Monetary Policy Influence on the Economy—An Empirical Analysis

Some economists and policy makers are concerned that the ability of monetary policy to influence economic activity has been seriously weakened by developments in the financial system during the 1970s and 1980s. The main argument is that financial innovations and the deregulation of interest rates have led to a breakdown of non-price credit rationing barriers that were important in transmitting monetary restraint to particular sectors, such as housing and small business. Without those credit availability effects, monetary policy must rely largely on the response of private spending to interest rates. This shift in the channels of monetary policy influence implies that interest rates may have to rise to much higher levels than in the past to attain a given degree of restraint on private demand [1]

There is not much doubt that the role of credit rationing has been reduced greatly Whether this implies a significant decline in the effectiveness of monetary policy, however, is not clear. The channels of monetary policy transmission to the economy remain complex, operating through interest rates, exchange rates, asset values, and expectations about these and other variables. The same forces of innovation and deregulation that reduced or eliminated credit availability effects may have strengthened interest rate and wealth effects. For example, in the deregulated financial market environment, economic agents may be more aware of, and more sensitive to, changes in market interest rates, i.e., the interest and wealth elasticities of private demand may have increased over time. Perhaps even more importantly, the generalized floating exchange rate environment and the growing link between the U.S. economy and the rest of the world suggest a larger potential effect of exchange rates on economic activity.

All these developments are relevant for assessing the overall effectiveness of monetary policy, which depends on the link between policy instruments and financial variables as well as on the relationship between financial variables and real economic activity. These broad linkages may be viewed as the two major steps in the transmission of monetary policy influence to the economy. In this article, we look at the second step in the transmission by focusing on the key interest and exchange rate-sensitive sectors of the economy. consumer durable goods, producers' durable equipment, and residential construction. Together, these sectors account for nearly a third of total private expenditures and more than half of the recent business cycle fluctuations in those expenditures. More broadly, these sectors are of fundamental importance to the economy in that their direct and indirect (or spillover) effects are large and far reaching, extending to all sectors.

Based on a fairly standard framework we estimate interest and exchange rate effects on demand and explore the possibility of significant shifts in the estimated effects. Our main findings are as follows:

- Interest and exchange rate effects on private spending have been substantial and significant at least since the mid-1970s, suggesting that the long-run monetary policy influence on the economy remains powerful.

[1] See, for example, Lyle E Gramley, "Financial Innovation and Monetary Policy," *Federal Reserve Bulletin* (July 1982), Richard G Davis, "Recent Evolution in U S Financial Markets—Implications for Monetary Policy," *Greek Economic Review* (December 1981), and William R Keeton, "Deposit Deregulation, Credit Availability and Monetary Policy," Federal Reserve Bank of Kansas City *Economic Review* (June 1986)

- The interest sensitivity of private expenditures seems to have risen over time, and together with the strong exchange rate effects, has served to offset the reduced role of credit rationing. On balance, therefore, the long-run monetary policy influence on the economy is likely to have been as strong in recent years as in the earlier period
- The short- to medium-term monetary policy influence seems to be quite uncertain and difficult to estimate. It may have become less predictable over time, presumably reflecting increased uncertainty about the relationship between policy instruments, and interest and exchange rates

Given the complexity of issues involved and the difficulties of estimating relationships in the face of on-going financial and economic changes, these findings should be viewed as tentative.

Changing Channels of Monetary Policy Influence

In the 1960s and early 1970s, monetary policy relied on two principal channels to moderate private aggregate demand. interest rates and credit rationing. Increases in interest rates affected spending in interest rate-sensitive sectors directly by raising the opportunity cost of financing. At the same time, high interest rates triggered credit rationing when they collided with institutionally determined interest rate ceilings, restraining spending especially in the housing and small business sectors

Credit rationing took two general forms First, during periods of high interest rates, banks and thrift institutions experienced a decline in deposits and a loss of liquid assets because of Regulation Q ceilings on deposit rates As a result, they were forced to reduce their lending to households and small businesses. Second, a variety of limits on lending rates—usury laws, and interest rate ceilings on government-insured loans and on local government borrowing—acted to block credit to various sectors through reduced availability or tightening of non-price terms. Together these restrictions created substantial, though frequently short-lived, credit shortages [2]

Since the early 1970s credit rationing mechanisms have been weakening. In 1973, Regulation Q ceilings on all large negotiable certificates of deposits were removed, and during the next six years or so there was a substantial easing of interest rate ceilings on various types of deposit instruments The Deregulation and Monetary Control Act of 1980 phased out Regulation Q ceilings at all depository institutions. Although the phase-out lasted until April 1986, the bulk of deregulation occurred in the early 1980s In the late 1970s and early 1980s, usury ceilings on various types of loans were either eliminated or substantially eased.

