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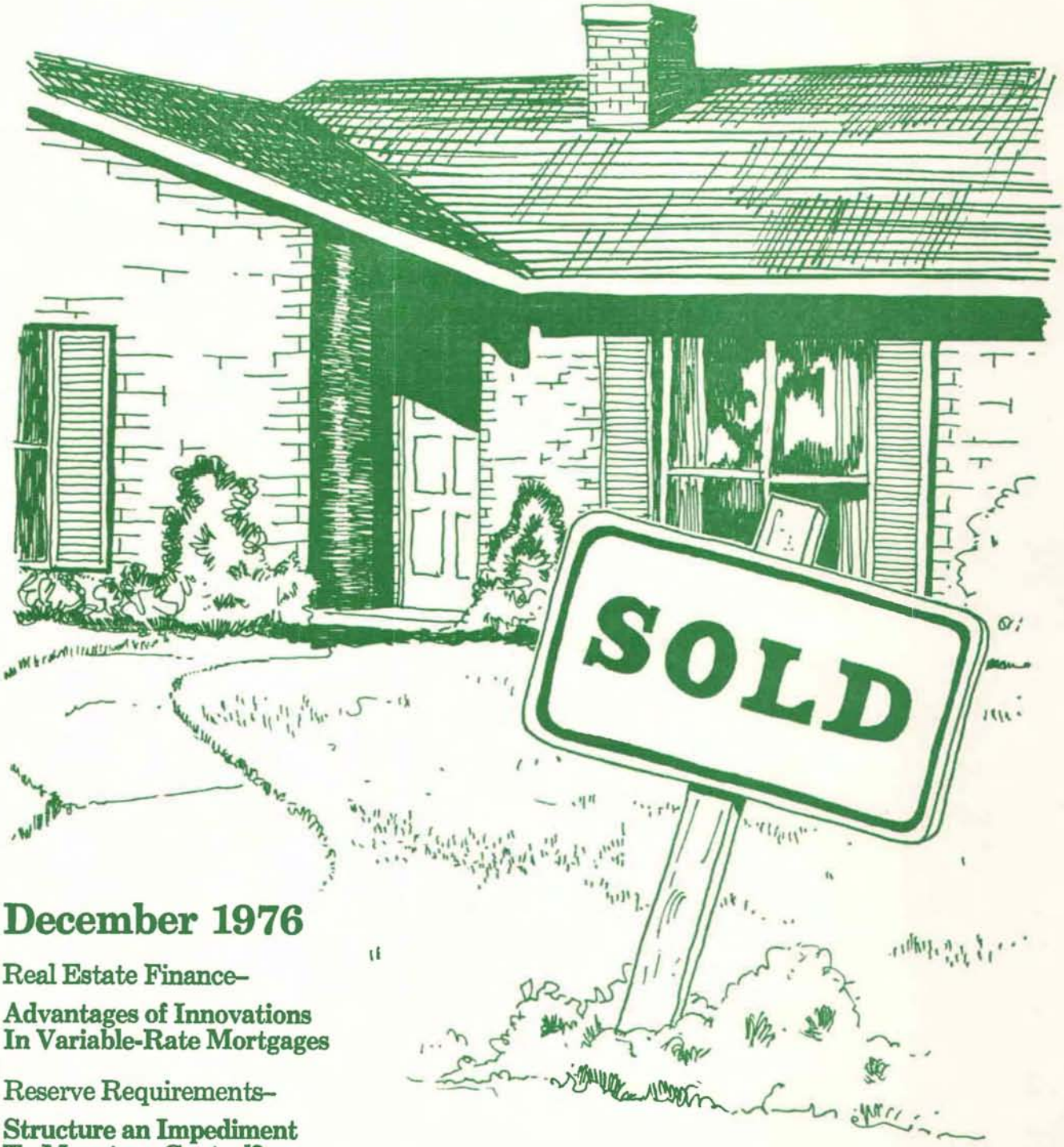

December 1976

Real Estate Finance–
Advantages of Innovations In Variable-Rate Mortgages

Reserve Requirements–
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Advantages of Innovations In Variable-Rate Mortgages

Rising inflation in the United States, because of its effect on mortgage markets, has tended to obstruct the allocation of resources to residential housing. One reason is the impact of expected inflation on the cost to borrowers of new mortgages. When inflation is widely anticipated, interest rates include a premium to compensate lenders for an expected reduction in the purchasing power of their investment.

The resulting increase in mortgage payments creates a financing gap to the extent that family income does not keep pace with the higher interest payments in the early years of the mortgage. Even though inflation increases family income relative to payments in the later years of the mortgage, the financing gap may force many households to downgrade their housing purchases or even to forego homeownership.

Another reason why inflation may interfere with the allocation of resources to housing is the impact of realized but unanticipated inflation on the supply of mortgage credit. Most mortgage funds are provided by specialized institutions that obtain their loanable funds from short-term deposits. By contrast, a significant portion of their portfolios is comprised of long-term loans. In a period of unanticipated inflation, the yields on these loans tend to fall below current short-term interest rates.

Consequently, the return on the portfolios of these mortgage specialists becomes too small to allow them to compete for short-term deposits with other institutions making shorter-term investments. Mortgage specialists have remained solvent during rising inflation in the United States largely because interest ceiling regulations prevented them from competing for deposits on the basis of yields. But as a result of these regulations, the supply of mortgage credit has been restricted, especially in periods when short-term rates were at cyclical highs.

Adoption of the variable-rate mortgage (VRM) is one of the major proposals of recent years to improve the functioning of mortgage markets in an inflationary environment. In 1975, the Federal Home Loan Bank Board proposed a change in its regulations to permit federally chartered savings and loan associations to offer VRM's on a broad scale.[1] However, because of objections by consumer and labor groups and substantial congressional opposition, the board withdrew its proposal on single-family structures but allows VRM's on multifamily structures and commercial real estate. Nevertheless, alternative kinds of more flexible mortgages for homeowners are under study by Congress.

The benefits of VRM's could be enhanced if innovations are introduced into the loan design to reduce the financing gap. The resulting loan plan is called the constant-payment-factor variable-rate mortgage (CPFVRM). While the CPFVRM has certain drawbacks, it offers a combination of desirable qualities not available in other mortgage designs, which facilitate financing of family housing in an inflationary environment.

Standard variable-rate mortgage

The VRM allows the mortgage rate to change over the term of the loan by indexing it to an appropriate reference rate. Changes in the mortgage rate can be implemented through two methods. First, the monthly payment may be allowed to vary, holding the term of the loan fixed. Alternatively, the monthly payment may be fixed, and the term allowed to vary. But the second method is not very practical since increases in interest rates can lead to extremely long maturities. Consequently, recent proposals for VRM's in the United States center on plans with fixed maturities.

The principal advantage of the variable-rate mortgage over the fixed-payment mortgage is that interest revenue on all outstanding loans can roughly vary with the current cost of funds.

The principal advantage of the VRM over the fixed-payment mortgage (FPM) is that interest revenue on all outstanding loans can roughly vary with the current cost of funds. Thus, mortgage specialists are in a better position to maintain adequate profit margins

1. The Federal Home Loan Bank Board had imposed regulations in 1972 to prohibit federally chartered associations from issuing mortgages on which interest is increased by adjusting payments above their initial level. Increases in interest were allowed by extending the loan maturity–but only up to 30 years. Most state-chartered financial institutions found it impractical to issue variable-rate mortgages because of state usury laws.

and can compete more readily for deposits with diversified lenders even though realized inflation may not have been anticipated. Since this provides a more stable supply of funds to finance housing, both lenders and borrowers can benefit. And those that borrow when interest rates are cyclically high avoid becoming locked in to high mortgage costs over the entire term of a loan.

Nevertheless, many consumer and labor groups in the United States remain opposed to the adoption of VRM's. Some fear the adoption of VRM's will actually restrict, rather than increase, the availability of mortgage credit. They contend that as interest rates and payments rise on VRM's, so will the proportion of defaulted loans. Mortgage lenders would then adopt more restrictive lending practices–particularly for lower and middle-income groups.

Others oppose VRM's on the ground that the most important problem in housing markets is high mortgage payments, caused largely by the financing gap, which cause many families to forgo homeownership. They point out that VRM's provide no solution to this problem and suggest efforts should be devoted to other reforms.

Experiences with VRM's

The first major market test for VRM's in the United States was in California in 1975. Variable-rate mortgages had been made by some small savings and loan associations in California ever since 1961. But it was not until the first half of 1975 that six large state-chartered associations, holding over 30 percent of the industry assets in California, began offering VRM's on a broad scale.[2]

To date, a substantial volume of such loans has been made. For example, in the last nine months of 1975, two-thirds of all new mortgages issued by the six associations were variable-rate mortgages. Since then, additional state-chartered associations and two large commercial banks have also begun making VRM's. However, it is too early to judge the impact of variable-rate financing on the availability of mortgage credit in California or on the demand for family-owned housing.

On the other hand, variable-rate mortgages have been the major instrument for residential real estate finance in the United Kingdom and Canada for several years.[3] Their experiences can help in assessing the advantages of adopting variable-rate financing in the United States since mortgage markets and institutions in the three countries are somewhat similar and inflation has become a growing problem for all three.

In the United Kingdom, 90 percent or more of new mortgage credit for owner-occupied dwellings is normally provided by building societies. These institutions have asset-liability structures comparable to those of savings and loan associations in the United States. For example, over 80 percent of their assets are held in long-term mortgages, and close to 90 percent of their funds are raised through savings shares on which withdrawals can be made on short notice.

Building societies began offering variable-rate mortgages in the 1930's. By 1967, over 80 percent of their loans were in this form. And today, almost all new housing loans in the United Kingdom have variable rates.

The typical variable-rate residential mortgage in the United Kingdom is issued for a term between 20 and 25 years on a fully amortized basis. Changes in the mortgage rate can be accomplished by adjusting either the payment level or the loan maturity. Before 1969, they were achieved almost exclusively through variations in maturities, but rising interest rates created situations in which the original payment level on many older loans was not sufficient to cover interest costs. So today, rate changes are typically made through adjustments in the mortgage payment.

The interest on variable-rate mortgages in the United Kingdom is not linked to a market-determined reference rate; instead, rate changes are left to the discretion of the lender. A practice has evolved since 1940 whereby the mortgage rate, as well as the rate paid on savings deposits, is determined by the recommendation of the Council of the Building Societies Association–the major trade association for these mortgage lenders. There

2. The recent California experiment with variable-rate mortgages is described in Mark J. Riedy, "VRM's in California: The Early Experience," *Federal Home Loan Bank Board Journal* 9, no. 3 (March 1976). Savings and loan associations in California, as well as in Wisconsin, issued variable-rate mortgages on a small scale for many years before 1975. And the Farm Credit System has experimented with them nationwide since 1970. These experiences are discussed in Eleanor Erdevig, "Is There a Future for Variable Rate Mortgages?," *Business Conditions,* Federal Reserve Bank of Chicago, November 1975; and James A. Millar and Stanley R. Stansell, "Variable Rate Mortgage Experience of the Farm Credit System," *Financial Management* 4, no. 4 (Winter 1975).
3. The use of variable rate mortgages in the United Kingdom and Canada is described more fully in David L. Cohen and Donald R. Lessard, "Experience with Variable-Rate Mortgages: The Case of the United Kingdom," and Donald R. Lessard, "Roll-Over Mortgages in Canada," both in *New Mortgage Designs for Stable Housing in an Inflationary Environment,* Federal Reserve Bank of Boston Conference Series, no. 14, January 1975. See also Jack Revell, *Flexibility in Housing Finance* (Paris, Organization for Economic Cooperation and Development, 1975).

