# The Changing Interest Sensitivity of the U.S. Economy

By George A. Kahn

Following the breakdown of relationships between the monetary aggregates and the economy, the Federal Reserve in recent years has had to rely more heavily on short-term interest rates as an instrument of monetary policy. As a result, policymakers want reliable measures of how changes in short-term interest rates affect the U.S. economy. Recent events, however, may have changed the historical relationship between interest rates and economic performance. These events include changing methods of housing and consumer finance, the rising importance of international trade, and the changing financial structure of business firms.

Because of the structural changes implied by these events, policymakers need to reconsider how monetary policy affects the economy. For example, eliminating interest rate ceilings

George A. Kahn is a senior economist at the Federal Reserve Bank of Kansas City. Kristina Jacobson, a research associate at the bank, assisted in the preparation of this article.

on consumer deposits may have made the housing industry more immune to increases in interest rates. New forms of financing consumer durable purchases may have had a similar effect on consumption. On the other hand, the greater share of exports and imports in GNP and the rising indebtedness of business firms may have made these other sectors of the economy more sensitive to interest rates.

While economists generally agree that the channels of monetary policy have changed, economists have reached no such consensus on the overall effect of these changes. Any change in the overall sensitivity of the economy to interest rate changes, however, is at least as important as changes in the channels of influence. Overall changes in the economy's interest sensitivity affect the potency of monetary policy. A decrease in interest sensitivity, for example, might mean that a larger swing in short-term interest rates would be required to achieve the same results that a smaller change once generated. Moreover, periods of monetary

restraint or ease might have to be sustained for longer periods than in the past to achieve the same results.

This article examines evidence on the changing interest rate sensitivity of the U.S. economy. The first section of the article shows how interest rates affect real output and how this effect may be changing in four key sectors —housing, consumption, business fixed investment, and foreign trade. The second section uses an empirical model to measure changes in the interest sensitivity of sectoral and aggregate output. The article concludes that declining interest sensitivity in many key sectors of the economy has led to an overall reduction in the interest sensitivity of real GNP in the 1980s. Evidence supports a decline in the interest sensitivity of housing and consumption but fails to detect a significant relationship between investment and interest rates, much less a change in this relationship. Net exports, which used to rise when interest rates rose, now fall.

# I. WHY THE ECONOMY'S INTEREST SENSITIVITY MAY HAVE CHANGED

The economy of the 1980s is in many ways different from the economy of earlier decades. Financial markets have moved gradually toward deregulation; new financial instruments have emerged; international trade and financial flows have become more important to the United States; and business firms have become caught up in a mergers-and-acquisitions boom financed largely by borrowing. As a result of these structural changes, it would not be surprising to find that monetary policy now works through different interest rate channels than in earlier decades. Nor would it be surprising to find that

the size of monetary policy's effect on the economy has changed.

Monetary policy works principally through interest rates. By directly controlling very short-term interest rates, the Federal Reserve indirectly influences longer term interest rates. Longer term interest rates, in turn, affect spending on housing, business investment, consumer durables, and other interest sensitive sectors. Thus, any change in the economy's interest sensitivity potentially changes the impact that monetary policy has on overall economic activity as well as on individual sectors of the economy. This section examines how and why the interest rate sensitivity of housing, consumption, business investment, and foreign trade may have changed in the 1980s.[1] While the interest sensitivity of other sectors may also have changed, the sectors examined in this article are generally thought to have been affected the most by structural change.

## Housing

The housing sector has customarily served as an important fulcrum of monetary policy. Because housing starts have traditionally been very sensitive to mortgage interest rates, policy actions that have led to increased mortgage rates have tended to contract the housing industry. Over the last few years, however, financial market deregulation and innovation have lessened the interest sensitivity of housing. In particular, the diminishing influence and eventual removal of interest rate ceilings on con-

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1 For more detailed discussions of these issues, see Bosworth 1989, Friedman 1989, and Dudley 1989.

sumer deposits, the growth of the secondary mortgage market, and the advent of adjustable-rate mortgages have reduced the interest sensitivity of the housing industry.[2]

When deposit rate ceilings were in effect, contractionary monetary policy hit the housing industry particularly hard. Before the 1980s, interest rates on deposits could only rise so far when the Federal Reserve tightened monetary policy and market interest rates rose. In 1972, for example, the interest rate ceiling at thrifts was 5.0 percent on passbook savings accounts and 5.25 percent on short-term time deposits under $100,000. Such interest rate ceilings restricted the ability of banks and savings and loan institutions to attract deposits used to fund mortgages and other loans. As market rates rose above interest rate ceilings, consumers pulled their money out of banks and savings and loans and put it into assets earning a market rate of return. This process, called disintermediation, forced depository institutions to reduce mortgage originations and caused housing starts to plummet.[3] From 1972 to 1974, for example, single-family housing starts fell roughly 33 percent as short-term market interest rates rose from about 4 to 8 percent.

The Depository Institutions Deregulation and Monetary Control Act of 1980 (DIDMCA) gradually reduced disintermediation by phasing out interest rate ceilings on consumer

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[2] For a more detailed examination of factors affecting the interest sensitivity of the housing industry, see Pozdena 1989.

[3] For more information on the effects of financial market deregulation and disintermediation, see Keeton 1986 and Lombra 1984.

deposits and authorizing the introduction of new deposit accounts. Under DIDMCA and subsequent legislation, banks were allowed in late 1982 to issue special deposit accounts, such as money market deposit accounts, that paid market rates of interest. Moreover, the Federal Reserve completely lifted interest rate ceilings on demand deposits in 1986. Because of these regulatory developments, interest rates on deposits now rise more closely in line with market interest rates. When the Federal Reserve tightens monetary policy and interest rates rise, banks can continue to attract funds for mortgages and other loans by raising deposit interest rates. Qualified home buyers who are willing to pay higher rates for mortgages are able to obtain them.

Another related development that has possibly changed the interest sensitivity of the housing sector is the development of the secondary mortgage market. Before the development of this market, depository institutions provided the majority of funds for mortgages. In 1964, for example, savings and loan associations, mutual savings banks, and commercial banks together accounted for nearly 80 percent of all mortgage lending (Friedman 1989, p. 6). When deposit growth slowed at these institutions because of disintermediation, no alternative source of funds was available for mortgage finance.