These regulatory changes, together with financial innovations and the growth of financial markets, have led to greater interest-rate competition, more integrated credit markets, and a freer flow of funds The increased role of market forces on the domestic scene has been reinforced considerably by globalization of financial markets, i.e., enhanced integration of domestic and international financial markets. In these circumstances, credit rationing no longer appears to be a significant channel of monetary policy influence on the economy.

The breakdown of credit rationing mechanisms and the greatly increased role of market forces and interest rate competition in determining credit flows clearly imply a significant shift in the manner of monetary policy transmission to the economy For example, interest rate effects on spending are more gradual and less disruptive than those of credit rationing. A more important question, however, is whether the financial changes also imply a significant weakening of the magnitude of policy influence on non-financial sectors. A case for weakening rests on at least two major assumptions. first, interest elasticities of final demands have remained unchanged at their earlier low levels, and second, developments in the 1970s and 1980s have not opened new policy channels or made existing channels more important.

Some features of the new financial environment suggest that private spending may now be more sensitive to interest rates.[3] With an unprecedented rise in the 1970s, interest rates may have reached a threshold where they start to have a stronger effect on spending. It may be that financing costs are an important influence on profits and investment decisions only at high rates

[2] A necessary, but sometimes unstated, assumption in this argument is that credit lost to one sector was not simply added to credit in other sectors This would be true if the alternatives were not perfect substitutes Implicit also is the notion that restrictions on the quantity of credit are more effective in curbing spending than increases in the price For a more detailed discussion of the credit rationing mechanism, see A M Wojnilower, "The Central Role of Credit Crunches in Recent Financial History," *Brookings Papers on Economic Activity*, 2 (1980), "Private Credit Demand, Supply, and Crunches—How Different are the 1980's?" *American Economic Review* (May 1985), Davis, *op cit*, B M Friedman, *Monetary Policy in the United States Design and Implementation*, a study prepared for the Trustees of the Banking Research Fund Association of

Footnote 2 continued
Reserve City Bankers, June 1981, Chapter 2, and A W Throop, "Financial Deregulation, Interest Rates and the Housing Cycle," Federal Reserve Bank of San Francisco *Economic Review* (Summer 1986)

[3] For a detailed discussion, see M A Akhtar, "Financial Innovations and Their Implications for Monetary Policy An International Perspective," *BIS Economic Paper*, No 9 (December 1983), and M A Akhtar and G E J Dennis, "Financial Innovations and the Interest Elasticity of Private Expenditures," Federal Reserve Bank of New York Research Paper No 8422 (October 1984)

Once such cost considerations become a more important part of investment decisions, they are likely to remain so even after rates come down This would be particularly true if, as some economists have argued, deregulation of rates and other changes in the financial environment have pushed up the average level of interest rates permanently.

Other forces more directly related to the process of deregulation and innovation may also lead to greater sensitivity of private demand to interest rates The increased market competition implies that any changes in interest rates are more quickly transmitted to a larger number of assets and economic agents than before. Similarly, financial innovations may increase substitution among various types of financial assets without any significant alteration in the degree of substitution between financial assets, as a group, and physical assets If so, changes in interest rates would tend to have a greater impact on investment in physical assets by immediately altering the rate of return on the whole range of financial relative to physical assets The increased dependence on short-term and adjustable rate loans may also increase interest sensitivity since changes in interest rates will affect the cost of both existing and new investments. On the other hand, the adjustable rate environment may reduce the impact of higher interest rates because borrowers have less incentive to wait for lower rates.

The experience since the early 1970s suggests that other monetary channels may have developed as well. Floating exchange rates and the increased openness of the U.S. economy have made the external sector an important channel of monetary policy. Our international transactions—both trade in goods and services, and financial flows—have expanded greatly over the last fifteen years or so The total of exports and imports of goods and services relative to gross national product (GNP) is now about 60 percent above the 1970 level; the ratio of imports to GNP is 90 percent above its 1970 level. The expansion of financial transactions is even larger and is evident in virtually all measures of private financial transactions. For example, U.S. bank claims on foreigners in 1985 were more than 30 times greater than they were in 1970.