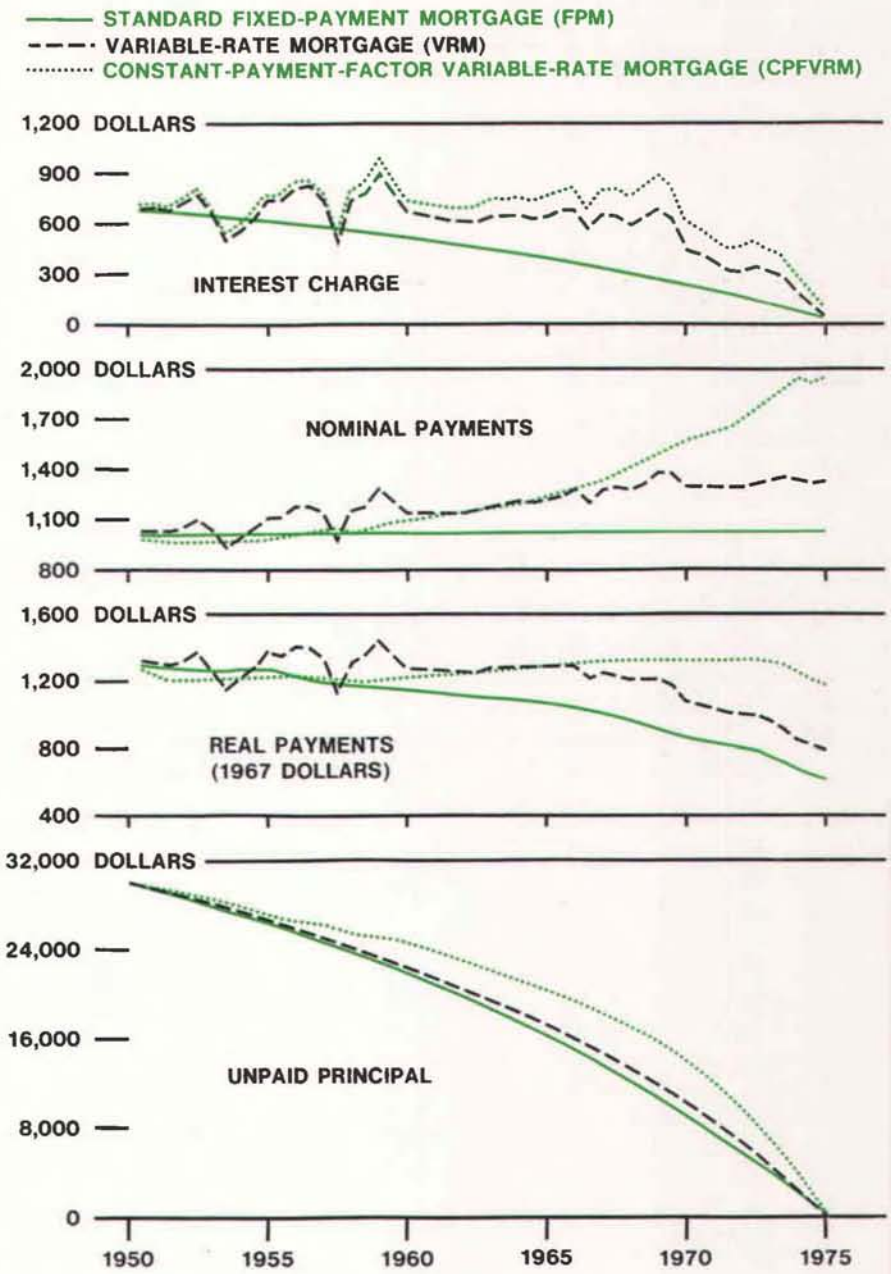
are no legal ceilings on mortgage rates or savings deposit rates. So, the arrangement could be capable of allowing flexible adjustments in mortgage rates that give building societies adequate profit margins, allowing competitive yields on savings deposits, and providing a more stable supply of mortgage credit.

But partly because of political pressures, the Building Societies Association has been reluctant to raise mortgage and deposit rates until deposit outflows were experienced by lending institutions. A mechanism to reduce the burden of the financing gap–and, hence, reduce the political pressure to keep mortgage rates from rising–would have helped the use of variable-rate mortgages to be more effective in stabilizing the supply of mortgage credit in the United Kingdom.

Most mortgage credit in Canada is provided by four types of financial institutions. Two of these, mortgage loan companies and trust companies, specialize in housing finance. Trust companies fund their investments through issuance of time deposits maturing within five years and with inflows to demand deposit accounts. The liability structure of mortgage loan companies is similar, but it includes time deposits and debentures with maturities that exceed five years. The other institutions, chartered banks and life insurance companies, are diversified lenders; and together, they hold approximately 44 percent of total mortgage debt.

A rollover variety of the variable-rate mortgage has been offered in Canada on conventional loans–those that carry no government guarantee–since 1931. But until 1969, only standard fixed-payment mortgages were permitted on loans guaranteed by the federal government. Then, the law was changed to allow five-year rollover contracts on these loans as well, provided their original maturity

Mortgage Terms in Period of Less Than Fully Anticipated Inflation



NOTE: Terms are calculated on a semiannual basis for a $30,000 loan with a 25-year term. Initial payments for the FPM and the VRM are calculated at a contract rate of 4.6 percent. The initial payment for the CPFVRM is calculated at a rate of 4 percent. The debiting factor for both variable-rate mortgage designs is computed by linking the initial contract rate of 4.6 percent to the yield on one-year U.S. Government securities. Payments for the CPFVRM are linked to changes in the consumer price index. The consumer price index is also used to deflate nominal payments for all three mortgage designs to obtain real values.

exceeds 24 years. By 1973, practically all new mortgages on single-family dwellings were of the rollover type.

Rollover mortgages are issued with a fixed interest rate and a fixed schedule of payments for each five-year term. The payment is calculated to fully amortize the loan over its remaining term to maturity, which originally ranges from 20 to 30 years for conventional mortgages and 25 to 40 years for government-guaranteed mortgages.

At the end of each five-year term, the outstanding balance comes due, but the holder of either a conventional or government-guaranteed mortgage has the option of refinancing it at the current market rate, usually without additional closing costs. A borrower with a government-guaranteed loan has the additional option of increasing the maturity of his mortgage up to 40 years to prevent payments from increasing when interest rates rise.

Variable-rate financing has helped stabilize the supply of mortgage credit in Canada. Specialized mortgage lenders began increasing the length of their liabilities in the 1960's to match more closely the five-year maturity of rollover mortgages, and by 1969, all statutory ceilings on mortgages and deposits were abolished. Mortgage lenders have, consequently, been able to maintain satisfactory profit margins in recent years. As a result, the severe disintermediation that occurred in mortgage markets in the United States in 1974 appears to have been avoided in Canada, even though market pressures pushed interest rates up sharply.

Still, housing starts in Canada experienced a sharp decline in 1974. Observers suggest that high payments on new mortgages reduced the amount of single-family housing demanded. In the 1963-73 period, for example, payments on a typical mortgage for a 25-year term increased 50 percent faster than the overall consumer price index–mainly because of higher mortgage rates. Then, in 1974, as mortgage rates jumped 250 basis points above their 1973 average, monthly payments on a new mortgage rose twice as fast as the consumer price index. High mortgage costs undoubtedly caused some households to withdraw from housing markets.

Observers of the Canadian economy also suggest that high mortgage costs reduced activity in markets for multifamily housing. Apartments are generally financed with standard fixed-payment mortgages in Canada. Many investors avoided new apartment projects in 1974 because of uncertainties about whether future rents would compensate for high fixed interest costs that reflected, in part, expectations of continued inflation.

Constant-payment-factor variable-rate mortgages

The experiences in Canada and the United Kingdom suggest that benefits from variable-rate financing can be enhanced by a mortgage design that provides not only a competitive return but also a time profile of scheduled payments more similar to that of money incomes–and, hence, diminishes the financing gap. A new mortgage design with these features is called the constant-payment-factor variable-rate mortgage (CPFVRM).[4]

The CPFVRM has two characteristics that distinguish it from other fixed-term mortgages.[5] First, payments can be designed to start low and increase over time with prices and family incomes. Second, separate interest rates are used to compute payment levels and interest charges.

The interest rate used to compute payment levels is called the constant-payment factor. The initial payment is determined by amortizing the loan's principal over its full term at this constant-payment factor. Ideally, the payment factor can be chosen to approximate the "real"–or inflation-free–mortgage rate so that the first payment is at a level that eliminates the financing gap.

Interest changes are determined in the same manner as with the standard VRM, by applying a current interest rate, or debiting factor, to the unpaid principal. Periodic adjustments in the debiting rate are made by indexing it to an appropriate reference rate that reflects the cost of funds to mortgage lenders.

Monthly payments are recomputed at the same time as adjust-

4. The constant-payment-factor variable-rate mortgage and other types of loans with low-start payments are discussed in Richard A. Cohn and Stanley Fischer, "Alternative Mortgage Designs," *New Mortgage Designs for Stable Housing in an Inflationary Environment,* Federal Reserve Bank of Boston Conference Series, no. 14, January 1975. One of these designs, the graduated-payment mortgage (GPM), is geared for payments to increase on a prescribed schedule determined at the time the loan is made. It is currently being studied by Congress and will be insured under an experimental program by the Department of Housing and Urban Development in late 1976.

   Since payment changes are scheduled in advance, the GPM exposes both borrower and lender to risks from unanticipated inflation. Higher than anticipated inflation will reduce the real return to the lender, and lower than expected inflation will increase the real costs to the borrower. The CPFVRM, on the other hand, includes provisions designed to eliminate both of these risks.

5. The formulas used to calculate payment level and unpaid principal for the FPM, VRM, and CPFVRM are discussed in the accompanying technical appendix.

ments are made in the debiting rate. This is done by amortizing the principal outstanding at the end of the last adjustment period over the remaining term to maturity at an interest rate equal to the constant-payment factor. The resulting payment level is then increased in proportion to the inflation that has occurred since the previous adjustment to arrive at the actual monthly payment.

Benefits from variable-rate financing can be enhanced by a mortgage design that provides not only a competitive return but also a time profile of scheduled payments more similar to that of money incomes–and, hence, diminishes the financing gap.

The paths for payments and the outstanding principal are determined by the actual course for inflation and the difference between the debiting rate and the payment factor. Suppose, for example, that a CPFVRM is issued when no inflation is anticipated and that its debiting rate and payment factor are identical. Furthermore, suppose no inflation develops so that the two rates stay approximately equal.[6]

In this case, the CPFVRM will behave much like an FPM. The nominal value of its payments will remain at about the initial level and, since prices are stable, so will the real value, or purchasing power. In addition, the amount of its outstanding principal will decline throughout the loan's term at approximately the same pace as with a comparable FPM.