With the development of the secondary mortgage market, however, the housing industry no longer depends as critically on depository institutions. In fact, secondary mortgage pools now provide the majority of mortgage funds. Sponsors of mortgage pools, such as the Federal National Mortgage Association and the Federal Home Loan Mortgage Corporation, take mortgages from approved originators and issue debt

instruments against the resulting pool.[4] These mortgage pools, which grew relatively slowly in the 1970s, experienced rapid growth in the 1980s. From 1980 to 1988, they accounted for over 50 percent of all net lending for mortgages (Friedman 1989, p. 7). These pools have opened housing finance to the enormous savings controlled by institutional investors such as pension funds, mutual funds, and life insurance companies. As a result, the secondary mortgage market has sharply reduced the dependence of the housing industry on depository institutions and reduced the adverse effects of disintermediation.[5]

A final source of reduced interest sensitivity in housing is the advent of adjustable rate mortgages (ARMs). ARMs tie mortgage interest rates to short-term market rates. ARMs are attractive to consumers because they offer a lower initial interest rate than fixed-rate mort-

gages. Issuers of ARMs can provide attractive rates because consumers assume part of the risk of future increases in market rates. Consumers assume only part of the risk, however, because the adjustment of interest rates in ARMs is capped. For example, a typical ARM might be tied to the one-year Treasury bill rate, but limited to an interest rate increase of 2 percent in any one year and 5 percent over the life of the mortgage.

Sharp increases in market interest rates made qualifying for a mortgage much more difficult before 1981, the year the Federal Home Loan Bank Board first allowed federally chartered savings and loans to issue ARMs. Before 1981, when interest rates rose, many consumers found they could not afford a mortgage or did not qualify for one. Rules of thumb for mortgage qualification require that mortgage payments—mostly interest in the first years of a mortgage—not exceed a certain percent of household income. Thus, a rise in mortgage interest rates reduced the number of qualified potential home buyers and slowed the growth of housing starts.

With the introduction of ARMs in 1981 and their increasing acceptance among consumers, higher rates on fixed-rate mortgages no longer necessarily cause households to drop out of the housing market. Instead, consumers can opt for an ARM that carries a lower initial interest rate, making qualification easier. The option of purchasing adjustable, rather than fixed-rate, mortgages has given the housing industry greater resilience in the face of interest rate increases.

Partly offsetting the effect of ARMs on the interest sensitivity of housing, however, is the increased sensitivity ARMs impart to the non-mortgage component of the household budget. When interest rates rise, holders of ARMs

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[4] For a description of the secondary mortgage market and the impact of securitization on housing finance, see Sellon and VanNahmen 1988.

[5] Partly offsetting this effect, though, is the growing link between mortgage markets and other capital markets. Before the development of the secondary mortgage market, the market for mortgages was regional. The amount of credit issued in a regional market depended on the supply of deposits to banks and thrifts in that region and on the regional demand for mortgage credit. As a result, housing markets were relatively isolated from national credit markets. Changes in the level of long-term interest rates in national capital markets did not necessarily lead to changes in mortgage interest rates at the regional level. With the growth of the secondary mortgage market, however, mortgage rates more closely follow capital market rates. Changes in long-term market interest rates have a more immediate impact on mortgage markets. Therefore, the transmission lag from monetary policy to the mortgage market may have been shortened. See Roth 1988 for details on the importance of this effect.

generally face higher monthly mortgage payments. These higher payments potentially reduce the spending of households on other goods and services. Thus, the decreased sensitivity of housing to interest rate changes is partly offset by the increased sensitivity of other components of spending. Limiting the importance of this effect, though, is the caps most ARMs place on interest rate increases and the initial discount most ARMs offer over fixed-rate mortgages.[6]

## Consumption

Structural changes affecting the interest sensitivity of consumption are smaller and more likely to be mutually offsetting than changes in the structure of the housing industry. Nevertheless, because consumption represents a much larger share of GNP than housing, even a small change in consumption's interest sensitivity has important ramifications for aggregate output and monetary policy. The analysis of the housing sector has already alluded to two opposing factors that may nevertheless have changed the interest sensitivity of consumption behavior. These factors are the decreased importance of disintermediation, which reduces interest sensitivity, and the growth of ARMs, which increases the interest sensitivity of the nonmortgage component of the household budget. Other factors that work in opposite directions are innovations in consumer finance, which decrease the interest sensitivity of consumption,

and a buildup of consumer debt, which increases interest sensitivity.

Just as the decline of disintermediation reduces the interest sensitivity of the housing sector, it also reduces the interest sensitivity of consumption. Because consumer durables, especially automobiles, are often financed by borrowing from banks, spending on consumer durables is influenced by the ability of banks to attract deposits and make loans. When interest rate ceilings were in effect, increases in market interest rates reduced the availability of credit for automobile purchases and potentially reduced auto sales. Today, with the deregulation of deposit interest rates, auto sales should be less affected than before by changes in market interest rates.

Reinforcing this reduced interest sensitivity of consumption are recent innovations in consumer finance. Cut-rate auto financing, for example, has reduced or eliminated the connection between market interest rates and rates paid on automobile loans.[7] Automobile manufacturers frequently offer below-market interest rates on car loans as a buyer incentive that does not require marking down sticker prices. To the extent that such arrangements sever the link between market interest rates and rates paid on car loans, cut-rate financing reduces the interest sensitivity of consumption.

Two additional innovations in consumer finance that may have reduced consumption's interest sensitivity are longer terms and lower down payments for loans on durable goods such as automobiles. These innovations have likely reduced the interest sensitivity of consumer spending by making it easier for consumers to

[6] For a discussion of the view that ARMs are not significantly different from fixed-rate mortgages and, therefore, that they have not had a significant effect on the housing market's interest sensitivity, see Romer 1989, p. 116.

[7] Blinder (1989) makes this point.

qualify for loans. Before these innovations, markets for consumer durables excluded consumers who could not qualify for a loan when interest rates rose. Today, with more flexible financing, fewer consumers are excluded from markets just because of a rise in interest rates.

In contrast, the advent of ARMs and other forms of adjustable rate consumer debt has probably increased the interest sensitivity of consumption. As discussed in the last section, ARMs have made household budgets more sensitive to changes in market interest rates. In addition to ARMs, though, another source of consumer credit—home equity loans—has also contributed to increased interest sensitivity. Home equity loans have grown in popularity in recent years because of changes in the federal income tax code that have reduced, and will eventually eliminate, all other forms of consumer interest deductions. Home equity loans, unlike most other forms of short-term consumer credit, carry adjustable interest rates. Thus, like ARMs, home equity loans increase the exposure of the household budget to interest rate fluctuations. As a result, higher interest rates might cut consumer spending more sharply today than in the past.

Another factor increasing the interest sensitivity of consumption is the increasing indebtedness of consumers. Partly because of more liberal financing terms, consumer debt has risen to record levels in the 1980s. As a result, any restrictive monetary policy action that cuts production and increases unemployment might risk a sharper downturn than in the past. With relatively large debts outstanding and a reduction in income, some consumers might, out of necessity, sharply reduce spending. Other consumers, fearful of a future loss of income, might cut spending for precautionary reasons.

Either way, the resulting fall in consumption might be greater than it would be with less consumer debt.