With the increased scale of international transactions, the exchange rate is an important influence on domestic economic activity. The principal exchange rate effect tends to reinforce, on balance, the more direct interest rate effect. A tightening of monetary policy, for example, not only drives up interest rates but also may lead to an appreciation of the dollar exchange rate. This reduces the competitiveness of domestically produced goods, causing our demand for those goods to shift abroad and exports to fall.

The workings of the exchange rate channel are quite complex, however. The timing and extent of exchange rate changes associated with monetary policy actions are hard to predict, and together with uncertain lags in the effect on relative prices of domestic versus foreign goods, do not allow us to estimate reliably the exchange rate influence on the economy, especially over a time horizon of up to 2 or 3 years To some extent, these uncertainties reflect the more general problems of predicting exchange rates in an environment of high capital mobility across national borders. Exchange rate movements are subject to a large number of diverse influences—including expectations about the economy, future exchange rates, and economic policy—and empirical models have not been able to capture these influences well enough to predict exchange rates systematically.

Another complicating factor in assessing the exchange rate influence is that monetary policy actions lead to changes in exchange rates partly through alterations in interest rates For this and other reasons, movements in the two variables are closely associated over time. Thus, it is very hard to separate the interest rate effect on the economy from the exchange rate effect.

The complexity of the exchange rate channel arises as well from the fact that not all the exchange rate effects on economic activity work in the same direction. While the primary effect of exchange rate appreciation is to reduce the demand for domestic goods, it may also have an offsetting influence on the economy. The latter could happen, for example, if appreciation leads to significant capital inflows, thereby putting downward pressures on interest rates. Similarly, appreciation may increase domestic demand through higher expected wealth induced by the lower level of general prices These effects, which apply to domestic expenditures on foreign as well as home produced goods, may be small but they are difficult, if not impossible, to separate from other interest rate and wealth effects.

Lack of Empirical Evidence

It is obvious from the preceding discussion that the demise of the credit rationing mechanism does not necessarily imply a weakening of monetary policy influence on the economy. Whether developments in the 1970s and 1980s have made monetary policy more or less effective, however, can only be resolved empirically. Unfortunately, the literature has very little to offer on this subject The bulk of the evidence does not deal with the experience of the last ten years or so, a few studies analyze the recent experience in some sectors but usually consider one sector at a time and differ greatly in empirical methodology. To be sure, the evidence does point to significant exchange rate effects on tradeable goods, and a few studies, e.g , on inventories, also

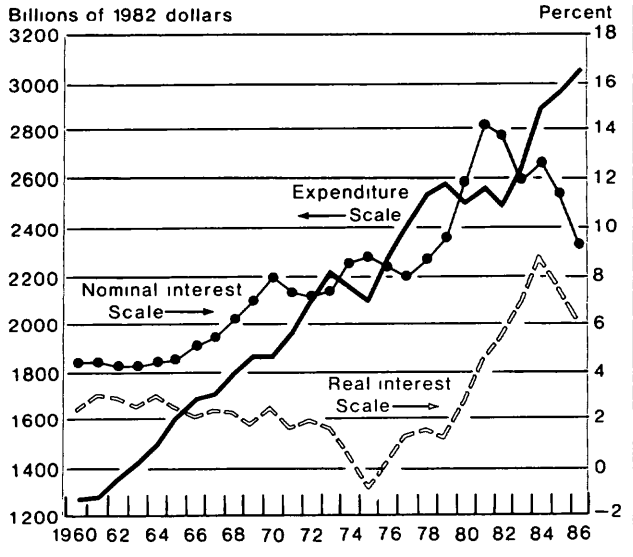
suggest that interest rate effects may be stronger in more recent periods. But none of these studies simultaneously considers internal and external sector channels of monetary policy influence on all the major sectors of the economy, and none systematically examines the possibility of a shift or drift in the impact of monetary influences over time.

It is also not possible to discern a change by comparing estimates of the policy influences from earlier studies to estimates from more recent studies. Over time the objectives of research and statistical techniques have changed so dramatically that the results from the recent period are only remotely related to those from the earlier period.

The present study focuses on the main interest and exchange rate-sensitive sectors Our presumption is that the results for these sectors would give us some sense of the broader trend in monetary policy influence on domestic economic activity Two caveats should be mentioned at the outset. First, a comprehensive empirical analysis covering all important non-financial sectors would be needed to reach a more complete judgment on the effectiveness of monetary policy. Second, final quantitative judgments on the issues involved may prove elusive, not only because the financial and economic environment is continuously changing but also because some important aspects of the policy channels can not be modeled empirically in a satisfactory manner.