On the other hand, suppose an inflationary environment has pushed the debiting rate above the payment factor. After recomputation, the first payment will be the same as before, but a higher portion of it is required to cover interest charges than would be the case with an FPM at an interest rate equal to the payment factor. Consequently, in subsequent periods, amortization of the outstanding principal over the remaining term at an interest rate equal to the payment factor will tend to yield higher levels of payments.

So long as the difference between the two interest rates approximately averages out over time to the inflation rate, nominal payments will increase at about the same rate as prices. And the real values for payments and the outstanding principal will be about the same throughout the term of the loan as those for a comparable FPM in a noninflationary environment.

Pattern of payments of CPFVRM

To illustrate the advanages of the CPFVRM in an inflationary environment, the path for its interest charges, payments, and unpaid principal is compared with the paths of an FPM and a VRM over the postwar period. Three loans for $30,000 with a 25-year maturity are assumed to have been issued in 1951.

The first is an FPM made at the contract rate of 4.6 percent then prevailing on conventional mortgages. The second, a VRM, is assumed to have been issued at the same initial contract rate but with subsequent payments recomputed every six months by indexing interest charges to movements in the yield on one-year U.S. Government securities. This same variable rate is used as the debiting factor in calculating interest charges on the CPFVRM. The constant-payment factor for the CPFVRM, chosen to approximate the real rate of interest, is fixed at 4 percent, and the consumer price index is used to link payment levels to changes in prices.

Interest rates rose over the 25-year period, increasing the debiting factor on the VRM and CPFVRM from 4.6 percent to 11.8 percent by 1974. Consequently, total interest earned on the FPM is 30 percent less than with the VRM and 37 percent less than with the CPFVRM.

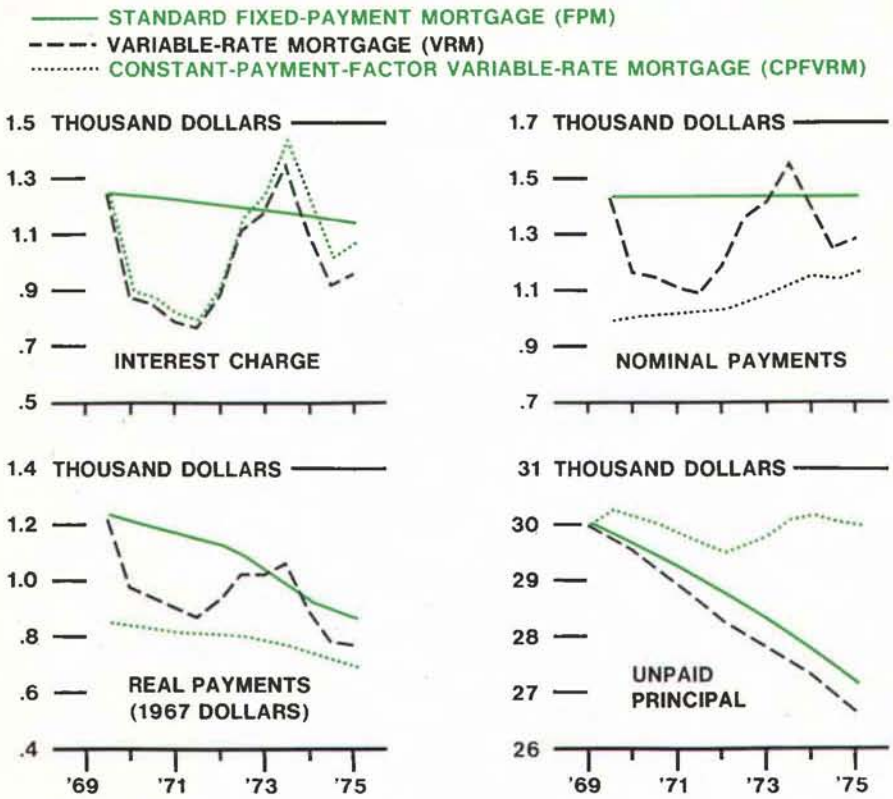
For the lender, the advantage in interest earnings from the CPFVRM is offset, to some degree, by the fact that payments are lower than for the other mortgages in the first few years. For an organization building a new portfolio in CPFVRM's, this presents a cash flow problem that initially reduces the funds available for reinvestment. Nevertheless, a portfolio comprised of either VRM's or CPFVRM's, rather than FPM's, would have offered mortgage lenders a clear advantage in earning power.

The initial payment level on the CPFVRM would have been 2.5 percent lower than on the other mortgages. The advantage to the borrower is relatively small because, in 1951, inflation had not yet created a large financing gap. However, if the experiment begins with 1970, a contract rate of 8.3 percent is substituted in the computations for the FPM and VRM, and initial payments would have been 31 percent lower with the CPFVRM.

The advantage of a CPFVRM to the borrower in reducing the financing gap is offset, to some extent, by uncertainties surrounding the future course of payments.

6. It is assumed here that movements in the debiting rate result primarily from changes in inflationary expectations. This is a reasonable assumption since economic studies show that the real rate of interest has remained relatively unchanged in the United States.

Mortgage Terms in Period of More Fully Anticipated Inflation



NOTE: Initial payments for the FPM and the VRM are calculated at a contract rate of 8.3 percent. Other details of the calculations are the same as those for the 1951-75 period.

If, by chance, a family's income does not keep pace with inflation, pressure would develop on the household budget, perhaps causing delays in payments or even default. Also, short-run changes in payments caused by fluctuations in market rates of interest might cause problems. But these disadvantages may by no means be overwhelming in many cases.

The risks of default with the CPFVRM because a family's income may not keep pace with inflation can be reduced by selecting a higher payment factor. In this fashion, initial payments are made higher, and the mortgage principal is repaid faster in the early term of the loan. Therefore, smaller payment increases are required later to amortize the outstanding balance. Of course, more of the financing gap remains when a higher payment factor is selected. But in most cases, a payment factor can be chosen that eliminates at least part of the gap and, at the same time, is consistent with a degree of risk acceptable to borrower and lender.

Moreover, short-run changes in payments are not likely to be as large with a CPFVRM as with a VRM. The path for payments is smoothed in the case of a CPFVRM since the same payment factor is employed to amortize principal throughout the term of the loan. For example, in the experiment beginning with 1951, the largest one-period increase in real payments is only 1 percent, compared with 15 percent for the VRM.

Summary and conclusions

The standard fixed-payment mortgage has been the dominant instrument used in real estate finance in the United States since the late 1930's. Over much of the period, it has functioned admirably to provide economical financing for housing through the existing system of mortgage specialists. However, since the mid-sixties, inflation has interfered with the ability of the fixed-payment mortgage to serve the needs of lenders and borrowers.

When inflation is unanticipated, it reduces the profitability of portfolios in fixed-payment mortgages, and mortgage specialists cannot effectively compete for short-term funds. Moreover, expectations of continued inflation increase interest rates on new mortgages. The resulting increase in mortgage payments creates a financing gap, which causes some households to forgo homeownership.

The variable-rate mortgage has been proposed as a means of improving the operation of mortgage markets in an inflationary environment. Since the standard variable-rate mortgage can increase the ability of mortgage lenders to compete for funds, it can help stabilize the supply of mortgage credit. However, the benefits to a borrower can be enhanced by also including a provision in the mortgage that reduces the financing gap. The resulting loan plan, which has yet to be tested in the United States to any great extent, is a constant-payment-factor variable-rate mortgage.

The constant-payment-factor variable-rate mortgage allows payments to start at a relatively low

level and increase over the term of the loan at approximately the same rate as prices. Therefore, the purchasing power, or real value, of the payments remains fixed–just as for a standard mortgage in the absence of inflation.

There is uncertainty, which does not exist with the standard fixed-payment mortgage, about whether a family's income will keep pace with the rising nominal value of its mortgage payments. Therefore, some families and lenders may well prefer fixed-payment financing. But as a means of both reducing the financing gap and providing a satisfactory profit margin, the constant-payment-factor variable-rate mortgage would be advantageous to many borrowers and lenders.

–William R. McDonough

Technical appendix

The standard fixed-payment mortgage is designed so that a constant-payment level will provide the agreed-on nominal rate of return and fully amortize the original principal over the term of the mortgage. The unpaid principal, or par value, of the mortgage can thus be expressed as:

$$(1)\ M_{t-1} = \sum_{x=t}^{T} P(1+R)^{t-x-1},\ t = 1, \ldots, T,$$

where M is the unpaid principal, t is a subscript for time, T is the loan's term, P is the mortgage payment, and R is the contract rate of interest.

The standard annuity formula is applied to (1) to obtain a solution for the unpaid principal:

$$(2)\quad M_{t-1} = P\,[1-(1+R)^{t-T-1}]\,R^{-1}.$$

Equation (2) can then be solved to determine the payment level in terms of M_0, the value of the principal at the time the mortgage is issued:

$$(3)\quad P = R\,M_0\,[1-(1+R)^{-T}]^{-1}.$$

An alternative form for expressing the value of the unpaid principal–M_t–that is useful in comparing the features of the standard fixed-payment mortgage with those of other mortgage forms can be solved from (1) through (3), as:

$$(4)\quad M_t = M_0\,(1+R)^t - P\sum_{i=0}^{t-1}(1+R)^i,\quad t = 1, \ldots, T.$$

The first term on the right-hand side of (4) represents the rate at which interest is being debited, or charged, to the loan. The second term represents the rate at which interest and principal are being credited.

The standard variable-rate mortgage is designed to fully amortize its principal over the term of the loan. However, it differs from the standard fixed-payment mortgage in that its contract rate, $RVRM$, is allowed to vary with changes in market conditions:

$$(5)\quad RVRM_t = RVRM_1 + RF_t - RF_{t-1},\quad t = 2, \ldots, T,$$

where RF is an appropriate reference reflecting the cost of funds to mortgage lenders. If the maturity of the loan is fixed, payments will vary with changes in $RVRM$.