Partly or completely offsetting this effect, however, is the increase in household assets that has matched the run-up in debt. Despite the increase in debt, household net worth relative to GNP has not changed significantly in the 1980s (Friedman 1989, p. 15). Moreover, consumers continue to be net creditors. Finally, the payment of market interest rates on deposits may also increase income and consumption as interest rates rise. The extent to which these factors affect consumption depends on, among other things, the distribution of accumulated assets relative to the distribution of the accompanying accumulation of debt. If wealthy consumers are the primary holders of credit, for example, higher interest rates might do little to boost consumer spending. Nevertheless, because of factors that increase consumer income when interest rates rise, consumers might maintain confidence in the economy and continue to spend even as monetary policy turned restrictive.[8]

## Business fixed investment

Paralleling structural changes that affect consumption are structural changes affecting business fixed investment. While financial market innovations have made investment less sensitive to changes in interest rates, the unprecedented increase in business debt has increased investment's interest sensitivity.

[8] For further information on the effect of interest rates on consumption, see Cantor 1989.

Because most corporate debt has traditionally carried adjustable interest rates, businesses have traditionally faced interest rate risk. As market interest rates rose, investment projects that were originally profitable sometimes became unprofitable, forcing firms to cut back on spending plans. Because of this interest rate risk, financial markets have developed new methods to insulate businesses from the risk of interest rate fluctuations. For example, three fairly recent innovations—interest rate swaps, cap markets, and the junk bond market—have reduced the interest sensitivity of business fixed investment.[9]

Interest rate swaps allow a business owning fixed-rate debt to exchange interest-payment obligations with a business owning variable-rate debt. These transactions allow both businesses to lower interest rate risk and obtain credit at a lower cost than by directly issuing their preferred variable-rate or fixed-rate debt instrument.[10] They also allow businesses that have limited access to commercial paper markets because of their relatively low credit ratings to convert floating-rate bank credit to debt obligations with fixed payments. In this way, businesses with low credit ratings can reduce their exposure to interest rate fluctuations.

The market for caps allows businesses to reduce the interest rate risk associated with variable-rate debt in much the same way that ARMs limit interest rate risk to consumers. The cap market provides businesses the opportunity to buy debt with a limit on possible interest rate increases. This innovation, therefore, reduces the sensitivity of business investment to sharp upturns in interest rates.

Finally, the junk bond market allows firms lacking high credit ratings to issue debt, thereby obtaining credit that might otherwise be unavailable or more expensive. Before the advent of the junk bond market, these firms were often unable to obtain long-term financing for investment opportunities when short-term interest rates were high. By issuing junk bonds, these businesses shield themselves from increases in short-term interest rates.

The advent of the junk bond market also has a down side, however. Junk bonds, along with a wave of mergers, acquisitions, leveraged buyouts, and stock repurchases, have contributed to a tremendous increase in business debt in the 1980s. This increase in debt—unique to the postwar U.S. economy—increases the economy's interest sensitivity in much the same way as increases in consumer debt. But because businesses have failed to acquire real assets at the same pace as their accumulation of debt, the buildup of business debt is potentially a more serious problem than the buildup of consumer debt.[11]

The increase in business debt increases the sensitivity of investment to changes in interest rates and other adverse shocks. When a tightening of monetary policy leads to an economic downturn, business revenues decline. Lower revenues would make it difficult for some businesses to make interest payments on accumulated debt. Some businesses would cut back on investment spending, some might sell off assets, and others

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[9] These innovations are cited in Dudley 1989, p. 7.

[10] For more information about interest rate swaps, see Whittaker 1987 and Beidleman 1985.

[11] This view is expressed in Friedman 1986, 1988, and 1989.

would be forced into bankruptcy. Moreover, creditors might face a loss of principal and interest income and find themselves similarly caught up in the downturn. In this way, a mild downturn might turn into something much more serious. Thus, the risk of monetary restraint may have increased in the 1980s. Monetary policies that once merely slowed economic growth might today cause a more severe economic downturn because of the fragility of heavily leveraged businesses.

## Foreign trade

The growth of foreign trade and international capital flows may also have changed the economy's interest sensitivity. Since the advent of floating exchange rates in 1973, imports of goods and services have grown from roughly 10 percent to 15 percent of GNP, and exports of goods and services have grown from roughly 9 percent to 13 percent of GNP. Moreover, the difference between exports and imports—net exports—has fluctuated widely. Real net exports have fallen from a surplus of $57 billion in 1980 to a record deficit of $130 billion in 1986. Since then, they have only partly recovered, reaching a deficit of $75 billion last year. Matching the increase in the trade deficit is a huge increase in international capital flows, as the United States has financed its trade deficit by borrowing from abroad. In the process, the United States has become the world's largest debtor nation, with a net international debt of $533 billion at the end of 1988.[12]

The internationalization of the U.S. economy implied by these statistics reduces the

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[12] Scholl 1989 as quoted in Friedman 1989.

Federal Reserve's influence over interest rates but, nevertheless, potentially increases the economy's sensitivity to monetary policy. This apparent paradox is the result of monetary policy's effect on exchange rates due to financial market interdependence. Because deregulation and innovations in international capital markets have made foreign and domestic assets closer substitutes, the Federal Reserve's influence over domestic capital markets may have diminished. Nevertheless, because the Federal Reserve now influences the foreign exchange value of the dollar through its influence over interest rates, the Federal Reserve now has a greater impact on foreign trade.

Traditionally, when the Federal Reserve tightened monetary policy causing short-term interest rates to rise, long-term interest rates also tended to rise. The rise in long-term rates then reduced spending in interest sensitive sectors such as housing and investment. The contraction of housing and investment, in turn, reduced real output. The principal effect on the foreign sector came through income effects. With a decline in income, imports would fall, thereby increasing net exports. Today, because of the increasing integration of international financial markets, this channel of monetary policy may no longer be as important as it was in the past.

With increased capital mobility, attempts by the Federal Reserve to raise short-term interest rates generate inflows of capital to the United States as foreign investors seek higher rates of return. The increased demand for dollar-denominated assets, however, causes an appreciation of the dollar. If the higher dollar increases the attractiveness of all U.S. assets and if foreign investors are large players in U.S. financial markets, the prices of U.S. assets may

remain strong. In particular, long-term bond prices may fall less than in the past, causing long-term interest rates to rise by less than in the past.[13] Traditional monetary policy actions may thus have nontraditional effects. Specifically, if long-term interest rates do not rise as much as in the past when the Federal Reserve tightens policy, such traditionally interest sensitive sectors as housing and business fixed investment will not contract as much—at least not initially.

This nontraditional result does not imply that the economy as a whole is insensitive to monetary policy, however. Because monetary policy influences the foreign exchange value of the dollar, policy actions affect net exports. When the Federal Reserve tightens monetary policy, for example, the value of the dollar rises in foreign exchange markets, making imports less expensive and exports more expensive. As the demand for imports rises and the demand for exports falls, net exports contract. The decline in net exports, in turn, reduces real GNP. Although business fixed investment and other spending categories would eventually respond to the fall in GNP, the primary impact of the monetary tightening is felt in the foreign sector.

