatives, November 1975.
6. Prepayment and assumption provisions depend on the magnitude of the maximum interest rate band and degree of risk sharing. The larger the spread, the more liberal the provisions are.

TABLE A-1

Monthly Payments and Unpaid Balance Variable and Fixed Rate Mortgages†

1967-1975

Period (Semi-Annual)	Variable Rate Mortgage* Standard Index	Loan Rate	Monthly Payments (dollars)	Unpaid Balance @	Fixed Rate Mortgage‡ Monthly Payments (dollars)	Unpaid Balance @
1/1/67				20,000.		20,000.
1967.1	5.35	6.85	131.06	19,897.	133.20	19,899.
1967.2	5.03	6.60	127.77	19,785.	133.20	19,794.
1968.1	5.08	6.60	127.77	19,670.	133.20	19,686.
1968.2	5.10	6.60	127.77	19,551.	133.20	19,575.
1969.1	5.17	6.60	127.77	19,428.	133.20	19,459.
1969.2	5.27	6.75	129.65	19,304.	133.20	19,339.
1970.1	5.58	7.00	132.78	19,181.	133.20	19,215.
1970.2	5.67	7.15	134.65	19,057.	133.20	19,086.
1971.1	5.64	7.15	134.65	18,928.	133.20	18,953.
1971.2	5.57	7.15	134.65	18,795.	133.20	18,815.
1972.1	5.55	7.05	133.45	18,655.	133.20	18,672.
1972.2	5.56	7.05	133.45	18,510.	133.20	18,524.
1973.1	5.60	7.05	133.45	18,359.	133.20	18,371.
1973.2	5.83	7.30	136.35	18,209.	133.20	18,213.
1974.1	6.14	7.55	139.23	18,059.	133.20	18,049.
1974.2	6.44	7.80	142.10	17,908.	133.20	17,879.
1975.1	6.41	7.90	143.24	17,754.	133.20	17,703.

†$20,000, 30-year mortgage extended January 1, 1967.
*Initial loan rate = 6.85 percent.
‡Loan rate = 7 percent.
@At end of semi-annual period.

Inflation and the Efficiency of Capital Markets

Joseph Bisignano*

The recent period of inflation resulted in a dramatic rise in yields on long-term debt securities. The rise in yields was accompanied by a change in the spreads between different grades of corporate and municipal bonds, and in the spreads between yields on prime-grade corporates and yields on long-term U.S. Government securities. In this paper we investigate the question of whether the bond markets were "efficient" in establishing yield differentials between different grades of bonds and between prime corporate and long-term Government bonds. In addition, we consider to what extent "inefficiencies" were related to the recent period of inflation, more specifically, related to the unanticipated portion of the recent inflation.

Our analysis suggests that while the market was efficient in removing any systematic profits available by arbitraging across different grades of securities (for example, between Aaa and Baa bonds), the market was not efficient in establishing the differential between prime grade corporates and long-term Government bonds. The significant rise in unanticipated inflation caused the market to demand much greater premiums for prime corporates over Governments than the underlying risk would have justified. Long-term Governments appear to have lost at least in part their role as a "safe asset" in long-term portfolios, and this has impaired the market's ability to determine the appropriate spread of prime corporates over long-term Governments.

Defining capital market "efficiency"

The concept of capital-market efficiency in modern finance theory concerns the extent to which the price of a security "reflects" the "information" the "market" has available to it. An efficient market is one in which the price always incorporates all of the information available to the market.[1] It is obvious that this concept of efficiency is a loose one and needs to be more rigorously stated in order to make it operational. (See Appendix I for a technical treatment of the concept of market efficiency.) There is, however, a more intuitive corollary to this notion of capital market efficiency. If a market is efficient it should not be possible for participants to exploit the available information to make above-normal profits on the basis of some "trading rule." More precisely, an efficient market is one in which the history of the price of the security, other than the current price, provides no useful information for knowing what the expected value of tomorrow's (or next year's) price will be. All the information is "fully reflected" in the current price. This notion of efficiency leads to the equation of an efficient market with a concept of a "fair game," in which there is an equal expectation of gain or loss—or in which the expectation is for a zero gain.

Tests of the efficient market hypothesis are implicitly "joint tests," that is, they are both a test of the hypothesis that the market is efficient and a test of a particular hypothesis regarding how investors' expected returns on the security are formed to establish equilibrium in the market for the security. This complication creates some ambiguity in deriving implications regarding the efficiency of markets. If the hypothesis is rejected, it may imply either (1) that the market is efficient and that the theory of the formation of the expected return is in error or

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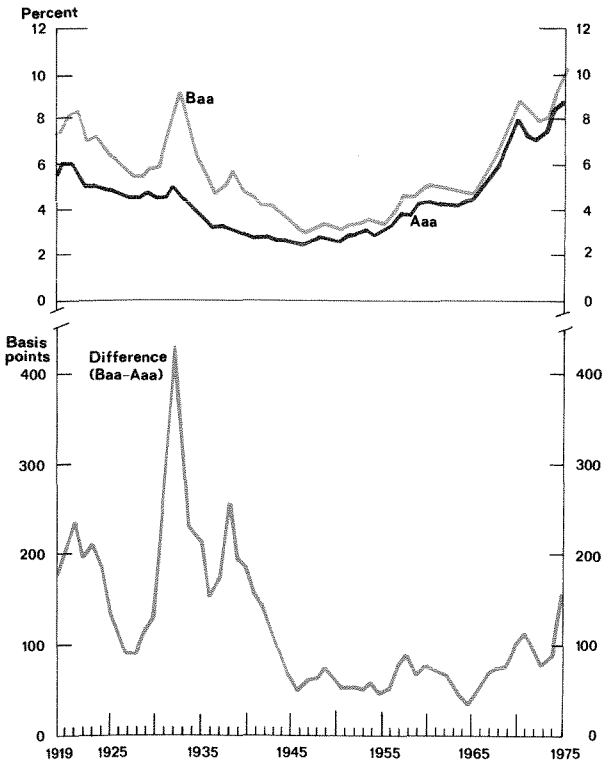
Chart 1
Corporate Bond Yield and Yield Spreads



(2) the reverse, that the expected return model is correct but the market is inefficient.

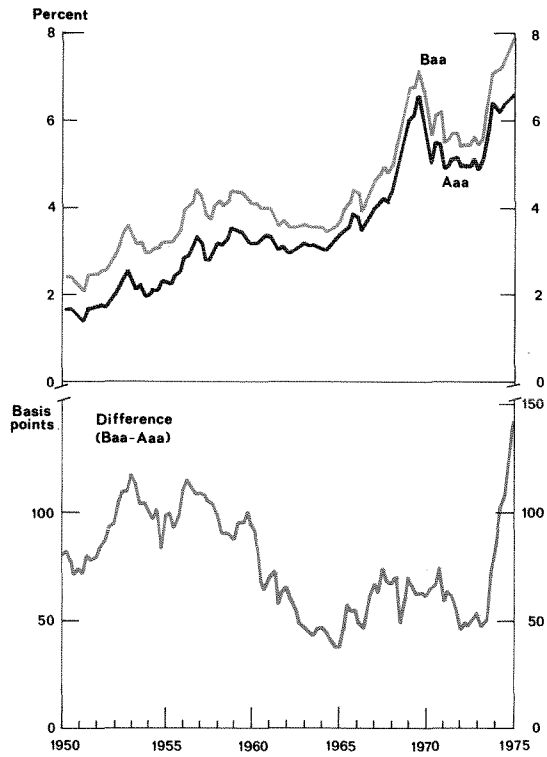
Our interest in the efficient markets hypothesis first centers on the question of whether the yield spread between various "grades" of rated bonds adequately incorporates all the market information which reflects substantive differences in the quality of the securities. To test this hypothesis, we assume at the start that the underlying quality differential between Aaa and Baa bonds remained constant in the corporate and municipal markets in the period since 1950. Thus, our test of the efficiency of these markets is made "conditional" on this assumption. Interpretation of our statistical results should recall this conditionality. Simply stated, our argument is that if bond markets are operating efficiently, it should not be possible to gain arbitrage profits systematically between different security markets (e.g., corporate vs. Governments), and similarly, it should not be possible to arbitrage systematically between risk classes of securities in the same market (e.g., Aaa vs. Baa corporates).

Measuring risk spreads

A glance at the postwar data indicates that the Baa-Aaa "quality differential" was very stable for the corporate sector and fairly stable for the municipal market, except for the last few years. The Baa and Aaa market yields and their spreads are shown in Charts 1 and 2, while the numerical averages, standard deviations, and coefficients of variation (standard deviation divided by the mean) are shown in Tables 1 and 2.

Between the 1950's and the 1960's, corporate bond yields rose significantly but the average Baa-Aaa corporate yield spread and its variation remained almost unchanged, averaging about 65 basis points, with a standard deviation of 16 basis points. This quality yield differential remained stable even though both Baa and Aaa corporate rates rose by about 170 basis points during the 1960's. Assuming an efficient mar-

Chart 2
Municipal Bond Yield and Yield Spreads



ket, we can interpret this stability as indicating an unchanged quality differential over this period.

Market yields on municipals rose about 100 basis points during the 1960's, while the Baa-Aaa yield differential narrowed appreciably, from 95 to 61 basis points, but with greater relative variability. These data would indicate, assuming an efficient market and constant quality of rating services, that the average quality of Baa issues may have improved significantly, relative to Aaa municipals, over this period.

The evidence concerning the quality differential between Aaa and Baa bonds gives rise to a question of market efficiency. Did the markets in the 1950-69 period utilize information in an efficient manner, such that knowledge of past movements in the Baa-Aaa differential provided little or no help in predicting each subsequent monthly change in the differential? To answer this question, we should consider the auto-correlations of the Baa-Aaa market yield spread over that period, assuming constancy in the underlying Baa-Aaa quality differential.

Table 3 shows the autocorrelations for twelve lagged periods, although 50 autocorrelations were estimated.[2] The test statistics indicate that there was very little serial dependence in the changes in the Baa-Aaa yield spread during the 1950-69 period. The autocorrelations were all quite low, and only the first-order autocorrelation in the corporate bond spreads was statistically significant. This latter result is not unexpected, however. As Holbrook Working has shown, the monthly averaging of daily random increments will often produce a first-period autocorrelation of +0.25.[3]

Table 1

Corporate Yields and Yield Spreads

1919 — 1975

(percent)

	Average Market Yield		Yield Spread: Baa-Aaa		
Period	Aaa	Baa	Mean	Standard Deviation	Coefficient of Variation
1919-1929	5.11	6.72	1.61	0.51	0.31
1930-1939	3.89	6.32	2.43	0.98	0.40
1940-1949	2.71	3.73	1.02	0.46	0.45
1950-1959	3.30	3.93	0.63	0.16	0.25
1960-1969	5.00	5.65	0.65	0.16	0.24
1970-1975 III	7.90	8.97	1.06	0.29	0.27

Table 2

Municipal Yields and Yield Spreads

1950 — 1975

(percent)

	Average Market Yield		Yield Spread: Baa-Aaa		
Period	Aaa	Baa	Mean	Standard Deviation	Coefficient of Variation
1950-1959	2.34	3.29	0.95	0.13	0.13
1960-1969	3.59	4.20	0.61	0.16	0.27
1970-1975	5.61	6.31	0.70	0.25	0.35

Since the remaining autocorrelations were all small and statistically insignificant, we can conclude that past changes in the Baa-Aaa spread —for both the corporate and municipal markets —were of no use in predicting the change in the spread. This can be interpreted, loosely, as saying that people cannot profitably arbitrage between different grades of securities in the same market.

Decomposition of risk exposure

The notion of risk is a relative one. The Baa-Aaa spread represents only the marginal risk—not the total risk—that a Baa bond holder

Table 3

Estimated Autocorrelations for the Change in the Baa-Aaa Yield Spread

1950 — 1969

Lag: (months)	1	2	3	4	5	6	7	8	9	10	11	12
Corporate Bonds	0.20*	0.07	0.06	0.01	—0.05	—0.06	—0.04	—0.02	0.02	—0.04	0.07	0.00
Municipal Bonds	0.07	—0.08	—0.13	—0.08	—0.10	0.00	—0.04	0.12	0.12	—0.03	—0.06	—0.12

*Coefficient is more than twice its standard error.