The current payment level, $PVRM_t$, is determined by using the standard annuity formula to fully amortize the unpaid principal, $MVRM_{t-1}$, over its remaining term:

$$(6)\ PVRM_t = RVRM_t \times MVRM_{t-1} \times [1-(1+RVRM_t)^{t-T-1}]^{-1},\quad t = 1, \ldots, T-1$$

$$PVRM_t = MVRM_{t-1}\,(1+RVRM_t),\quad t = T.$$

The value of the unpaid principal depends on the pattern of previous interest rates and payments:

$$(7)\quad MRVM_t = MVRM_0 \prod_{i=1}^{t}(1+RVRM_i) - \left\{PVRM_t + \sum_{i=1}^{t-1} PVRM_i \times \left[\prod_{k=i+1}^{t}(1+RVRM_k)\right]\right\},\quad t = 1, \ldots, T.$$

The constant-payment-factor variable-rate mortgage differs in that separate inter-

est rates are used in computing payments and interest charges. Ideally, the interest rate used to compute payments–the constant-payment factor, or *CPF*–is chosen to approximate the real, or inflation-free, rate of interest so that the financing gap is eliminated. The current payment level, $PCPF_t$, is determined by amortizing the unpaid principal, $MCPF_{t-1}$, over its remaining term and indexing the result to changes in prices, p_t, since the last adjustment:

$$(8)\quad \begin{aligned} PCPF_t &= CPF \times MCPF_{t-1} \\ &\quad \times [1-(1+CPF)^{t-T-1}]^{-1} \\ &\quad \times [1+(P_t-P_{t-1})/P_{t-1}], \\ &\quad t=1,\ldots,T-1 \\ PCPF_t &= MCPF_{t-1}\,(1+RVRM_t), \\ &\quad t=T. \end{aligned}$$

The unpaid principal is calculated by employing the same contract rate used to determine interest charges with the standard variable-rate mortgage:

$$(9)\quad \begin{aligned} MCPF_t &= MCPF_0 \prod_{i=1}^{t} (1+RVRM_i) \\ &\quad -\left\{PCPF_t + \sum_{i=1}^{t-1} PCPF_i \right. \\ &\quad \left. \times \left[\prod_{k=i+1}^{t} (1+RVRM_k)\right]\right\}, \\ &\quad t=1,\ldots,T. \end{aligned}$$

When *CPF* is less than *RVRM*, payments start low and the principal is paid off at a slower rate in the early term of the loan than with either of the alternative mortgage designs. It is even possible for *MCPF* to increase over part of the early term because interest charges may exceed payment credits.

Reserve Requirements–

Structure an Impediment To Monetary Control?

Reserve requirements are widely viewed as the fulcrum of monetary policy–the policy instrument that enables the Federal Reserve System to manage the nation's money stock by controlling the volume of reserves available to the banking system. Proceeding from this premise, critics of the present structure of reserve requirements have pointed to characteristics they suggest could impede, rather than enhance, monetary control.[1] In particular, they have noted that differences in the requirements on different sizes of banks and on different types of deposits can complicate monetary control and cause instability in the money stock.

It is true that the relationship between total reserves and the money stock varies more under present requirements than it would if requirements applied uniformly to all deposits included in the money stock. However, whether the variability in the relationship is a significant source of imprecision for monetary control depends, in part, on how the Federal Reserve exercises control. When the Federal Reserve offsets changes in bank reserves to stabilize interest rates, the structure of reserve requirements is not a significant source of monetary instability.

In this article, the potential problem for monetary control inherent in the present structure of reserve requirements is analyzed within the money multiplier framework. Next, recent management of monetary policy is described, noting how the Federal Reserve offsets changes in the relationship between reserves and the money stock in the course of stabilizing money market conditions. Finally, a statistical analysis is presented that indicates the current structure of reserve requirements does not contribute importantly to instability in the money stock under current operating procedures.

Structure of requirements

The view that the structure of reserve requirements can disrupt monetary control is usually stated in terms of a money multiplier relationship in which the stock of money, M, is the product of the money multiplier, m, and the monetary base, B:[2]

$$M = mB. \quad (1)$$

The monetary base is composed of currency held by banks and the public plus member bank deposits at Federal Reserve banks. Monetary authorities can increase or decrease the base by buying or selling U.S. Government securities–a process known as open market operations. When the Federal Reserve buys Government securities, for example, it usually pays for the securities by crediting the reserve account of a member bank. This increases the bank's reserves–and, hence, the monetary base–by the amount of the purchase.

The quantity of money that can be supported by a given base depends on the value of the multiplier (m), which, in turn, depends

RESERVE REQUIREMENTS ON MEMBER BANK DEPOSITS

Deposit interval (Million dollars)	Requirement (Percent of deposits)
Net demand deposits[1]	
Less than $2	7½%
$2 to $10	10
$10 to $100	12
$100 to $400	13
Over $400	16½
Time deposits[2]	
Savings deposits	3
Other time deposits	
Maturing in 30 to 179 days	
Less than $5	3
Over $5	6
Maturing in 180 days to 4 years	2½
Maturing in 4 years or more	1

1. Demand deposits subject to reserve requirements are gross demand deposits minus cash items in process of collection and demand balances due from domestic banks. Requirement schedules are graduated, and each deposit interval applies to that part of the deposits of each bank.
2. The average of reserves on savings and other time deposits must be at least 3 percent, the minimum specified by law.

SOURCE: *Federal Reserve Bulletin*

1. In one study, William Poole and Charles Lieberman suggest five changes in reserve requirements (along with four other reform measures) that would improve the stability of the relationship between the money stock and reserves. See their comprehensive study "Improving Monetary Control," *Brookings Papers on Economic Activity*, 1972, no. 2, pp. 293-335. Numerous less technical articles also relate reserve requirements to monetary control. See, for example, William Burke, "Primer on Reserve Requirements," *Business Review*, Federal Reserve Bank of San Francisco, Winter 1974, and J. A. Cacy, "Reserve Requirements and Monetary Control," *Monthly Review*, Federal Reserve Bank of Kansas City, May 1976.
2. It is assumed here that the monetary aggregate to be controlled is the narrowly defined concept of the money stock, M_1, composed principally of private nonbank demand deposits plus currency in the hands of the public. A similar analysis could be applied to other aggregates.

on a number of things. One is the public's demand for currency. Another is the member banks' demand for reserves. The public's demand for currency determines the amount of the base that circulates outside banks. And the demand for reserves influences the amount of demand deposits banks are willing to provide.

Within the multiplier framework, these factors are measured in terms of four ratios: k, the ratio of the public's currency to the demand deposit component of the money stock; r, the ratio of required reserves at member banks to these demand deposits; e, the ratio of excess reserves at member banks to these deposits; and v, the ratio of vault cash at nonmember banks to these same deposits. The multiplier can be expressed as a function of the ratios so that the relationship above can be written:[3]

$$(2) \quad M = \frac{1+k}{r+e+v+k}B.$$

The argument that the current structure of reserve requirements hampers monetary control focuses on the required reserve ratio, r, and the characteristics of the present structure that lend instability to this ratio:

- Reserve requirements at member banks vary with the level of net demand deposits at the individual bank. Five different reserve requirements, ranging from 7½ percent to 16½ percent, apply over five different deposit intervals.
- Reserve requirements apply to deposits other than demand deposits. Requirements apply to such diverse member bank liabilities as time and savings deposits, Eurodollar borrowings, and U.S. Government deposits.
- Reserve requirements for nonmember banks vary even more than for member banks as they derive from the laws of the 50 individual states. Both the reserve percentages and the types of assets that can be counted as reserves vary from state to state.

Most nonmember banks hold correspondent balances with member banks. And the level of these correspondent balances depends, in part, on the volume of demand deposits at the nonmember banks. Demand deposits at the nonmember banks indirectly give rise to required reserves through their effect on correspondent balances that are subject to the System's reserve requirements. Therefore, the effect on required reserves of a shift in deposits to nonmember banks would be similar to that of a shift to member banks with low reserve requirements.

The argument that the current structure of reserve requirements hampers monetary control focuses on the required reserve ratio, *r*, and the characteristics of the present structure that lend instability to this ratio.

How these characteristics affect the r ratio can be illustrated by considering a check drawn on a large member bank subject to the 16½-percent marginal reserve requirement. Suppose the check is deposited to a demand deposit account at a bank with less than $2 million in net demand deposits and, therefore, subject to the 7½-percent minimum requirement. When reserve requirements are calculated on the new deposits, required reserves, R, fall by 9 percent of the amount of the check while the demand deposit component of the money stock, D, remains constant. So, the required reserve ratio, R/D, declines.

Suppose, on the other hand, the check is deposited to a savings account, subject to 3-percent reserve requirements. Required reserves fall by 13½ percent of the amount of the check, while demand deposits fall by the entire amount. The required reserve ratio rises.

Finally, suppose the check is for federal taxes and the proceeds are credited to the U.S. Government's tax and loan account at the same bank on which the check is drawn. Required reserves remain unchanged because the same reserve requirements apply to the Government demand deposits as to the account on which the check is drawn. But Government demand deposits are not part of the money stock, so D falls and r (the required reserve ratio) increases.

The reserve ratio does vary under the present structure of reserve requirements. But because other changes can offset fluctuations in r, this variation does not necessarily imply corresponding variations in the money stock. For example, if excess reserves were to increase the same amount that required reserves decreased, the two changes would exactly offset each other and the multiplier would remain constant. More important, however, the Federal Reserve, in the normal course of its open market operations, usually offsets changes in the required reserve ratio caused by shifts in the composition of deposits.

Effect of interest rate control

The current operating strategy of monetary policy focuses on short-run control over money market conditions–particularly the Federal funds rate. The basic thrust of monetary policy is quantified in terms of targets for monetary growth, which, in turn, are shaped in the light of the outlook for such

3. A simple derivation of equation (2) is in the accompanying technical appendix.

History and rationale of reserve requirements

Reserve requirements originated long before monetary policy. In the early 1800's, state legislatures began requiring banks to hold coin in their vaults equal to a specified percentage of their outstanding bank notes. At that time, bank notes accounted for a larger portion of bank liabilities than did demand deposits and, so, represented a more important claim on bank assets.

By the time of the Civil War, deposits had overtaken bank notes, and the National Banking Act of 1863 established reserve requirements against both deposits and notes. The Federal Reserve Act of 1913 retained the basic structure of reserve requirements of the National Banking System and incorporated some important improvements. For example, the act prohibited member banks from holding reserves with other commercial banks–a practice that, on occasion, had added to the severity of banking panics.

Reserve requirements were a fixed, constant percentage during their entire early history. Then, amendment of the Federal Reserve Act in 1933 authorized changes in requirements under emergency conditions. Further amendment in 1935 permanently established variable reserve requirements as a policy instrument.

In keeping with other moves toward centralization of authority at that time, the 1935 amendment stipulated that authority over reserve requirements would reside exclusively with the Board of Governors of the Federal Reserve System. Other policy instruments–open market operations and the discount rate–remained joint responsibilities of the Board of Governors and Federal Reserve bank officials.

The use of variable reserve requirements as a policy instrument was widely hailed as a significant innovation and was subsequently adopted by several other countries. However, with a few important exceptions, changes in reserve requirements have been infrequent and have played a minor role in monetary policy.

The rationale of reserve requirements during most of their history was to assure banks a source of funds to redeem liabilities that are payable *on demand.* At present, almost 40 percent of all bank deposits are demand deposits and, in practice, banks also pay most time deposits on demand. In contrast to these extremely liquid liabilities, most bank assets are relatively illiquid. Loans make up about 60 percent and securities less than 25 percent of bank assets, and a portion of the securities are tied up as collateral for government deposits.

Based on this difference in the liquidity of bank assets and liabilities, the liquidity argument for reserve requirements asserts that banks must hold a portion of their deposits as reserves in order to maintain sufficient liquidity to meet deposit withdrawals. It was this rationale that prompted the first reserve requirements in state laws.