A complicating factor with this relatively new channel of monetary policy is the time it takes for net exports to respond to policy changes. Imports and exports adjust very slowly to changes in the value of the dollar—more slowly, for example, than housing and investment traditionally reacted to interest rate changes. In particular, even as the dollar reversed its climb and began to fall sharply in

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13 Friedman (1989, p. 13), among others, makes this argument.

early 1985, net exports continued to deteriorate until late 1986. Thus, to slow an economy that is expected to overheat, monetary policymakers must now act much further in advance than they once had to act given more traditional channels of influence.

## Summary

Structural changes in the U.S. economy have likely changed the interest sensitivity of several key sectors of the economy in the 1980s. While the interest sensitivity of housing has likely declined, the interest sensitivity of net exports has likely increased. The interest sensitivity of consumption and business fixed investment, on the other hand, may have increased or decreased depending on the relative importance of various structural changes. Thus, determining the net effect of these changes on sectoral output is largely an empirical issue. Moreover, determining the net effect of structural changes on the interest sensitivity of aggregate output also requires empirical evidence.

## II. EVIDENCE ON THE ECONOMY'S CHANGING INTEREST SENSITIVITY

It is relatively easy to identify structural changes affecting the economy's interest sensitivity; however, measuring the importance of these changes is much more difficult. Such measurements are inherently problematic because most of the structural changes that have been identified occurred fairly recently. Therefore, not enough data have yet accumulated to estimate very accurately changes in historical relationships. Nevertheless, because of the

potential importance of structural change to monetary policy, gathering whatever empirical information is already available is worthwhile, even if the results are not conclusive. This section presents empirical evidence on the economy's changing interest sensitivity. After describing the basic approach, evidence is presented for each of the four sectors under consideration—housing, consumption, business fixed investment, and foreign trade—as well as for aggregate output. Finally, the results are compared with other studies and the monetary policy implications of the evidence are examined.

## The empirical approach

In looking for empirical evidence of changes in the economy's interest sensitivity, one approach is to use a different analytical framework for each sector. In considering the housing industry, for example, one study (Bosworth 1989) compared the United States with Canada because Canadians have had much more experience with ARMs. In considering the foreign sector, however, the study used a multicountry econometric model. Another study (Friedman 1989) estimated a different model, based largely on economic theory, for each sector of the U.S. economy that may have experienced a change in interest sensitivity.

In contrast, this article uses a single analytical framework, called a Bayesian vector autoregression (BVAR), to study both aggregate and sectoral output. The BVAR, based more on statistical relationships than economic theory, explains current real output growth by its statistical relationship to past output growth and past changes in interest rates. Separate BVARs, described more fully in the

appendix, are estimated for residential investment, consumption, business fixed investment, net exports, and real GNP. The interest rate used in all cases is the federal funds rate—the interest rate banks charge each other for overnight loans of reserves.

The federal funds rate is the best interest rate for analyzing the monetary policy implications of the economy's changing interest sensitivity even though longer term interest rates more directly affect economic behavior. Because the Federal Reserve exerts considerable control over the federal funds rate, the funds rate is a better indicator of monetary policy than longer term rates.[14] Furthermore, as discussed in the last section, increased capital mobility may have reduced the Federal Reserve's control over longer term interest rates. As a result, changes in the relationship of the federal funds rate to economic activity indicate potential changes in the efficacy of monetary policy.[15]

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14 Another reason for using the federal funds rate instead of longer term rates is that the federal funds rate is more closely related to most indicators of real economic performance. In particular, Bernanke and Blinder (1989) find that the federal funds rate is a better predictor of economic activity than the Treasury bill or long-term bond yield (or, for that matter, M1 or M2). Furthermore, the authors find that the federal funds rate is a relatively good indicator of Federal Reserve policy, at least before 1979. Supporting the use of the nominal federal funds rate rather than a measure of the real federal funds rate is the lack of a statistically significant relationship between current real GNP growth and lags of changes in GNP and the ex post real federal funds rate. Moreover, accounting for changes in inflation expectations by including lags of both inflation and changes in the nominal federal funds rate in a real output growth equation does not fundamentally alter the relationship between the nominal federal funds rate and real output.

15 A decline in the Federal Reserve's ability to influence longer term interest rates through its control over the federal

The basic approach is the same for both aggregate and sectoral output. The interest sensitivity of output from the fourth quarter of 1955 to the third quarter of 1979 is compared with the interest sensitivity of output from the first quarter of 1983 to the second quarter of 1989. Because the Federal Reserve placed significantly less emphasis on the federal funds rate from the fourth quarter of 1979 to the fourth quarter of 1982 than in either the earlier or later period, this interim period is omitted in the two forecasts.[16] For each period, output is forecast, first, under the assumption of no change in the federal funds rate, then, under the assumption of a permanent one-percentage-point increase in the federal funds rate. Again, for each period, the difference between the two forecasts is plotted. Results are normalized so that, with no interest rate change, output would remain constant at its second-quarter 1989 level.[17]

## Evidence from the BVAR model

Results are presented for housing, consumption, business fixed investment, the foreign sector, and finally, real GNP. While the federal funds rate generally contributed significantly to explaining output in the earlier sample period, the funds rate was generally not significant in the later sample period. One possible explanation for this finding is that, while output was sensitive to the federal funds rate in the earlier period, it was completely interest insensitive in the later period. An alternative interpretation is that output was somewhat less interest sensitive in the post-1982 period than in the earlier period but that a shortage of data makes estimates of this effect imprecise.[18] Accepting this alternative explanation implies that the estimated direction of the change in output's interest sensitivity is more reliable than its estimated size.

In all sectors except business fixed investment and net exports, evidence supports a reduced interest sensitivity of output. While evidence for business fixed investment is inconclusive, evidence for net exports shows a

funds rate would reduce monetary policy's influence on interest-sensitive spending. Confirming this reduced efficacy of monetary policy would be a breakdown of statistical relationships between the federal funds rate and interest sensitive spending. However, such a decline in the efficacy of monetary policy might not show up in estimated relationships between longer term interest rates and interest-sensitive spending. Thus, the federal funds rate is better than longer term interest rates for determining how changes in the economy's interest sensitivity affect the efficacy of monetary policy.

[16] Ignoring this interim period reduces the likelihood that structural causes for changes in the economy's interest sensitivity might be mistaken for the effect of a change in monetary policy regime. Nevertheless, except for net exports, results for the period from 1979:Q1 to 1989:Q2 are very similar to results for 1983:Q1 to 1989:Q2.

[17] Friedman (1989) uses a similar technique to present conditional forecast of sectoral equations from the Federal Reserve Board MPS model. Friedman uses different sample periods for each sector but in all cases includes the period from 1979:Q4 to 1982:Q4 in one of the forecasts.