Box-Pierce Q-statistic: Municipals 50.95; Corporates 40.49
Critical χ^2 95% value: 67.5

assumes by not holding a prime grade bond. A Baa bond holder's total risk can only be measured with reference to the most default-free long-term debt instrument, a government bond. To capture this total risk, we divide the differential between the market yield on a Baa bond and that on a long-term U.S. Government security into two components—the spread between a Baa and Aaa, and the spread between a Aaa and a long-term U.S. Government. (Table 4) The sum of these two components we have defined as the "total risk differential," on the grounds that this can only be defined with respect to a "safe" long-term asset, in terms of default risk and marketability.

Given this definition of "total risk differential," the Baa-Aaa differential can be regarded as equivalent to a Baa default premium only if the two assets are alike in every other respect (marketability, price variability, and so on). Although the total risk differential may reflect other institutional factors, such as liquidity and call protection, we assume that it is dominated by default considerations. The differential between the Aaa corporate bond and the long-term U.S. Government bond—the premium over the safe asset—can then be thought of as the additional risk one assumes by purchasing the highest quality corporate long-term debt. Let us refer to the Baa-Aaa spread as the "Baa quality premium." The decomposition of the "total risk differential" provides some interesting insights into the risk one assumes with a Baa corporate security.

Table 4 indicates that, between the 1940's and the 1950's, the total risk differential between a Baa corporate bond and a long-term government security declined from 128 basis points to 94 basis points. Most of this decline was due to a 29 b.p. decline in the "Baa quality premium," compared to only a 6 b.p. decline in the average Aaa risk premium over the "safe asset," U.S. Government securities. During the 1960's there was only a modest change in these spreads. However, the 1970-75 period witnessed a dramatic swing in these premiums, with the total risk differential growing from 114 to 262 basis points. But in this case, most of the higher differential (104 b.p.) was due to an increase in the Aaa risk premium over long-term governments, while only 44 basis points was due to the increased risk of holding a Baa corporate security. The recent rise in the risk structure of interest rates thus seems to reflect the perceived greater risk of corporate securities generally, rather than the greater riskiness of less than premium rated corporate securities.

After the mid-1960's, quite atypically for the postwar period, the risk premium between Aaa corporates and long-term Governments began to increase greatly and with much more variability (Chart 3). Indeed, in early 1968, this risk premium exceeded the Baa-Aaa quality differential for the first time in the postwar period. This shift may be best understood in terms of an increased public demand for greater risk premiums on corporate securities. As Edward S. Shaw has emphasized in a previous

Table 4

Decomposition of Risk Exposure
Corporate Bonds
(basis points)

	Baa-Aaa "Baa Quality Premiums"			Aaa-U.S. Gov't "Aaa Risk Premium"			Baa-U.S. Gov't "Total Risk Differential"		
Periods	Means	Standard Deviations	Coefficient of Variation	Means	Standard Deviations	Coefficient of Variation	Means	Standard Deviations	Coefficient of Variation
1941 — 1949	92	37	.40	37	13	.35	128	44	.34
1950 — 1959	63	16	.25	31	7	.23	94	21	.23
1960 — 1975	81	31	.38	89	57	.64	169	84	.49
1960 — 1969	64	16	.25	50	25	.51	114	37	.33
1970 — 1975	108	31	.28	154	30	.19	262	55	.21

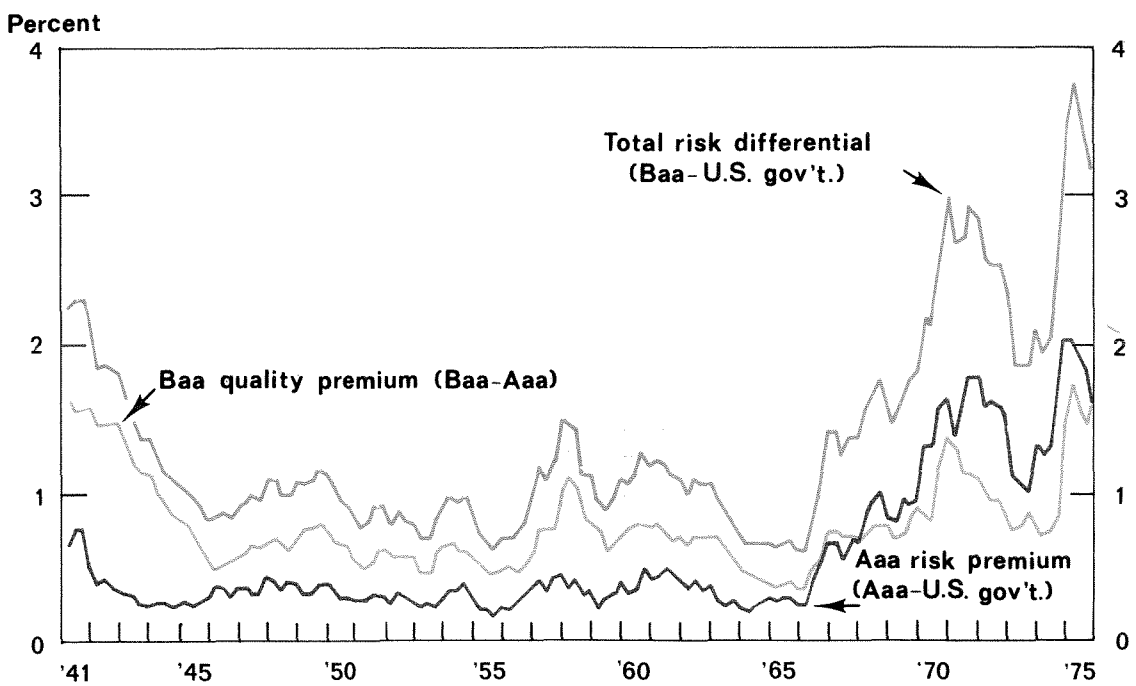
article in this *Review*,[4] price inflation can play havoc with so-called "safe assets"—i.e., assets which have real yields with small unanticipated variance. The existence of safe assets normally permits risk-averse individuals to increase their expected returns by forming portfolios of safe and risky assets. In Shaw's words, "accumulation of safe assets is complementary with accumulation of productive and risky assets, reducing the supply price of savings to riskier uses."[5] However, the gradual erosion of U.S. Government securities as safe assets during the late 1960's and 1970's, due to a rise in unanticipated inflation, led investors to demand greater premiums for purchasing corporate securities rather than Governments.

The hitherto strong correlation between different types of bond rates also disappeared during the 1970's. Long-term Governments and Aaa corporates were very strongly correlated in the two preceding decades, with a simple correlation of 0.98, but this correlation fell to a modest 0.34 in the 1970-75 period. A similar but less dramatic fall occurred in the municipal bond market. In the 1970's Aaa corporate bond holders demanded three times' the 50-basis point premium that these securities commanded over long-term Governments during the 1960's. There are a number of possible explanations for this phenomenon, but the very rapid (and atypical) rise in unanticipated inflation may be crucial. The rate of unanticipated inflation reached 8 percent in 1974, and this increased uncertainty was reflected in the premium demanded on corporate securities.

The risk premium between Aaa corporates and long-term Governments went from an average of 50 basis points in the 1960's to 154 basis points in the first half of the 1970's. In contrast, the Baa-Aaa corporate spread increased by only 44 basis points between these periods. Thus, the capital markets in recent years have been demanding greater interest yields on Baa corporate securities, more because of the loss of the safe asset than because of the increased inherent risk of Baa bonds.

Our previous results concerning the 1950-69 constancy of the Aaa-Baa risk differential, sug-

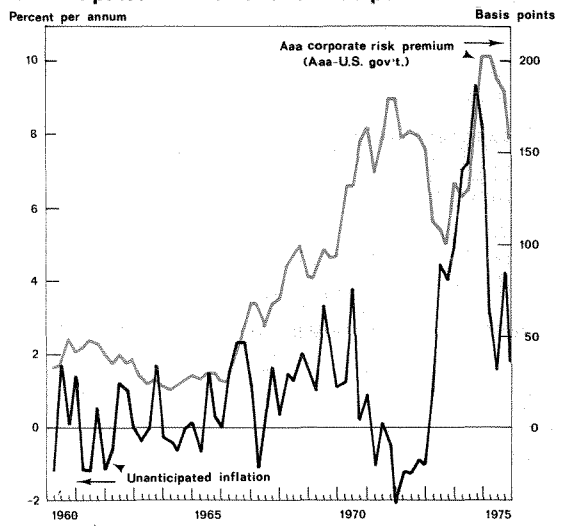
Chart 3
Corporate Bond Yield Differentials



gested that the capital markets operated efficiently in incorporating available information in the differential, so that knowledge of past changes in the Baa-Aaa spread was of little more use than knowledge of the most recent change. Was the market equally efficient in removing the potential for arbitrage profits between U.S. Governments and Aaa corporates? The autocorrelations for the change in the Aaa-U.S. Government spread have a substantial amount of statistical significance, and the chi-square statistic rejects the hypothesis of random fluctuations in the monthly change in this series (Table 5). Similar results were evident for the municipal-bond market. This evidence supports the argument that the loss of the safe asset during the late 1960's and 1970's led to inefficient capital markets.

For most periods, the capital markets efficiently used available information in determining the Baa-Aaa corporate and municipal bond spreads. Some evidence suggests, however, that the market had difficulty properly determining the premium between Aaa bonds and long-term Governments. As we stated earlier, autocorrelation results provide only tentative information on capital-market efficiency, because they are really a joint test of the hypotheses that the market is efficient and that the true underlying risk premium between the two securities is constant. Significant autocorrelations may indicate that either or both of these hypotheses are false, so that we are unable, with these simple statistics, to distinguish which of them is rejected.[6] However, our evidence indicates (at least conditionally) that the capital market properly assessed default-risk differentials between Aaa and Baa bonds but was inefficient in capturing the risk differential between Aaa bonds and long-term Governments. This supports Shaw's suggestion that the rise of "dirty inflation" (i.e., unanticipated inflation) helped distort relative financial prices in recent years.

Chart 4
Unanticipated Inflation and Aaa Corporate Risk Premium



A rough estimate of unanticipated inflation may be obtained by the following procedure. Following a definition developed by Irving Fisher, we may calculate the anticipated portion of price inflation by subtracting an estimate of the real rate of interest from the nominal (market) rate of interest—specifically, by subtracting Standard and Poor's composite dividend yield from S&P's high grade bond yield. Then we can obtain a rough estimate of "unanticipated inflation"[7] by subtracting this estimated "anticipated rate of inflation" from the observed inflation rate calculated from the Consumer Price Index.

Table 5

Estimated Autocorrelations of the Change in the Aaa-long-term U.S. Government Yield Spread

1950 — 1969

Lag (months)	1	2	3	4	5	6	7	8	9	10	11	12
Aaa-U.S. Gov't	—0.17*	—0.27*	0.06	—0.02	0.00	0.16*	—0.10	—0.16*	0.15*	—0.05	—0.05	0.12

*Coefficient is more than twice its standard error.

Box-Pierce Q-statistic: 117.6

Critical χ^2 95% value: 67.5

Table 6

Aaa Corporate Risk Premium and Unanticipated Inflation

1960 — 1975

Period	Aaa corporate-Long-term U.S. Gov't. Bond Spread	Unanticipated Inflation
	(basis points)	(annual rate of change)
1960-1964	35	0.06
1965-1969	65	1.23
1970-1975	154	2.32

Table 6 provides estimates of unanticipated inflation for the 1960-75 period, together with the spread between the Aaa corporate bond rate and the long-term U.S. Government bond rate. The Aaa corporate risk premium increased from 35 basis points between 1960 and 1964, when the average rate of unanticipated inflation was only 0.06 percent, to 154 basis points between 1970 and 1975, when unanticipated inflation grew to over 2 percent annually.

