# 2

# Changing Effects of Monetary Policy on Real Economic Activity

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A series of developments in the U.S. economic environment in the 1980s has resulted in major changes in prevalent thinking about how monetary policy affects economic activity. One important part of this change simply reflects the heightened awareness, following the experience of disinflation early in the decade, that monetary policy is not neutral—that is, that actions taken by the central bank can and do influence real economic outcomes. Indeed, in the wake of the early 1980s disinflation, the more traditional view that monetary policy affects inflation by and only by influencing real economic activity seems much closer to the mark than the polar opposite view, which became increasingly popular in the 1970s, that monetary policy determines prices without affecting real economic activity at all.

Another aspect of the change in thinking about monetary policy that has taken place in recent years reflects the loss of confidence in the conventional monetary aggregates as a satisfactory measure of the effect of monetary policy on either real economic activity or prices. Standard relationships between the M's and either real or nominal income have largely broken down, and the correlation between money growth and price inflation, calculated in the way advocated by Milton Friedman (that is, using two-year moving

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averages to smooth out erratic movements, and a two-year lag between the money growth and the supposedly resulting inflation), is actually negative for sample periods including the 1980s.[1]

Because both of these changes mitigate in favor of a renewed emphasis on earlier, more "structural" ways of thinking about monetary policy, having a solid quantitative understanding of how monetary policy actions affect economic activity has assumed heightened importance. Here, too, however, the current state of empirical knowledge is less than satisfactory. One reason, of course, is the well-known tendency of empirical models based on different theoretical specifications to deliver differing quantitative estimates. Perhaps more importantly, several specific changes in the relevant economic environment have, at least potentially, rendered earlier quantitative representations of the monetary policy process seriously inadequate. Given the background of existing knowledge about how monetary policy affects economic activity, three such changes are—again, at least potentially—of particular importance.

First, the elimination of Regulation Q interest ceilings has weakened the Federal Reserve System's ability to arrest deposit growth at savings institutions merely by raising short-term market interest rates. In the meantime, the development of the secondary mortgage market has weakened the link between the growth of thrift deposits and the supply of mortgage lending. Both changes have presumably limited the Federal Reserve's ability to influence the pace of home building solely by changes in short-term nominal interest rates that do not necessarily correspond to movements in interest rates and asset prices more generally.

Second, the increased openness of the U.S. economy, with exports and especially imports rising as a share of aggregate output and spending, has increased the direct importance of dollar exchange rates for real economic activity. At the same time, exchange rates themselves have become much more volatile. Similarly, the greater integration of U.S. and world financial markets—including tighter linkages reflecting reduced costs of international investment and arbitrage, as well as the growing presence of foreign investors in U.S. asset markets as a cumulative result of the chronic U.S. trade imbalance in the

1 For quartarly data spanning 1970:1-1988:4, for example, the simple correlation between M1 growth and the change in the GNP deflator is $-.33$.

1980s—has raised the possibility that movements of short-term interest rates, or other instruments subject to close Federal Reserve control, may not be sufficient to influence long-term asset prices and yields in the way required to achieve any given set of monetary policy objectives.

Third, the increasing indebtedness of borrowers throughout the U.S. economy, especially including corporate businesses, probably means that the economy's financial structure has become more fragile in the face of adverse shocks. At current levels of indebtedness, a general decline in business profits would leave many companies without adequate cash flow to service their obligations, and would thereby create the prospect of a widespread default that could further compound the slowdown in real economic activity that initially caused it. As a result, the real economy may have become not insufficiently sensitive to financial influences for purposes of carrying out monetary policy but, at least on the down side, excessively sensitive.

The object of this paper is to assess some of the major changes that have taken place in recent years in the ability of monetary policy to influence real economic activity, in part or as a whole: To what extent is housing now insulated from movements of short-term interest rates? How correct is the conventional wisdom that fundamental economic forces like real interest rate effects on investment and wealth effects on consumption, rather than credit rationing and other forms of sand in the economy's gears (to use James Tobin's phrase), now constitute the heart of the monetary policy process?[2] Apart from the relative growth of imports and exports per se, have exchange rates really become more important in how monetary policy works?

Clearly no one paper can-provide satisfactory answers to questions like these, but the several forms of empirical evidence summarized here are suggestive in potentially interesting ways. The first section indicates the broad dimensions of the three major economic developments of recent years mentioned above, including changes in the financing of residential construction, changes in U.S. international economic relations, and changes in patterns of business indebtedness. The second section shows that these (and presumably other) changes in the economy's structure have resulted in major changes in the kind

2 See for example; Tobin (1984).

of simple aggregate-level reduced-form relationships that, in the past, have often provided the basis for quantitative discussion of monetary policy. The third section reports the results of a more sharply focused examination of some of the potentially important changes that have taken place, based on more carefully constructed equations describing the behavior of home building, business investment, consumer spending, and foreign trade. The final section briefly summarizes the paper's major conclusions.

## Some recent developments in the U.S. economy

Table 1 summarizes, for each of the major business recessions that have occurred in the United States since World War II, the extent to which different kinds of spending have systematically accounted for different shares of the decline in overall economic activity. For each recession, the table's upper panel reports the peak-to-trough decline in total output, measured in billions of 1982 dollars. It also reports the corresponding increase or decline in each of several familiar categories of spending, measured from peak to trough of each respective spending component in case of a decline, and from the overall cycle peak to cycle trough in case of an increase—so that the component declines indicated for each episode usually add up to substantially more than the corresponding decline for total output.

As is well known, cutbacks in inventory accumulation have typically been the greatest single element accounting for U.S. recessions in this sense. Among the major components of final demand, residential construction has played the leading role ever since the beginning of the 1960s, followed by business fixed investment and consumer spending on durables, in that order. Consumption of nondurables and services has continued to rise in real terms throughout each recession, while net exports has exhibited little regular relationship to recessionary episodes in the domestic economy. Reductions in government purchases were especially important in the recessions that accompanied the end of the wars in Korea and Vietnam, but not otherwise.

This simple-minded breakdown provides a useful overview, but even as such, it is seriously deficient in a variety of ways. The most obvious of these is that any given component of economic activity may be a major part of the typical recession story, even if it never

# Table 1
## Composition of U.S. Business Recessions, 1953-1982

| GNP Peak | GNP Through | GNP | Inven. Accum. | Final Demand | Res. Constr. | Bus. Fixed Inv. | Dur. Cons. | Nondur. Cons. | Net Exports | Govt. Purch. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | **Decline Measured in Constant 1982 Dollars** | | | | | | |
| 1953:2 | 1954:2 | −43.7 | −18.4 | −29.2 | −3.5 | −4.6 | −2.8 | −2.6 | 5.5 | −55.3 |
| 1957:3 | 1958:1 | −55.4 | −23.2 | −32.9 | −7.6 | −24.4 | −9.3 | −4.3 | −21.6 | −0.9 |
| 1960:1 | 1960:4 | −17.5 | −40.6 | −1.9 | −13.0 | −6.1 | −8.7 | −3.0 | 12.0 | −4.1 |
| 1969:3 | 1970:2 | −26.7 | −23.4 | −7.5 | −17.3 | −9.5 | −5.3 | 30.1 | −7.4 | −31.3 |
| 1973:4 | 1975:1 | −120.1 | −86.6 | −63.8 | −70.2 | −47.9 | −32.2 | −15.2 | 39.8 | −8.1 |
| 1980:1 | 1980:2 | −76.4 | −53.4 | −74.6 | −50.5 | −27.3 | −39.0 | −12.6 | 15.1 | 7.3 |
| 1981:3 | 1982:3 | −110.1 | −59.7 | −69.9 | −42.1 | −50.4 | −18.3 | −2.9 | −62.4 | −6.2 |
| | | | | **Change in Annual Percentage Growth Rate** | | | | | | |
| 1953:2 | 1954:2 | −11.1 | — | −9.1 | 1.2 | −11.2 | −2.7 | −2.7 | — | −28.8 |
| 1957:3 | 1958:1 | −10.4 | — | −7.2 | −5.6 | −21.7 | −14.5 | −4.2 | — | 2.1 |
| 1960:1 | 1960:4 | −6.7 | — | −2.1 | −29.3 | −6.6 | −6.7 | −2.5 | — | 2.8 |
| 1969:3 | 1970:2 | −6.0 | — | −4.7 | −19.1 | −11.1 | −8.1 | −1.0 | — | −9.0 |
| 1973:4 | 1975:1 | −7.5 | — | −4.8 | −36.9 | −16.1 | −15.2 | −2.4 | — | 2.2 |
| 1980:1 | 1980:2 | −13.2 | — | −12.8 | −70.1 | −29.6 | −43.4 | −6.2 | — | 4.3 |
| 1981:3 | 1982:3 | −6.1 | — | −3.9 | −17.0 | −17.4 | −9.5 | −0.2 | — | 1.3 |

declines in absolute terms, merely by undergoing a sharp slowdown in its rate of expansion. The lower panel of Table 1 addresses this possibility by reporting, for each category of spending considered above (except inventory accumulation and net exports), the difference between the average real growth rate during the recession and the average real growth rate during the previous expansion. Viewing the data in this way changes the picture in some ways—for example, a slowdown in nondurable consumption, which typically accounts for some three-fifths of aggregate demand, is part of each recession—but the more prominent role of investment-type spending, including especially home building, is readily apparent from this perspective as well.

### *Changes in the financing of residential construction*

A quarter century ago—specifically, in 1964, to pick a typical nonrecession year midway between presidential elections—the average home buyer in the United States put 28 percent of the purchase price down and borrowed the remaining 72 percent.[3] Of the $17 billion lent that year in the form of one-to-four family home mortgages (net of repayments), savings and loan associations accounted for $8.1 billion, mutual savings banks for $3 billion, and commercial banks for $2.3 billion. Hence these three kinds of consumer deposit-oriented intermediaries accounted for nearly 80 percent of the final absorption of all home mortgage lending. Furthermore, in 1964, the share of these institutions' liabilities that consisted of ordinary deposits and deposit-type instruments was 93 percent at savings and loan associations, 98 percent at mutual savings banks, and 95 percent at commercial banks.[4] Federal legislation had precluded interest payments on demand deposits altogether since the 1930s, and had also imposed interest ceilings on commercial banks' time and saving deposits under the Federal Reserve System's Regulation Q. The Interest Rate Control Act of 1966 imposed analogous ceilings (administered by the Federal Home Loan Bank Board, in consultation with the Federal Reserve Board) on similar instruments issued by thrift institutions.

3 Data on down-payment ratios are from the Federal Home Loan Bank Board.

4 Data on both lending and liabilities are from the Board of Governors of the Federal Reserve System, Flow of Funds Accounts.

As a result, while the market for home mortgages depended heavily on financial intermediaries whose ability to lend depended in turn on their ability to attract deposits, by 1966 the Federal Reserve had available a ready device with which to affect these institutions' deposit flows—the relationship between short-term market interest rates and Regulation Q ceilings. For example, in 1969 the prevailing ceilings at thrift institutions were 5 percent a year on passbook saving accounts and 5¼ percent on saving certificates. When Treasury bill rates rose to an average 6.68 percent a year for 1969 (from 4.32 percent on average in 1967, and 5.34 percent on average in 1968), thrift institutions' total deposit inflow fell to less than half the 1967 level, and the pace of home building slowed as well. Similarly, in 1974 market interest rates averaged 7.89 percent a year for Treasury bills and 10.81 percent for commercial paper, compared to ceiling rates of 5¼ percent for passbook accounts and 6½ percent for certificates. Thrift institutions' 1974 deposit inflows were less than half of the 1972 level, and again home building slowed sharply.

In 1986—to pick another nonrecession year midway between presidential elections—the average home buyer in the United States put down 26 percent of the purchase price and financed the remaining 74 percent, a slightly greater loan-to-value ratio than in 1964. But of $219 billion in net lending that year for one-to-four family mortgages, commercial banks accounted for $20 billion, credit unions for $7 billion, mutual savings banks for $6 billion and savings and loans for just $500 million—in sum, just 15 percent of the total. Secondary mortgage pools sponsored by the Federal National Mortgage Association (FNMA), the Government National Mortgage Association (GNMA), the Federal Home Loan Mortgage Corporation (FHLMC), and the Farmer's Home Administration (FHA) absorbed (net of repayments) $168 billion of home mortgages in 1986, or nearly 77 percent of the entire market volume. Thrift institutions and commercial banks continued to originate new mortgage loans, but in aggregate they sold almost as many loans to these pools as they retained in their own portfolios. While 1986 was a somewhat extreme year in this regard, mortgage pools accounted for fully 52 percent of all net lending for home mortgages during 1980-88, compared to 12 percent for banks and 21 percent for the three kinds of thrift institutions combined.

Just within this two-decade period, therefore, the development and rapid growth of the secdndary mortgage market shifted the majority of net mortgage lending in the United States away from deposit-based intermediaries to specialized pools that package mortgages and sell bond-type obligations against them into the open market. FNMA had begun its lending operstions in 1955, but, as the comparison to a quarter century ago illustrates, the enormous growth of the secondary mortgage market is more recent.[5] Congress separated GNMA from FNMA in 1968 and founded FHLMC in 1971, and private issuers of collateralized mortgage obligations (CMOs) did not begin activity until 1982. By the late 1980s this secondary market had effectively severed the traditional link between the volume of net mortgage lending done and the net addition of mortgages to the balance sheets of deposit-based intermediaries.

Moreover, by the late 1980s the Regulation Q ceilings that had earlier enabled the Federal Reserve to interrupt these intermediaries' deposit flows and hence to curtail the net volume of new assets they could book, had disappeared anyway. Although the Federal Reserve began the elimination of these ceilings on its own in June 1970, by suspending the ceiling on interest paid on most large bank certificates of deposit, Congress mandated the widespread elimination of interest ceilings in the Depository Institutions Deregulation and Monetary Control Act of 1980. This legislation phased the ceilings out by successive steps beginning in 1981 and ending in 1985. The old Regulation Q is therefore gone, and (apart from the continuing legislative prohibition of explicit interest on corporate demand deposits) nothing has taken its place.