However, reserves that banks hold to meet legal reserve requirements do not contribute significantly to the liquidity they need to meet withdrawals. A member bank cannot use such reserves to meet heavy deposit withdrawals because legal reserves may not be drawn below required levels. Except for a 2-percent deficiency that the bank is allowed to carry over to the succeeding week, any deficiency in reserves must be made up within the current reporting week. This means that if a member bank with a 10-percent reserve requirement suddenly loses deposits, only 10 percent of the withdrawal is freed through a reduction in required reserves.

Under current structure, even this description overstates the role of reserve requirements in providing liquidity. In September 1968, the Federal Reserve System introduced lagged reserve accounting, specifying that member banks hold reserves against deposit levels two weeks earlier. There is no longer any immediate tie between deposits and reserve requirements, and a proportionate volume of reserves is not freed when a deposit withdrawal occurs. Under lagged requirements, the decrease in required reserves resulting from a deposit withdrawal occurs two weeks later.

The related view that reserve requirements assure the solvency of banks is also debatable. *Liquidity* refers to the adequacy

of immediately available or readily marketable assets, whereas *solvency* refers to the adequacy of all assets, liquid or otherwise, to cover all liabilities, whatever their maturity. Since banks are so highly leveraged–because they rely so heavily on borrowed funds–a relatively small decrease in loan value represents a large change relative to a bank's capital. Even a moderate decrease in the value of the bank's loans can eliminate equity and produce insolvency.

While bank solvency is an appropriate concern of the monetary authorities, reserve requirements are probably not the most efficient means to that end. Capital requirements, for example, are simpler and more direct since solvency is measured against capital, not reserves. A more important consideration, however, is that reserve requirements may not contribute to bank solvency over a longer period. To the extent that idle reserves decrease the income of member banks, reserve requirements do not encourage the accumulation of capital from earnings or provide incentive for further investment.

With wider agreement on these issues, attention has focused increasingly on the contribution of reserve requirements to monetary control. That issue has acquired even more importance the past few years as the Federal Reserve has shifted its focus of attention and begun to direct more effort at controlling the money stock.

ultimate goals as price stability, full employment, and satisfactory economic growth.

Still, day-to-day implementation of policy focuses on the Federal funds rate. Each month, the Federal Open Market Committee establishes a target range for the Federal funds rate that it estimates is consistent with the targeted rate of growth for money. The Trading Desk then generally maintains the Federal funds rate within that range.

To the extent that it constrains this interest rate within a narrow range, the Federal Reserve relinquishes short-run discretionary control over reserves and the monetary base. To keep the Funds rate from rising, the Trading Desk supplies additional reserves by buying Government securities. To keep the Funds rate from falling, the Desk withdraws reserves by selling Government securities. Consequently, in order to control the Federal funds rate, the Trading Desk increases or decreases the volume of reserves in response to market demand.

Until the Federal Open Market Committee began publishing numerical ranges for short-run operating targets in January 1974, it was difficult to quantify the relative importance of the many possible target variables, though the high priority attended the Funds rate was well known. Since that time, records from the FOMC meetings have included information on numerical targets. As an example, the relevant section from the record of policy actions for the meeting in May 1976 reads:

> The members agreed that growth in M_1 and M_2 over the May-June period at annual rates within ranges of 4 to 7½ per cent and 5 to 9 per cent, respectively, would be acceptable. They decided that, in assessing the behavior of the aggregates, approximately equal weight should be given to M_1 and M_2.
>
> The members agreed that until the next meeting the weekly-average Federal funds rate might be expected to vary in a gradual and orderly way within a range of 5 to 5¾ per cent.[4]

As the accompanying chart shows, since July 1974, the average value of the Federal funds rate has fallen within the target range specified by the FOMC every month.[5] By contrast, the growth rates for M_1 and M_2, which are averaged over two-month periods, have fallen within their target ranges only a third of the time since July 1974. The monetary base has never been formally targeted, but until recently, targets have been set for a major component of the base–reserves available to support private deposits,

4. *Federal Reserve Bulletin,* July 1976, pp. 587-88
5. In April, May, and June 1974, the Federal funds rate traded at levels above the target ranges specified in the FOMC meetings. In unusual moves, the FOMC raised the upper limit of the Federal Funds rate range in this period. The Committee's willingness to allow the Federal funds rate to rise, instead of injecting reserves, enabled it to hit the RPD target range in four of the six target periods in the first half of 1974. Over that span, both M_1 and M_2 were within their target ranges in each of the six target periods. This evidence is too limited to draw a firm conclusion, but it does suggest that large changes in the Federal funds rate and close control of reserves might permit tighter control over growth in the money stock.

or RPD's. The actual growth rate for RPD's fell within the target range only five times between July 1974 and March 1976, when the targets were no longer included in the policy directive.

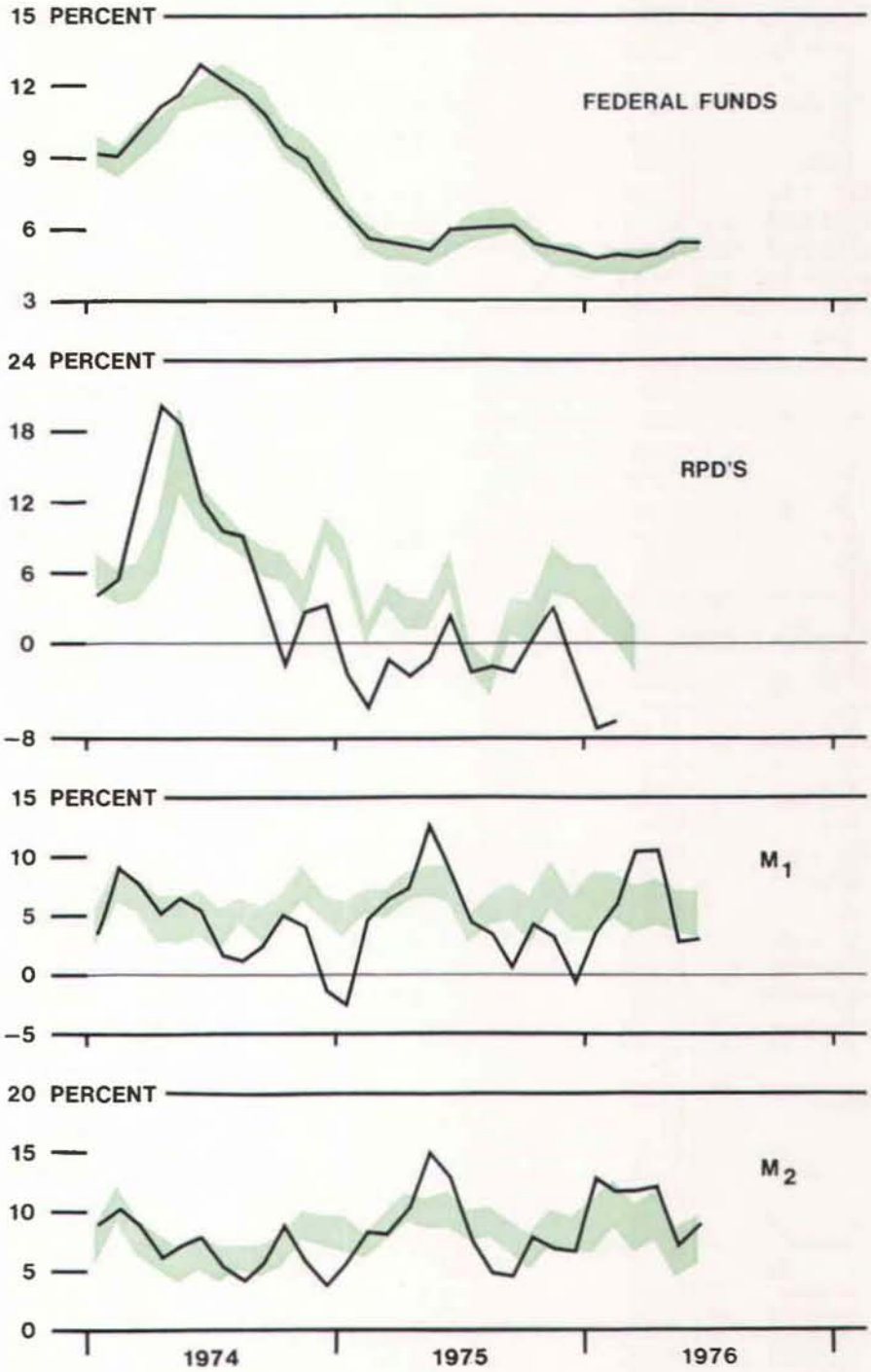
This record indicates that, in the short run, the Federal Reserve has tended to alter the supply of reserves in response to changes in the quantity demanded. If such changes had not been offset, the Federal funds rate would have been pushed outside the target range as affected banks bid in the Federal funds market to eliminate undesired deficiencies or excesses in their reserves.

An open market operation that offsets a change in required reserves, so as to leave money market conditions unchanged, produces a change in the monetary base that, to a large degree, neutralizes the movement in the money multiplier.

For example, if the demand for reserves happened to increase because of a shift of demand deposits to larger banks with higher marginal reserve requirements, the desired borrowing in the Federal funds market would be greater than the lending. The banks with reserve deficiencies would then bid up the Federal funds rate in competition for the available reserves. The Federal funds market provides an efficient mechanism for redistributing reserves among banks, but it cannot be a source of new reserves to the banking system as a whole. So, the initial result of excess borrowing pressure can only be a bidding up of the Federal funds rate.

As the Federal funds rate is increased, banks might then turn to other sources of reserves—through selling securities or com-

Ranges of Intermediate Targets and Achieved Values



SOURCES: Board of Governors, Federal Reserve System
Federal Reserve Bank of Dallas

peting harder for reserves by raising rates offered on time deposits. As they sell securities to the public, the reduction in demand deposits would constitute a reduction in the money supply.

But if the Federal Reserve tends to offset the reserve deficiency through an open market operation that stabilizes the Federal funds rate, and money market conditions generally, there is no longer an incentive for banks to sell securities to the public and no significant net change in the money stock. An open market operation that offsets a change in required reserves, so as to leave money market conditions unchanged, produces a change in the monetary base that, to a large degree, neutralizes the movement in the money multiplier.[6]

Empirical estimates of offset

If changes in required reserves caused by compositional shifts in deposits under the current structure of reserve requirements are offset dollar for dollar by changes in the monetary base, there will not be a significant disturbance in the money stock. The policy record verifying the Trading Desk's success in controlling fluctuations in the Federal funds rate shows that the Federal Reserve has tended to alter the supply of reserves in response to changes in the quantity demanded, thereby tending to accomplish such an offset, in fact. In addition, statistical regression analysis confirms that the degree of offset provided by the normal operating procedures of the Trading Desk is very close indeed.[7]

This analysis shows that since January 1974, the Trading Desk has, on average, responded to a weekly change of one dollar in required reserves by creating a change, in the same direction, of 97 cents in the monetary base through purchases or sales of securities. Furthermore, the difference between the estimated value of 97 cents and the theoretically desirable one-for-one response is not statistically significant. So, the evidence supports the view that the Trading Desk successfully offsets week-to-week changes in required reserves.

The fact that changes in required reserves tend to be accommodated on a weekly basis does not imply that the Federal Reserve loses control of monetary aggregates over longer periods. By adjusting the tolerable range of the Federal funds rate month to month, the Federal Open Market Committee uses interest rates to influence monetary growth over the long run.