Chart 4 shows that the Aaa corporate risk premium over long-term U.S. governments remained quite stable during the early 1960's, but then rose rapidly when the rate of unanticipated inflation began to climb after 1965. However, the two series did not always move together. The fall in unanticipated inflation between 1970 and 1972 failed to show up in the Aaa corporate risk premium until 1973. But then, as unanticipated inflation increased, the Aaa corporate risk premium responded as expected by rising rapidly. From the third quarter of 1973 to the fourth quarter of 1974 the Aaa risk premium rose by 104 basis points, reflecting the 11-percent increase in unanticipated inflation which began in 1972.

The unprecedented demand for risk premiums on high-rated corporate bonds is yet another example of the so-called "rush for quality" seen in both short-term and long-term debt markets in recent years. Unanticipated inflation is but one ingredient in the premium demanded by the holders of private debt instruments. Nonetheless, the distortion in financial markets caused by unanticipated inflation, here described in terms of the efficiency of capital markets, deserves to be considered as an important cost of the recent U.S. inflation.

Conclusion

The period of tranquil stability in bond markets experienced during the 1950's and early 1960's was replaced by an entirely different situation after 1965. Yield spreads increased between different grades of bonds in both the corporate and municipal market, as did their variability. While the bond markets apparently were efficient in incorporating available information in the spread between Aaa and Baa securities, this was not the case for the market's determination of the appropriate spread between Aaa corporates and long-term U.S. Government bonds. The difficulty in determining this spread appears to be related to the unprecedented rise in unanticipated inflation experienced since the late 1960's.

It should be emphasized that the conclusions of this paper are strongly conditional on the assumption of long-term constancy of the underlying risks between different grades of rated securities—a somewhat questionable assumption in light of the severity of the recent recession and inflation. Further work needs to be done on an alternative hypothesis, namely, that capital markets were efficient throughout the post-war period in assessing risk differentials, but that the underlying risk differentials widened significantly because of substantive and pervasive changes in the economic environment. This Bank's Research Department is continuing an extensive study of the impact of these changes on the capital market's perception of financial risks.

FOOTNOTES

1. The most thorough review of efficient markets theory is Eugene F. Fama, "Efficient Capital Markets: A Review of Theory and Empirical Work," **Journal of Finance** (May 1970).
2. See G. E. P. Box and G. M. Jenkins, **Time Series Analysis: Forecasting and Control,** Holden-Day, San Francisco (1970), for a discussion of the estimation and statistical tests conducted in the text.
3. Holbrook Working, "Note of the Correlation of First Differences of Averages in a Random Chain," **Econometrica** (October 1960).
4. Edward S. Shaw, "Inflation, Finance and Capital Markets," **Economic Review,** Federal Reserve Bank of San Francisco (December 1975).
5. Ibid. p. 7.
6. With regard to the joint hypothesis nature of efficient

market tests, see Eugene F. Fama, "Short-term Interest Rates as Predictors of Inflation," **American Economic Review** (June 1975).

7. For a further discussion of unanticipated inflation, see Joseph Bisignano, "The Effect of Inflation on Savings Behavior," Federal Reserve Bank of San Francisco, **Economic Review** (December 1975).

8. See, for example, Burton G. Malkiel, **A Random Walk Down Wall Street,** W. W. Norton and Company, Inc., New York (1973).

9. For an insightful clarification of Fama's concept of market efficiency, see Stephen F. LeRoy, "Efficient Capital Markets: Comment," **Journal of Finance,** March 1976, and Fama's reply.

APPENDIX I

The Concept of Efficient Markets

One form of an efficient market (the so-called "weak form"), in which the "information" is only the history of the price itself, can be stated quite simply as:

$$E(P_{t+j} | P_t, P_{t-1}, P_{t-2}, \ldots) = E(P_{t+j} | P_t) \quad (1)$$

Equation (1) states that the mathematical expectations (denoted by E) of the price (P) to prevail j periods hence, P_{t+j}, given our knowledge of the current price and the previous history of this price, is precisely equal to the expected value of the price j periods hence given only the knowledge of the current price. In other words, knowledge of past prices is irrelevant. Alternative definitions of market efficiency differ primarily by extending the range of information upon which the expectation of the future price in (1) is made conditional. In addition, a more concrete notion of market efficiency would suggest that the probability density function of the future security price, given the market's set of information, is equal to the true density function of the future price given the available information.

The efficient market theory, however, says more than (1). Let us define the information available to the market at time t as Z_t. Then, if the market is efficient,

$$E(P^*_{t+j} | Z_t) = P_t \quad (2)$$

where the * denotes that the future price is a random variable; that is, not known with certainty. If we define the change in the future price from time t, we have

$$\Delta P^*_{t+j} \equiv P^*_{t+j} - P_t \quad (3)$$

From (2) and (3) it is clear that the expected price change, given the information available, Z_t, is equal to zero,

$$E(\Delta P^*_{t+j} | Z_t) = 0 \quad (4)$$

While the above concepts of market efficiency may appear somewhat esoteric, they are important concepts for enhancing our general understanding of financial markets. Equation (2), for example, states that in an efficient market the current price is an unbiased estimate of the future price. It also implies that successive changes in the price of the security ought to be uncorrelated, that is, statistically unrelated. Indeed, a wealth of information on stock-market prices indicates that the equity market is efficient under these definitions. In recent years, a number of non-technical publications have stressed this notion that prices in the stock market follow a "random walk;" that is, successive price changes are independent.[8] Although this concept is not formally equivalent to the statement that the stock market is an efficient market, it says something very similar. The general point is the same—the market incorporates price information in such a manner that one cannot exploit this information in a systematic fashion to make a profit.[9]

Data Sources

Yield data for Aaa and Baa corporate bonds and the long-term U.S. Government bonds were obtained from the Federal Reserve *Bulletin, Banking and Monetary Statistics,* and the *Supplement to Banking and Monetary Statistics* (Money Rates and Security Markets). All are Federal Reserve publications.

Data on municipal yields were obtained from Moody's Municipal and Government Manual.

Equity Shares and the Financial Markets

Herbert Runyon*

The renascence of the stock market has been one of the more newsworthy aspects of the 1975-76 economic recovery. This spring, after a suitable period of suspense, the closely watched Dow Jones Industrial Average broke through the four-digit barrier which had not been broached since the January 1973 peak. Stock prices surged ahead on a rising volume of transactions. The recovery of economic activity promised a higher stream of future profits, and the price/earnings ratio—a barometer of the state of investor expectations—made at least a partial recovery from its 1974 trough.

Another important development has been the upswing in the issuance of new equity shares, amidst the hospitable environment created by rising prices and heightened investor expectations. Corporations have attempted to maximize the amount of new capital at their command without unduly diluting the earnings of shares already outstanding. Small firms, with a limited ability to raise new capital, have gone "public" and sold shares of ownership to investors. In 1975, nearly 25 percent of total long-term financing raised in the capital markets was secured in the equities markets. Yet, despite the recent increase, equity financing in the last two decades has remained a relatively minor source of new corporate financing, generally averaging about 10 percent of the funds raised in the financial markets.

In fact, over the past two decades, corporations have frequently been forced to go to market with new shares at unfavorable times. This reflects the fact that equity is only part of the capital structure of corporations. Corporate balance sheets have been transformed since the mid-1950's, with corporations making extensive use of the debt markets to modify the composition of their capital base, despite the rising cost of such funds. On the surface, this situation might seem difficult to explain. However, a more thorough examination suggests that there are sound economic explanations of the changes occurring in corporate balance sheets over the past 20 years. Both the shift to debt of earlier years and the recent corporate response to rising inflation can be viewed as a matter of corporate treasurers trying to find the best mix of equity and debt in response to changing conditions.

Our examination of this subject gives rise to three basic questions. First, has a shift actually occurred in the composition of corporate capital structures? Second, how vulnerable have leveraged corporations become to the inflation of the 1970's and to the longer-term changes in the tax structure? Finally, to what extent did the necessity for selling equity into a rather unfavorable market spring from the need to lessen the exposure of leveraged corporations?

Changes in the corporate capital structure follow a clearly discernible sequence. An increase in corporate debt, relative to equity, results in higher leverage. The higher leverage has a two-fold effect; it leads first to an increase in profits available to stockholders, but at the same time, it increases the risks inherent in a greater dependence upon debt financing. The resulting increase in risk may lead corporate treasurers to sell more equity relative to debt, leading to a decline in the leverage of the corporate capital structure. In essence, this is just

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what has happened over the past 20 years, as this paper shows by its analysis of the changes in capital structure and their impact on the capital market.

Factors affecting return to equity

In a pioneering work, Franco Modigliani and Merton Miller demonstrated that, under certain conditions, the market value of a corporation—outstanding equity plus debt—is independent of its capital structure.[1] Given this premise, the introduction of debt into the capital structure of a firm increases the expected rate of return on a share of stock by an amount equal to the spread between the expected rate of return and the interest rate on bonds times the debt to equity ratio (i.e., leverage).

$$(1) \qquad i = P + (P - r)\frac{D}{E}$$

where: i = expected rate of return on the equity to the firm.

P = internal rate of return for the firm. (Firms have differing risk characteristics and appropriate P's will thus vary from firm to firm.)

r = rate of interest payable on the firm's outstanding bonds.

D=value of the firm's outstanding debt.

E = value of the firm's outstanding stock.

This formula says that the return on equity, i, depends upon the internal rate of return plus the spread between P and the market rate of interest *and* the capital structure of the firm (D/E, the ratio of outstanding debt to equity). If the risk associated with the stream of income is low, the firm can increase its expected rate of return by issuing debt. The price that the firm must pay is the increased risk on its return, because the reduced share of equity in total capital must bear all of the risk inherent in the profits stream.[2] For the individual corporation, investment will be expanded as long as P exceeds the market rate of interest. The limiting case for all firms is i=r. At this point, the expected return on assets (i) is equal to the market rate of interest (r), and firms will cease borrowing.

Equation 1 only holds in a situation where there is no direct income tax, and must be modified to be applicable to the U.S. Where corporate-bond interest payments are deductible from corporate income, we have the following:

$$(2) \qquad \pi_t = (X - rD(1 - t)$$

where: X = total income, including the return to debt generated by the firm

t = corporate income-tax rate

π = net income available for common stockholders

rD = cost of debt service (interest rate times outstanding debt)

Equations (1) and (2) contain all three of the elements which have contributed to the change in corporate balance-sheets over the past two decades.

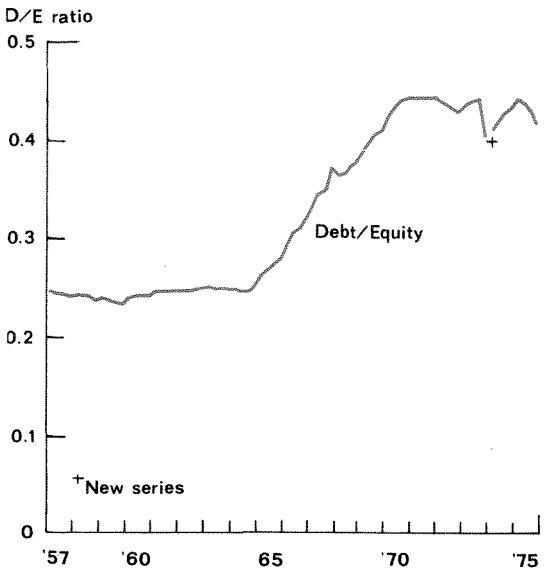
The first element is leverage, or the ratio of debt to equity. If the return on a firm's total assets consistently exceeds the market rate of interest, the firm has an incentive to borrow in the market, thus increasing the return to equity. The second factor is the corporate tax rate and the deductibility of bond interest. To the extent that bond interest payments are a deductible business expense, the government assumes a part of the risk of borrowing to increase investment. Government risk sharing does not decrease total risk taking in the economy; this will normally increase in response to corporate taxes as companies move to a riskier but higher-yield leverage position in order to get back part of the income government has taxed away.[3]

The last element in the picture is the interest rate. The high market rates at which corporations have had to borrow in recent years have made debt a relatively less attractive source of new funds, and have reduced the prospects of increasing the returns to equity through raising the leverage of the capital structure.