The development of the secondary mortgage market and the elimination of Regulation Q certainly do not render residential construction activity immune to the effects of 'monetary policy. But they do mean that the kind of directly visible impact that used to ensue when short-term market interest rates rose above the prevailing deposit ceilings, as in 1969 or 1974, will not recur. In the aftermath of these

5 A large part of the motivation for the development of these new lenders, of course, was to shelter the housing industry from just the effects that Regulation Q brought at times of high market interest rates. Before the mortgage pools became such a major factor in this regard, the government relied on a different solution to this problem, using the Federal Home Loan Bank System to issue securities in the open market and channel the proceeds to savings and loan institutions via direct advances. Largely between FHLBS and FNMA, federal support accounted for 45 percent of total net extensions of one-to-four family mortgages in 1969 and 52 percent in 1974.

changes, the effect of monetary policy on home building no doubt depends, to a much greater extent than in the past, on fluctuations in both real and nominal mortgage interest rates.

Fluctuations in the relevant real interest rate presumably influence home buying and home building decisions in the familiar way that is standard in most theories of investment-type spending. Fluctuations in nominal mortgage rates per se can also have important effects, since for any given size of loan it is the nominal rate that determines the size of the monthly payment, which in turn affects the willingness of liquidity-constrained home buyers (that is, almost all home buyers) to take on the commitment, as well as their ability to qualify in the eyes of potential lenders. In addition, with a large part of mortgage lending now done on an adjustable rate basis—between one-third and two-thirds of the total in a typical year—the influence of movements in both real and nominal interest rates may be either greater or smaller than when all mortgages bore fixed interest rates. In short, monetary policy presumably can still affect home building, but in different ways than in the past.

### *Changes in the openness of the economy*

The Federal Reserve System has traditionally given a prominent place to international economic and financial considerations in its public accounts of the motivation underlying the conduct of U.S. monetary policy. Pressures on the dollar value of foreign currencies under the Bretton Woods system, fluctuations in currency values during the subsequent period of floating exchange rates, and the balance of international trade have all been standard items of concern in this context. Even so, there has always been suspicion that these expressions of concern were merely that—in other words, a belief that while the Federal Reserve paid ample lip service to international considerations, in fact it took little account of them in actual monetary policy decisions.

A quarter century ago—again, 1964 to be precise—exports of goods and services constituted 6.5 percent of total real output in the United States, while imports equaled 6.2 percent. By 1988, exports and imports had risen to 12.6 percent and 15.1 percent of total real output, respectively. With the foreign sector approximately twice as large as before, relative to the size of the economy, the opportunity for monetary policy to affect aggregate economic activity by discouraging exports and encouraging imports, or vice versa, had clearly increased. (By comparison, residential construction and business fixed investment, the two spending components traditionally emphasized in this context, respectively accounted for 5.8 percent and 8.9 percent of total real output in 1964, and 4.8 percent and 12.2 percent in 1988).

In addition to the fact that exports and imports have grown secularly relative to overall economic activity—and perhaps more important, from a monetary policy perspective—the gap between the two has become both larger and more volatile in recent years. From 1950 through 1970, the U.S. merchandise trade balance fluctuated in a fairly narrow range, with maximum $6.8 billion (1 percent of total nominal income) in 1960 and minimum $600 million (less than 0.1 percent of nominal income) in 1969. Trade deficits first began to appear in the early 1970s, especially after the OPEC cartel quadrupled crude petroleum prices in 1973, although even as late as 1976 the largest recorded deficit was still only $9.5 billion, or 0.5 percent of nominal income. During 1977-82 the trade deficit stabilized at $25-35 billion a year, or roughly 1 percent of nominal income, despite another doubling of oil prices in 1979. But under the combination of extraordinarily expansionary fiscal policy and anti-inflationary monetary policy that prevailed thereafter, the trade deficit rose dramatically to $169 billion, or 3.5 percent of nominal income, in 1987. Wholly apart from the implications for aggregate economic activity of a swing of this magnitude in the economy's foreign sector, the collapse of U.S. competitiveness that this implosion of the trade balance reflected rapidly became a national problem serious enough to figure importantly in macroeconomic policymaking.

Part of the reason why the U.S. trade balance became so unstable, of course—and, correspondingly, part of the reason for supposing that monetary policy either could or should do something about it—was the change from fixed to flexible exchange rates. In 1964 the Bretton Woods system was still firmly in place. The United States fixed the price of gold, at $35 an ounce, but otherwise played no explicit role in setting currency values. Other countries mostly fixed the price of their own currencies in terms of the dollar, with relatively infrequent changes. This system weakened in 1968, with the increase in the official gold price to $42.50 an ounce and effective restrictions on U.S. willingness to sell gold even at that price, but it remained in place until the United States unilaterally terminated it in 1971. Since then, exchange rates have fluctuated with more or less freedom, according to a shifting balance of market forces and official intervention that is sometimes coordinated and sometimes not.

The dollar has, in fact, fluctuated substantially since 1971. The dollar's maximum trade-weighted average value against 10 major foreign currencies (in February 1985) was almost twice its minimum value during this period (in July 1980). At times, major changes have occurred quite rapidly. For example, after the February 1985 peak, the dollar fell by 44 percent by December 1987. Moreover, theories of purchasing power parity notwithstanding, these have mostly been real changes, not merely the reflection of different countries' differing rates of price inflation. Given the familiar dependence of imports and exports on real exchange rates, together with the dollar's evident relationship to interest rates—or at least to the differential between interest rates on dollar assets and on assets denominated in other currencies—the combination of a larger foreign sector in the U.S. economy and flexible exchange rates has clearly opened new avenues for monetary policy to affect economic activity. At the same time, given the far greater volatility of exchange rates, participants in international trade may be less likely than in the past to view exchange rate changes as permanent, rather than as mere transitory blips, and therefore may be less likely to change their business relationships in response to whatever exchange rate fluctuations do occur.[6]

The increasing openness of the U.S. economy has created complications as well as opportunities for monetary policy in areas other than just the sensitivity of trade flows to exchange rates. One direct result of the United States' chronic inability to meet foreign competition in goods markets both at home and abroad in the 1980s is a greatly enhanced role of foreign capital and foreign lenders in U.S financial markets. The enormous U.S. trade deficit since 1982 has necessarily brought huge U.S. capital imports. As a result, the United States' net international investment position peaked at $141 billion in 1981, and it has declined at an accelerating rate since then. By 1985 the United States had entirely dissipated the positive net inter-

6 For an argument along these lines, see Baldwin and Krugman (1989).

national investment position built up since 1914, when the country first became a net creditor. By yearend 1988, the U.S net international investment position was *minus* $533 billion.'

Because U.S. investors have continued to acquire modest amounts of foreign assets throughout this period, the growth in foreign ownership of financial assets issued and traded in U.S. markets is even greater than the erosion of the net international investment position suggests. For example, as of yearend 1980, private foreign investors held $19 billion in U.S. Government securities, or only 1.9 percent of the total amount outstanding. By yearend 1988, private foreign holdings had risen to $121 billion, or 3.7 percent of the amount outstanding. Including central banks and other official institutions, foreign holdings of U.S. Government securities rose from $139 billion in 1980 to $384 billion in 1988. Nor is the government securities market the only one to be so affected. Foreign holdings of corporate bonds issued in the United States, for example. rose from $22 billion, or 4.4 percent of the total amount outstanding, in 1980 to $180 billion, or 13.5 percent of the market, in 1988. And because foreign holdings in these markets are dominated by large institutional investors to an even greater extent than is the case among U.S. holdings, the percentages of trading volumes accounted for by foreign orders are typically even greater.

These large increases in foreign participation in U.S. financial markets complicate monetary policymaking in several ways. Merely changing the composition of asset holdings, away from one group of investors toward another, changes the market average portfolio behavior when the two groups of investors exhibit different asset preferences—as foreign investors and U.S investors on average clearly do.[8] More worrisome, in conjunction with flexible exchange rates, the increase in foreign participation raises the possibility that familiar cause and effect relationships may no longer obtain. For example, throughout the post World War II period, a typical (though not invariable) market reaction to an increase in short-term interest rates has been an increase in long-term interest rates. But if higher U.S.

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[7] See Scholl (1989).

[8] See Friedman (1986a) for a discussion of how foreign investors' portfolio preferences differ from those of U.S. investors on average, and the implications that follow from these differences.

short-term interest rates make dollar assets as a whole more attractive relative to assets denominated in other currencies, and if participants in the foreign exchange market also account for a large share of the trading in the dollar bond market, the effect of the stronger dollar may overwhelm the effect of higher short-term rates, so that bond yields decline rather than rise. Analogous examples, involving markets for other assets, are plentiful.

These new complications for monetary policy are hardly the most worrisome aspect of the remarkable transformation of the United States from the world's leading creditor to its largest borrower. From a broader perspective, the increasing dependence on countries whose central banks prop up the dollar and support auctions of U.S. Treasury bonds, the wholesale acquisition of the nation's productive assets and real property by foreign investors, and the inevitable erosion of U.S. influence in world financial, commercial and other affairs are the issues that genuinely matter.[9] But monetary policy is important as well, and to the extent that these changes have made the conduct of a successful monetary policy more difficult, that, too, is a proper object of concern.

### *Changes in business indebtedness*[10]

A quarter century ago—that is, at yearend 1964—U.S. corporations in nonfinancial lines of business owed $201 billion in debt borrowed from the credit markets, an amount equal to 30.4 percent of total U.S. nominal income at the time. By yearend 1988, nonfinancial business corporations owed $1.9 trillion in credit market debt, equivalent to 37.5 percent of nominal income. Substantially all of this increase has taken place in the 1980s, as a consequence of the extraordinary wave of mergers, acquisitions, leveraged buyouts and stock repurchases that has seized corporate America during this period. During 1984-88 alone, the amount of their equity that U.S. nonfinancial business corporations paid down through such transactions exceeded the amount of new equity that they issued by $444 billion.

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[9] I have discussed these matters at some length in Friedman (1988a).

[10] This section draws on Friedman (1986b, 1988b).

Corporate businesses are hardly alone in having borrowed in record volume recently. Since 1980 all major sectors of the U.S. economy except farms have increased their outstanding indebtedness at a pace significantly faster than the economy's overall growth. The huge budget deficits that became the hallmark of U.S. fiscal policy under the Reagan administration led to the first sustained peacetime increase in the federal government's debt, compared to gross national product, since the founding of the Republic. State and local governments have also increased their combined indebtedness, relative to gross national product, although their borrowing has clearly slowed since 1985 (presumably because of new tax legislation). Households—mostly individuals, but also including personal trusts and nonprofit organizations—have likewise borrowed record amounts.

The resulting across-the-board rise of debt relative to income has marked a sharp departure from prior patterns of U.S. financial behavior. From the end of World War II until the 1980s, the outstanding debt of all U.S. obligors other than financial intermediaries fluctuated relative to total nominal income within a narrow range, with no evident trend either up or down. The overall debt-to-income ratio was especially stable from the end of the Korean War until the 1980s, averaging $136 of debt for every $100 of total income during 1953-80. At yearend 1980, the total debt outstanding amounted to $137 for every $100 of total income. By yearend 1988, however, the corresponding level was $181, greater than any prior U.S. debt level recorded in this century except for 1932-35 (when many recorded debts had defaulted de facto anyway).

Private-sector borrowers, including both individuals and businesses, have accounted for two-thirds of this increase. Not surprisingly, this phenomenon has generated widespread concern. In particular, discussion at a variety of levels has questioned whether a cascade of defaults by private-sector borrowers, initially touched off by some external shock—a collapse of oil prices, for example, or a sharp rise in interest rates needed to defend the dollar—might threaten the nation's financial system, or perhaps even the nonfinancial economy. Such concerns are clearly relevant for monetary policy.

While both households and businesses have borrowed in record volume during the 1980s, households have also built up record asset levels, including not just equities and other assets exhibiting high price volatility, but also liquid assets and other stable-price debt instruments. As a result, aggregate-level household net worth has shown no significant deterioration compared to national income since 1980 (and that remains true after the October 1987 stock market crash). By contrast, during the 1980s U.S. nonfinancial businesses have increasingly borrowed not to invest, in either tangible or financial assets, but simply to pay down their own or other businesses' equity. As a result, the aggregate net worth of both the corporate sector and the noncorporate business sector has declined substantially compared to national income.

As would be expected under such circumstances, interest coverage has deteriorated along with balance sheets. Since 1980 it has consistently taken more than 50 cents of every dollar of pre-tax earnings, and more than 30 cents of every dollar of pre-tax cash flow, just to pay corporations' interest bills—far more than in earlier periods. More troubling still, the corporate sector's problem in this regard has not gotten better as the economic expansion has advanced. Continuing large-scale borrowing has about offset the effect of continuing economic expansion in boosting earnings, as well as the effect of declining interest rates, so that corporations' interest coverage has remained poor throughout the decade to date. It is not surprising, therefore, that the current business expansion has been the only one since World War II (the only one ever?) to be accompanied by a rising, rather than falling, rate of business bankruptcies and debt defaults.

There is no lack of ready explanations for businesses' eagerness to take on debt. The U.S. tax code favors reliance on debt, by allowing borrowers to deduct interest payments but not dividends from taxable income while nonetheless treating interest and dividends alike in the taxation of income earned by recipients. This discrimination is all the greater in that borrowers can deduct the full (nominal) interest that they pay, including not just that part corresponding to the "real" interest rate but also the part that compensates the lender for the erosion of principal value due to inflation. Legal and regulatory restrictions on ownership of equities by many kinds of financial intermediaries create an additional incentive to fashion instruments (like "junk" bonds) that have risk and return properties similar to equities but nonetheless constitute debt in the eyes of the relevant authorities. Larger underwriting spreads for equity than for debt offerings further increase the incentive to rely on debt when firms raise new capital. The greater speed at which firms can typically issue new debt than new equity is also a factor in contexts like unsolicited takeovers, in which timing can be all-important.