Conclusion

When the Federal funds rate is contained within a narrow band on a weekly average basis, as it has been the past two years, different reserve requirements on demand deposits and requirements on other bank liabilities probably do not seriously disrupt monetary control. Banks adjust to net changes in required reserves in ways that create pressure on the Federal funds rate and induce the Trading Desk to absorb or supply reserves through open market operations to maintain the rate within its target range. As this happens, changes in the money multiplier caused by shifts in the composition of deposits are largely offset by changes in the monetary base.

Uniform reserve requirements on all deposits that are included in the money stock could permit more precise monetary control if that were desired.[8] However, under present objectives of open market operations, reserve requirements do not function as the fulcrum of monetary control. Reserves and reserve requirements do not fix the volume of demand deposits. In fact, the opposite is true. The vol-

6. The nature of the offset in terms of the multiplier model is described in the technical appendix.
7. Details of this analysis are given in the technical appendix.
8. If policy were conducted so as to achieve precise short-run control over the monetary base instead of the Federal funds rate, changes in the structure of reserve requirements that make the relationship between reserves and the money stock more stable would then make a difference for monetary control. A more stable and predictable money multiplier would lead to a more predictable money stock, given the base, and, hence, facilitate monetary control.

   Of course, precise control of the money stock has not been the sole short-run objective of the Federal Reserve. When the money stock departs from its targeted path, the Federal Reserve generally attempts to bring it back on course only gradually because the alternative would require an adjustment in the Federal funds rate deemed too large and disruptive to be consistent with the maintenance of orderly financial markets.

   Nevertheless, if the current practice of smoothing short-run fluctuations in interest rates were abandoned in favor of more precise control of the money stock over short periods, recent studies suggest that–given the current structure of reserve requirements–an operating strategy focusing on the monetary base would be about as effective as one keyed to the Federal funds rate. See, for example, William R. McDonough, "Monetary Policy–Effectiveness of Alternative Approaches to Monetary Control," *Business Review,* Federal Reserve Bank of Dallas, August 1976. Therefore, steps to reform the structure of reserve requirements so as to make the required reserve ratio more stable than at present might tip the advantage to a reserve aggregate strategy and allow more accurate short-run monetary control than is currently feasible.

ume of deposits depends on interest rates and other variables. Reserve requirements determine the volume of reserves the Trading Desk supplies or absorbs to maintain interest rates in the target range.

Just as reserves depend on the level of deposits, the base depends on the total money stock. Some observers believe that increases in the monetary base are a leading indicator of increases in the money supply. This argument would have some merit if the base were independently determined. But when reserves are supplied in response to current demand, the base is determined by the money stock–rather than the other way around. The base then becomes a coincident indicator of currency and, because of lagged reserve requirements, a lagging indicator of demand deposits. Any value it has as a leading indicator is accidental.

–Edward E. Veazey

Technical appendix

The basic multiplier model expresses the money stock (M) as a multiple (m) of the base (B):

$$M = mB.$$

The expression for m in terms of ratios can be derived by substituting the elements of the money stock and the base in the money multiplier relationship. The money stock is composed of demand deposits (D) plus currency held by the public (C). The base is composed of required reserves at member banks (R) plus excess reserves at member banks (E) plus vault cash at nonmember banks (V) plus currency held by the public (C). Substituting terms and dividing by D, the multiplier is obtained as:

$$m = \frac{M}{B} = \frac{(D + C)/D}{(R + E + V + C)/D}.$$

Division by D makes it possible to express the multiplier in terms of four ratios–$r = R/D$, $e = E/D$, $v = V/D$, and $k = C/D$. Thus:

$$m = \frac{1 + k}{r + e + v + k},$$

and

$$M = \frac{1 + k}{r + e + v + k} B.$$

The impact of a change in required reserves can be analyzed by differentiating the multiplier model with respect to R:

$$\frac{dM}{dR} = \frac{dm}{dR} B + \frac{dB}{dR} m.$$

Consider a change in required reserves that is caused by a shift that leaves total demand deposits unchanged. (This would be the case, for example, if demand deposits simply shifted between banks of different sizes.) The currency ratio, k, would not be affected. If the demand for excess reserves and for vault cash depends on such factors as interest rates, deposit variability, and total demand deposits–rather than on the distribution of deposits among banks–the e and v ratios would also remain constant. In this case, dm/dR can be evaluated as:

$$\frac{dm}{dR} = -\frac{1 + k}{(r + e + v + k)^2} \frac{1}{D} = -\frac{m}{B},$$

and substitution then gives:

$$\frac{dM}{dR} = -m + \frac{dB}{dR} m.$$

If B were exogenous (if $dB/dR = 0$), the disruptive impact of an increase in R would be to reduce M by m times the change in R. However, when the base is adjusted by the

Trading Desk to offset changes in R (that is, when $dB/dR = 1$), then the two components exactly offset one another, and $dM/dR = 0$.

It is possible to test the Trading Desk's response to changes in required reserves by estimating a model of open market operations. The equation estimated is:

$$\Delta G = b_0 + b_1\Delta R + b_2\Delta C + b_3\Delta O + u.$$

The variables are defined as follows:

ΔG = change in Reserve bank holdings of U.S. Government securities

ΔR = change in required reserves

ΔC = change in currency in circulation

ΔO = change in the composite of other variables that also affect bank reserves[1]

u = random disturbance, assumed to have an expected value of zero

The equation was estimated with a least squares regression on first differences of average weekly levels, beginning in January 1974 (when numerical ranges for interest rates and monetary aggregates were first announced) and ending with June 1976. To minimize the possibility of simultaneous equation bias stemming from the possible endogeneity of the composite variable, O, we created O^*, an instrumental variable that excludes the effect of Wednesday data. That is, in place of the daily average of O for the entire statement week ending Wednesday, we use O^*, which depends on the daily values only through Tuesday.

By Wednesday, the Trading Desk has fairly accurate data for the major factors affecting reserves for the first six days of the statement week and bases Wednesday's open market operations on those data. Using O^* in place of O in the regression reduces the possibility that the value of the regressor is determined simultaneously with open market operations. The value of O^* has already been determined when the Trading Desk determines the level of ΔG for the statement week in a final adjustment in Wednesday's operations.

The required reserve variable, ΔR, presents no problem since it is predetermined under lagged reserve accounting. The currency variable, ΔC, is assumed to be determined by factors, such as seasonal demand for currency, that are not affected by the level of open market operations. Also, the Federal Reserve can measure changes in C by simply monitoring its own shipments of currency. Therefore, it is assumed that ΔC is exogenous and its value is known.

We are interested in determining whether the structure of reserve requirements has contributed to the instability of the money stock. There is little doubt that variation in required reserves caused by deposit shifts would complicate monetary control if the Trading Desk were attempting to maintain the monetary base on a predetermined path. However, if each change in required reserves is matched by an equal change in the base, the two changes would tend to offset one another. The variation in required reserves would not then be a significant source of monetary instability.

Since open market operations have a direct impact on the reserve component of the base, we can test the hypothesis that the Trading Desk offsets changes in required reserves by testing the hypothesis that the coefficient of ΔR is equal to 1. The regression results favor acceptance, rather than rejection, of that hypothesis. The regression results are given in the accompanying table.

1. Weekly average holdings of U.S. Government securities, currency in circulation, and all variables except net reserve carryover that are included in the composite O are in the *Federal Reserve Bulletin* table "Member Bank Reserves, Federal Reserve Bank Credit, and Related Items." Carryover is reported in the Federal Reserve release H.4.1. Required reserves are in the Bulletin table "Reserves and Borrowings of Member Banks."

The composite variable is calculated as: O = float + other Federal Reserve assets + acceptances and discrepancy (calculated by subtracting the itemized components of Reserve bank credit outstanding from the total) + gold stock + Special Drawing Rights certificate account + Treasury currency outstanding – Treasury cash holdings – deposits, other than member bank reserves with Federal Reserve banks – other Federal Reserve liabilities and capital + member bank currency and coin reserves + net reserve carryover.

MULTIPLE REGRESSION ANALYSIS OF OPEN MARKET OPERATIONS

(Dependent variable = ΔG)	Constant	Independent variables				
		ΔR	ΔC	ΔO^*	T_1	T_2
Ordinary least squares estimate ...	8.53	.97	1.04	−1.09		
	(39.62)	(.08)	(.14)	(.32)		
Estimated variance of coefficient, assuming random coefficient model	.14	.05	.04	.08		
Ordinary least squares estimate ...	−68.15	1.11	1.04	−1.10	−26.40	30.99
	(473.48)	(.10)	(.17)	(.04)	(48.36)	(35.77)

NOTE: Figures in parentheses are standard errors of the coefficients.

The estimate of b_1, the coefficient of ΔR, is .97–with a standard error of .08.

Thus, the empirical evidence is consistent with the hypothesis that when a shift in deposits between banks with different requirements gives rise to a deficiency or surplus of reserves, the Federal Reserve accommodates the shift by supplying or withdrawing reserves in open market operations. Similarly, when fluctuations in time deposits, U.S. Government deposits, or other bank liabilities create changes in required reserves, the Federal Reserve largely accommodates the new demand. The structure of reserve requirements influences the volume of open market operations, but, on balance, there is no significant effect on the money stock.

A similar argument applies to an increase in currency demand by the public, given its demand for the total money stock. When demand for currency increases and depositors increase their currency holdings by drawing down their checking accounts, the transaction–in addition to changing a bank's required reserves–also changes the bank's available reserves.[2] But if the Federal Reserve exactly matches the flow of currency from its vaults with open market transactions (in addition to offsetting the change in required reserves), the transaction probably does not destabilize the money stock to a significant degree.

Although currency in circulation, C, includes vault cash of nonmember banks, it consists mainly of currency in the hands of the public. Therefore, we can test the response of the Trading Desk to changes in the public's demand for currency with the statistics already estimated. The hypothesis that the coefficient of ΔC in the regression equation equals 1 cannot be rejected. Our estimate of this coefficient is 1.04, with a standard error of .14. These results are consistent with the hypothesis that the Trading Desk offsets changes in C that might otherwise be the cause of instability of the money stock.

An assumption underlying this regression model is the standard one that the coefficients are constant. But when this assumption is applied to the behavior of the Trading Desk, it assumes away an interesting question: Is the response of the Trading Desk to changes in reserve requirements uniform over all observations? If the demand for reserves varied unpredictably with changes in required reserves, the response of the Trading Desk would have to vary also in order to stabilize the Federal funds rate. Under these circumstances, it might be argued that the structure of reserve requirements added to the difficulty of controlling the Federal funds rate.

To test the stability of the Trading Desk's response, we altered the basic assumption of the regression model to allow for the possibility that the coefficients vary over time. In this random coefficient model, each coefficient can be written:

$$b_i = b^*_i + d_i,$$

where b^*_i is the expected value of the co-

2. Lagged reserve accounting changes the timing, but not the direction or amount, of these changes.

efficient of the ith explanatory variable and d_i is a random component with assumed zero mean and constant variance. Thus, for all observations, it is assumed that:

$$E(d_i) = O \text{ for all } i$$
$$E(d_i d_j) = \sigma_{ii} \text{ for } i = j$$
$$= O \text{ otherwise.}$$

Unbiased and consistent estimates of the variance of the coefficients were obtained with a method due to Clifford Hildreth and James P. Houck.[3] The estimated variances of the required reserve coefficient and the currency coefficient are .05 and .04, indicating relatively stable responses.