Benefits of leverage

The role of leverage in the composition of corporate capital structures has been argued for years, and cannot yet be said to be resolved to anyone's complete satisfaction. At one end of the spectrum, Modigliani and Miller argue that

Chart 1
Capital Structure of Manufacturing Corporations



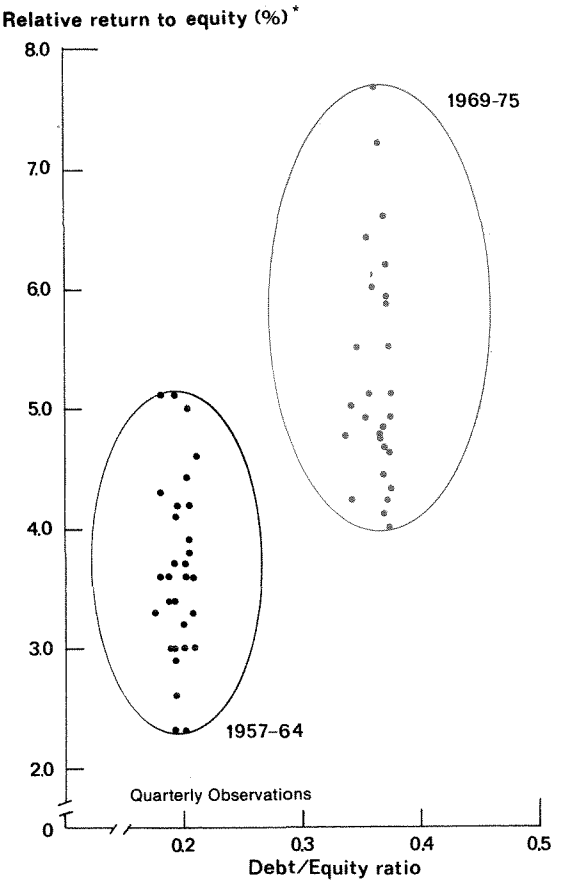
the average cost of capital is completely independent of the degree of leverage.[4] Ezra Solomon expresses the more traditional view, wherein increased leverage affects market value because total earnings rise relative to the increased use of debt capital, causing lower costs.[5] However, all agree that, although leverage may be safely increased within a certain range, further increases will adversely affect equity earnings.[6]

Whatever their reasoning, corporation treasurers began to alter the debt-equity mix of their capital portfolios in the mid 1960's (Chart 1). The relative costs of alternative sources of capital funds was an incidental but by no means negligible consideration in the determination of the capital structure, but the ultimate objective of the shift was to expand the share of earnings accruing to the firm's common-stock holders.

The experience of the 1957-65 period illustrates in vivid detail the advantages of debt financing to increase the leverage of the corporate capital structure. Within rather narrow limits, the debt/equity ratio (i.e., leverage) of a selected group of corporations remained near 25 percent throughout the 1957-64 period, fluctuated for several years, and then stabilized near 44 percent throughout the 1969-75 period.[7] The stability maintained during the 1957-69 period, and again during the 1969-75 period, strongly suggests that corporations desired the particular capital structure existing during each of those periods.

The purpose of increasing leverage is to increase the return to common stockholders. By introducing relatively more debt into the capital structure and increasing the debt/equity ratio, corporate treasurers seek to increase the return on total assets to improve their return to equity. Chart 2 describes the relation between the spread in the return to equity and the return on assets for the two periods of relatively stable leverage. Although there is a certain amount of

Chart 2
Leverage and Earnings



*Spread between return on equity and return on assets.

overlap in the yield spread in the two sets of observations, this could be expected in view of the highly cyclical nature of the return to equity.

The change in the composition of the corporate capital structure that took place between 1957-64 and 1969-75 resulted in a distinct upward shift in the return to shareholders. With a greater proportion of debt included in the capital base, the spread rose from a range of about 2½ to 5 percent to a range of 4 to 7½ percent. This finding supports the first premise of this paper; viz., corporate treasurers changed the composition of the corporate capital structure in a successful effort to improve the earnings of common stockholders.

Sources of corporate funds

Corporations thus can be seen as altering their leverage positions by changing the proportion of equity and debt funds in response to a given capital need. But as all corporate treasurers know, other financing sources are also important. Indeed, internal sources of funds—also known as cash flow—are the mainstay of corporate capital funds for investment. In the main, these consist of undistributed profits after taxes (i.e., retained earnings) and capital-consumption allowances (i.e., depreciation). Depreciation simply provides funds for the replacement of existing capital as it wears out or becomes obsolete; therefore, depreciation does not provide for net capital expansion.

From 1957 through 1964, internally generated funds supplied most of the nation's capital-expenditure requirements. However, the situa-

Table 1

Sources of Nonfinancial Corporate Financing
1957 — 1975
($ billion)

	Gross Internal Funds	Retained Earnings	Net Funds Raised in Financial Markets*	Internal Funds as Percent of Capital Expenditures
1957	30.6	10.6	11.9	89.1
1958	29.5	7.3	11.7	109.6
1959	35.0	11.6	20.1	95.7
1960	34.4	9.0	12.8	89.3
1961	35.6	9.0	18.8	98.3
1962	41.8	11.1	17.2	95.9
1963	43.9	12.0	21.6	97.2
1964	50.5	16.5	22.2	98.1
1965	56.6	21.3	34.8	91.0
1966	61.2	23.0	36.3	80.1
1967	61.5	19.0	32.5	86.1
1968	61.7	17.5	51.9	82.4
1969	60.7	13.6	57.4	72.6
1970	59.5	8.3	44.1	70.7
1971	68.0	13.3	52.4	78.0
1972	78.7	20.7	69.3	76.9
1973	84.6	31.0	91.6	69.9
1974	81.5	33.5	101.8	64.7
1975	103.9	27.7	40.1	108.1

*Includes equity sales
Source: Federal Reserve Board of Governors

tion changed markedly by 1970, when funds raised in the financial markets were more than five times the amount of new equity generated by retained earnings. This situation reflected a sharp fall-off in retained earnings, which came about because of both the Viet Nam tax increase and the post-1966 profits decline. In the first period of observations (1957-64), retained earnings averaged nearly two-thirds of the average net volume of funds raised externally in the financial markets. In contrast, in the period 1969-75, the situation was dramatically reversed and retained earnings amounted to only one-quarter of externally-generated funds.

Questions arise also about internally generated funds as a source of equity. Although retained earnings may remain in the corporation's possession, this only means that stockholders are content to settle for the prospect of future capital gains as opposed to present income in the form of paid-out dividends. Retained earnings are a highly erratic source of investment funds, subject as they are to unexpected movements in both gross earnings and corporate taxes (Chart 3). In addition, retained earnings are the buffer between net profits after tax and net dividends paid, and corporate policymakers traditionally try to stabilize dividend payments, holding them steady when profits fall off and increasing them less rapidly when profits are on the rise.

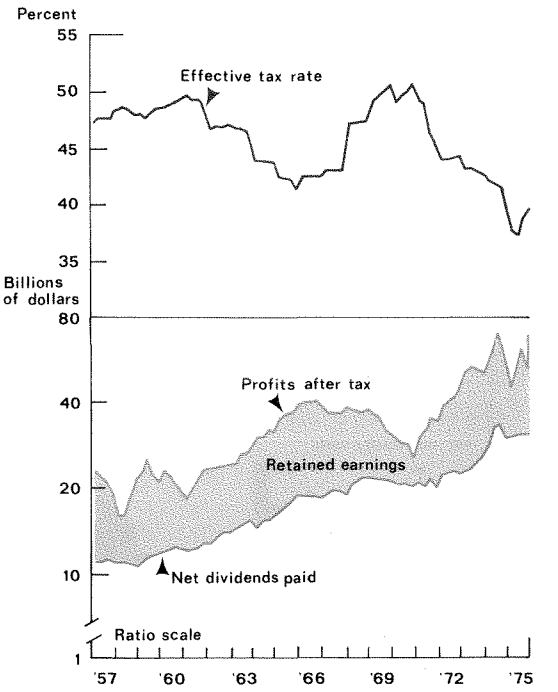
On the surface, it would appear that retained earnings are a cheap source of funds to corporate treasurers. However, a number of studies have shown that the cost of retained earnings, from the shareholder's point of view, is in the neighborhood of 10 percent.[8] Retained earnings are subject to two sets of taxes affecting stockholders—the corporate income tax and the capital gains tax—and IRS data on these tax categories (Statistics of Income for 1972) indicate the validity of this 10-percent estimate. Also, transaction costs must be incurred if the stockholder should wish to realize a capital gain by selling his stock.[9]

Stock prices and equity sales

If shares of common stock were to be viewed in the general context of the usual market for commodities, a high or rising price should elicit a greater volume of the good in question. However, financial markets are not quite the same as the markets for shoes and ships and sealing wax. Common stocks gain their value from expectations of the future stream of earnings that may accrue from ownership in the corporation. If expectations are favorable for a corporation's future earning power, this will be reflected in the market price of its shares.

The relative desirability of a corporation's shares may be gauged by comparing its price/earnings ratio with that of other firms. This ratio, known as the "multiple," embodies the stock's current market price and the firm's current earnings. The value of the stock to the rational investor is the discounted value of the stream of future earnings that the stock is expected to generate. But to paraphrase Keynes, the actual price is likely to be closer to the expectations generated by what the "rational" investor perceives to be the expectations of other rational investors.

Chart 3
Profits, Retained Earnings and the Corporate Tax Rate

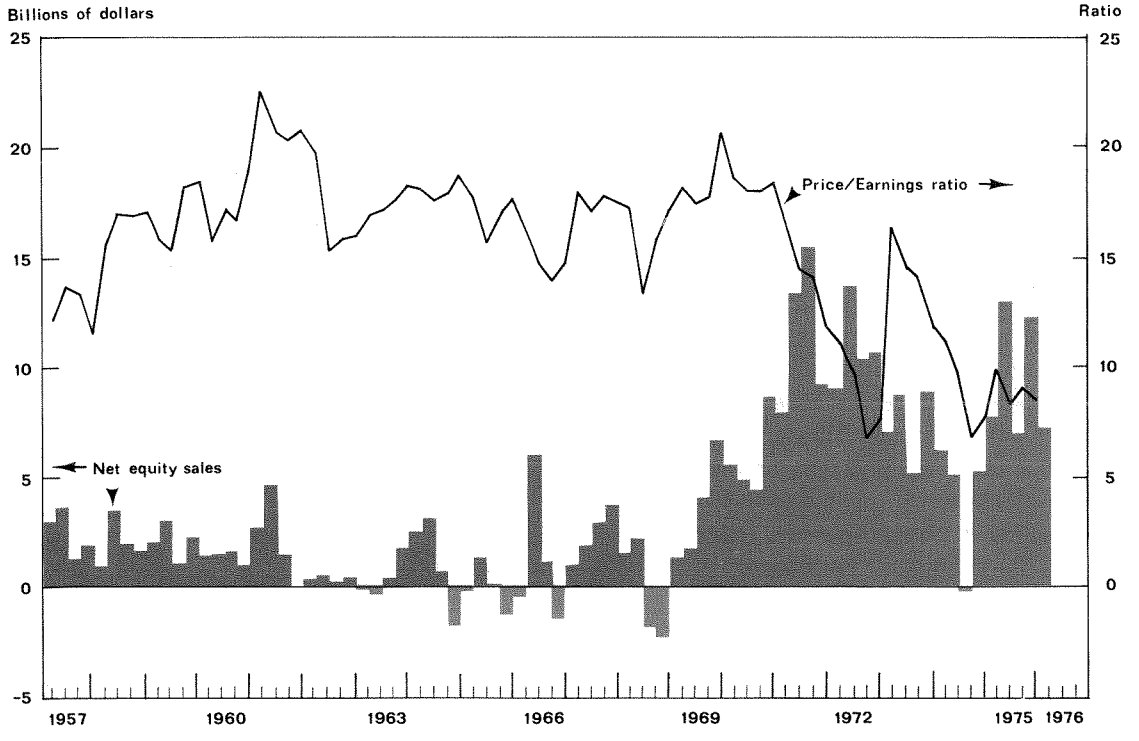


Another peculiarity of the stock market is that it is essentially a secondhand market. Stocks which have traded in the market for some time are a more-or-less known quantity (i.e., "seasoned") and unlike used cars, may command a premium over new issues just entering the market. A prevailing high price/earning ratio for the market in general would seem to create a hospitable environment for the sale of new equity shares. However, precisely the reverse has been true over much of the past two decades (Chart 4).