What is puzzling, however, is why business reliance on debt has accelerated so much in the 1980s. Each of these features of the U.S. financial system favoring debt financing has been present for a long time, and some should be less potent now than they were in the past. The lowering of tax rates in the 1980s, for example, should have reduced the incentive to borrow. Given the continuing non-neutrality of the tax code, so should the slowing of inflation. At least for the present, therefore, the most honest answer to the question of why all this has happened in the 1980s is that nobody really knows.

But regardless of just what motives lie behind it, the massive increase in business indebtedness has raised concerns that it will make the U.S. economy excessively fragile in the face of downward shocks. The chief danger posed by an overextended debt structure in this context is that the failure of some borrowers to meet their obligations will lead to cash flow inadequacies for their creditors—who may, in turn, also be borrowers, and so on—and that both borrowers and creditors facing insufficient cash flows will then be forced to curtail their spending. Similarly, forced disposal of assets by debtors and others facing insufficient cash flows will lead to declines in asset prices that erode the ability of other asset owners to realize the expected value of their holdings if sale becomes necessary, and will therefore threaten the solvency (in a balance sheet sense) of still others. The most likely implications for the nonfinancial economy would be reductions in employment and in a variety of dimensions of business spending, no doubt prominently including investment in new plant and equipment. Indeed, it is likely that deteriorating interest coverage has also rendered the average company's capital spending more sensitive than in the past to tight financial markets generally.

At the same time, the ability of debtors to service their obligations is clearly not independent of what is happening in the economy. For most borrowers, both the size of cash flows and the value of the marketable assets that they could liquidate in the event of an insufficiency depend to a great extent on general business conditions. Business downturns typically shrink the earnings of many firms, slow the growth of earnings for most others, and in many cases also reduce the market values of assets. Hence problems of debtors' distress are most likely to become widespread in the context of just the kind of economic difficulty that they tend to aggravate.

The most important implication for monetary policy is probably that, in the event of a business downturn, the U.S. economy would be likely to exhibit less resilience, and correspondingly more proclivity to contractionary dynamics, because of the greater potential for financial instability.[11] Hence the real costs of a recession—costs in terms of forgone output, incomes, jobs, capital formation, and so on—are likely to be greater than would be the case without the higher level of business indebtedness. Given the ever present risk that the economy may suffer an adverse shock from some entirely independent source, the higher level of business indebtedness therefore makes it all the more important for the Federal Reserve to arrest promptly any resulting contractionary tendencies.

But higher business indebtedness also matters for monetary policy in a more complicated, and more important, way because of the key role historically played by tight money in resisting price inflation. If the potential cost of recession is now greater because of higher business indebtedness, it is greater whether the recession's source is an external shock or an anti-inflationary monetary policy. To put the point in simple shorthand, the borrowing that U.S. corporations (and other businesses) have done in the 1980s has shifted the short- and intermediate-run tradeoffs confronting monetary policy, both in the sense of changing the most likely set of outcomes following from any given course of Federal Reserve action, and in the sense of changing the attendant risks.

## Evidence of change from reduced-form relationships

In light of the three changes in the structure of the U.S. economy described above, not to mention others besides, it would be surprising if simple summary relationships between real economic activity and various measures of financial conditions had remained unchanged throughout the past quarter century. In fact, they have not. As is well known, standard reduced-form equations relating either nominal income or real output to money, credit, or interest rates have largely

[11] See Bernanke and Campbell (1988) for an analysis based on individual company data that reinforces the argument made here on the basis of aggregate data.

broken down in the 1980s.[12] For example, the familiar "St. Louis" equation relating the growth of nominal income to the lagged growth of the M1 money stock and the lagged growth of high-employment federal expenditures exhibited $\bar{R}^2$ of .32 for the 1960:2-1979:3 period. For 1970:3-1986:4, the $\bar{R}^2$ was .02.

Table 2 gives an overview of the extent to which simple reduced-form equations say different things about recent years than about earlier time periods. The table summarizes the respective real output equations from a series of vector autoregressions of the form

$$(1)\ \Delta X_t = a + \sum_{i=0}^{4} b_i \Delta X_{t-i} + \sum_{i=0}^{4} c_i \Delta P_{t-i} + \sum_{i=0}^{4} d_i \Delta G_{t-i} + \sum_{i=0}^{4} e_i Z_{t-i}$$

where X is real gross national product, P is the corresponding implicit price deflator, G is real high-employment federal expenditures—all measured in logarithms—and Z is, in turn, one of a list of financial variables that could plausibly represent the influence of monetary policy. The table shows results for 16 different choices for Z, including the growth rates of the monetary base, the M1 and M2 money stocks, and total domestic nonfinancial debt outstanding; nominal interest rates on commercial paper and corporate bonds; the difference between the commercial paper rate and the rate of change of the consumer price index; the difference between the corporate bond rate and a one-year average of consumer price inflation; the change in each of these nominal and "real" interest rates; the difference between the corporate bond rate and the commercial paper rate; the difference between the commercial paper rate and the Treasury bill rate; and the change in each of these spreads.[13]

12 See Friedman and Kuttner (1989) for details.

13 The timing used in constructing the real interest rates is as follows: For the short-term rate, the nominal rate is the average of daily observations throughout the quarter, computed as the average of reported monthly averages. The price change subtracted from the short-term rate is the annualized percentage change from the prior quarter to the present quarter, based in each case on averages of monthly observations. For the long-term rate, the nominal rate is the average of daily observations during the last month of the quarter. The price change subtracted from the long-term rate is the average annualized percentage change for the current and the preceding three quarters, based in each case on the last monthly observation in each quarter.

The table shows separate results for two halves of the sample period spanning the current availability of data corresponding to the Federal Reserve System's current definitions of the monetary aggregates. For each equation, within each separate sample, the table reports the **F**-statistic for the test of the null hypothesis that the $e_i$ coefficients in equation 1 are uniformly zero. It also reports the $\bar{R}^2$ value for the entire equation.

**Table 2**
**Summary Statistics for Financial Variables in Real Output Equations**

| Financial Variable | 1960:2-1975:4 | | 1976:1-1988:4 | |
|---|---|---|---|---|
| | F | $\bar{R}^2$ | F | $\bar{R}^2$ |
| A Monetary Base | 1.60 | .17 | 2.25* | .16 |
| A Money (M1) | 1.52 | .17 | .87 | .04 |
| A Money (M2) | .42 | .09 | .14 | — |
| A Credit | 3.04** | .25 | 1.21 | .10 |
| Short Rate | 3.64** | .28 | 3.00** | .21 |
| Long Rate | 2.05 | .20 | .50 | .00 |
| Real Short Rate | .25 | .07 | 1.26 | .08 |
| Real Long Rate | 3.15** | .26 | .25 | — |
| A Short Rate | 2.35* | .22 | 2.58* | .18 |
| A Long Rate | 2.98** | .25 | .48 | — |
| A Real Short Rate | .31 | .08 | 1.66 | .11 |
| A Real Long Rate | 3.38** | .27 | .32 | — |
| Long-Short Spread | 1.56 | .17 | 2.04 | .14 |
| Default Premium | 5.86*** | .37 | 1.53 | .10 |
| A Long-Short Spread | 2.18* | .21 | .67 | .02 |
| A Default Premium | 5.27*** | .35 | 1.20 | .07 |

*significant at .10 level
**significant at .05 level
***significant at .01 level

There is little useful similarity between the results shown for these two sample periods. The short-term interest rate level and its change stand out as the only financial variables among the 16 examined for which there is evidence of a relationship to real economic activity that is statistically significant, even at the .10 level, in both samples. Variables like the growth of credit, nominal and real long-term interest rates, the long-short rate spread, and the default premium on commercial paper all showed a significant relationship in the earlier sample but not the later.[14] The monetary base is (weakly) significant in the later sample, but not the earlier. Money growth and real short-term interest rates show a significant relationship in neither sample.

Further, even those few relationships that are statistically significant in both samples are hardly identical across time in an economic sense. For example, the financial variable showing the strongest relation to movements of real economic activity in the later sample is the level of the nominal short-term interest rate, and this relationship is also significant in the earlier sample. For the earlier sample, the estimated values of coefficients $e_i$ for this variable in equation 1 are, successively, $-.0029$, $-.0013$, $.0004$ and $-.0007$ (sum $-.0045$). The corresponding estimated values for the later sample are $.0003$, $-.0042$, $.0033$ and $-.0004$ (sum $-.0010$). Although the relevant F-test does not warrant rejecting the null hypothesis that these two sets of coefficients are identical, the failure to meet the .05 significance level in this case simply reflects the imprecision with which the individual coefficients are measured in the first place. The change in estimated values between the earlier and later samples is easily large enough to make an important difference—for forecasting, or for planning monetary policy—depending on which ones are relevant.

These results, and others like them reported by numerous researchers, warrant little confidence in the ability of monetary policy to affect real economic activity in any dependable way by merely relying on simple aggregate reduced-form relationships. There is ample evidence of change between a quarter century ago and more recent

14 The F-statistic for the nominal long-term rate in the earlier sample barely fails to meet the critical value for significance at the .10 level. The same is true for the default premium in the later sample.

experience—including not just statistically significant changes of small magnitude in relationships that are precisely measured, but changes on a scale to matter importantly in a macroeconomic context.

## Changes in the sensitivity of four components of spending

Even simple reduced-form relationships for aggregate income and output like those summarized in the preceding section, indicate that the sensitivity of real economic activity to monetary policy has changed in potentially important ways. But a more focused, and more detailed, approach is necessary to flesh out the nature of those changes in a sufficiently substantive way to provide information of potential use for the conduct of monetary policy. In light of the changes in the U.S. economy reviewed in the opening section, four distinct aspects of economic activity represent plausible places to look for such changes: home building, business capital spending, consumer spending, and foreign trade.[15]

Deriving from first principles a detailed representation of each of these four components of aggregate spending would be a task well beyond the scope of any one paper. The approach adopted here is instead to exploit the extensive research embodied in the Federal Reserve Board MPS model.[16] For each component of spending, the general question to be addressed is then whether the relevant empirical relationships have changed in recent years in ways that have either heightened or dulled the sensitivity of real economic activity to aspects of financial conditions that are subject at least to influence, if not outright control, by monetary policy.

The answers yielded by this kind of single-equation approach are clearly only partial in nature. They necessarily omit the entire range of repercussions that act in a general equilibrium setting to reinforce the real effects of monetary policy, because one agent's spending decision determines another's product demand or income flow, and

15 A fifth possibility is business inventory accumulation, but the empirical literature has generated little consensus on the nature of financial influences on inventory investment. Irvine (1981) and Akhtar (1983) reported significant effects of interest rates on inventory behavior, but many other researchers (see, for example, the many references cited in those two papers) failed to do so.

16 The version used here is described in detail in Brayton and Mauskopf (1985).

because many agents' asset demands collectively determine asset prices and goods prices, and hence alter their own and other agents' wealth. They also necessarily omit the whole range of repercussions that act to dampen the real effects of monetary policy, because many agents' spending and portfolio behavior collectively determines interest rates and inflation rates, and hence the financing costs that they and other agents face. Even so, the limited exercise of establishing what changes have occurred in the first-round effects of monetary policy actions is informative too. After all, if there were no first-round effects there would be no repercussions either.

Beyond the question of partial versus general equilibrium analysis, the findings from any empirical exercise along these lines are also necessarily limited by the use of the specific model that underlies it. Nonrobustness of quantitative estimates with respect to model specification has long been a familiar phenomenon in empirical economics, certainly including the investigation of relationships bearing on monetary policy. Nevertheless, any such analysis requires some well-specified model as a base, and in light of its long history of use in just this context, the FRB-MPS model is probably as appropriate a vehicle as any for this purpose. Especially for policy purposes, the right response to concerns about robustness with respect to model specification is presumably to carry out parallel empirical analyses based on alternative models, not to eschew empirical investigation in the first place.[17] While such a comparative approach clearly lies beyond the scope of this paper, it is appropriate to view the findings reported here as one element—given the historical role played by the FRB-MPS model, a particularly interesting element—in such a broader endeavor.

### *Residential investment*

The most immediate question to ask about home building is to what extent the elimination of deposit interest ceilings and the development of the secondary mortgage market have made residential construction less sensitive to monetary policy by precluding restrictions

[17] See, for example, McCallum (1988) for an investigation that explicitly addresses the robustness issue in this way.

on mortgage lending like those that occurred in tight money episodes in the 1960s and 1970s, when market interest rates rose sharply above the then permissible deposit rates. Was the resulting credit rationing all there was to the effect of tight money on housing? Or is housing also sensitive to mortgage interest rates? If so, how far do mortgage rates have to rise to depress housing as much as an episode of credit rationing? And has the sensitivity of home building to changes in mortgage rates become greater or smaller in recent years?

The FRB-MPS model's treatment of residential construction activity combines a relatively straightforward model of investment, based on the real after-tax cost of capital, with a completely separate model for episodes of credit rationing. The complete equation is

$$(2)\ IH_t = (1-DCR_t)\left\{(1-DPO_t)\left[a + \sum_{i=0}^{3} b_i RH_{t-i} + c\,CON_t + d\,\Delta UE_t + e\,KH_{t-1}\right] + f\,DPO_t \cdot IH_{t-1}\right\} + DCR_t\left\{\sum_{i=0}^{4} g_i \dot{SLD}_{t-i} + h\,UE_t + k\,IH_t^*\right\}$$

where IH is the natural logarithm of per capita real expenditures on housing; DCR is a dummy variable indicating whether a "credit rationing" episode is in progress (value 1 if so, 0 if not); DPO is a dummy variable indicating the phase-out of a credit rationing episode (non-zero value if an episode had occurred within the prior four quarters, 0 if not); RH is the logarithm of the real after-tax cost of capital for housing investment; CON is the recent average per capita consumer spending; UE is the unemployment rate; KH is the existing stock of residential capital; $\dot{SLD}$ is the per annum real growth rate of deposits at savings and loan institutions; IH* is the value of IH in the most recent period prior to the onset of credit rationing; and lower case letters (a, b, . . . , k) indicate coefficients to be estimated.[18]

[18] Appendix A gives the exact definition of each variable used here and in the other equations presented in this section. As the appendix indicates, some variables are in logarithmic form.