[18] Another possible explanation is that the economy has grown steadily since 1982, and, therefore, output has not contracted in response to an increase in interest rates. Reestimating the model for the period starting in 1979:Q1 and ending in 1989:Q2, however, yields a similar decline in the economy's interest sensitivity in all sectors except net exports. Thus, despite the inclusion of more volatile data from the early 1980s, evidence still suggests a decline in the economy's interest sensitivity. Moreover, when the model is estimated for the entire period from 1955:Q4 to 1989:Q2, the federal funds rate is generally significant, and the interest sensitivity of sectoral and aggregate output is an average of interest sensitivities in the two subperiods. Therefore, as would be expected, including data from the 1980s in the early sample period reduces estimated interest sensitivities.

# CHART 1
## Effect of higher interest rates on residential investment
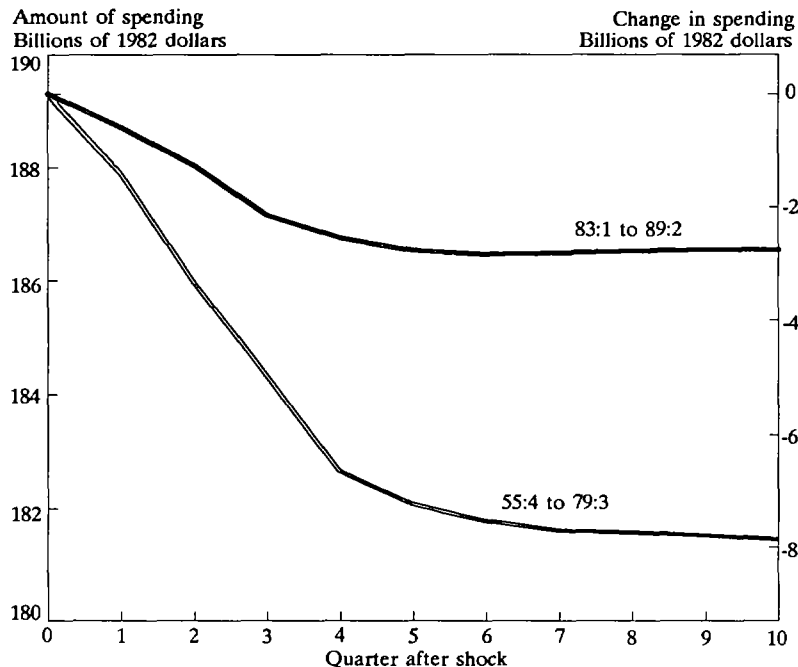
Amount of spending
Billions of 1982 dollars

Change in spending
Billions of 1982 dollars



Note: Curves show the effect of a permanent one-percentage-point increase in the federal funds rate. Quarterly figures are annualized. Base quarter is 1989:Q2.
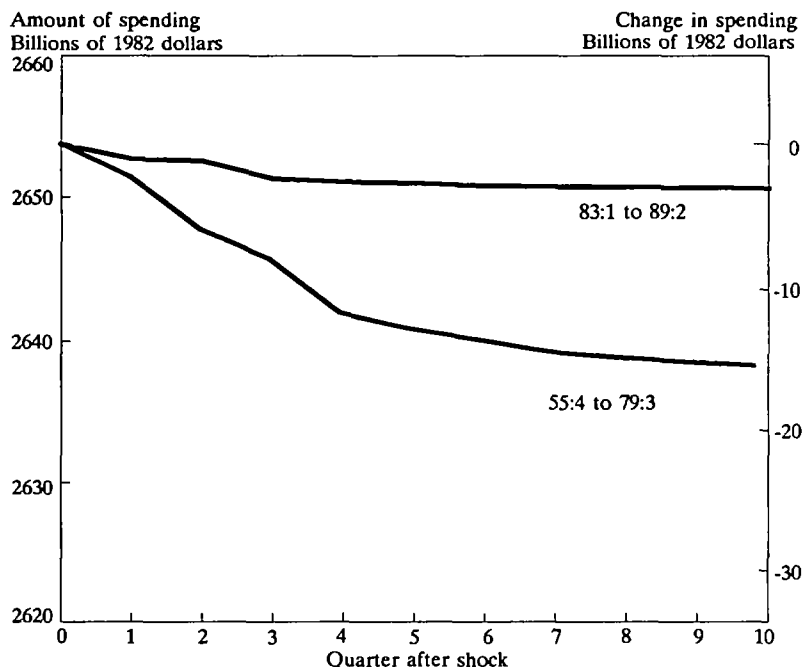
Source: Author's estimates, based on model described in text.

change in the direction of interest rate effects. Ignoring business fixed investment and adding together results for the other individual sectors imply a reduced interest sensitivity of aggregate output. Results for real GNP confirm this reduced interest sensitivity and are broadly consistent with the sum of the individual sectors.

*Housing.* The strongest evidence of a change in the economy's interest sensitivity comes in the housing sector. Chart 1 shows the effect on residential investment spending of a permanent one-percentage-point increase in the

federal funds rate. Before 1980, this interest rate change caused residential investment to fall about $7 billion after six quarters. Today, according to the BVAR, the effect is down to about $2 billion. This empirical evidence is thus consistent with observations about institutional change in the housing industry. Financial market deregulation and innovation apparently have reduced the interest sensitivity of housing. If these results hold up as more evidence accumulates, the housing sector can no longer be the fulcrum of monetary policy it once was.

## CHART 2
## Effect of higher interest rates on consumption

Amount of spending
Billions of 1982 dollars

Change in spending
Billions of 1982 dollars

83:1 to 89:2

55:4 to 79:3

Quarter after shock

Note: Curves show the effect of a permanent one-percentage-point increase in the federal funds rate. Quarterly figures are annualized. Base quarter is 1989:Q2.

Source: Author's estimates, based on model described in text.

*Consumption.* Consumption spending displays an even bigger dollar reduction in interest sensitivity than housing (Chart 2). Before 1980, a permanent one-percentage-point increase in the federal funds rate led to a $15 billion reduction in consumer spending. After 1982, the effect had fallen to about $3 billion.[19] Because consumption represents a much larger sector

of the economy than housing, however, this effect actually implies a smaller percentage change in consumption. In other words, the interest sensitivity of consumption was relatively low before 1980. Therefore, the decline in consumption's interest sensitivity was relatively small. Nevertheless, because consump-

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[19] Results for consumption of durable goods (not shown) indicate that today spending on durable goods is virtually interest insensitive, whereas before 1980 a one-percentage-

point increase in the federal funds rate led to an $8 billion reduction in consumer durables spending. Thus, as would be expected, most of the former interest sensitivity of consumption was in durable goods.

tion represents a large share of GNP, even a small reduction in consumption's interest sensitivity has important ramifications for GNP and monetary policy. If the results for consumption hold up, financial market innovations and the decline in disintermediation would appear to be more important influences on the interest sensitivity of consumption than the advent of ARMs and the rise of home equity loans and consumer debt.