The combined price/earnings ratio of the 500 stocks in the Standard and Poor's industrial index averaged above 16 throughout the 1958-70 period, and during most of that time, the demands upon the equity market were fairly modest. During 1957-64, nonfinancial corporations were consistent (if small) net sellers of equity, averaging $2-3 billion per year. In the mid- and late-1960's they retired outstanding stock almost as often as they sold it. But then, in the first half of the 1970's, these corporations paradoxically became substantial net sellers of equity, selling new issues in the face of a price/earnings ratio that averaged about 11 and which dipped below 7 on occasion (Chart 4). In other words, corporations were reluctant to sell equity in a period of relatively high stock prices, and then turned around and marketed shares in a period of far less favorable prices.

All of this suggests that market conditions may be only a secondary factor in the decision to sell stock. Corporate treasurers stayed on the sidelines during the long period of rising stock prices, and then entered the market in the 1970's when it was much less amenable to new issues. This can be explained in terms of the desire of financial managers either to reduce the degree of leverage or, alternatively, to maintain a given leverage position but with the substitution of retained-earnings equity for market-raised equity. (The first explanation accords with a wish to reduce leverage in an increasingly risky world.) The steadiness of the leverage ratio in the 1969-75 period noted in Chart 1

Chart 4
Stock Prices and Net Equity Sales for Nonfinancial Corporations



suggests that corporate treasurers now wish only to maintain their current leverage position.

Limits of leverage

The higher rate of return on a leveraged capital structure carries with it a greater degree of risk as the costs of debt service rise relative to income. This is true in a period of price inflation, and doubly true in a recession when pre-tax profits fall. Dividend payments upon common stock may need to be trimmed or eliminated if the profitability of a firm worsens. But since interest payments are not postponable without a threat of default, the leveraged firm in this case faces more risk than the firm capitalized with equity. Thus, it should be expected that as firms come to rely more heavily upon debt as a source of capital funds, their vulnerability to fluctuations in profits and interest rates would increase accordingly.

The relationship of changes in the leverage ratio of manufacturing corporations to their interest-payment burden is described in Chart 5.[10] Here, as in Chart 2, there is a bifurcation of observations, with 1957-64 observations clustering around a debt/equity ratio of 25 percent and 1969 - 75 observations clustering around a ratio of 44 percent, with the schedule shifting upward and to the right. During the latter period, corporations' increased reliance upon debt in their capital structure increased their possible exposure, and their high debt/equity ratio served as an effective ceiling for leverage. In 1970, when the debt-equity ratio reached 44 percent, interest costs assumed a much larger claim upon corporate revenues, and net equity sales showed a significant increase.

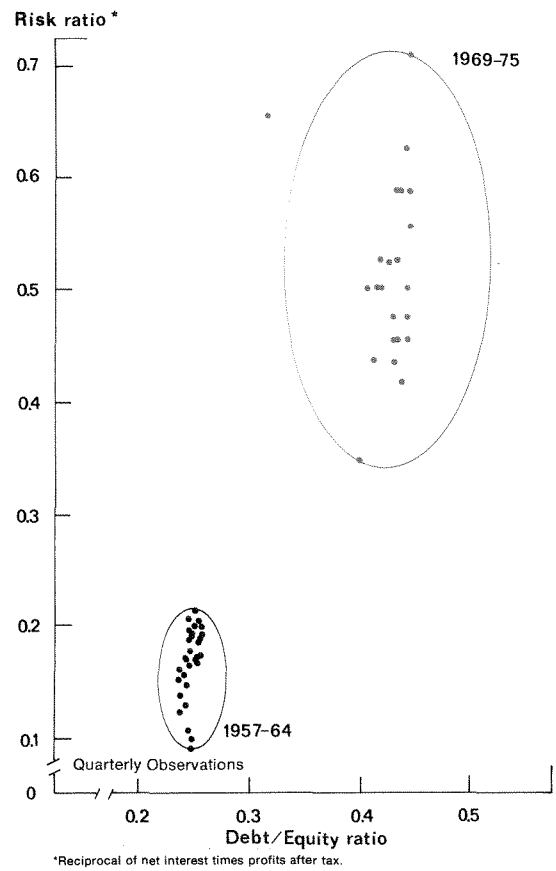
The close clustering of observations around the low (25 percent) and high (44 percent) debt/equity ratios helps illustrate the trade-off between risk and earnings that was implicit in the shift in corporate leverage between the two periods studied (Chart 6). In this comparison, the spread between return on equity and assets after taxes is used as a measure of equity earnings, and the net interest cover is used as a surrogate for risk, with a diminishing coverage corresponding to an increasing degree of risk.

Taxes, markets and risk assumption

Several sets of factors influenced the sources of corporate financing over the past two decades, the first of these being changes in the corporate income tax. The average or effective corporate tax rate varied substantially—from 50 to 37 percent—because of the institution (and suspension) of the investment tax credit, as well as changes in depreciation accounting and in tax-rate structure. These shifts had the direct effect of increasing or constricting the flow of retained earnings, depending upon the direction of the tax rate.

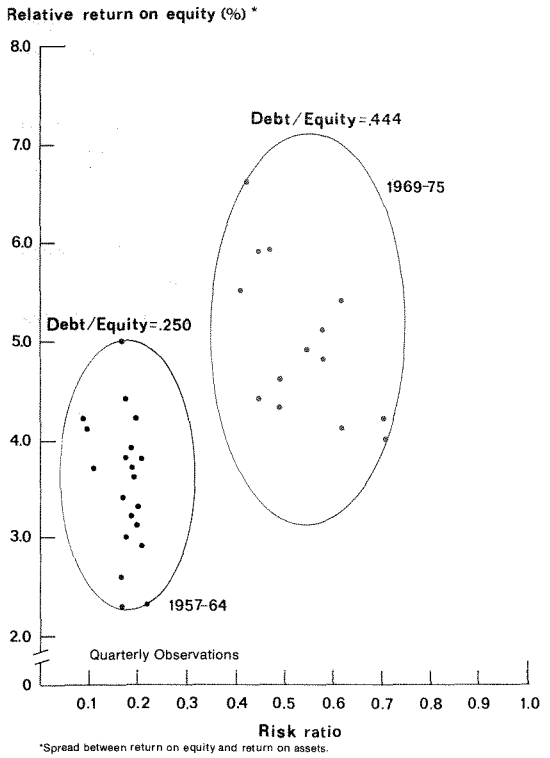
The tax rate thus represents another influence on the cost of funds raised by credit-market borrowing. Since interest costs are fully deductible for tax purposes, changes in the corporate tax rate directly affect the costs of borrowing. A high tax rate tends to insulate the firm from

Chart 5
Leverage and Risk



*Reciprocal of net interest times profits after tax.

Chart 6
Change in the Terms of the Earnings-Risk Tradeoff



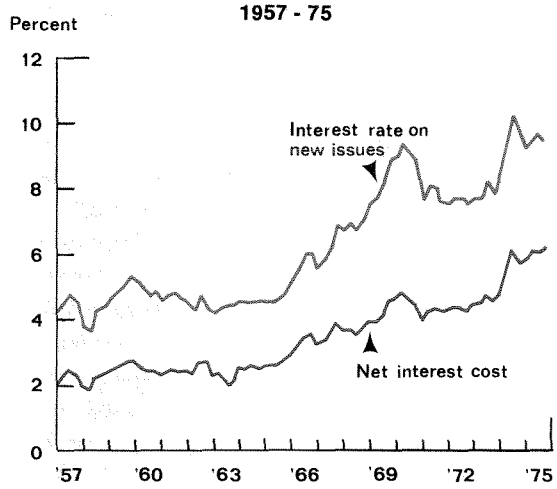
market interest costs, because the government assumes a share of the borrower's risk to the extent of the amount of interest deducted. Conversely, a lower tax rate increases the net burden of interest costs to the corporation—as was seen in 1974-75, when net interest costs continued to rise in the face of falling market interest rates (Chart 7).

Corporate borrowers are also affected by inflation, through its impact upon the long-term interest rate. The long rate was remarkably constant, around 4½ percent, in the first half of the 1960's, when the inflation rate fluctuated around a base rate of about 1½ percent. But then as inflation increased, long-term interest rates increased, and corporate net interest costs also started to rise. Thus, throughout this decade of large net borrowing by corporations, the actual terms of borrowing were working against them with respect to the interest burden.

The decline in the effective corporate income tax over the past two decades has, on the whole, favored equity financing—chiefly through retained earnings—over credit-market borrowing. This has been accomplished through a redistribution of the risks related to capital expansion based upon borrowed funds. Let us say that a corporation is indifferent to the tax rate when considering the risk of credit-market borrowing. If the tax rate is high and bond interest is deductible, the government essentially underwrites a part of the firm's interest cost and shoulders a corresponding part of its risk. As the tax rate falls, the corporation's net interest cost rises and the federal share correspondingly declines.

As long as interest expense is fully deductible as a cost of doing business, the corporation income tax will have a differential impact upon equity and debt financing. However, a declining tax rate tends to favor equity financing, because it forces the corporation to absorb a proportionately greater part of the total interest cost. As the debt/equity ratio rises—and the corporation becomes more highly leveraged—the interest burden becomes a much more critical consideration, especially during a period of inflation and rising market interest rates. It should also be noted, however, that the costs of capital—whether equity or debt—both rose in this period as stock prices fell and the terms of borrowing grew more onerous. Whether corporations sought to reduce leverage or to replace the

Chart 7
Corporate Bond Yields and Net Interest Cost
1957 - 75



diminished internal flow of equity, the result was the same: they sold more equity into the financial markets.

Conclusion

Corporate behavior over the past two decades with respect to equity sales is readily explainable in terms of the institutional structure within which financial markets function. As a group, manufacturing corporations followed a fairly conservative capital-financing program from the mid-1950's through the mid-1960's. At that point, however, they began to expand the debt in their balance sheets in an attempt to realize their full profit-maximization potential on equity shares. For a while they were successful, widening the spread between the return on equity and the return on assets. This was altogether in tune with the temper of the Sixties, when performance was the name of the game and the bottom line took precedence.

Manufacturing corporations, like other firms, faced a more difficult situation in the 1970's. The combination of inflation (with higher interest rates) and declining effective tax rates increased the exposure of highly leveraged firms to both higher market interest rates and cyclical fluctuations in earnings. And these corporations reacted to their problems in the manner we have seen in recent years.

All these changes in corporate financing have demonstrated in rather dramatic fashion both the positive and negative aspects of financial leverage. The events of the past several years have probably given many painful moments to corporate treasurers. Given a world of increased risks, less leverage may be well advised. Still, the retreat from the high leverage ratios of 1970 could be rather limited. There are still advantages to be realized if the yield on the total capital base exceeds the cost of borrowed funds. The breadth and complexity of financial markets and the experience and imagination of corporate financial officers have increased apace. However, corporations in the years ahead will probably meet their capital requirements in a more balanced fashion than they have recently, drawing on both the equity and debt markets as they keep in mind the main lesson of the 1970's —leverage can cut both ways.

FOOTNOTES

1. Franco Modigliani and Merton H. Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," **American Economic Review,** June 1968, p. 267, ff.