Apart from episodes of credit rationing, the direct influence of monetary policy on home building lies in the real after-tax cost of capital, defined here by

$$(3)\ RH = \log \frac{PH}{PC} \left\{ (I - TP)\,(RM + TPR) + 2.4 - 6\ \dot{PR} \right\}$$

where PH and PC are the implicit price deflators for residential construction and consumption, respectively; TP is the average effective tax rate on personal income, including federal, state and local taxes; RM is the mortgage interest rate; TPR is the average property tax rate; and $\dot{PR}$ is the recent average rate of change of the rental component of the consumer price index. For a given relative price of housing, given tax rates, and given inflation, a change in the mortgage interest rate directly affects the cost of capital in equation 3, which in turn affects home building via the $b_i$ coefficients in equation 2. This effect is strong empirically, with each estimated $b_i$ value but the last (which is small) individually negative as is to be expected, and the sum negative with t-statistic −4.5, for the equation estimated over the 1964:3-1988:4 sample.[19]

By contrast, during episodes of credit rationing what matters is not the cost of capital but the growth of deposits at thrift institutions, which is presumably slower than normal because of the interaction of market interest rates and deposit rate ceilings. Indeed, during the three historical periods identified in the model as credit rationing episodes (1966:3-4, 1969:3-1970:3, and 1974:1-1975:1) real deposit growth averaged −0.26 percent a year versus 5.76 percent a year on average during the remaining quarters of the post-Accord period. Within the credit rationing regime, faster or slower deposit growth matters for housing activity, although here the empirical evidence is much weaker. Again for the equation estimated over the 1964:1-1988:4 sample, each estimated $g_i$ value but the last (which

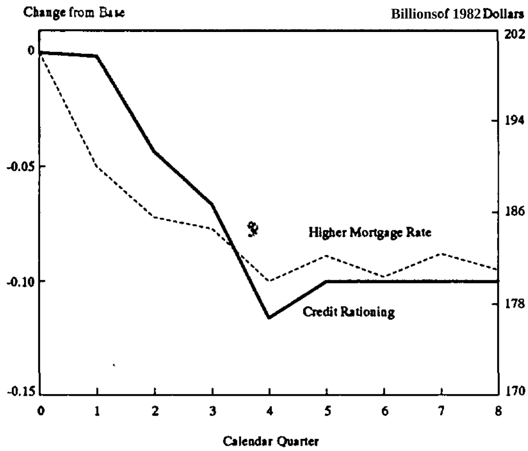
19. Appendix B gives the complete estimation results for all equations described in this section. The sample period in most cases reflects that shown in Brayton and Mauskopf (1985), extended to incorporate subsequently available data.

is small) is individually positive, but the t-statistic for the sum is merely 0.8.[20]

Chart 1 indicates the relative strength of these two channels of monetary policy influence by showing the results of using the estimated equation 2 to simulate the effects of two separate experiments. The solid line shows the effect on home building of a sustained increase of 1 percent (that is, one percentage point) in the mortgage interest rate, beginning in quarter 1. The dashed line shows the effect of a sustained episode of credit rationing involving a 6 percent (six percentage points) decrease in the annual growth of real savings deposits. In both simulations all values other than the mortgage rate and the deposit growth rate are normalized to the actual values that prevailed in 1988:4 and held fixed at those values throughout. In the absence of either the mortgage rate increase or

## Chart 1

### Residential Investment: Responses to 100 Basis Point Rise In Mortgage Rate and Imposition of Credit Rationing




Note: Base = 1988.4, Real Mortgage Rate = 4.9%, Unemployment Rate = 5.4%; Effective Tax Rate = 23%, Quarterly Figures Are Annualized

20 Brayton and Mauskopf reported a t-statistic of 2.2 for the equation estimated over 1960:1-1982:4. Indeed, in the 1964:3-1988:4 sample there is little evidence to warrant separate treatment of credit rationing episodes at all. The $\bar{R}^2$ value for the equation as written in equation 2 is .9311. For the simple form with DCR and DPO always set equal to zero, the corresponding $\bar{R}^2$ is ,9230.

the credit rationing, therefore, home building would simply remain constant at the 1988:4 base level.[21]

The 1 percent increase in mortgage interest rates depresses housing fairly rapidly, with substantially all of the effect occurring within four quarters. The full effect is to depress the level of spending by approximately 9 percent (left scale), or roughly $19 billion in constant 1982 dollars, based on the 1988:4 level (right scale).[22] The imposition of credit rationing acts more slowly but has approximately the same effect after four quarters. Apart from differences in timing, therefore, these results imply that, given the relatively high level of real interest rates prevailing in 1988:4, it takes an increase of approximately 1 percent in mortgage interest rates to have an effect on home building comparable to that of a 1960s-1970s credit rationing episode.[23]

What about the possibility that home buyers have become more interest sensitive in recent years, so that monetary policy can still depress housing without large increases in mortgage rates despite the inability to create conditions of credit rationing as in the past? These relationships provide only modest evidence to support such a claim. For the 1964:3-1988:4 sample, the estimated sum of the $b_i$ coefficients in equation 2 is $-1.095$ (t-statistic $-4.5$). For the 1964:3-1976:4 and 1977:1-1988:4 samples taken separately—that is, dividing the full sample approximately in half—the corresponding sums are $-.954$ (t-statistic $-1.1$) and $-1.320$ (t-statistic $-3.9$), respectively.[24] Moreover, even this modest difference is difficult to

21 The simulation does, however, allow for incremental effects via changes in the stock of residential capital. As is clear from equation 2 as written, the deposit growth rate does not matter in the absence of credit rationing, The credit rationing simulation uses a base value of 4.45 percent (the 1988 average) for DSL in quarter 0 and before, and $-1.55$ percent from quarter 1 on.

22 For purposes of comparison, here and below, aggregate gross national product in 1988:4 was $4,033.4 billion in 1982 dollars.

23 Because one of the variables held fixed in the simulations is the rate of increase in the CPI rental index, the mortgage rate increase under study here is explicitly an increase in the *real* interest rate on mortgage loans. The base real interest rate matters in this simulation because the equation is in logarithmic form.

24 The finding of no significant (economically or statistically) change in the interest sensitivity of housing investment corresponds to the conclusion reached by Akhtar and Harris (1987) on the basis of a much simpler model.

interpret, because of changes in the coefficient on the lagged stock of residential capital (e). The effect of real interest rates on housing may be either large or small, depending on one's point of view, but there is no firm basis here for concluding that in recent years it has been larger or smaller than it was earlier.

### *Business fixed investment*

Business capital spending typically exhibits less cyclical volatility than does housing, at least on a percentage basis. But because capital spending bulks much larger in overall economic activity, the dollar decline in capital spending has exceeded the dollar decline in housing in four of the seven post-Accord recessions.[25]

A standard approach to modeling business investment behavior, which the FRB-MPS model also follows, treats spending on structures and spending on equipment separately. Spending on equipment is by far the larger of the .two, usually almost three-fourths of the total. Moreover, a typical finding in, the empirical literature that distinguishes between these two components of business investment is that spending on equipment exhibits economically important and statistically significant sensitivity to changes in the relevant cost of capital—caused by changes in tax rates, changes in financial markets, and so on—while spending on structures does not.[26]

The FRB-MPS model's treatment of business equipment spending follows the standard neoclassical investment model according to which the capital stock adjusts over time to an optimal value determined by the level of output and the optimal capital-output ratio, which in turn depends on the cost of capital. The specific relationship is

$$(4)\ IE_t = \sum_{i=0}^{16} a_i\,[XB_{t-i}\,V_{t-i-1}] + \sum_{i=1}^{16} b_i\,[XB_{t-i}\,V_{t-i}] + \sum_{i=1}^{16} c_i\,[XB_{t-i-1}\,V_{t-i}]$$

25 See again Table 1.

26 See, for example, Bischoff (1971b). Experimentation based on an analog to equation 4 below similarly failed to reveal any significant sensitivity for investment in structures.

where IE is real expenditures on producers' durable equipment; XB is gross business output; V is the equilibrium ratio of equipment to output; and the $a_i$, $b_i$, and $c_i$ are coefficients to'be estimated.[27] The equilibrium equipment-output ratio is given by the cost ratio

$$(5)\ V = \frac{PXB}{RRE}$$

where PXB is the implicit price deflator corresponding to XB and RRE is the per-unit after-tax rental rate for producers' equipment, determined as

$$(6)\ RRE = PE \frac{[1-K-TC \bullet Z]}{1-TC} (DE + RFE)$$

where PE is the implicit price deflator corresponding to IE, K is the percentage investment tax credit (if any), TC is the federal corporate income tax rate, Z is the present value of the depreciation allowance for equipment, and DE is the relevant depreciation rate. Finally, RFE, the real financial cost of capital for equipment, is determined as

$$(7)\ RFE = DR \left\{ (1-TC)\ RCB - \dot{PX} \right\} + (1-DR) \frac{ERN}{PRI}$$

where DR is the ratio of debt to total capitalization for nonfinancial corporations, RCB is the corporate bond rate, $\dot{PX}$ is the recent average inflation rate for gross domestic product, and ERN/PRI is the earnings-to-price ratio for the Standard & Poor's 500.[28]

27 The equation also includes seasonal dummy variables. See, for example, Bischoff (1971a) and the references cited there.

28 A key feature of this model that has importantly influenced the literature of empirical findings based on it is the assumption, here embedded in the form of equations 6 and 7, that changes in the cost of capital due to tax factors and changes in the cost of capital due to market rates of return on debt and equity exert isomorphic effects on investment. See Jorgenson (1963) for a discussion of the basic theoretical conceptions underlying the model. Especially for sample periods during which there was little actual change in measured debt and equity returns, the inferred effects of hypothetical changes primarily reflect actual effects of changes in the tax factors.

Given equations 4—7, monetary policy directly affects business fixed investment in two ways. Changes in the corporate bond rate alter the financial cost of capital and thereby affect the rental rate, hence the equilibrium equipment-output ratio and, over time, actual expenditures on new equipment. In addition, to the extent that monetary policy influences the stock market, the resulting change in the effective yield on equity (for given earnings) acts in the same way as a change in the corporate bond rate. (In a general equilibrium context, of course, there are also secondary effects due to changes in output, goods prices and earnings, but the focus of attention here is on the immediate, direct effects of monetary policy.)

Unraveling the separate effect of the $a_i$, $b_i$ and $c_i$ coefficients that together determine the time response of equipment investment to changes in output and in the optimal equipment-output ratio is both complex and unilluminating. More to the point is that the total effect is unambiguously positive and statistically significant. For the 1958:2-1988:4 sample, the combined sum of the $a_i$, $b_i$ and $c_i$ coefficients is positive, with t-statistic 2.5. For given values of output, goods prices, and the relevant tax parameters, therefore, an increase in the (real) corporate bond rate depresses spending on new equipment, as does a decline in stock prices.

For purposes of analyzing the immediate effects of monetary policy on business investment spending, simply taking as given any specific change in the corporate bond rate is straight forward. By contrast, some additional apparatus is necessary to represent the part of the effect on investment that takes place through changes in stock prices, and hence (for given earnings) in the earnings-to-price ratio. The auxiliary equation used for this purpose here is

$$(8)\ PRIL_t = d + e\,t + \sum_{i=0}^{6} f_i\, RCP_{t-i} + \sum_{i=0}^{6} g_i\, (RCP - \dot{CPI})_{t-i}$$

where PRIL is the logarithm of the market value of corporate equity; t is a linear time trend; RCP is the commercial paper rate; $\dot{CPI}$ is the rate of increase of the consumer price index; and d, e, the $f_i$ and the $g_i$ are coefficients to be estimated. The results of estimating equation 8 for the 1956:1-1988:4 sample indicate that increases in short-term interest rates depress stock prices regardless of whether or not they are accompanied by inflation. The estimated sum of the $f_i$ coefficients is $-.0675$, with t-statistic $-3.8$, so that a 1 percent (that is, one percentage point) increase in the commercial paper rate lowers stock prices by nearly 7 percent (that is, to a level equal to .93 times the previous level). By contrast, the estimated sum of the $g_i$ coefficients is indistinguishable from zero.[29]

In contrast to the results for housing investment, estimating equation 4 for different sample periods does indicate a substantial change over time in the behavior of business equipment investment. In particular, in recent years firms' investment behavior has apparently become more sensitive to variations in output and in the various determinants of the optimal equipment-output ratio. Chart 2 illustrates this change by plotting the results of two simulations that differ only in the sample used to estimate equation 4.[30] In both cases the experiment analyzed is an increase of 1 percent (as before, one percentage point) in both the corporate bond rate and the commercial paper rate beginning in quarter 1. The higher corporate bond rate directly raises the debt component of the cost of capital in equation 7, while the higher commercial paper rate raises the equity component by lowering stock prices as in equation 8. Throughout both simulations all variables other than the two interest rates and the level of stock prices are normalized to their historical 1988:4 values, and these three variables are set equal to their 1988:4 values for all quarters prior to and including quarter 0. In the absence of the interest rate increases, therefore, equipment investment would simply be constant throughout at its 1988:4 level. In addition, both simulations rely on a single set of coefficient values in equation 8, so that the difference shown is strictly due to differences in the estimated coefficients in equation 4.[31]

29 The estimated value is .0012, with t-statistic 0.0.

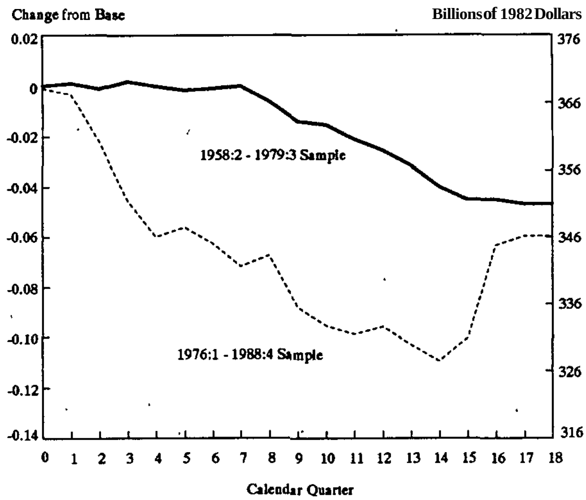
30 Choice of 1979:3 for the end of the first sub-sample corresponds to a familiar benchmark used in discussions of how monetary policy has changed, based on the Federal Reserve's introduction of new monetary policy procedures in October 1979. Choice of 1976:1 (rather than 1979:4) as the beginning of the second sub-sample merely reflects the need for additional observations to facilitate suitable estimation of so many parameters.