*Business fixed investment.* No statistically significant relationship could be found between business fixed investment and the federal funds rate in either the pre-1980 period or the post-1982 period.[20] As a result, no forecasts are plotted. Although it may seem surprising that no significant relationship can be found in a sector that simple economic theory suggests is highly interest sensitive, the result is not unusual. The result is not unusual because interest rates are only one component of the real cost of capital. Other components include the inflation rate, tax rates, and the cost of equity. When interest rates rise at the same time as inflation, for example, one component of the cost of capital partly offsets the other. Furthermore, increases in interest rates are often associated with economic upturns, the very kind of economic environment that is favorable to investment.[21] Thus, it is actually not very surprising that the BVAR cannot identify the interest sensitivity of investment, much less changes in interest sensitivity since 1982.

The failure of the model to detect a signifi-

cant relationship between the federal funds rate and investment, however, does not diminish the potential importance of structural changes. For example, no model would likely show the effects of the huge run-up of business debt because the economy has not suffered a downturn since this run-up occurred. Policymakers must, therefore, use considerable judgment in assessing the importance of business debt. Recent history provides no clear evidence on possible effects of this debt on business spending in even a mild recession.
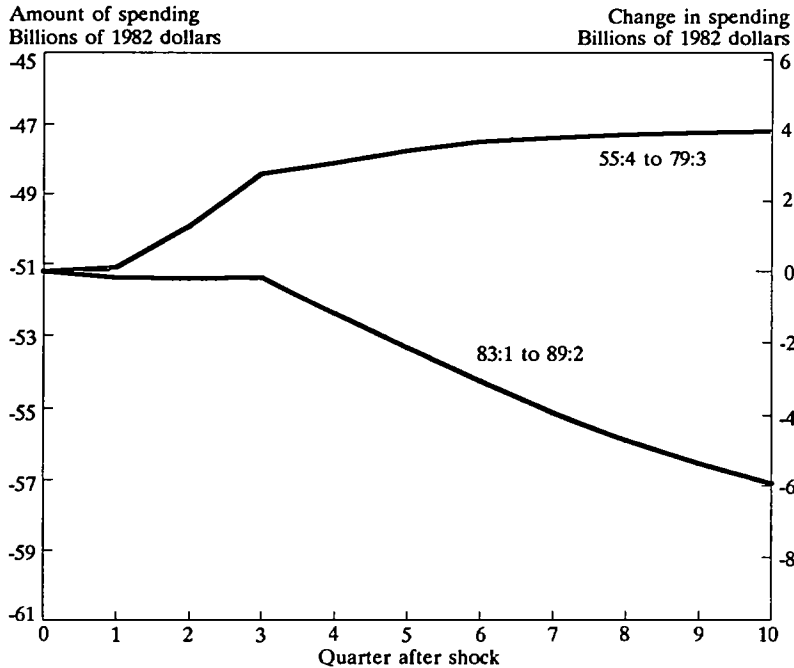
*Foreign Trade.* Just as the interest sensitivity of net exports has changed since 1982, so has the direction of the effect. This change in the pattern of response of net exports to an increase in the federal funds rate is shown in Chart 3. The chart shows that before 1980 an increase in the federal funds rate caused net exports to rise. This increase in net exports could be the result of higher interest rates reducing income, and therefore, imports. It could also result from higher financing charges on imported durable goods, such as automobiles. After 1982, however, the chart shows that an increase in the federal funds rate caused net exports to fall. Today, price effects apparently dominate income effects.[22] Higher interest rates

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[20] Also, no statistically significant relationship was found in any period between spending on producers' durable equipment and the federal funds rate.

[21] See, for example, Dudley 1989.

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[22] The importance of price effects after 1980 may be the result of the switch from fixed to floating exchange rates in 1973. Real exchange rates fluctuated much less during the fixed exchange rate regime than they do in today's floating exchange rate regime. However, when the sample was split at 1973, an increase in the federal funds rate still increased rather than decreased net exports. The same was true for a sample split at 1979. These results did not change when lags of real GNP and the real exchange rate were added to the BVAR. Thus, while the results are puzzling and of questionable statistical significance, the dominance of price effects over income effects seems to be a characteristic of only post-1982 data.

CHART 3
## Effect of higher interest rates on net exports

Amount of spending
Billions of 1982 dollars

Change in spending
Billions of 1982 dollars



Quarter after shock

Note: Curves show the effect of a permanent one-percentage-point increase in the federal funds rate. Quarterly figures are annualized. Base quarter is 1989:Q2.
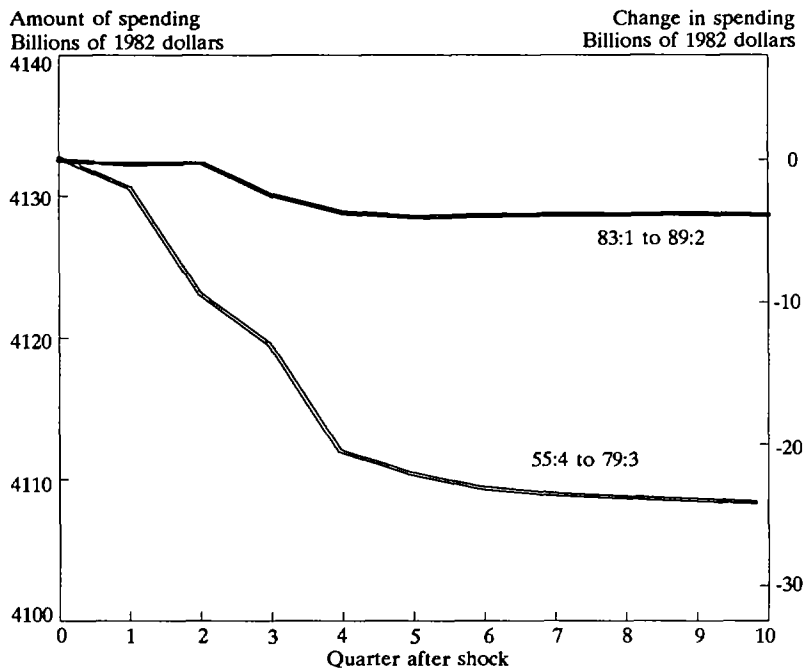Source: Author's estimates, based on model descrbed in text.

cause the dollar to appreciate, which in turn causes exports to fall and imports to rise.

The change in the interest sensitivity of net exports has important ramifications for monetary policy. First, a tightening of monetary policy now causes net exports to contract. To the extent other sectors of the economy contract less than in the past, net exports now carry a larger burden of the economy's adjustment to changes in monetary policy. Second, because net exports react so slowly to changes in the federal funds rate, monetary policy affects net exports much more slowly. As Chart 3 shows, a change in the funds rate has no significant

effect on net exports until after three quarters. Efforts by monetary policymakers to smooth fluctuations in the business cycle must, therefore, be made much further in advance than in the past. In other words, actions taken by policymakers today affect net exports and, through net exports, the economy as a whole, only after three quarters. After that, monetary policy actions continue to have real effects long into the future.