2. As long as relatively safe investments are available, the firm will not be pressed by this limit because the proceeds of a financing can be used to lower the firm's intrinsic risk. This process—the firm's deliberate mixing of safe and risky investments—is logically no different from issuing "negative" debt. The only limit on this process is that debt cannot be less than zero, so that a firm with risky profits cannot, under equation 1, reduce the risk exposure of its earnings.

3. For a recent discussion of this point, see Richard A. Musgrave and Peggy B. Musgrave, **Public Finance in Theory and Practice,** second edition (New York: McGraw Hill, 1976), p. 307.

4. Modigliani and Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," **op.cit.,** pp. 281-282.

5. Ezra Solomon, **The Theory of Financial Management,** (New York: Columbia University Press, 1963), p. 94.

6. **Ibid.,** Modigliani and Miller, **op.cit.,** p. 275. The location of such a point of leverage is proximate rather than precise. Modigliani and Miller, after testing the effect of leverage on common stock yields for electric utilities and oil companies, concluded that the results appeared to support their theoretical construct, but that the empirical evidence was not conclusive. **Ibid,** pp. 284-287.

7. The debt/equity ratios used in Chart 1 and thereafter are for manufacturing corporations as reported in the Federal Trade Commissions' **Quarterly Financial Report.** The financial information for this group of corporations is presented in balance-sheet and income-statement form, with equity and debt shown on the basis of book value rather than market value. The ratios are presented in the QFC as equity/debt but are transposed to accord with the more usual definition of leverage.

8. Martin J. Bailey, "Capital Gains and Income Taxation," **Taxations of Income from Capital,** M. J. Bailey and A. C. Harberger (Washington, D.C. Brookings Institution, 1969), pp. 11-49.

9. William J. Baumol and Burton G. Malkiel, "The Firms' Optimal Debt-Equity Combinations and the Cost of Capital," **The Quarterly Journal of Economics,** November 1967, pp. 565-566.

10. The ratio of after-tax profits to interest for nonfinancial corporations is used here as a measure of the relative burden of debt service. This ratio is quite different from the usual accounting ratio, which measures before tax profits plus interest payments divided by interest payment. Because of data deficiencies, it was not possible to obtain both gross earnings and interest payments for manufacturing firms. The "times interest" ratios on an after-tax basis are much lower than on a pre-tax basis. For example, a times-interest coverage of 1.0 on a pre-tax basis indicates that the firm is insolvent, since gross earnings are zero. On an after-tax basis, a ratio of 1.0 is roughly equivalent to a ratio of 3.0 on a pre-tax basis, assuming a corporate tax rate of 50 percent, since interest payments and taxes have been deducted from gross earnings. In order to make a lower interest cover correspond to higher risk, the reciprocal of after tax times-interest is used, scaled from 0.1 to 1.0.

Has the Money-GNP Relationship Fallen Apart?

Rose McElhattan*

During the first year of the current economic recovery (1975.1-1976.1), the nation's gross national product, in nominal terms, increased by 13 percent. This rapid rate of economic expansion occurred along with relative ease in financial markets; interest rates were lower in the first quarter of 1976 than when the expansion began in 1975. Surprisingly, however, the growth in the economy and the decline in interest rates have been accomplished with a relatively moderate rate of growth in the money supply.

The actual M_1 rate of growth was 5.1 percent from 1975.1 to 1976.1[1]—about half the rate which standard money demand models estimate as necessary to support the observed income growth and decline in interest rates. This overprediction of money demand constitutes an unusually large forecast error, since standard money demand functions (which relate the public's demand for money balances to the level of GNP and interest rates) generally have performed well in estimating the growth in money.[2] However, beginning with the third quarter of 1974, these equations began overestimating the public's demand for money by relatively large and increasing amounts.

The demand for money is an important component in the final relationship between money and GNP. Changes in money have had fairly predictable, although not exact, effects over time on the gross national product.[3] Because of this relationship, the money stock has become a significant variable in economic analysis. The central bank, in turn, has a degree of control over the stock of money, making it an important Federal Reserve policy variable. The recent large forecast errors in the estimated demand for money suggest a deterioration in the ability of policymakers to predict the impact of changes in money upon economic activity. This in turn suggests that less emphasis should be placed upon the money supply as a guide in the conduct of monetary policy. This paper attempts to determine how much M_1 has deteriorated as an indicator of movements in GNP since the recent appearance of large errors in money demand.

Utilizing a version of the MPS model (Massachusetts Institute of Technology-University of Pennsylvania-Social Science Research Council),[4] we conclude that there has been no material deterioration in the overall relationship between money and GNP since mid-1974, relative to what would be expected from past experience. The money supply (M_1) remains as useful an indicator of overall economic activity as it has been in the past.

In the next section, we indicate the forecast errors in the money demand equation included in the MPS model and, using the familiar LM-IS diagram, illustrate the policy question raised by the recent shifts (i.e., forecast errors) in estimated money demand functions. Following that, we analyze GNP forecast errors generated by the MPS model and attempt to interpret recent velocity movements.

Forecast errors in money demand

Since 1974.3, money demand equations have shown large forecast errors, with forecasted money holdings by the private sector exceeding actual money (M_1) balances. A conventional relation which illustrates the nature of these

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errors is included in the MPS model. This model uses two equations to forecast money (M_1) demand—one for the demand for currency and one for the demand for demand deposits. The currency equation has performed well since mid-1974; the errors are relatively small and within the range of past experience for this equation. The demand deposit equation, on the other hand, has overestimated the public's demand for demand deposits and by relatively large amounts. This equation (Appendix A) is the major source of error in the prediction of M_1.

In four of the six quarters from 1974.3 to 1975.4, the error in the demand deposit equation was outside the range of past experience (Chart 1A and B, Table 1).[5] The largest error prior to mid-1974 was $4.7 billion in 1972.2. By 1974.4, however, demand deposits were over-estimated by $6.7 billion and the error reached $19.9 billion in 1975.4.

These estimates and the MPS model equations are based upon National Income and Product Accounts (NIPA) data for which information is available only through 1975.4. Consequently, we cannot extend the MPS model estimates beyond the end of last year—but we are able to estimate a standard-type money demand equation using newly revised NIPA data. This differs from the MPS model specification in Appendix A in only a minor way: the discount rate is deleted and the commercial-bank passbook rate is used instead of the weighted time-and-savings deposit rate. These minor changes do not alter the error pattern shown above.

The demand deposit equation estimated with the revised NIPA data displays the same problematic errors as the MPS equation, with errors increasing after 1974.3 and sharply accelerating in the last half of 1975. However, the magnitude of the errors then appears to stabilize, at

MPS Model Demand Deposit Equation

Chart 1A

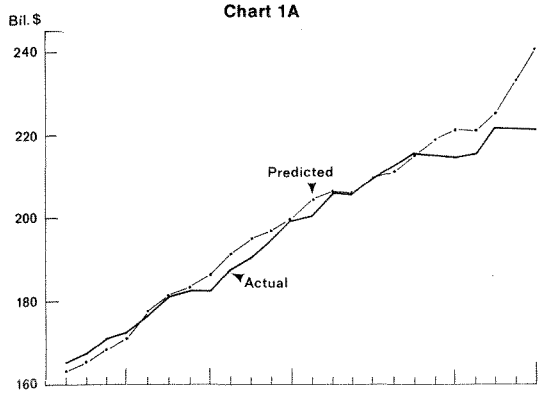
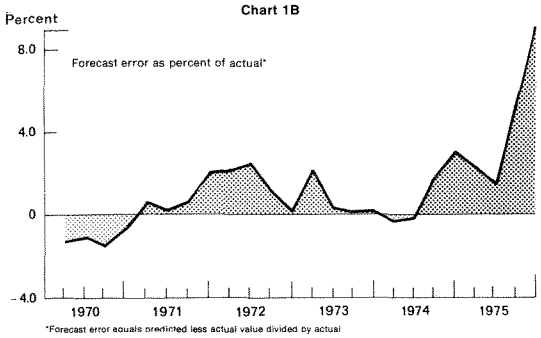


Chart 1B



*Forecast error equals predicted less actual value divided by actual

TABLE 1

Quarter	Forecast Error in billions $	Forecast Error as Percent of Actual Level
1970.1	–2.1	–1.3
.2	–1.8	–1.1
.3	–2.6	–1.5
.4	–1.3	– .7
1971.1	1.1	.6
.2	0.3	.2
.3	1.2	.6
.4	3.8	2.1
1972.1	4.1	2.2
.2	4.7	2.5
.3	2.2	1.1
.4	0.4	.2
1973.1	4.4	2.2
.2	0.5	.2
.3	0.3	.1
.4	0.3	.1
1974.1	–0.6	– .3
.2	–0.3	– .1
.3	4.2	1.9
.4	6.7	3.1
1975.1	5.1	2.4
.2	3.5	1.6
.3	11.7	5.3
.4	19.9	9.0

about $20 billion in each quarter from 1975.4 to 1976.2.

These relatively large forecast errors have led to questions regarding the stability of the public's demand for money—and even more importantly, to questions regarding the stability in the relationship between money and income. Specifically, do forecast errors in the demand for money indicate a change from past experience in the relationship between changes in money and changes in income? The question can be illustrated in terms of the familiar LM-IS diagram.

Large econometric models, such as the MPS model, can be thought of in terms of their two major economic markets—that for goods-and-services and that for money.[6] The IS function represents the equilibrium condition in the goods-and-services market. It provides the combination of all income levels and interest rates for which intended saving plus taxes are equal to investment plus government expenditures. The LM function represents the equilibrium condition in the money market. On the assumption of a given stock of money, it provides the combination of all income levels and interest rates for which the demand for money is equal to this supply. The equilibrium condition in the two markets is stated as a function of two variables—the rate of interest and the level of income.

In Diagram 1, the intersection of the LM and IS curves represents a solution of the model which provides the forecasted value of GNP, Y_0. If the public wishes to hold smaller money balances at each level of income, the demand for money and the corresponding LM curve will shift downward (LM_1). The observed value of GNP will be Y_1 (the intersection of IS and LM_1) rather than the forecasted value, Y_0.

If the public's demand for money and the LM curve continually shift downward by substantial magnitudes, the model (which provides a forecast based upon IS and the "old" LM function) will underestimate GNP by increasing amounts. It is in this sense that instability (i.e., shifts) in the money demand equation will lead to instability in the overall relationship between money and GNP. The uncertainty surrounding the degree and cause of shifts in the public's demand for money translates into uncertainty about the impact which monetary changes will have upon aggregate economic activity.

However, it is unrealistic to assume that everything else remains unchanged when LM fluctuates. The demand functions for goods and services, such as inventory investment and consumption, are not exact; in terms of Diagram 1, we expect shifts in the IS function also. A degree of uncertainty surrounds economic relations in both markets, so that a forecast generally is associated with a probable error range. This range can be represented in an LM-IS framework. In Diagram 2, LM_1 and LM_2 represent the range of values within which actual future values may be observed in this money market; IS_1 and IS_2 incorporate the range for the goods-and-services market values. As before, the forecast value for GNP is represented as the solution of the model, Y_0. Y_1 and Y_2 represent the range within which the actual value may occur because the model's estimate may be in error. When we take into consideration the uncertainty surrounding future events,

Diagram 1

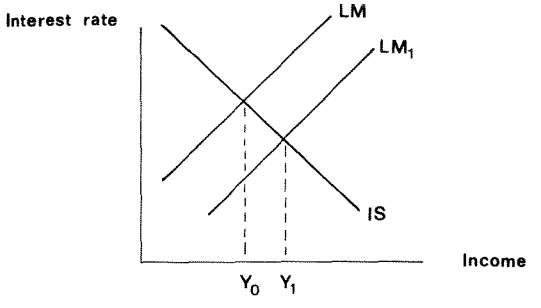
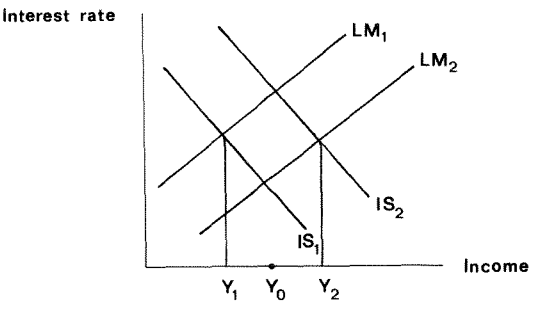


Diagram 2



the actual value of GNP could occur anywhere within the range Y_1-Y_2.