31 Using identical coefficient estimates for equation 8 in both simulations is consistent with the emphasis in this paper on changes more directly bearing on nonfinancial economic activity, rather than changes among financial variables per se. In a more general context, however, there is no reason not to allow the coefficients in equation 8 to change along with those in equation 4.

For equation 4 estimated using the 1958:1-1979:3 sample (the solid line), the decline in equipment spending that results from a 1 percent increase in both short- and long-term interest rates is modest in extent and gradual to take place. Little change occurs for the first six quarters, and the ultimate effect (which, by assumption, is complete after 18 quarters) is to depress equipment spending by 4.7 percent of its base level, or by $17 billion in 1982 dollars based on the 1988:4 value.[32] For equation 4 estimated using the 1976:1-1988:4 sample (the dashed line), the corresponding effect is somewhat greater. The ultimate result is to depress equipment spending by 6 percent, or $22 billion in 1982 dollars based on the 1988:4 value. Even more so than this difference in magnitude of the ultimate effect, however, the timing is very different. In the simulation based on the later sample, equipment spending falls approximately to the new (par-

## Chart 2

## Investment In Producers' Equipment: Response to 100 Basis Point Increase In Corporate Bond and Commercial Paper Rates




Note: Base = 1988:4; Earnings/Price = 8.5%; Corporate Bond Rate = 10%; Debt/Capitalization = 67%;
Quarterly Figures Are Annualized

32 The gradualness of the change is typical of results found using data from before the 1980s. *See*, for example, Clark (1979).

tial) equilibrium level within a year, after which the interim decline overshoots the equilibrium by roughly a .factor of two, before ultimately recovering.[33]

The finding that business investment in new equipment is now more sensitive to monetary policy actions, especially in the short run, than it was in prior decades no doubt reflects a complex interaction among several different effects which will require substantial further research to sort out.[34] For example, changes in the tax code legislated in the 1980s result in a greater share of the pre-tax interest burden of debt passing through to the borrowing corporation on an after-tax basis, and thereby presumably make firms more sensitive to interest rate changes.[35] At the same time, the increasing sensitivity of business capital spending to financial conditions is certainly consistent with the implications of the more heavily leveraged position of the corporate sector in recent years, as reviewed in the first section, including in particular the historically large share of earnings required in the 1980s for interest payments. Given the deterioration of interest coverage, first in the 1970s and then even more so after 1980, it is hardly surprising that the typical firm now cuts back its investment spending more promptly when market interest rates rise.[36]

### *Consumer spending*

Whether financial factors affect consumer behavior—and, if so,

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33 The FRB-MPS model results reported by Brayton and Mauskopf (for the 1961:1-1979:4 sample) constrained the $a_i$, $b_i$ and $c_i$ coefficients to lie along respective thirddegree polynomials. The results underlying Chart 2, reported in Appendix B, imposed no such constraint, hence permitting the irregular pattern shown in the chart.

34 This result, too, roughly accords with the finding of Akhtar and Harris (1987), despite their use of a much simpler model. In their results, however, it is also the long-run effect that differs.

35 The effective tax rate series used here is analogous to series (1) in Auerbach and Hines (1988), disaggregated to reflect equipment investment only, and updated through 1988. I am grateful to them for providing their unpublished series, as well as for helpful discussions.

36 Bosworth (1989) suggested several other reasons for expecting instability in relationships involving equipment investment, including unusually great changes in the relative price of equipment—at least as calculated by the Commerce Department for purposes of these data (see Bailey and Gordon [1988])—and the changing composition of equipment spending, in both cases with computers playing the central role. Yet another consideration along these lines is the changing (first rising, then declining) importance of investment for purposes of pollution control; see, most recently, Rutledge and Stergioulas (1988).

how—is a long debated issue. Early Keynesian consumption functions related spending solely to income levels, as did early versions of the "permanent income" hypothesis.[37] By contrast, from the outset, the closely related "life cycle" hypothesis emphasized the role of consumers' wealth and hence, at least implicitly, the importance of changes in asset prices. Yet a different line of inquiry has sought, without much success, to document effects on consumer spending due to interest rates directly.[38]

To a large extent, the experience of the 1980s has apparently belied the importance of financial influences on consumer behavior along either of these two lines. Despite record high real after-tax interest rates in the 1980s--due to a combination of high pre-tax interest rates, reduced inflation (given the non-neutrality of the tax code), and lower tax rates—personal saving fell to record lows.as a share of income. And although purchases of consumer durables did slow briefly after the October 1987 stock market crash, the decline was both milder and shorter-lived than most traditional life cycle models would have predicted in light of the severity of the crash.

The FRB-MPS model's treatment of consumption combines a Keynesian approach based on income flows and a life cycle approach based on wealth levels, as is presumably appropriate when a large part of the consuming population faces liquidity constraints.[39] It further disaggregates both income and asset totals in ways intended to capture differences in behavior among different groups of income recipients, as well as differences in the liquidity properties of different assets. The specific relationship is

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37 Friedman (1957) used a three-year moving average of past income to proxy perceived permanent income.

38 See, for example, Boskin (1978) and Howrey and Hymans (1978).

39 For evidence on the importance of liquidity constraints in this context, see Hayashi (1982), Hall and Mishkin (1982) and Zeldes (1989).

$$(9)\ C_t = a + \sum_{i=0}^{6} b_i (1-TP_t)\ YL_{t-i} + \sum_{i=0}^{6} c_i (1-TP_t)\ YP_{t-i} + \sum_{i=0}^{6} d_i\ YT_{t-i} + \sum_{i=0}^{6} e_i\ EQ_{t-i} + \sum_{i=0}^{6} f_i\ OFW_{t-i} + \sum_{i=0}^{6} g_i\ TAN_{t-i}$$

where C is consumer expenditures, YL is labor income, YP is property income, YT is income from transfer payments, EQ is household holdings of equities, OFW is the remainder of household financial wealth (financial assets minus liabilities), and TAN is household holdings of tangible assets—all measured in real per capita magnitudes; TP is again the average tax rate on personal income; and the a, $b_i$, . . . , $g_i$ are coefficients to be estimated.[40]

Estimating equation 9 for the 1955:4-1988:4 sample delivers results that are both economically sensible and, for the most part, statistically significant. The marginal propensity to consume out of each of the three different forms of income is positive, and it differs among them in ways that correspond to conventional expectations. The estimated values of the respective coefficient sums are .61 for labor income (t-statistic 7.2), .21 for property income (t-statistic 0.7). and .75 for transfer payments (t-statistic 3.9). The marginal propensity to consume out of each different form of wealth is also positive, although in this case it is not clear what prior expectations one would have about the differences among them. The estimated values of the respective coefficient sums are ,022 for equity (t-statistic 1.6)—that is, a 2.2 cent change in spending for every $1 change in the value of equity holdings—.168 for other financial wealth (t-statistic 4.0), and .077 for tangible assets (t-statistic 2.8).

40 As in much of the related literature, the FRB-MPS model distinguishes consumption of nondurable goods and services (including the implicit services provided by durables) from expenditures to purchase new durable goods. Indeed, much of the empirical literature addressing financial effects on consumer spending focuses primarily, or even exclusively, on durable goods purchases; see, most recently, Akhtar and Hams (1987). By contrast, the equation estimated here simply treats C as total consumption expenditures in the NIPA accounts. This choice reflects the result of initial experimentation with both aggregate and disaggregated equations.

Given equation 9, the direct effects of monetary policy on consumer spending follow immediately from the effect of interest rates on property income (of which almost one-half has been interest income since 1970, and more than one-half in the 1980s) and on asset prices. In light of the substantial literature associated with the theoretical possibility of a nonzero interest elasticity of saving, however, it is also worth asking whether there is evidence to support the claim that interest rates affect consumption directly, in addition to their effects via property income and asset prices. The answer is that there is not—at least not in the context of a mixed Keynesian-life cycle consumption function like equation 9. Re-estimating equation 9 with the addition of a distributed lag on the commercial paper rate, or on the commercial paper rate minus the rate of increase of the consumer price index, results in estimated coefficients for these variables that are both small and statistically insignificant.[41] (In addition, monetary policy presumably affects consumer spending in other ways, most obviously by reducing labor income. But the focus here is on direct effects rather than repercussions from other aspects of economic activity.)

Investigating the effect of monetary policy on consuption via equation 9 therefore requires a representation of the link between interest rates and asset values, and also between interest rates and property income. The four auxiliary equations used for this purpose are each of the form

$$(10)\quad EQ_t = h + k\,t + \sum_{i=0}^{6} m_i\, RCP_{t-i} + \sum_{i=0}^{6} n_i\,(RCP - \dot{CPI})_{t-i}$$

where the right-hand side variables are as in equation 8. Table 3 summarizes the respective estimated effects of nominal and real interest rates in these four equations. For equities and other financial wealth, changes in short-term interest rates again affect real asset values (negatively) regardless of whether or not they are accompanied by inflation. As is to be expected, the reverse is true for tangible assets. There what matters (negatively) is real interest rates. Finally, the results for property income are also about as one would expect.

41 For the nominal short-term rate, the estimated coefficient sum is −13.2, with t-statistic −1.3. For the real short-term rate, the estimated sum is −2.3, with t-statistic −0.3.

Changes in short-term real interest rates affect property income positively, although the effect is not statistically significant. Joint changes in nominal short-term market rates and inflation affect property income negatively—presumably because so much of household wealth is in instruments, like saving and checking deposits, bearing interest rates that adjust sluggishly if at all.

**Table 3**
**Summary of Estimated Interest Rate Effects on Asset Prices and Property Income**

| Equation | RCP | | RCP-CPI | |
|---|---|---|---|---|
| EQ | −430.5 | (−3.6) | 26.3 | (0.2) |
| OFW | −116.3 | (−4.5) | 30.5 | (1.1) |
| TAN | −49.7 | (−1.2) | −129.7 | (−3.0) |
| TP | −19.3 | (−2.6) | 8.3 | (1.1) |

Note: Values shown are estimated sums of coefficients (t-statistics in parentheses). Sample period is 1955:1-1988:4

Chart 3 shows the results of using equation 9 and the four equations like equation 10—one each for EQ, OFW, TAN and YP—to simulate the effect on consumption of monetary policy, represented once again by a 1 percent (that is, one percentage point) rise in the commercial paper rate beginning in quarter 1. Apart from the interest rate, the three wealth components, and property income, all other variables are normalized throughout to their historic 1988:4 values. As usual, the variables that change in the simulation are fixed at their 1988:4 values for all quarters prior to quarter 1.

As in the case of business capital spending, the effect of monetary policy apparently differs in recent years from what it was in the past. The two lines in Chart 3 show results for simulations that are identical except for the sample used to estimate equation 9.[42] For coeffi-

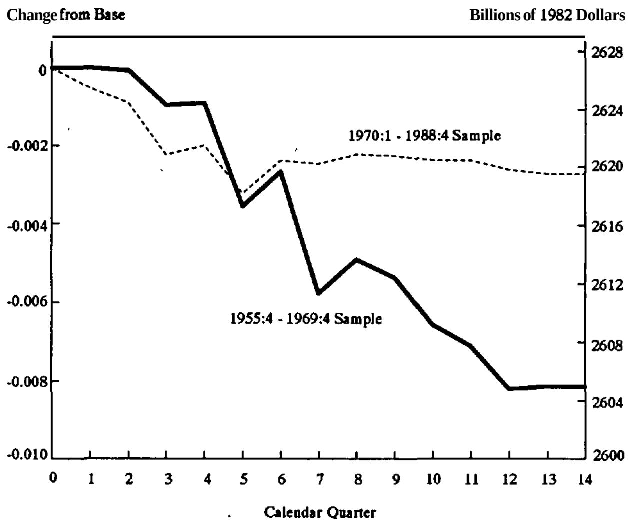
[42] The choice of the two sub-samples reflected an approximate halving of the sample period, together with a (slight) preference for conforming to popular discussions that often draw distinctions by decades. The same coefficient values for the four auxiliary equations 10, estimated for the full 1955:1-1988:4 sample, are used in both simulations; see again, footnote 31.

cient values based on the 1955:4-1969:4 sample (the solid line), a 1 percent increase in short-term interest rates ultimately lowers consumer spending by 0.8 percent. While this percentage change may appear small, the effect is still highly meaningful in terms of the ability of monetary policy to affect economic activity because consumption bulks so large in aggregate spending. Based on the 1988:4 level, the resulting decline in consumer spending is equivalent to $21 billion in 1982 dollars—a greater amount than in any of the simulations shown in Charts 1 and 2.