Evidence presented in the text suggests that the Trading Desk has been much more successful in hitting its interest rate target than in maintaining the monetary aggregates within their target ranges. The Federal funds rate has fallen within the target range every month since July 1974, while the monetary aggregates, M_1 and M_2, have fallen within their target ranges only about a third of the time. This evidence supports the hypothesis that the Trading Desk allows smaller fluctuations in the Federal funds rate relative to the target than in the monetary aggregates.

It is possible to examine this hypothesis more formally by adding other explanatory variables to the model of Trading Desk operations and testing for the relevance of other influences on open market operations. Of particular interest is the response of the Trading Desk to deviations of the monetary aggregates from the targets specified by the Federal Open Market Committee. The Trading Desk continuously monitors the growth rate of money and might be expected to adjust open market operations when the current growth rates deviated widely from target.

We reestimated our model of open market operations to include two additional variables, T_1 and T_2, which measure deviations of the growth rates of the monetary aggregates from target levels. When these variables are included in the regression model of open market operations, neither is significant at a 10-percent level. The hypothesis that these variables do not significantly influence the volume of day-to-day open market operations cannot be rejected.

Of course, this does not imply that monetary growth rates do not influence policy. The FOMC continuously monitors monetary growth rates and considers past growth and estimated future growth before deciding on the appropriate monthly range for the Federal funds rate and other target variables. Thus, the range that the FOMC adopts for the Federal funds rate is based partly on desired long-run monetary growth rates. However, in day-to-day open market operations, there is no significant response in the amount of reserves provided to the deviations from two-month monetary growth targets.

3. "Some Estimators for a Linear Model with Random Coefficients," *Journal of the American Statistical Association* 63, no. 322 (June 1968)

New member bank

Hays County National Bank, San Marcos, Texas, a newly organized institution located in the territory served by the San Antonio Branch of the Federal Reserve Bank of Dallas, opened for business November 5, 1976, as a member of the Federal Reserve System. The new member bank opened with capital of $400,000, surplus of $400,000, and undivided profits of $200,000. The officers are: William C. Carson, Chairman of the Board; John N. Cunningham, President; David M. Edwards, Vice President and Cashier; and Steve Hadlock, Vice President.

New par banks

Caldwell Bank & Trust Company, Columbia, Louisiana, an insured nonmember bank located in the territory served by the Head Office of the Federal Reserve Bank of Dallas, began remitting at par November 1, 1976. The officers are: E. L. Carroll, Sr., Chairman of the Board; R. J. Lee, Executive Vice President; R. E. Chapman, Vice President and Cashier; Ronnie Darden, Vice President; and Margie Fore, Vice President and Assistant Cashier.

Texas Bank of Amarillo, Amarillo, Texas, a newly organized insured nonmember bank located in the territory served by the Head Office of the Federal Reserve Bank of Dallas, opened for business November 15, 1976, remitting at par. The officers are: J. Richard Hankins, President; Rhea F. Raines, Vice President and Cashier; and Cecil Mason, Vice President.

Federal Reserve Bank of Dallas
December 1976

Eleventh District Business Highlights

DEMAND DEPOSITS TURN OVER FASTER

Rapid inflation and high interest rates the past few years have resulted in more sophisticated asset management by the public. Sound economic management dictates that idle funds be reduced to a minimum and that most funds be held as earning assets.

This is evident in the management of the public's cash balances at commercial banks. Demand deposits have become more expensive for people to hold in recent years, as inflation cut deep into the purchasing power of money and interest rates rose sharply.

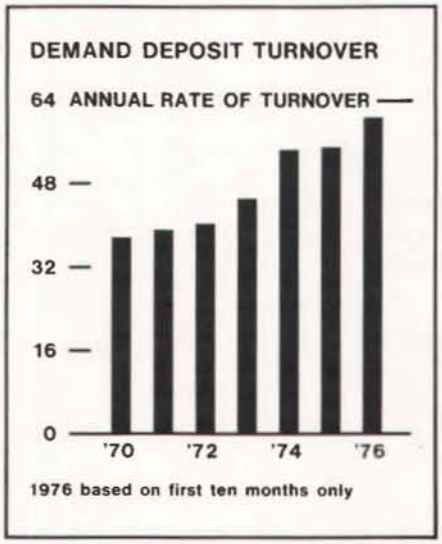
The rapid inflation of the past four years has increased the nominal cost of household and business operations. Since most payments for goods and services are by check, use of demand deposits at banks has risen substantially. Consequently, the dollar volume of checks written has risen sharply—much more than the average level of deposits. Stated another way, the annual rate of turnover of these accounts—the number of times each dollar of demand deposits is spent during a year—has increased sharply.

Each month commercial banks in the 30 largest metropolitan areas in the Eleventh District report data on demand deposit accounts of individuals, partnerships, and corporations and of state and local governments. These groups hold the bulk of demand deposit accounts.

In 1970, depositors used demand deposit balances an average of 38 times. By the end of 1972, however, inflationary pressures began to build rapidly. Prices and interest rates escalated, and speculative buying by consumers and businessmen mounted to a fever pitch. The increase in spending pushed debits up sharply. At the same time, the growth in demand deposits slowed markedly. And by 1974, the annual turnover rate had risen to nearly 55 at District banks.

In 1975, the economy moved from recession to recovery. Short-term interest rates fell sharply. The three-month Treasury bill rate, for example, fell to 5.8 percent from 7.8 percent the prior year. Moreover, the rate of inflation declined to almost 9 percent from about 11 percent, and real disposable income inched upward.

As a result, demand deposits at District banks began to expand at a faster pace, after slowing two consecutive years. The growth rate of debits, however, slowed sharply, mainly because business—still keenly aware of excessive spending in the two previous years—assumed a cautious stance toward further spending. Therefore, the turnover of demand deposits rose only slightly from a year earlier.



With a continued slowdown in inflation from very high levels, most short-term interest rates declined about 50 basis points more in the first ten months of 1976, and total demand deposits in the District picked up. As the recovery progressed, spending by both businesses and consumers rose moderately. The ratio of debits to demand deposits resumed climbing steeply, so the annual turnover reached 61.

The turnover of demand deposits has risen considerably faster in the largest metropolitan areas in Texas. In the first ten months of 1976, customers of banks in the Dallas area, for example, turned over their demand deposit balances at an annual rate of 89 times; in the Houston area, the turnover rate was 69. Historically, these two areas have accounted for well over half the total debits to demand deposits in the 30 reporting centers in the District.

Since Dallas and Houston are the major business and financial centers in the District, it is not surprising that debits to demand deposits are higher in these areas. Large metropolitan areas have a high concentration of businesses, and business accounts generally have a faster turnover than others.

BUSINESS LOAN DEMAND SOFT

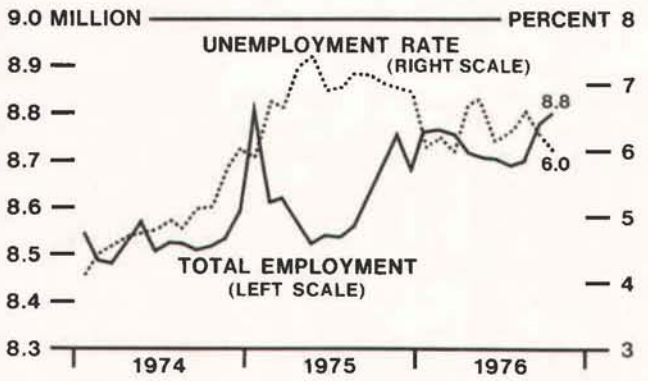
With few exceptions, demand for business loans at weekly reporting commercial banks in the Eleventh District has remained weak in 1976. Many industries have made sizable net repayments of their bank indebtedness, and total loans to businesses increased only 1.6 percent in the first ten months of the year, compared with a decrease of

(Continued on back page)

INDUSTRIAL PRODUCTION
(SEASONALLY ADJUSTED)

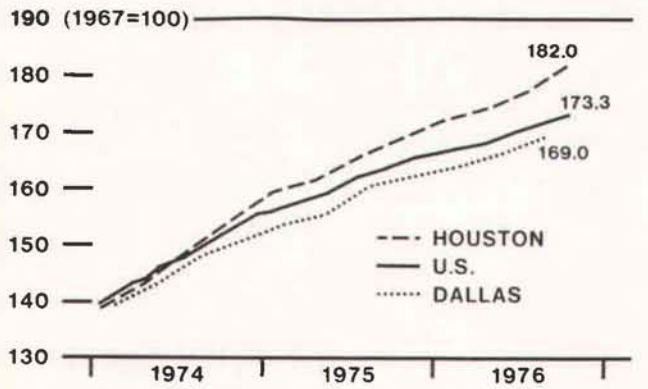
SOURCES: Board of Governors, Federal Reserve System
Federal Reserve Bank of Dallas

EMPLOYMENT AND UNEMPLOYMENT
FIVE SOUTHWESTERN STATES[1]
(SEASONALLY ADJUSTED, BY FRB)



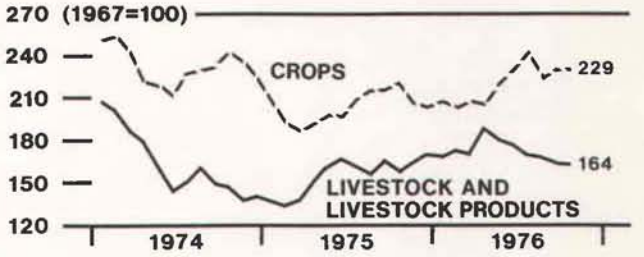
1. Arizona, Louisiana, New Mexico, Oklahoma, and Texas
SOURCE: State employment agencies