Diagram 2 illustrates that the forecast error in one equation—for example, the demand for money—may not throw the estimate of GNP outside the expected range when changes occur elsewhere, even when the forecast errors are very large. In other words, the overall net impact of unpredictable shifts in both the LM and IS sectors are important in the final determination of GNP. Despite the uncertainty surrounding the public's demand for money balances, we can determine empirically whether the overall relationship between money and GNP has changed from what past experience would lead us to expect.

Forecast errors in MPS model

The MPS model was designed to capture the channels through which monetary policy affects aggregate economic activity, as is described in a recent article by Albert Ando.[3] The forecast errors generated by the model should reveal any change in the ability of money to track GNP since large errors first occurred in money demand equations. The model was used to generate ex-post forecasts of GNP one to four quar-

TABLE 2

Nominal GNP Forecast Errors*
MPS Quarterly Model
No Correction for Serial Correlation
(in billions of dollars)

	Quarters Beyond Initial Conditions**			
Forecast of:	**1**	**2**	**3**	**4**
1970.1	1.8			
.2	–9.3	–8.2		
.3	–22.5	–15.4	–12.3	
.4	–20.4	–22.7	–11.8	–6.6
1971.1	–36.0	–33.2	–31.8	–17.8
.2	–24.1	–30.1	–22.5	–17.6
.3	–17.7	–16.6	–21.5	–10.1
.4	–23.6	–18.2	–19.5	–21.8
1972.1	–22.0	–16.2	–14.6	–14.9
.2	–16.0	–15.8	–6.3	–5.6
.3	–16.8	–9.7	–13.3	–2.2
.4	–14.1	–14.6	–8.5	–14.6
1973.1	–17.2	–15.9	–15.5	–10.9
.2	0.6	–12.7	–6.5	–7.7
.3	5.2	5.6	–2.5	3.5
.4	3.2	3.4	11.4	3.5
1974.1	3.4	15.3	18.1	24.6
.2	–26.0	–10.9	–1.0	1.2
.3	–30.9	–31.6	–15.1	–8.5
.4	–16.5	–16.8	–6.6	–6.5
1975.1	–17.2	1.1	17.2	28.7
.2	–4.6	6.1	22.7	40.6
.3	–47.4	–29.6	–18.4	–5.6

*Forecast error = Forecasted minus Actual.

**Quarters beyond initial conditions refers to the number of quarters after the initial conditions quarter on which the forecast was based. The first initial conditions quarter is 1969.4.

ters ahead from 1970.1 to 1975.3, the last quarter for which we have a consistent data bank.[7] Results of these simulations are presented in Table 2.[8]

These ex-post forecasts differ from the usual type of ex-ante forecasts in several important respects. First, all values of the exogenous variables are known and are set equal to their historical values. For the MPS model version we are using, this means that the forecasts use actual values for the money supply and such variables as federal government expenditures, tax rates, farm inventories, population measures, and exports.

Second, in our model simulations, we do not utilize information available from knowledge of previous behavioral equation errors. In an actual ex-ante forecast, the pattern of equation errors is projected forward if the errors appear systematic. Because this procedure is somewhat arbitrary, we have not used it here, and in fact have not used any information about past equation errors. All serial correlation terms have been removed from the behavioral equations.

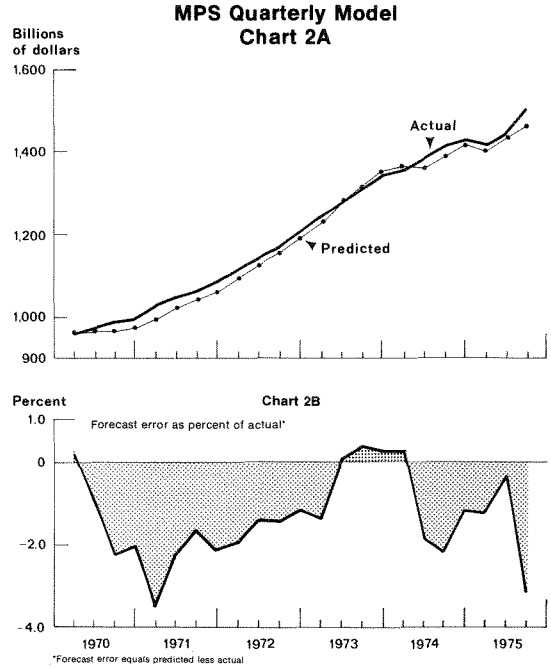
Third, we do not utilize the ex-ante forecast procedure, whereby knowledge of special factors not included in the model specification would be used to adjust the appropriate equations. For example, a labor strike which is expected in the forecast period would lead to some adjustment of the labor market equations, which of course are not structured to capture the impact of such events. This type of information, when used in an actual ex-ante forecast, can cut the model's errors substantially.

We do not utilize such model adjustments (with several exceptions noted below), because they contain an element of arbitrariness. We are interested in what the model's estimated structure has to say about the changing ability of money to predict total income in the recent period of money-demand overestimation. It is not our concern here to minimize model errors, but to observe and compare their size and pattern over time. Nevertheless, we have made several exceptions to take account of certain economic events which have directly affected the model's basic structure.

First, after the 1971 change in the international payments system, the model's import equations began to generate very large underestimates of imports. Second, the introduction of revenue sharing (which the model's state-and-local government expenditure equations could only treat as categorical grants) caused overestimates of state-and-local government expenditures. Third, major errors occurred because of the failure of the model's price equations to pass through price increases generated outside the domestic economy—such as those occurring in the wake of the dollar devaluations, OPEC oil price increases, and world crop shortages.

We adjusted for these factors by adding the residuals from the estimated behavioral equations into the model equations, using some judgment in adjusting for price increases. The adjusted equations for these variables then forecast historical values exactly when all the "right-hand" variables were known. In our dynamic simulations, errors in the adjusted equations result only from misestimates by other equations as they feed into the "corrected" equations. Thus the obvious misspecification in the foreign

Nominal GNP
MPS Quarterly Model
Chart 2A



and state-and-local government sectors is not allowed to bias the full model simulation results.

The forecast error for one-quarter out (column 1, Table 2) is shown in Graph 2B as a percentage of actual GNP. When shown in this form, the forecast errors remain within the range of the model's past experience throughout the period of large money-demand overforecasts. After declining from 1974.3 to 1975.2; the error increased in 1975.3 to 3.1 percent of GNP—understandably so, because quarters following a business-cycle trough are difficult periods to predict. Generally, however, these percentage errors do not reflect any marked deterioration in the money-income relation as structured in the MPS model after mid-1974. From 1974.3 to 1975.2, both the dollar level and the GNP percentage level of forecast errors are within the range of past observations (column 1, Table 2). It is interesting to note that the large $47.4-billion underforecast of GNP in 1975.3 occurred in the same quarter as the largest error in the demand-deposit estimate. But as noted above, this error is within the range of past model behavior when considered as a percentage of actual GNP.

It may be argued that changes in money have an impact upon GNP only after some delay, so that changes in money demand behavior should have little influence on aggregate demand until several quarters have passed. Thus, errors in the money demand equation may not show up immediately in the GNP forecasting model. Many studies indicate that between 25 and 40 percent of the response in nominal GNP to a change in money will occur within four quarters of a monetary change,[9] so we could expect a significant forecast error in GNP to appear about 4 quarters after the initial date (1974.3) of the large money demand errors. In other words, we should look at least three and four quarters ahead, in order to allow more time for a given change in money demand to influence GNP.

Only a limited number of such forecasts are available after 1974.3. The third quarter-out forecast errors for the first three quarters of 1975 are $17.2 billion, $22.7 billion and -$18.4 billion respectively. The four quarter-out forecast errors for 1975.2 and 1975.3 are $40.6 billion and -$5.6 billion. These forecast errors, with one exception, are within the range of error which the model has displayed since 1970. The size and pattern of these errors suggest no deterioration in the overall money-income relationship as structured in the MPS model. The one exception is the $40.6-billion overforecast of 1975.2, which results from the model's failure to capture the depth of the recent trough approximately one year before it occurred. However, this does not indicate a continuing forecasting failure, since the model was otherwise able to forecast within the range of past experience for all other forecast quarters since mid-1974.

We should emphasize that many of the errors in third and fourth quarter-out forecasts have the opposite sign from what the typical money demand-GNP model would suggest. Normally we would expect a decline in the demand for money to lead the model to underforecast GNP, and not the reverse. This point was demonstrated above in LM-IS Diagram 1. While the errors we have observed generally are within the expected historic range, the signs of many of the forecast errors are not consistent with the assumption that a downward shift in the money demand has dominated the money-income relationship.

In brief, no matter how uncertain money demand estimates have been since 1974.3, the money-income relation—as structured in the MPS model—does not appear to have gone off track because of shifts in money demand. In the one quarter in which the error was outside past experience, we observed a $40.6 billion overforecast of GNP. But we would have expected a negative forecast error, an underforecast of GNP, if downward shifts in money demand had dominated the money-income relationship.

A look at M_1 velocity

A key question is what has happened to the money-GNP relationship since 1975.3. The M_1 velocity series, the ratio of nominal GNP to the

money stock, provides some information regarding this matter. Current erratic movements in the velocity series could signal instability in the complicated economic process by which changes in money are related to current economic activity. In Michael Keran's words, "If we are entering a period of unpredictable movements in money turnover, it means increasingly unstable relationships between money and income due possibly to an increased instability in the demand for money."[10] But after looking at deviations from trend in the velocity data, Keran concluded that "velocity may not be too far out of line given the present stage of the business cycle. . . ."

The data in Chart 3 portray the typical cyclical pattern in M_1 velocity—growing below the trend rate in the downswing of a cycle and above it in the upswing. Recent velocity behavior follows that pattern. The past recession was particularly severe—the steepest decline since the late 1930's—and this was followed by the sharpest recovery of post-World War II history, with a 13-percent gain in nominal GNP from 1975.2 to 1976.2. Velocity mirrored these sharp GNP movements, growing slowly relative to trend during the recession and quite rapidly in the last half of 1975 (at about a 10-percent annual rate compared with a 3-percent trend rate). Thus, velocity was close to its long-run trend value by late 1975, and it has remained close to trend during the first half of 1976.

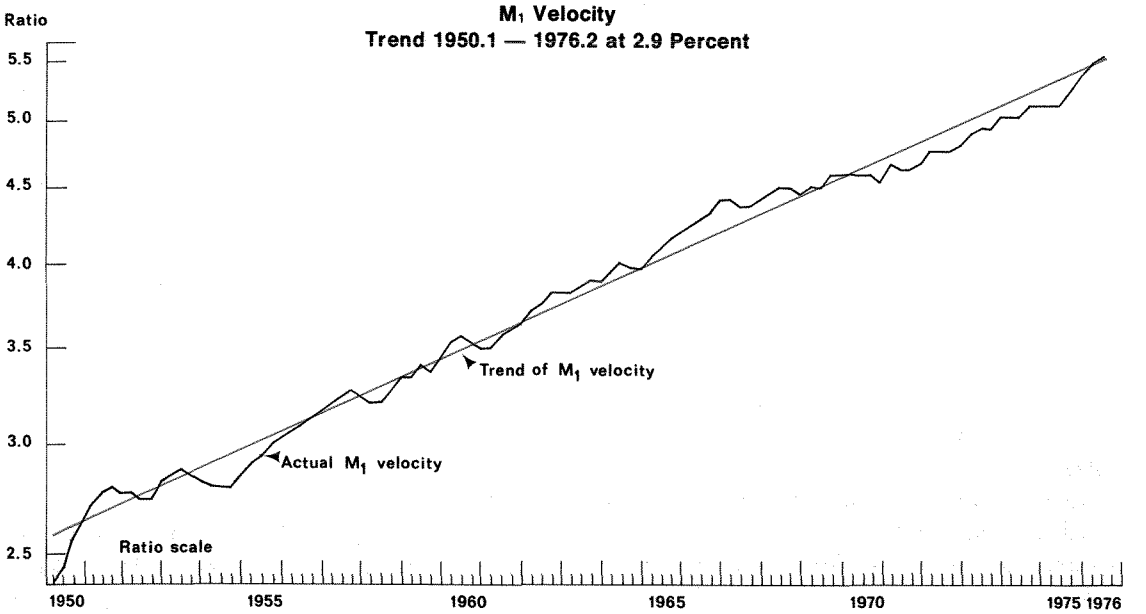
Despite the large shifts in velocity since 1974.3, the deviations from trend are within the range of past experience and are actually smaller than in some earlier periods, such as 1966-67. This suggests that a model relating movements in money to GNP should continue to be successful in its tracking abilities, as has been demonstrated by a small model developed at the Federal Reserve Bank of San Francisco.[11] The model's basic output equation relates movements in real money balances to real GNP. Its forecasting errors through 1975.4 indicate an ability to track GNP within an error range consistent with the equation's past performance.