For coefficient values based on the 1970:1-1988:4 sample, the ultimate effect of tight money on consumption is much smaller. A 1 percent rise in short-term interest rates depresses spending by only 0.3 percent, or $7 billion in 1982 dollars. In contrast to the long time required for the effect to become complete in the simulation based on the earlier sample, however, here the effect is substantially complete within one year. Indeed, during the first year after the rise in interest rates, the effect on consumer spending is greater in the results

## Chart 3

## Personal Consumption Expenditures: Response to 100 Basis Point Rise In Commercial Paper Rate




Note: Base Quarter = 1988:4
Quarterly Figures Are Annualized

based on the more recent sample.[43] To the extent that episodes of tight money typically last not much more than a year, if that long, these results therefore suggest that the ability of monetary policy to affect real economic ability by slowing consumer spending is approximately unchanged.[44]

### *Foreign trade*

Finally, the larger share of both exports and imports in the aggregate U.S. economy in recent years raises the prospect of an enhanced opportunity for monetary policy to affect real economic activity through the impact of interest rate changes on dollar exchange rates. Despite uncertainty about the magnitudes of the relevant income and price elasticities, there is substantial agreement that export demand depends on the level of economic activity abroad while import demand depends on income levels in the United States, and that both exports and imports depend on the relevant terms of trade. The FRB-MPS model specifies these relationships as

$$(11)\ EX_t = a + \sum_{i=0}^{4} b_i\, WIP_{t-i} + \sum_{i=0}^{6} c_i\, TTEX_{t-i}$$

$$(12)\ IM = d + \sum_{i=0}^{4} e_i\, X_{t-i} + \sum_{i=0}^{6} f_i\, TTIM_{t-i}$$

where EX and IM are real non-agricultural exports and real non-petroleum imports, respectively; WIP is industrial production out-

43 In contrast to the results shown in Chart 3, Akhter and Harris (1987) concluded that the "long-run" interest sensitivity of consumer spending has increased in recent years. Wholly apart from their focus on purchases of durables only, versus aggregate consumption expenditures here, the explanation may lie in the different dynamics of their simpler equation. In particular, the finding here that consumer spending is somewhat *more* sensitive in the first year may—given the equations' different dynamic structures—be the appropriate counterpart of Akhtar and Harris' result.

44 As the coefficient values reported in Appendix B suggest, the principal source of the difference is the change in the sensitivity of consuption to the three asset values, including especially equities. A further reason for not emphasizing the differences between the two sets of results is that, while the coefficient sum for the three assets is plausible enough in both samples—.15 in the earlier sample, .29 in the later—some of the individual asset sums are not plausible, and the same is true for property income.

side the United States; X is U.S. gross national product; and TTEX and TTIM are the U.S. terms of trade with other countries, weighted by the volume share of each country in U.S. export trade and U.S. import trade, respectively—all in logarithms; and a, . . . , $f_i$ are coefficients to be estimated.

Estimating equations 11 and 12 delivers results broadly in line with standard notions about how activity levels and real exchange rates affect international trade. For the 1968:1-1987:4 sample, the sum of the estimated coefficients on foreign industrial production in equation 11 is 1.81, with t-statistic 15.8. The corresponding sum for U.S. gross national product in equation 12 is 2.56, with t-statistic 43.7. The coefficient sums for the terms of trade variables are −.347, with t-statistic −2.9, in equation 11—that is, an improvement in the U.S. terms of trade, corresponding to a deterioration in other countries' terms of trade with the United States, reduces demand for U.S exports—and .739, with t-statistic 11.5, in equation 12.[45]

Since the terms of trade variables in equation 11 and equation 12 are simply weighted exchange rates, adjusted by relative prices, the familiar connection between interest rates and exchange rates immediately implies an effect of monetary policy on the terms of trade, and hence on both exports and imports. Following equations 8 and 10 above, the auxiliary equations used here to represent this link are both of the form

$$(13)\quad TTEX_t = g + h\,t + \sum_{i=0}^{6} k_i\, RCP_{t-i} + \sum_{i=0}^{6} m_i\, (RCP - \dot{(CPI)})_{t-i}$$

where the right-hand-side variables are again as before. In sharp contrast to the effects of short-term interest rates on asset values, the evidence strongly indicates that exchange rates depend on real rather than nominal interest rates. For the 1968:1-1987:4 sample, the estimated coefficient sum for the real interest rate in the export-weighted terms of trade equation is .0560, with t-statistic 20.0, while the estimated sum for the nominal rate is −.0055, with t-statistic −1.5. The corresponding sums for the import-weighted terms of trade

45 Empirical estimates of the elasticities of exports and imports with respect to the terms of trade have varied widely in the literature; see the survey of such results in Helliwell and Padmore (1985).

are ,0565 (t-statistic 19.8) for the real rate and −.0004 (t-statistic −0.1) for the nominal rate.

Charts 4 and 5 show the results of simulating the effects of monetary policy on U.S. foreign trade, based on the usual 1 percent increase in the commercial paper rate. The terms of trade equations underlying these simulations are, in each case, estimated for the 1968:1-1987:4 sample.[46] Each figure shows different results based on the export and import equations estimated first for 1968:1-1979:4 and then for 1980:1-1987:4.[47]

Both exports and imports exhibit less sensitivity to fluctuations in the terms of trade—and therefore less sensitivity to interest rates, and hence to monetary policy—in the more recent sample. In the earlier sample, the 1 percent increase in interest rates causes the dollar to appreciate by enough to depress U.S. exports by 5.2 percent, and to boost U.S. imports by 4.8 percent, resulting in a net subtraction from U.S. economic activity equivalent to $36 billion in 1982 dollars based on historic 1988:4 values. The corresponding percentage effects on exports and imports in the later sample are −4.2 percent and 2.1 percent, respectively, resulting in a $21 billion real net subtraction from total activity at 1988:4 values.

Given the increased volatility of exchange rates, it is not surprising that the responsiveness of both exports and imports to fluctuations in the terms of trade has moved in the direction that offsets at least part of the larger role of foreign trade in the U.S. economy.[48] What is interesting about the results summarized in Charts 4 and 5 is the finding that, especially in the case of imports, the smaller (in absolute value) responsiveness is more than sufficient to offset the larger foreign trade share, therefore resulting in a smaller overall effect on aggregate economic activity. To be sure, having more exports and more imports relative to aggregate U.S. output and spend-

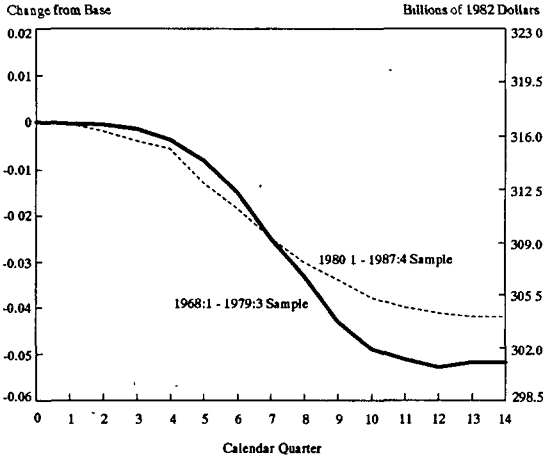
46 To guard against the possibility that the use of data from 1968-72 (that is, before the floating exchange rate regime) might have affected the estimates for the terms of trade equations, both equations of form in equation 13 were also estimated using the 1973:1-1987:4 sample. The results were essentially unchanged. See again footnote 31 on the logic of not dividing the sample used to estimate equation 13 in parallel with the sub-samples used for equation 11 and equation 12.

47 Breaking the sample after 1979:4 reflects the increased volatility of exchange rates in the 1980s.

48 See again Helliwell and Padmore (1985).

# Chart 4

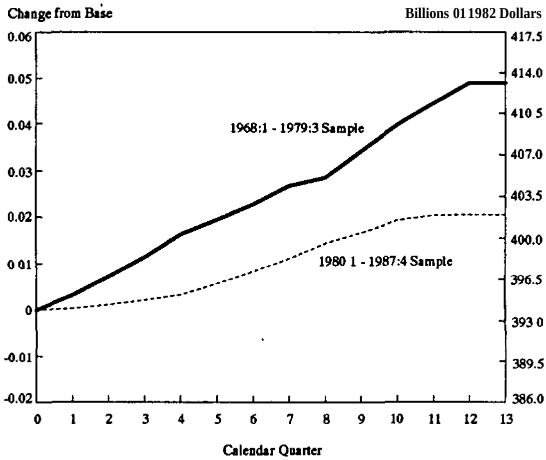
## Non-Agricultural Exports: Response to 100 Basis Point Rise In Commercial Paper Rate




Note: Base = 1988:4,
Quarterly Figures Are Annualized

# Chart 5

## Non-Petroleum Imports: Response to 100 Basis Point Rise In Commercial Paper Rate




Note: Base = 1988:4;
Quarterly Figures Are Annualized

ing provides a larger base through which exchange rates can affect real activity. But with exports and imports less sensitive to dollar values, interest rates and exchange rates now have to move not less but more in order to achieve the same real effects.

## Conclusions and caveats

Major changes have taken place in the U.S. economy within the past quarter century. Three of these changes have implications that, at least potentially, are especially important for the ability of monetary policy to affect real economic activity. First, the elimination of Regulation Q interest ceilings and the development of the secondary mortgage market have deprived monetary policy of the ability to slow economic activity, via a decline in home building, merely by increases in short-term interest rates not accompanied by increases in asset yields and declines in asset values more generally. Second, the greater openness of the U.S. economy, including both goods markets and financial markets, has broadened the potential base of effects on economic activity due to changes in dollar exchange rates but has also complicated other key linkages in the monetary policy process. Third, the rapidly increasing indebtedness of private borrowers, including especially nonfinancial business corporations, has made the economy's financial structure more fragile and hence has increased the risks associated with business recessions.

As is becoming increasingly widely known, these changes—and presumably others as well—have in turn led to major changes in standard reduced-form relationships of the kind that often stand behind quantitative analysis of monetary policy at either formal or informal levels. Relationships between aggregate economic activity and financial variables that could plausibly represent the influence of monetary policy show little useful stability over the past quarter century. Many variables that earlier exhibited statistically significant relationships to real output no longer do so, and in some cases the opposite is true. Even for variables that were significantly related to output earlier and continue to be so, the quantitative relationships have changed in ways that are not just statistically significant but economically important. The principal implication of all this for the conduct of monetary policy is that, whatever may have been true in the past, familiar simple relationships of this kind do not provide a sound basis for policymaking at this time.

Examination of relationships between monetary policy and economic activity at a more detailed, disaggregated level indicates a variety of potentially relevant changes within the past quarter century, most of them at least broadly consistent with the changes that have taken place in the underlying economic environment. The elimination of major episodes of credit rationing in the mortgage market has clearly rendered housing less sensitive to restrictive monetary policy; Moreover, there is no solid evidence of change in the sensitivity of home building to mortgage interest rates. Business fixed investment has apparently become more sensitive to financial market conditions, at least in the short run, as is to be expected from the much higher leverage now carried by the typical nonfinancial firm. By contrast, consumer spending has apparently become less sensitive to interest rate increases and stock price declines, at least in situations that persist for lengthy periods of time. Although foreign trade has clearly grown relative to aggregate U.S. economic activity, both exports and imports exhibit less sensitivity to exchange rate changes (perhaps because exchange rates have become more volatile), and hence presumably less sensitivity to monetary policy actions, than in earlier years.

Especially in light of the conditions that have confronted U.S. monetary policy since simpler relations connecting income growth or price inflation to money growth broke down, the practical role of empirical findings like these is to enable policymakers to do more—presumably to do better—than following mechanical rules like changing the federal funds rate by one-fourth of a percentage point and then waiting to see what happens next before making another change. The potential shortcomings of such interest rate formulae—due in part to lags in the effect of policy actions on the economy, in part to the insufficiently clear distinction in practice between real and nominal interest rates, and in part to the tendency to confuse interest rates as a means of influencing the economy with interest rate control as an end in itself—are certainly well known from the experience of the 1950s and 1960s.[49] Part of the contribution of empirical relationships like those developed in this paper is therefore

49 See Friedman (1988c). The classic review of these issues in their historical context is by Brunner and Meltzer (1964).

to help guide policy in an environment in which simple relationships based on money growth have disappeared and mechanical rules based on interest rates expose policy decisions to traps like those that have had such severe consequences in the not so distant past.

At the same time, substantial caution is appropriate before going on to apply in practice any specific set of results like those developed here. One reason, already emphasized above, is the need to take account of repercussion effects that could—in some cases, presumably would—substantively alter the empirical inferences drawn here on the basis of single-equation relationships alone. Some analytical framework more compatible with the general equilibrium of a highly complex economy, in which different aspects of economic behavior are fundamentally intertwined, is necessary. A second reason, also emphasized above, is that even within the limited context of partial equilibrium analyses, such inferences are not necessarily robust with respect to the specification of the underlying conceptual relationships. Hence comparative empirical investigation of different specifications, not just the ones drawn here from the FRB-MPS model, would be especially helpful.

And third, even if all of the findings reported here were robust with respect to model specification as well as to distinctions between partial and general equilibrium, the changes in the economy studied here are hardly the last that will occur. Changes in the economic environment that matter for macroeconomic behavior—not just in the sense of statistical significance without economic importance, but changes with effects that are central to how monetary policy works—have happened repeatedly in the past, and no doubt will continue to do so.

Taken together, the specific changes reported in this paper probably leave the Federal Reserve System neither more nor less able to influence real economic activity than it used to be. But they also mean that the influence of monetary policy works in different ways, which present different opportunities as well as different risks. Sound policymaking means taking account of those differences, not obscuring them behind aggregate-level relationships or mechanical rules that no longer fit the economy's actual experience.