*Real GNP.* Ignoring business fixed investment and adding together the results for the other individual sectors imply that aggregate output declines when the federal funds rate

## CHART 4
## Effect of higher interest rates on real GNP

Amount of spending
Billions of 1982 dollars

Change in spending
Billions of 1982 dollars



Quarter after shock

Note: Curves show the effect of a permanent one-percentage-point increase in the federal funds rate. Quarterly figures are annualized. Base quarter is 1989:Q2.

Source: Author's estimates, based on model described in text.

rises.[23] This decline, however, is less in the post-1982 period than in the pre-1980 period. The estimated interest sensitivity of real GNP, shown in Chart 4, confirms this effect. The difference reported in the chart between the decline in GNP in the later period and the

decline in the earlier period is about $20 billion. The same difference obtained by adding together sectoral changes reported in Charts 1 to 3 is about $8 billion. The difference between these two separate estimates of the change in the interest sensitivity of real GNP is partly attributable to sectors that have been ignored in the analysis. The difference between these two estimates, however, also highlights the imprecision of the results for both sectoral output and real GNP, particularly in the post-1982 sample. Nevertheless, the economy's overall interest sensitivity appears to have declined.

Furthermore, the decline in GNP is slower

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[23] This result does not imply that monetary policy can permanently affect real output. The Federal Reserve cannot permanently fix the federal funds rate, as assumed in the forecasts, at a level inconsistent with market forces. Moreover, the results are fully consistent with the veiw that monetary policy cannot affect the economy's long-run real growth rate.

to materialize and faster to bottom out in the post-1982 economy. While in the earlier period real GNP fell roughly $10 billion by the second quarter after the interest rate shock, in the later period, GNP was almost unchanged. And while in the earlier period real GNP continued to fall until about the seventh quarter, GNP stopped falling after about four quarters in the later period. Thus, according to these estimates, for a monetary policy action to have the same effect on real GNP today as it did in the past, policy would have to move the federal funds rate sooner and by much more. Policy actions might also have to be sustained for a longer period.

## Comparison with other studies

The results from the BVAR are somewhat different from results reported in other studies. However, other studies generally use longer term interest rates than the BVAR. While most studies report changes in sectoral interest sensitivities, these studies differ on the size of sectoral changes and the overall impact of these changes on real GNP. For example, one study (Friedman 1989) reports results that are very similar to results from the BVAR for consumption, but different for housing, investment, and net exports. While housing displays a sharp decline in interest sensitivity in the study, its interest sensitivity is greater than estimated by the BVAR, both before and after 1980. Furthermore, the study finds significant effects of monetary policy on investment—in particular, a greater short-run interest sensitivity of investment in new equipment in the 1980s than earlier. Finally, the study finds a decline in the interest sensitivity of net exports in the 1980s, which is consistent with the BVAR's short-run results but different from its longer run results.

Together, the sectoral results of the study imply that the relationship between interest rates and real GNP is little changed in the 1980s. The differences between the study's results and those of the BVAR again point to imprecise estimates of changes in the economy's interest sensitivity.[24]

## Monetary policy implications

The empirical results from the BVAR have potentially important implications for monetary policy. They differ from other studies that imply only the channels of influence of monetary policy, not its overall potency, have changed. Interpreting the results as qualitatively correct, but quantitatively unreliable, implies that the economy's overall interest sensitivity has decreased but that the size of the decline is uncertain. Thus, the main implications of the results are that the effects of monetary policy-induced changes in interest rates on real output are less pronounced, take longer to be realized, and are more uncertain today than in the past.

To the extent that any given change in the federal funds rate ultimately causes smaller changes in real output, monetary policymakers would have to move interest rates more to generate the same outcome as in the past. How much more policymakers would have to move interest rates and for how much longer is uncertain. Nevertheless, stabilizing fluctuations in

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[24] Another study (Bosworth 1989) finds that housing is now somewhat less interest sensitive than in the past and that the interest sensitivity of net exports has increased a little in the short run but accumulates over several years. The main implication for aggregate output is that changes in interest rates now take longer than in the past to affect real GNP.

real output could cause greater interest rate volatility than in the past. Furthermore, if policymakers influence inflation indirectly by influencing real output, larger increases in interest rates than in the past would be needed to slow real economic activity and, thereby, to reduce inflation. Such an interest rate increase would affect housing disproportionately, although by much less than in the past. Unlike in the past, however, interest rate increases would also depress net exports.

The longer it takes monetary policy actions to affect real output, the greater is the premium on accurate economic forecasts in formulating monetary policy. The primary source of a longer policy transmission lag, according to the empirical results in this study, is net exports, which now appear to respond much slower to interest rate hikes. This longer lag means that monetary policymakers must respond earlier if monetary policy is to stabilize output fluctuations. If policymakers merely respond as they have in the past, their actions might come too late and only exacerbate output fluctuations. Longer policy transmission lags, therefore, magnify the need for better and longer term economic forecasts.

Finally, the empirical evidence implies greater uncertainty about the real effects of monetary policy actions today relative to the past. Because structural changes have occurred relatively recently, estimates of their effect on the economy's interest sensitivity are highly imprecise. As a result, uncertainty about both the sensitivity of real output to interest rate changes and the length of policy transmission lags is greater today than in the past. Moreover, the effects of some structural changes are currently impossible to estimate. No one knows, for example, what effect the huge run-up in cor-

porate debt will have in a recession because no recession has occurred since corporations began their unprecedented accumulation of debt. Because of this increased uncertainty of the effects of monetary policy on real output, policymakers need to exercise caution in carrying out monetary policy. Greater uncertainty about the effects of monetary policy would make arguments against "fine tuning" the economy even more compelling today than in the past.

## Summary

Empirical evidence suggests a reduction in the economy's overall interest sensitivity. This reduction in interest sensitivity is not spread equally across all sectors of the economy, however. Residential investment and consumption are less interest sensitive, while net exports now fall rather than rise in response to an interest rate hike. No conclusions can be drawn from available evidence on business fixed investment. In addition to a decline in the overall sensitivity of the economy to a change in interest rates, the time between a change in the federal funds rate and its effect on output has become longer. This lag in the transmission of monetary policy to the economy and its associated uncertainty could pose new and challenging problems for monetary policy.

## III. CONCLUSIONS

Financial market deregulation and innovation, along with the rising importance of international trade in both goods and capital, have changed the structure of the economy and the conduct of monetary policy. Not only has the Federal Reserve had to reduce its emphasis on

the monetary aggregates as targets of monetary policy, but also policymakers have had to reconsider the channels of monetary policy transmission.

Evidence suggests that today interest sensitive sectors such as housing play less of a role in the transmission of policy and that net exports play more of a role. But because of the transmission lag between interest rate changes and their effect on net exports and the economy, policymakers must respond more quickly to economic shocks. Otherwise, policy actions might come too late and possibly exacerbate the problems they were designed to correct. Complicating policy decisions, however, is considerable uncertainty about the exact nature of the economy's interest sensitivity in the 1980s. Only with experience and more observation will this uncertainty diminish.