In brief, the M_1 velocity series is not displaying atypical behavior. This suggests that the money-income relationship has remained stable after 1974.3, when increasingly large errors began to appear in money demand equations.

Summary and conclusions

Since mid-1974, economists have been bewildered by the large overforecasts of money growth which their standard money demand re-

Chart 3
M_1 Velocity
Trend 1950.1 — 1976.2 at 2.9 Percent



lationships have produced. Forecast money growth was about twice as great as actual money growth for the first year of the current recovery. These large forecasting errors have led to questions regarding the ability of standard models of the U.S. economy to forecast GNP. Econometric models of the U.S. economy link changes in a monetary aggregate to changes in overall economic activity. The demand for money is an important element in the transmission mechanism by which changes in money lead to changes in income.

In this paper we have focused upon an empirical study of the GNP forecast errors in one large quarterly econometric model. The forecast errors in GNP since mid-1974—the start of the large errors in money demand—were generally inside the range of forecast errors made by the model in the past. But since MPS data extend only through 1975.3, we have utilized the M_1 velocity series to gain some indication of the more recent money-income relationship. The data suggest that the current relation between money and income has remained similar to its past expected behavior. The relationship, while not exact, has remained consistent, and thus did not fall apart during the time of unpredictable shifts in money demand.

Our study suggests two possible interpretations of this finding. First, the MPS model results demonstrate that the money-income relationship may remain on track as a result of the net impact of errors in both the IS and LM sectors. Although errors in the money demand equation (and corresponding LM function) were larger than expected in late 1974, the GNP forecast errors demonstrate that the uncertainty in the goods-and-services sector for several quarters dominated the actual deviation of output from its expected value. The largest GNP errors in the latter forecast quarters were overestimates of GNP—rather than underestimates, which would have been consistent with the errors in money demand.

Whether or not money fails to track GNP will depend upon the behavior of all economic markets. This has an important policy implication. One factor in the choice of a monetary policy instrument is the relative stability of the monetary sector compared with that of the goods-and-services sector. When there is greater uncertainty (i.e., unpredictable shifts) in the monetary than in the goods-and-services sector, there may be less variation in final output with an interest-rate policy instrument than with a monetary aggregate. Accordingly, the unpredictable shifts in money demand since mid-1974 led some observers to advocate an interest rate policy. This policy, however, is not appropriate when the major source of unpredictability in GNP stems from changes in investment behavior, consumption expenditures or any of the other components of GNP. The MPS simulations suggest that the unpredictable nature of the real sector may have been the major source of unpredictable movements in GNP for some time after mid-1974, and that a monetary aggregate policy was appropriate although the money demand equation exhibited large overforecasts of money demand at that time.

This interpretation thus emphasizes the net impact of sector errors, and assumes that the estimated money demand function is an accurate representation of the public's behavior.

However, there is an alternative explanation for the stability of the money-income relationship—namely, that the public's demand for money has not changed. The velocity series appear consistent with this alternative interpretation. The observed errors may be the fault of a misspecification of the equation used to predict the public's actual demand for money. The estimated money demand function simply failed to capture the money demand relationship accurately, and the errors became pronounced beginning in 1974.3. Similar situations have occurred before, with large errors occurring in estimated money demand equations.[12] In previous instances, many analysts argued that forecast errors were the result of an inadequate specification of the demand for money. Their efforts led to the development of improved equations which provided a more accurate measurement of the public's behavior.

Recent work by Enzler, Johnson and Paulus[13] may be interpreted along these lines. These

authors contend that while the post mid-1974 errors in the money demand function are still relatively large, they can be substantially reduced from those shown in Table 1 by respecifying the income variable and the interest rate in the MPS equation. They also note that recent errors may be reduced by $4.5-5.0 billion, by adjusting demand deposit data to exclude foreign bank and official deposits and to include NOW accounts (Negotiable Orders of Withdrawal). Foreign balances are generally held for purposes unrelated to domestic economic activity; NOW accounts, which are still quite small but growing, are interest bearing accounts at commercial banks and thrift institutions on which checks can be drawn.

Work along these lines appears most promising and deserving of further research. Keran,[10] for example, is critical of the typical use of the Treasury bill rate as the appropriate measure of the opportunity cost of holding money. He suggests that alternative measures be sought to capture the substantial rise in risk which accompanied the recent era of unprecedented inflation and recession. In addition, there are many institutional factors and technological innovations which may reduce the (actual or potential) demand for transaction balances. Several of these factors, such as changes in compensating balance requirements or in the corporate management of cash balances, have been analyzed by Ruth Wilson.[14]

As the research into money demand continues, we may find that institutional factors and technological innovations will cause significant changes in the relationship between money (however defined) and total economic activity (as measured by GNP). However, the evidence presented in this paper suggests that much of the recent uncertainty in money demand can be reduced and that since mid-1974 the ability of M_1 to track movements in GNP has not deteriorated relative to past expected behavior.

The Federal Reserve has found M_1 to be a useful policy variable, although the achievement of a particular preconceived money stock is not the objective of monetary policy. Federal Reserve Chairman Arthur Burns, referring to targeted growth rates for monetary aggregates, has stated before Congress,

> We at the Federal Reserve have viewed these growth ranges as useful guides for the conduct of monetary policy. However, the objective of monetary policy is not to achieve any preconceived growth rates of monetary or credit aggregates, but to facilitate expansion of economic activity and to foster stability in the general price level.[15]

The recent errors in forecasting the public's demand for money have raised questions as to whether the money supply can still serve as a useful guide to monetary policy. The results presented in this paper suggest that it can do so.

APPENDIX A

The MPS Model Demand Deposit Equation

The demand for Demand Deposits by the nonbank public is represented in the MPS model by a standard type of money demand function which is consistent with the Baumol transaction demand model.*

$$\ln \frac{DD}{GNP\$} = -.519 + .280 \ln \frac{DD_{-1}}{GNP\$} - .062 \ln RTB$$

$$(-4.1) \quad (1.6) \quad (-5.1)$$

$$-.123 \ln RS - .339 \ln \frac{GNP}{N} + .078 \ln \frac{RDISC}{RDISC_{-1}}$$

$$(-5.1) \quad (-2.3) \quad (3.9)$$

DD is the commercial bank demand deposits measured as the two - month average surrounding the end of the quarter.

GNP$ is Gross National Product (GNP) in current dollars.

GNP is GNP in 1958 dollars.

RTB represents the 90-day Treasury Bill Rate.

RS is an average offering rate paid on time and savings deposits at commercial banks and thrift institutions.

RDISC is the Federal Reserve Discount Rate.

$\frac{GNP}{N}$ is the U.S. population.
is the highest per capita GNP achieved in the current or any preceding 19 quarters.
Sample period: 1955.3 - 1972.4.

An iterated instrumental variable estimation technique was used to estimate the equation together with the bank free reserves equation. The estimation included GNP per capita; this term was replaced by the maximum GNP per capita value early in 1974 although the equation was not re-estimated. The values in parenthesis are T-statistics. For further discussion of this equation as well as the currency equation, see Franco Modigliani, Richard Cooper and Robert Rasche, Central Bank Policy, Interest Rates, and the Money Supply, *Journal of Money, Credit and Banking,* Vol. 2, 1970: 166-218.

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*See W. J. Baumol, "The Transactions Demand for Cash; An Inventory Theoretic Approach, *Quarterly Journal of Economics,* November 1952.

FOOTNOTES

1. M_1 refers to the narrowly defined money supply which is equal to currency in the hands of the public and demand deposits of commercial banks.
2. For a comprehensive review of conventional money demand equations see Stephen Goldfeld, "The Demand for Money Revisited." **Brookings Papers on Economic Activity,** 3 (1973): 577-638.
3. For a recent survey of the monetary transmission process which contains a comprehensive bibliography see Roger W. Spencer, "Channels of Monetary Influence: A Survey," Federal Reserve Bank of St. Louis **Review,** November 1974; 8-26. For a recent discussion of the channels of monetary influence structured in the MPS model, see Albert Ando, "Some Aspects of Stabilization Policies, the Monetarist Controversy, and the MPS Model," **International Economic Review,** Vol. 15, No. 3, October 1974: 541-571.
4. A listing of the MPS econometric model equations is obtainable from EFA, University of Pennsylvania, Philadelphia, Pennsylvania, and a comprehensive description is provided by Ando, see footnote 3.
5. The prediction errors in the MPS demand for demand deposits equation were obtained by setting all the explanatory variables equal to actual values and setting the autocorrelation coefficient equal to zero. The third quarter of 1975 is the last quarter for which we have consistent data bank: revisions are being made in light of the recently issued NIA data. Appendix A provides the money demand equation used in the MPS model.
6. For a text which describes the LM-IS functions, see Thomas F. Dernburg and Duncan M. McDougall, **Macro-Economics,** McGraw-Hill Book Co., Inc., New York, 1960.
7. The Board of Governors Staff is re-estimating an enlarged version of the MPS model using the recently revised NIPA data.
8. Table 2 is read as follows: The first forecast is based upon historical data values known through 1969.4 (i.e., the first initial conditions quarter is 1969.4). The first-quarter ahead forecast of GNP is a forecast for 1970.1 and GNP was overforecasted by $1.8 billion. The second-quarter ahead forecast for 1970.2 (still based upon the initial conditions of 1969.4) is an underforecast of $8.2 billion. The third- and fourth-quarter ahead forecasts for 1970.3 and 1970.4 are also underforecasts of $12.3 and $6.6 billion. The last simulation reported in the table was based upon historical data through 1975.2 and we could simulate only one-quarter ahead; the forecast error for 1975.3 is an underestimate of $47.4 billion.
9. For a discussion which uses an early version of the MPS model see Franco Modigliani, "Monetary Policy and Consumption, Consumer Spending and Monetary Policy: The Linkage," the Federal Reserve Bank of Boston, **Conference Series No. 5,** June 1971.
10. Keran, Michael, "Changing Money Demand?" **Business and Financial Letter,** Federal Reserve Bank of San Francisco, April 30, 1976.
11. See Larry Butler, "Has the Relation Between Income and Money Shifted?" unpublished paper, Federal Reserve Bank of San Francisco.
12. Meigs, James A. "Recent Innovations: Do They Require a New Framework for Monetary Analysis," **Financial Innovations,** William Silber editor, Lexington Books, 1975.
13. Enzler, Jared, Johnson, Lewis and Paulus, John; "Some Problems of Money Demand," **Brookings Papers on Economic Activity,** 1976.
14. Wilson, Ruth, "M_1's Institutional Factors," **Business and Financial Letter,** Federal Reserve Bank of San Francisco, March 5, 1976.
15. Statement by Arthur Burns before the Committee on Banking, Housing and Urban Affairs, U.S. Senate, May 3, 1976.