# Appendix A
# Glossary of Symbols Used in the Section "Changes in the Sensitivity of Four Components of Spending"

| | |
|---|---|
| C | Personal consumption expenditures, per capita, 1982 dollars *NZPA* (equation 9). |
| CON | Log of eight-quarter, equally-weighted, moving average of expenditures on consumption of services and non-durable goods, 1982 dollars *NZPA* (equation 2). |
| CPI | Annualized rate of change in consumer price index, on average over current and immediate prior period *BLS* (equations 8, 10a-d, 13a-b). |
| DR | Ratio of debt to total capitalization *FRS* (equation 7). |
| DE | Rate of depreciation for durable equipment, *.16 BM* (equation 6). |
| DCR | Binary variable indicating credit rationed regime *BM* (equation 2). |
| DPO | Credit rationing phase-out parameter *BM* (equation 2). |
| ERN/PRI | Earnings-to-price ratio, Standard and Poor 500 (S&P) (equation 7). |
| EQ | Per capita value of corporate equities on balance sheet of household sector *FRS,* deflated using implicit deflator on consumption expenditures *NZPA* (equations 9, 10a). |
| EX | Log of nonagricultural exports, 1982 dollars *NZPA* (equation 11). |
| IH | Log of per capita expenditures on residential investment, 1982 dollars *NZPA* (equation 2). |
| IH* | Value of IH in most recent period prior to the imposition of credit rationing (equation 2). |
| IE | Expenditures on purchases of producers' durable equipment, 1982 dollars *NZPA* (equation 4). |
| IM | Log of nonpetroleum imports, 1982 dollars *NIPA* (equation 12). |
| K | Rate of investment tax credit, implicit in Auerbach and Hines (1988), (equation 6). |
| KH | Per capita residential wealth component of all sectors at current cost *FRS,* deflated using implicit deflator on residential investment expenditures *NZPA* (equation 2). |

**OFW** Per capita sum of deposits and credit market instruments, minus total liabilities, on household sector balance sheet *FRS*, deflated using implicit deflator on consumption expenditures *NZPA* (equations 9, 10b).

PE Deflator corresponding to IE, *NIPA* (equation 6).

PRIL Log of the market value of corporate equities minus mutual fund shares *FRS* (equation 8).

PX Equally-weighted average of past four quarters rate of inflation on gross domestic product, *NZPA* (equation 7).

RCB Corporate bond yield *FRS* (equation 7).

RCP Interest rate, six-month commercial paper *FRS* (equations 8, 10a-d, 13a-b).

RFE Real financial cost of capital (equations, 6, 7).

RRE Rental rate for producers' equipment (equations 5, 6).

**RH** Log of real after-tax cost of capital for residential investment (equations 2, 3).

SLD Annual rate of growth of deposits at saving institutions *FRS*, deflated using implicit price deflator for residential investment *NZPA* (equation 2).

TAN Per capita sum of tangible wealth components on household sector balance sheet *FRS*, deflated using implicit price deflator for consumption expenditures *NZPA* (equations 9, 10c).

**t** Time index.

**TC** Statutory corporate tax rate, implicit in Auerbach and Hines (1988); (equations 6, 7).

**TP** Average personal income tax rate, constructed by dividing personal tax and nontax payments by personal income less interest paid by consumers to business and transfers from government *NIPA* (equations 3, 9).

TPR Average property tax rate, interpolated to fill in years not reported ACIR (equation 3).

TTEX Log of export-weighted terms of trade for the United States, constructed by author using CPIs, nominal bilateral exchange rates, and bilateral trade flows, between the United States and other G-7 countries plus Mexico *IMF* (equations 11, 13a).

TTIM Log of import-weighted terms of trade for the United States, constructed by author using CPIs, nominal

| | |
|---|---|
| | bilateral exchange rates, and bilateral trade flows, between the United States and other G-7 countries plus Mexico *IMF* (equations 12, 13b). |
| UE | Civilian unemployment rate *BLS* (equation 2). |
| V | Reciprocal of the relative rental cost of capital for producers' equipment (equations 4, 5). |
| WIP | Log of weighted index of world industrial production, constructed by author using industrial production indexes weighted by bilateral U.S. export flows to G-7 countries plus Mexico *IMF* (equation 11). |
| X | Gross national product, 1982 dollars NIPA (equation 12). |
| XB | Gross domestic business product, 1982 dollars NZPA (equation 4). |
| YL | Per capita income from wage and salary disbursements plus other wage income, 1982 dollars *NIPA* (equation 9). |
| YT | Per capita income from transfer payments, 1982 dollars NZPA (equation 9). |
| YP | Per capita property income: sum of interest income, rental income, and proprietors' income, 1982 dollars NZPA (equations 9, 10d). |
| Z | Present value of depreciation allowances under current tax codes, implicit in Auerbach and Hines (1988) assuming 4 percent discount rate (equation 6). |

Key to sources:

| | |
|---|---|
| ACIR | Advisory Commission on Intergovernmental Relations. |
| *BLS* | Bureau of Labor Statistics. |
| BM | Brayton and Mauskopf (1985), see references. |
| FRS | Federal Reserve System, Board of Governors. |
| *IMF* | International Monetary Fund, International Financial Statistics. |
| NZPA | National Income and Product Accounts, Bureau of Economic Analysis. |
| S&P | Standard & Poor's. |

# Appendix B
# Equations Used in Simulations Reported in the Section on "Changes in the Sensitivity of Four Components of Spending"

## Residential Investment:

$$(2)\ IH_t = (1-DCR_t)\left\{(1-DPO_t)[a + \sum_{i=0}^{4} b_i\ RH_{t-i} + c\ CON_t + d\ \Delta UE_t + e\ KH_{t-i}] + f\ DPO_t \bullet IH_{t-i}\right\} + DCR_t\ [\sum_{i=0}^{4} g_i\ \dot{SLD}_{t-i} + h\ UE_t + k\ IH_t^*]$$

## Sample: 1964:3 - 1988:4

| | | | | | |
|---|---|---|---|---|---|
| a = −5.12 | $b_0$ = −0.3862 | c = 2.072 | d = −0.0422 | e= −0.6227 | f = −0.9979 |
| (−2.1) | $b_1$ = −0.4144 | (3.7) | (−1.6) | (−1.3) | (66.6) |
| | $b_2$ = −0.1379 | | | | |
| | $b_3$ = −0.1846 | | | | |
| | $b_4$ = −0.0286 | | | | |
| | Σb = −1.0946 | | | | |
| | (−4.5) | | | | |

| | | |
|---|---|---|
| $g_0$ = 0.000264 | h = −0.05104 | k = 1.017 |
| $g_1$ = 0.006959 | (−2.8) | (36.5) |
| $g_2$ = 0.003786 | | |
| $g_3$ = 0.008142 | | |
| $g_4$ = −0.002634 | | |
| Σg = 0.016517 | | |
| (0.8) | | |

$DCR_t = 1$ in the following periods:

1966:3 - 1966:4
1969:3 - 1970:3
1974:1 - 1975:1

$DPO_t = \max\,[0.8\ DCR_{t-1}, 0.6\ DCR_{t-2}, 0.4\ DCR_{t-3}, 0.2\ DCR_{t-4}]$

$\bar{R}^2 = 0.931$ SE = 0.0475 DW = 1.72 $\rho = 0.89$

## Investment in Producers' Equipment:

$$(4)\quad IE_t = \sum_{i=0}^{16} a_i\,[XB_{t-i}V_{t-i-1}] + \sum_{i=1}^{16} b_i\,[XB_{t-i}V_{t-i}] + \sum_{i=1}^{16} c_i\,[XB_{t-i-1}V_{t-i}]$$

## Sample: 1958:2 - 1979:3

| | | |
|---|---|---|
| a/ = 0.0248 | | |
| a, = 0.0808 | $b_1$ = −0.0574 | $c_1$ = −0.0321 |
| $a_2$ = −0.0376 | $b_2$ = 0.0089 | $c_2$ = −0.0881 |
| a, = −0.2983 | $b_3$ = 0.3887 | $c_3$ = −0.3536 |
| $a_4$ = −0.4623 | $b_4$ = 0.8205 | $c_4$ = −0.5204 |
| a, = −0.4238 | $b_5$ = 0.9454 | $c_5$ = −0.4823 |
| a, = −0.2815 | $b_6$ = 0.7570 | $c_6$ = −0.3339 |
| a, = −0.4287 | $b_7$ = 0.7614 | $c_7$ = −0.4808 |
| a, = −0.1623 | $b_8$ = 0.6396 | $c_8$ = −0.2061 |
| a, = −0.2465 | $b_9$ = 0.4613 | $c_9$ = −0.2946 |
| a,, = −0.5560 | $b_{10}$ = 0.8383 | $c_{10}$ = −0.5925 |
| $a_{11}$ = −0.4389 | $b_{11}$ = 1.0116 | $c_{11}$ = −0.4524 |
| $a_{12}$ = −0.3331 | $b_{12}$ = 0.7939 | $c_{12}$ = −0.3533 |
| $a_{13}$ = −0.0237 | $b_{13}$ = 0.3679 | $c_{13}$ = −0.0320 |
| a,, = 0.2593 | $b_{14}$ = −0.2225 | $c_{14}$ = 0.2509 |
| $a_{15}$ = 0.1980 | $b_{15}$ = −0.4526 | $c_{15}$ = 0.1954 |
| $a_{16}$ = 0.0007 | $b_{16}$ = −0.2050 | $c_{16}$ = 0.0050 |

$\Sigma a + \Sigma b + \Sigma c = 0.0212$
(20.9)

$\bar{R}^2 = 0.997$    SE = 2.78    DW = 1.60    $\varrho = 0.99$

## Sample: 1976:1 - 1988:4

| | | |
|---|---|---|
| a/ = 0.0117 | | |
| a , = 0.0044 | $b_1$ = 0.0550 | $c_1$ = −0.0651 |
| $a_2$ = 1.0274 | $b_2$ = −0.8742 | $c_2$ = 0.8828 |
| a, = 1.9397 | $b_3$ = −2.8328 | $c_3$ = 1.8193 |
| a, = 0.8432 | $b_4$ = −2.7318 | $c_4$ = 0.7974 |
| a, = −0.2653 | $b_5$ = −0.5080 | $c_5$ = −0.3432 |
| a, = 0.1429 | $b_6$ = 0.2665 | $c_6$ = 0.0020 |
| a, = −0.5476 | $b_7$ = 0.5227 | $c_7$ = −0.6614 |
| a, = −1.0879 | $b_8$ = 1.6613 | $c_8$ = −1.1184 |
| $a_9$ = −0.1736 | $b_9$ = 1.2786 | $c_9$ = −0.1742 |
| $a_{10}$ = −0.4547 | $b_{10}$ = 0.6092 | $c_{10}$ = −0.4334 |
| a,, = −0.4548 | b,, = 0.8394 | $c_{11}$ = −0.3851 |

| | | |
|---|---|---|
| $a_{12} = 0.2746$ | $b_{12} = 0.1142$ | $c_{12} = 0.3356$ |
| $a_{13} = 0.4598$ | $b_{13} = -0.7530$ | $c_{13} = 0.4848$ |
| $a_{14} = 1.0006$ | $b_{14} = -1.4305$ | $c_{14} = 0.9722$ |
| $a_{15} = 1.0433$ | $b_{15} = -2.0788$ | $c_{15} = 1.0712$ |
| a,, = 0.0051 | $b_{16} = -1.1127$ | $c_{16} = 0.0426$ |

$\Sigma a + \Sigma b + \Sigma c = 0.0215$
(5.9)

$\bar{R}^2 = 0.956$ SE = 9.86 DW = 1.89 $\varrho = 0.89$

$$(8)\ PRIL_t = d + e\,t + \sum_{i=0}^{6} f_i\, RCP_{t-i} + \sum_{i=0}^{6} g_i\, (RCP - \dot{CPI})_{t-i}$$

## Sample: 1956:2 - 1988:4

| | | | |
|---|---|---|---|
| $d = 14.35$ | $e = 0.024$ | $f_0 = -0.0216$ | $g_0 = -0.00014$ |
| (50.3) | (2.14) | $f_1 = -0.0184$ | $g_1 = -0.00309$ |
| | | $f_2 = -0.0087$ | $g_2 = -0.00022$ |
| | | $f_3 = -0.0106$ | $g_3 = 0.00308$ |
| | | $f_4 = -0.0040$ | $g_4 = -0.00065$ |
| | | $f_5 = -0.0083$ | $g_5 = 0.00246$ |
| | | $f_6 = 0.0040$ | $g_6 = -0.00021$ |
| | | $\Sigma f = -0.0675$ | $\Sigma g = 0.00123$ |
| | | (3.8) | (0.1) |

$\bar{R}^2 = 0.903$ SE =0.0802 DW = 2.00 $\varrho = 0.93$

## Consumption Expenditures

$$(9)\ C_t = a + \sum_{i=0}^{6} a_i\,(1-TP_{t-i})YL_{t-i} + \sum_{i=0}^{6} c_i\,(1-TP_{t-i})YP_{t-i}$$
$$+ \sum_{i=0}^{6} d_i\, YT_{t-i} + \sum_{i=0}^{6} e_i\, EQ_{t-i} + \sum_{i=0}^{6} f_i\, OFW_{t-i}$$
$$+ \sum_{i=0}^{6} g_i\, TAN_{t-i}$$