# Appendix
# The BVAR Model

This appendix describes the Bayesian vector autoregressions (BVARs) used in the text to determine changes in the economy's interest sensitivity. After providing technical details of the approach, the appendix describes the BVAR's advantages and disadvantages over more structural models. Finally, the appendix compares the overall interest sensitivity of the BVAR with the interest sensitivity of other, more structural models.

Each BVAR consisted of an output equation and a federal funds rate equation. A separate BVAR was estimated for each concept of output—residential fixed investment, consumption, business fixed investment, net exports, and real GNP. For aggregate output and all of the sectors except net exports, the BVAR included a constant term, four lagged values of aggregate or sectoral output growth, and four lagged values of changes in the federal funds rate. For net exports, the BVAR was specified in levels rather than rates of change.

The means of the prior distribution on all coefficients on lagged variables were set equal to zero, except the first own lag on net exports in the net export equation, which was set equal to one. In forecasting output, the federal funds rate was made exogenous so that, in effect, only the output equations were used to generate the results.[1]

The advantage of the BVAR approach is that it uses the same basic specification for each sector and requires only a few economic variables. The use of relatively few variables is an advantage because of a lack of data covering the period since many structural changes occurred. Bayesian estimation was chosen over ordinary least squares because, even with only a few variables, the number of observations is insufficient to obtain adequate estimates of the

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[1] Complete estimation results are available from the author upon request.

relatively large number of coefficients in the model[2].

The main disadvantage of the BVAR is that any change found in the interest sensitivity of the economy cannot be traced to a particular cause or a particular type of structural change. Nevertheless, the approach can be used to determine overall changes in each sector's interest sensitivity. The approach can also determine whether these changes are consistent with the structural developments identified in the first section of the article.

But can a BVAR adequately capture the effect of the federal funds rate on economic activity, much less capture changes in this effect? One way to answer this question is to compare the BVAR with other, more complex economic models. Ignoring the possibility of structural changes in the 1980s, Chart A-1 compares the interest sensitivity of output in the BVAR with the interest sensitivity of output in two other models of the economy.[3] Specifically, the chart shows the predicted reaction of real GNP in each model to a permanent one-percentage-point increase in the federal funds rate. The two alternative models are the Fairmodel and the Data Resources, Inc. (DRI) model. Each simulation starts from the actual level of real GNP in the second quarter of 1989. Results are normalized so that, with no interest rate change, output would remain constant at its

second-quarter 1989 level.[4]

Despite its relative simplicity, the BVAR exhibits characteristics that are qualitatively similar to those found in much larger structural models of the economy. For example, in the first year after the increase in the federal funds rate, all three models predict a gradual decline in real GNP. Furthermore, the three models forecast levels of real GNP in the first year that are within about $1 billion of each other.

Differences in model forecasts clearly exist, but these differences point more to uncertainty in the effect of the federal funds rate on real output than to shortcomings of the BVAR. Moreover, these differences appear even though the models do not reflect any uncertainty about recent structural changes in the economy. In the Fairmodel—a relatively small structural model of the U.S. economy—an increase in the federal funds rate immediately reduces real GNP by about $1 billion. After two and a half years, the effect is a $10 billion reduction in real GNP. In contrast, an increase in the federal funds rate has no immediate effect on real GNP in the DRI model—a much larger structural model of the U.S. economy. But after two and a half years, the DRI model predicts about a $35 billion decrease in real GNP. The BVAR
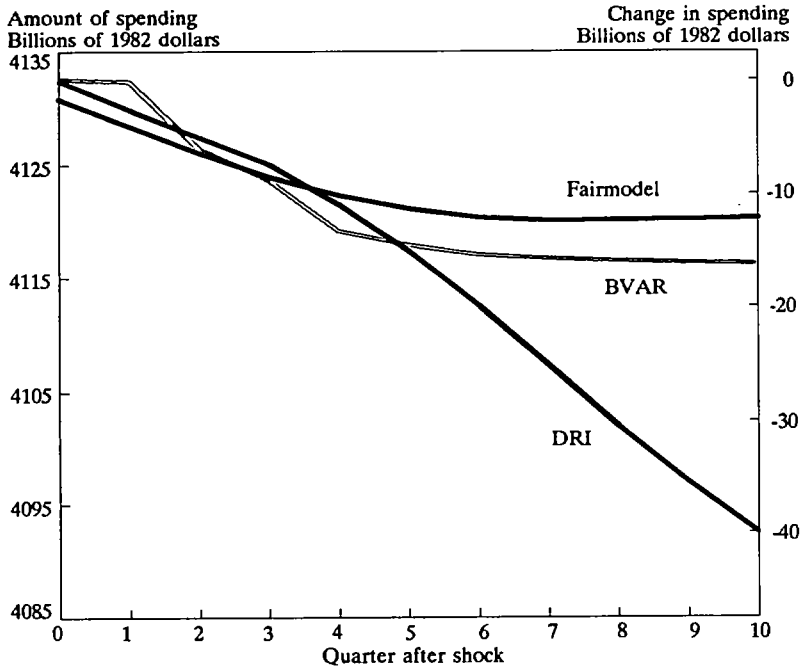
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[2] This overparameterization of the model would lead to large out-of-sample forecast errors. For more on Bayesian vector autoregressions, see Todd 1984.

[3] The stimation period for the BVAR is 1955:Q4 to 1989:Q2. Computing quarterly rates of change and creating lagged variables, however, require data from 1954:Q3.

[4] Specifically, output was forecast twice by each model— once assuming the federal funds rate remains constant at its 1989:Q2 level and once assuming the federal funds rate rises by one percentage point in 1989:Q3 and permanently stays at the new higher level. The differences between these two forecasts were plotted for each model, starting at the level of real GNP in 1989:Q2. The Fairmodel, however, was actually simulated starting in 1989:Q2, but the results were carried forward by one quarter and inflated by the ratio of actual real GNP in 1989:Q2 to real GNP in 1989:Q1.

## CHART A-1
## Effect of higher interest rates on real GNP in three models

Amount of spending
Billions of 1982 dollars

Change in spending
Billions of 1982 dollars



Quarter after shock

Note: Curves show the effect of a permanent one-percentage-point increase in the federal funds rate. Quarterly figures are annualized. Base quarter is 1989:Q2.

Source: DRI is based on the September 1989 quarterly U.S. model supplied by Data Resources, Inc. Fairmodel is based on the April 1989 quarterly U.S. model supplied by Macro, Inc. BVAR is based on model described in text.

displays less of a short-run effect than either Fairmodel or DRI, but displays a longer run effect that is close to an average of the two alternative models.[5]

Because the BVAR is broadly representative of other models of the economy, it can be used with some confidence to examine changes in the economy's interest sensitivity. Although evidence from larger structural models such as DRI would also be useful, such models are not suited to examining recent structural change. Because of their large size, they cannot be estimated for periods as short as the 1980s. Thus, only the BVAR is used to estimate changes in the economy's interest sensitivity.

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[5] The short-run result is not surprising since the BVAR, by definition, rules out contemporaneous effects.

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