CONSUMER PRICES



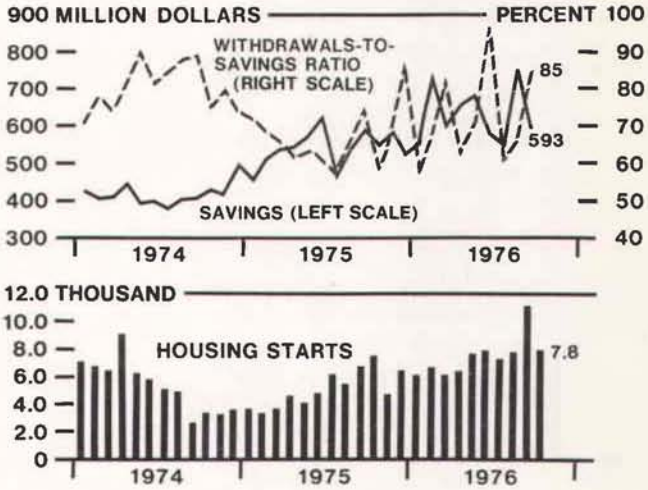
SOURCE: U.S. Bureau of Labor Statistics

PRICES RECEIVED BY TEXAS FARMERS



SOURCE: U.S. Department of Agriculture

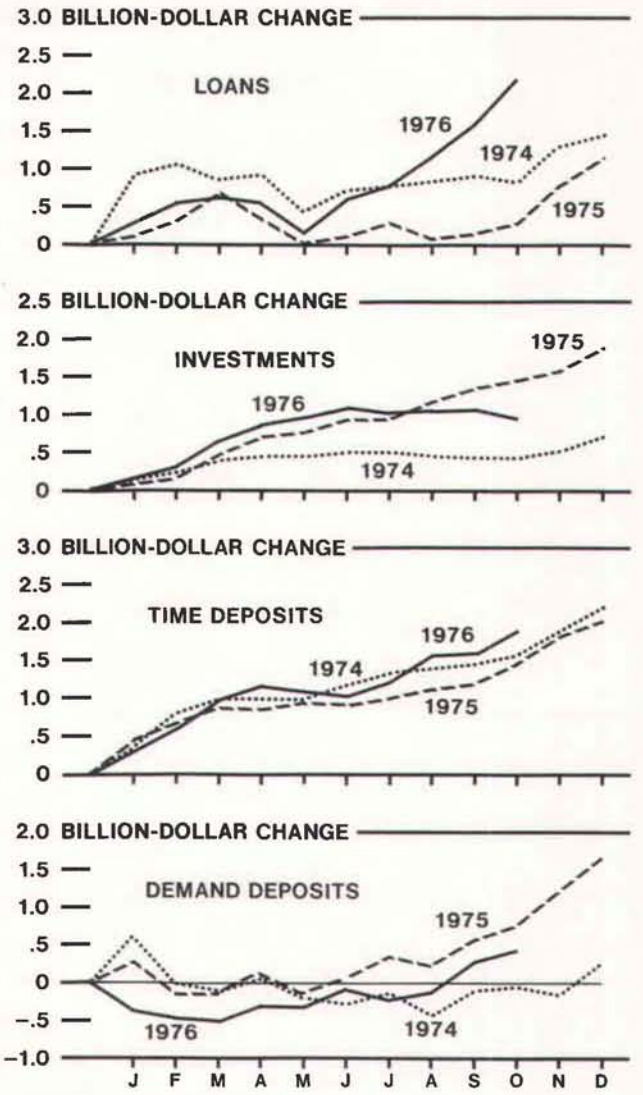
SAVINGS AND LOAN ASSOCIATION ACTIVITY AND HOME BUILDING IN TEXAS
(SEASONALLY ADJUSTED, BY FRB)



SOURCES: Bureau of Business Research, University of Texas
Federal Home Loan Bank of Little Rock

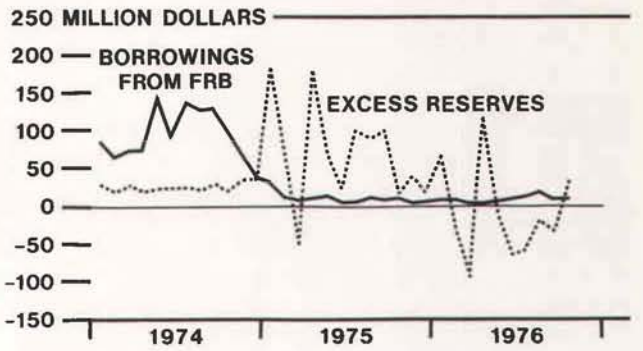
CONDITION STATISTICS OF ALL MEMBER BANKS

ELEVENTH FEDERAL RESERVE DISTRICT
(CUMULATIVE CHANGES)



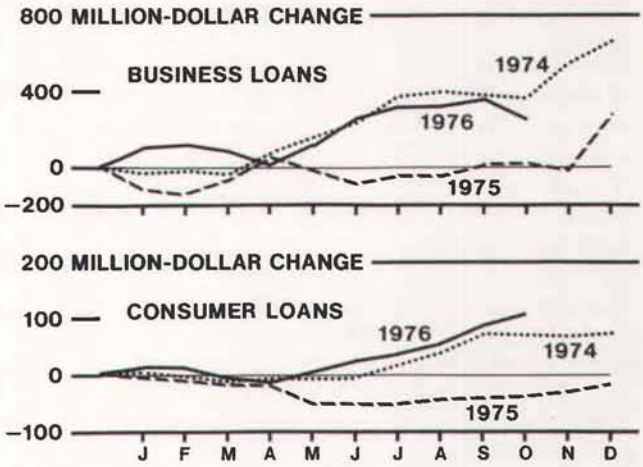
RESERVE POSITION OF MEMBER BANKS

ELEVENTH FEDERAL RESERVE DISTRICT
(MONTHLY AVERAGES OF WEEKLY DATA)



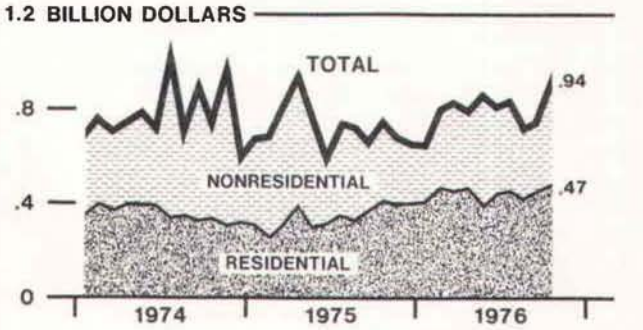
LOANS AT WEEKLY REPORTING BANKS

ELEVENTH FEDERAL RESERVE DISTRICT
(CUMULATIVE CHANGES)



BUILDING CONTRACTS

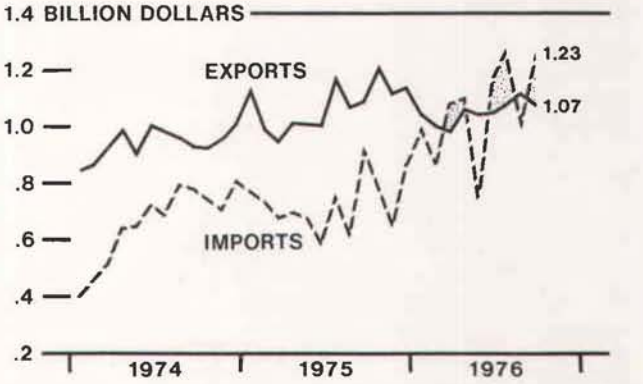
FIVE SOUTHWESTERN STATES[1]
(SEASONALLY ADJUSTED, BY FRB)



1. Arizona, Louisiana, New Mexico, Oklahoma, and Texas
SOURCE: F. W. Dodge, McGraw-Hill, Inc.

FOREIGN TRADE

HOUSTON CUSTOMS REGION
(SEASONALLY ADJUSTED, BY FRB)



SOURCE: U.S. Department of Commerce

0.5 percent in the corresponding period last year.

The slow growth in demand for business loans this year probably reflects both an increase in the supply of funds available from other sources and a decrease in the need for bank funds. Increased sales and profit margins during the recovery have resulted in sharply higher internal cash flows. Moreover, some companies have used the commercial paper market or have refunded short-term debt with borrowing in bond markets.

A reduced need for short-term funds has depressed the demand for bank loans. Business inventories have been reduced, and many firms used a portion of sales to repay bank debt. Inventory levels are being closely monitored to prevent involuntary buildup in inventories.

The only major sources of strength in business loan demand in in 1976 have been the oil and gas industry and retail trade. The rate of increase in mining loans slackened from the extremely rapid pace a year ago, as drilling activity slumped through last May from the peak level at the end of 1975. But with a rebound in drilling, the petroleum industry has continued to make heavy demand for bank funds to finance exploration and development of oil and gas fields.

Demand for bank loans by retailers has trended upward all year as merchants cautiously raised the level of their inventories. An acceleration in loan demand was evident in the fall, when retail inventories were expanded in anticipation of an improved Christmas buying season.

Loan demand by manufacturing industries as a group was flat in the first ten months of 1976. Output of manufactured goods, as measured by the Texas industrial production index, declined sharply in the second quarter and did not recover to the peak established last March until the end of the third quarter. Overall, producers of durable goods have made a small net repayment of their bank debt, despite sizable increases in borrowing by the primary metal and transportation equipment industries.

Loans to manufacturers of nondurable goods have risen only slightly this year. A sharp increase in loans to producers of textiles, apparel, and leather and a moderate gain in loans to manufacturers of chemicals and rubber were almost offset by declines in loans to producers of other nondurable goods.

Transportation, communication, and public utility industries have reduced their bank debt considerably this year. The decline in loans to public utilities has been especially sharp and reflected, in part, the continued refinancing of short-term debt in the capital market.

Bank loans to the construction industry declined 12 percent through October this year, even though residential building, especially of single-family houses, has been strong in the District. However, a pickup in the demand for funds has become apparent as building construction has begun to show more strength.

OTHER HIGHLIGHTS:

- The Texas industrial production index, seasonally adjusted, remained virtually unchanged in October from a month earlier, according to preliminary data. Manufacturing continued to recover, while mining output was down sharply.

In durable goods manufacturing, substantial output gains were evident for all major industries except stone, clay, and glass. In the case of nondurable goods, strong advances were recorded by the apparel and printing and publishing industries. Output of petroleum refining and paper products industries weakened.

Crude petroleum production accounted for the decrease in mining output. Drilling, however, increased for the fifth month in a row.

- The unemployment rate for the five southwestern states declined to 6.0 percent of the total civilian labor force in October from 6.3 percent a month earlier. The decline was the second in a row and placed the jobless rate at the lowest level since March.

Total employment increased for the third month in a row, reaching the highest level since January 1975. The statistics suggest that the rise can be traced largely to employment of unemployed workers already in the labor force, since unemployment has fallen sharply for two consecutive months.

- The value of total construction contracts in the five southwestern states reached an all-time high in October. The increase centered in nonbuilding construction, largely because of contracts for two electric power and heating plants in Texas and Louisiana that totaled $875 million.

The total value of contracts for structures in October was at the highest level since April 1975. Nonresidential building contracts climbed nearly three-fifths from September. Residential building contracts were more than 6 percent above a month before.

Housing starts in Texas fell to 7,800 units, seasonally adjusted, in October. The decline, however, followed the unusually high level of starts in September that resulted, in part, from increased Government-financed housing activities.

- Total loans and investments at member banks in the Eleventh District rose in October for the fifth consecutive month, as bank loans expanded at the fastest rate for any month since November 1973. The gain largely reflected a sharp increase in demand for real estate loans and continued strength in loan demand by consumers and the oil and gas industry.

Member banks slightly increased holdings of U.S. Government obligations and moderately reduced holdings of other securities in October. In addition, the banks stepped up borrowings in the Federal funds market to finance the increase in loan demand.

The growth of deposits at District banks slowed slightly in October. Two factors have contributed to the slowdown in deposit inflows. First, interest rates offered on time and savings accounts at a significant number of banks have been drifting down since last June. Moreover, many banks have switched their advertising campaigns promoting time and savings deposits to encouraging loans.

1976

Business Review

Federal Reserve Bank of Dallas