## Sample: 1955:4 - 1969:4

| | | | |
|---|---|---|---|
| $a = 281.8$ | $b_0 = 0.2807$ | $c_0 = -0.2861$ | $d_0 = 0.4096$ |
| (0.3) | $b_1 = 0.0756$ | $c_1 = -0.2929$ | $d_1 = 0.4807$ |
| | $b_2 = -0.1613$ | $c_2 = -0.2065$ | $d_2 = -0.2236$ |
| | $b_3 = -0.0127$ | $c_3 = 0.6097$ | $d_3 = -0.2327$ |
| | $b_4 = 0.2616$ | $c_4 = 0.4466$ | $d_4 = 0.7444$ |
| | $b_5 = -0.2829$ | $c_5 = 0.7057$ | $d_5 = 0.1044$ |
| | $b_6 = 0.2174$ | $c_6 = -0.0283$ | $d_6 = 0.2991$ |
| | $\Sigma b = 0.3783$ | $\Sigma c = 0.9480$ | $\Sigma d = 1.5818$ |
| | (0.6) | (1.4) | (5.5) |

| | | |
|---|---|---|
| $e_0 = 0.01770$ | $f_0 = -0.0313$ | $g_0 = -0.0405$ |
| $e_1 = 0.00950$ | $f_1 = 0.0226$ | $g_1 = -0.0645$ |
| $e_2 = 0.00573$ | $f_2 = 0.1246$ | $g_2 = -0.0097$ |
| $e_3 = -0.00030$ | $f_3 = -0.1551$ | $g_3 = -0.2005$ |
| $e_4 = 0.02055$ | $f_4 = 0.1569$ | $g_4 = 0.0520$ |
| $e_5 = -0.02232$ | $f_5 = 0.2481$ | $g_5 = -0.1106$ |
| $e_6 = 0.03255$ | $f_6 = 0.0008$ | $g_6 = 0.0926$ |
| $\Sigma e = 0.06340$ | $\Sigma f = 0.3665$ | $\Sigma g = -0.2812$ |
| (2.4) | (1.9) | (−1.6) |

$\bar{R}^2 = 0.999$ SE = 20.00 DW = 1.79 $\varrho = 0.09$

## Sample: 1970:2 - 1988:4

| | | | |
|---|---|---|---|
| $a = 650.8$ | $b_0 = 0.4497$ | $c_0 = 0.1351$ | $d_0 = -0.1770$ |
| (0.6) | $b_1 = 0.3929$ | $c_1 = 0.4648$ | $d_1 = -0.2487$ |
| | $b_2 = 0.0321$ | $c_2 = -0.3323$ | $d_2 = 0.1863$ |
| | $b_3 = 0.2271$ | $c_3 = -0.0622$ | $d_3 = -0.3993$ |
| | $b_4 = -0.2624$ | $c_4 = 0.2450$ | $d_4 = 0.2694$ |
| | $b_5 = 0.0823$ | $c_5 = -0.3859$ | $d_5 = 0.0568$ |
| | $b_6 = -0.2097$ | $c_6 = 0.6547$ | $d_6 = 0.1418$ |
| | $\Sigma b = 0.7121$ | $\Sigma c = 0.7192$ | $\Sigma d = -0.1707$ |
| | (2.1) | (2.6) | (−0.2) |

| | | |
|---|---|---|
| $e_0 = 0.02607$ | $f_0 = 0.0206$ | $g_0 = 0.05409$ |
| $e_1 = -0.00455$ | $f_1 = 0.1188$ | $g_1 = -0.01808$ |
| $e_2 = 0.02787$ | $f_2 = -0.0002$ | $g_2 = 0.03256$ |
| $e_3 = -0.03497$ | $f_3 = 0.0732$ | $g_3 = -0.00007$ |
| $e_4 = 0.02703$ | $f_4 = -0.0335$ | $g_4 = 0.01651$ |
| $e_5 = -0.01190$ | $f_5 = -0.0998$ | $g_5 = -0.00373$ |
| $e_6 = -0.02126$ | $f_6 = 0.1364$ | $g_6 = -0.00617$ |
| $\Sigma e = 0.00830$ | $\Sigma f = 0.2155$ | $\Sigma g = 0.07510$ |
| (0.3) | (2.2) | (2.0) |

$\bar{R}^2 = 0.997$ SE = 51.03 DW = 1.86 $\varrho = 0.38$

$$\text{(10a) } EQ_t = h + k\,t + \sum_{i=0}^{6} m_i\, RCP_{t-i} + \sum_{i=0}^{6} n_i\, (RCP - \dot{CPI})_{t-i}$$

**Sample: 1955:4 - 1988:4**

| | | | |
|---|---|---|---|
| h = 9570 | k = 21.87 | $m_0$ = −129.50 | $n_0$ = 6.67 |
| (5.1) | (0.3) | $m_1$ = −98.30 | $n_1$ = −11.64 |
| | | $m_2$ = −74.24 | $n_2$ = −3.89 |
| | | $m_3$ = −79.42 | $n_3$ = 28.09 |
| | | $m_4$ = −26.61 | $n_4$ = −2.09 |
| | | $m_5$ = −46.22 | $n_5$ = 16.75 |
| | | $m_6$ = 23.81 | $n_6$ = −7.54 |
| | | $\Sigma m$ = −430.46 | $\Sigma n$ = 26.34 |
| | | (−3.6) | (0.2) |
| $\bar{R}^2$ = 0.909 | SE = 537.4 | DW = 1.98 | $\rho$ = 0.93 |

$$\text{(10b) } OFW_t = h + k\,t + \sum_{i=0}^{6} m_i\, RCP_{t-i} + \sum_{i=0}^{6} n_i\, (RCP - \dot{CPI})_{t-i}$$

**Sample: 1955:4 - 1988:4**

| | | | |
|---|---|---|---|
| h = −13033 | k = 632.2 | $m_0$ = −37.97 | $n_0$ = −0.87 |
| (−0.2) | (0.7) | $m_1$ = −27.07 | $n_1$ = 3.84 |
| | | $m_2$ = −18.75 | $n_2$ = 0.13 |
| | | $m_3$ = −17.57 | $n_3$ = 12.67 |
| | | $m_4$ = −3.35 | $n_4$ = 6.00 |
| | | $m_5$ = −16.04 | $n_5$ = 7.73 |
| | | $m_6$ = 4.44 | $n_6$ = 1.00 |
| | | $\Sigma m$ = −116.32 | $\Sigma n$ = 30.50 |
| | | (−4.5) | (1.2) |
| $\bar{R}^2$ = 0.998 | SE = 109.2 | DW = 2.17 | $\rho$ = 0.99 |

$$\text{(10c) } TAN_t = h + k\,t + \sum_{i=0}^{6} m_i\, (RCP_{t-i}) + \sum_{i=0}^{6} n_i\, (RCP - \dot{CPI})_{t-i}$$

**Sample: 1955:4 - 1988:4**

| | | | |
|---|---|---|---|
| h = 3786 | k = 327.1 | $m_0$ = −23.93 | $n_0$ = −0.52 |
| (3.5) | (7.7) | $m_1$ = 76.99 | $n_1$ = −38.07 |
| | | $m_2$ = −46.77 | $n_2$ = −21.80 |
| | | $m_3$ = 16.39 | $n_3$ = −21.30 |
| | | $m_4$ = −30.46 | $n_4$ = −15.60 |
| | | $m_5$ = −64.20 | $n_5$ = −21.27 |
| | | $m_6$ = 22.25 | $n_6$ = −11.19 |
| | | $\Sigma m$ = −49.72 | $\Sigma n$ = −129.75 |
| | | (−1.2) | (−3.0) |
| $\bar{R}^2$ = 0.996 | SE = 177.3 | DW = 1.91 | $\rho$ = 0.96 |

$$\text{(10d)}\quad YP_t = h + k\,t + \sum_{i=0}^{6} m_i\,(RCP_{t-i}) + \sum_{i=0}^{6} n_i\,(RCP - \dot{CPI})_{t-i}$$

Sample: 1955:4 - 1988:4

| | | | |
|---|---|---|---|
| h = 1312 | k = 44.45 | $m_0$ = 0.051 | $n_0$ = 1.674 |
| (2.0) | (8.8) | $m_1$ = 9.646 | $n_1$ = 3.534 |
| | | $m_2$ = −8.355 | $n_2$ = −0.304 |
| | | $m_3$ = 0.901 | $n_3$ = 1.098 |
| | | $m_4$ = −9.568 | $n_4$ = 2.656 |
| | | $m_5$ = −4.972 | $n_5$ = −1.030 |
| | | $m_6$ = −6.994 | $n_6$ = 0.701 |
| | | $\Sigma m$ = −19.291 | $\Sigma n$ = 8.330 |
| | | (−2.6) | (1.1) |
| $\bar{R}^2$ = 0.991 | SE = 33.38 | DW = 1.82 | $\rho$ = 0.93 |

## Non-Agricultural Exports

$$\text{(11)}\quad EX_t = a + \sum_{i=0}^{4} b_i\,WIP_{t-i} + \sum_{i=0}^{6} c_i\,TTEX_{t-i}$$

Sample: 1968:1 - 1979:3

| | | |
|---|---|---|
| a = 4.075 | $b_0$ = 0.2469 | $c_0$ = −0.0903 |
| (2.5) | $b_1$ = 0.2061 | $c_1$ = 0.1197 |
| | $b_2$ = 0.0134 | $c_2$ = −0.3435 |
| | $b_3$ = 0.4076 | $c_3$ = −0.1353 |
| | $b_4$ = 0.1814 | $c_4$ = −0.1394 |
| | | $c_5$ = −0.4188 |
| | | $c_6$ = 0.1500 |

$\Sigma b = 1.0554$ (5.9) $\Sigma c = -0.8576$ (−4.3)

$\bar{R}^2 = 0.958$ SE = 0.0465 DW = 2.06 $\varrho = 0.20$

## Sample: 1980:1 - 1987:4

| | | |
|---|---|---|
| $a = 3586$ (0.0) | $b_0 = 0.8996$ | $c_0 = -0.1582$ |
| | $b_1 = 0.5490$ | $c_1 = -0.1184$ |
| | $b_2 = -0.4791$ | $c_2 = -0.0078$ |
| | $b_3 = -0.0171$ | $c_3 = -0.2388$ |
| | $b_4 = -0.0281$ | $c_4 = -0.0114$ |
| | | $c_5 = -0.0419$ |
| | | $c_6 = -0.1169$ |
| | $\Sigma b = 0.9242$ (2.3) | $\Sigma c = -0.6935$ (−4.3) |

$\bar{R}^2 = 0.978$ SE = 0.0167 DW = 1.18 $\varrho = 1.00$

## Non-Petroleum Imports

$$(12)\ IM_t = d + \sum_{i=0}^{4} e_i X_{t-i} + \sum_{i=0}^{6} f_i TTIM_{t-i}$$

## Sample: 1968:1 - 1979:3

| | | |
|---|---|---|
| $d = -19.75$ (−6.0) | $e_0 = 1.006$ | $f_0 = 0.2322$ |
| | $e_1 = 2.468$ | $f_1 = 0.3820$ |
| | $e_2 = -0.106$ | $f_2 = -0.2432$ |
| | $e_3 = -1.534$ | $f_3 = 0.0063$ |
| | $e_4 = 0.783$ | $f_4 = -0.0030$ |
| | | $f_5 = -0.1290$ |
| | | $f_6 = 0.6215$ |
| | $\Sigma e = 2.617$ (8.7) | $\Sigma f = 0.8668$ (4.0) |

$\bar{R}^2 = 0.901$ SE = 0.0529 DW = 2.04 $\varrho = 0.24$

## Sample: 1980:1 - 1987:4

| | | |
|---|---|---|
| $d = -23.07$ (−6.1) | $e_0 = 1.844$ | $f_0 = 0.0430$ |
| | $e_1 = 0.780$ | $f_1 = 0.0162$ |
| | $e_2 = 0.060$ | $f_2 = 0.1128$ |
| | $e_3 = 1.214$ | $f_3 = -0.1414$ |

| | | | |
|---|---|---|---|
| | | $e_4 = -0.590$ | $f_4 = 0.1926$ |
| | | | $f_5 = 0.1235$ |
| | | | $f_6 = 0.0189$ |
| | | $\Sigma e = 3.307$ | $\Sigma f = 0.3655$ |
| | | (8.6) | (1.7) |

$\bar{R}^2 = 0.995$  SE = 0.0200  DW = 2.01  $\varrho = 0.84$

## Terms of Trade

$$\text{(13a) } TTEX_t = g + h\,t + \sum_{i=0}^{6} k_i\, RCP_{t-i} + \sum_{i=0}^{6} m_i\, (RCP - \dot{CPI})_{t-i}$$

Sample: 1968:1 - 1987:4

| | | | |
|---|---|---|---|
| $g = 4.568$ | $h = -.007509$ | $k_0 = 0.002795$ | $m_0 = 0.002562$ |
| (80.4) | (−2.2) | $k_1 = -0.007959$ | $m_1 = 0.006754$ |
| | | $k_2 = 0.006422$ | $m_2 = 0.008004$ |
| | | $k_3 = -0.006524$ | $m_3 = 0.010384$ |
| | | $k_4 = -0.000187$ | $m_4 = 0.010391$ |
| | | $k_5 = 0.008503$ | $m_5 = 0.008378$ |
| | | $k_6 = -0.005017$ | $m_6 = 0.006920$ |
| | | $\Sigma k = 0.001593$ | $\Sigma m = 0.053393$ |
| | | (−0.2) | (8.3) |

$\bar{R}^2 = 0.935$  SE = 0.0373  DW = 1.78  $\varrho = 0.75$

$$\text{(13b) } TTIM_t = g + h\,t + \sum_{i=0}^{6} k_i\, RCP_{t-i} + \sum_{i=0}^{6} m_i\, (RCP - \dot{CPI})_{t-i}$$

Sample: 1968:1 - 1987:4

| | | | |
|---|---|---|---|
| $g = 4.583$ | $h = -0.01390$ | $k_0 = 0.002284$ | $m_0 = 0.002764$ |
| (88.9) | (−4.4) | $k_1 = -0.007864$ | $m_1 = 0.006846$ |
| | | $k_2 = 0.006816$ | $m_2 = 0.008313$ |
| | | $k_3 = -0.006042$ | $m_3 = 0.011233$ |
| | | $k_4 = 0.001411$ | $m_4 = 0.011060$ |
| | | $k_5 = 0.009943$ | $m_5 = 0.008993$ |
| | | $k_6 = -0.004159$ | $m_6 = 0.007101$ |
| | | $\Sigma k = 0.002388$ | $\Sigma m = 0.056310$ |
| | | (0.4) | (9.3) |

$\bar{R}^2 = 0.932$  SE = 0.0388  DW = 1.74  $\varrho = 0.71$

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