Chart 1

Private Expenditures and Real and Nominal Interest Rates*

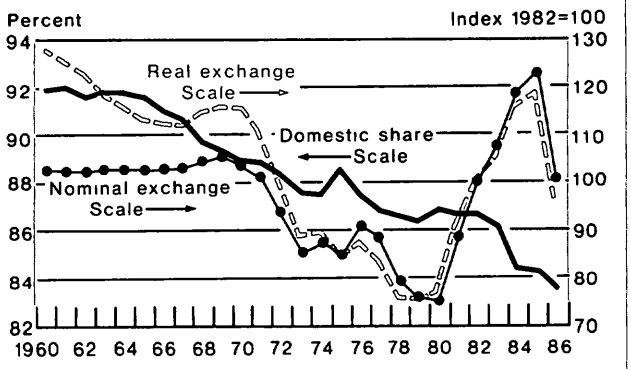


*The nominal interest rate is Moody's AAA corporate bond rate, and the real interest rate is constructed by subtracting the eight-quarter percent change in the implicit GNP deflator

Sources U S Department of Commerce, National Income and Product Accounts, Moody's Investor Service

Chart 2

Domestic Share of Expenditures and Nominal and Real Exchange Rates*



*Domestic share is total private expenditures minus imports, divided by total private expenditures The exchange rate variables are in units of foreign currency per dollar Precise definitions are given in Appendix 2

Sources U S Department of Commerce, National Income and Product Accounts, Federal Reserve Board, Federal Reserve Bulletin, Table A68, various issues

Evidence on Monetary Influences

A cursory look at the data reveals no systematic relationship between private spending and interest or exchange rates. For example, movements of total private spending appear to be only loosely related to nominal and "real" interest rates (Chart 1). The same is true for private spending on domestic goods and the dollar exchange rate (Chart 2) The influence of both interest and exchange rates is somewhat more visible when private spending is defined to include only the three most policy-sensitive sectors—producers' durable equipment, housing, and consumer durables (Charts 3 and 4). Even so, neither of the two variables shows a systematic and strong link to economic activity.

Further disaggregation at the sectoral level makes it somewhat easier to see the effects of interest and exchange rates. But their quantitative significance remains in doubt. This is not particularly surprising since

many policy and non-policy influences operate simultaneously, making it difficult to identify the role of any one of them at an impressionistic level. It is therefore necessary to utilize a more elaborate framework to examine monetary policy influence on the economy.

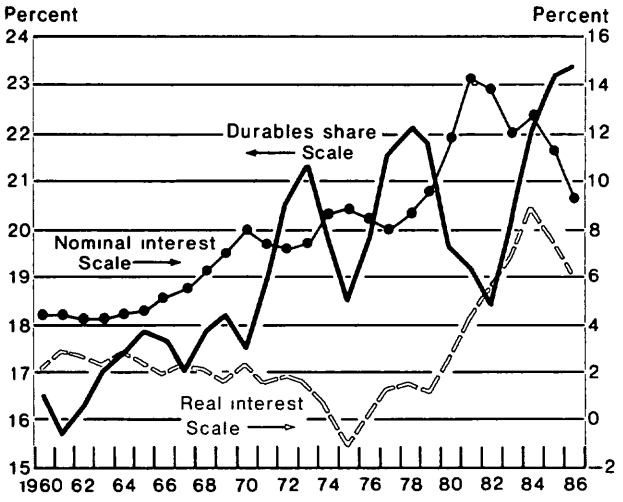
Our formal empirical analysis is based on a general open economy macroeconomic framework, the main features of which are described in Appendix 1. This framework is consistent with a broad range of policy and non-policy influences on the economy. Accordingly, our estimated equations for each of the three sectors under consideration include one or more policy-channel variables, such as interest rates, exchange rates, or credit rationing, as well as measures of overall economic activity. At a theoretical level, all these influences are well understood, but there are no unique or even generally accepted empirical proxies for them. In fact, many proxies are plausible for each variable, regardless of the form of estimated equations. In Appendix 2, we discuss various proxies used in the present study.

In what follows, we use two related empirical approaches First, we estimate total domestic expenditures in the three sectors. residential construction, consumer durable goods, and producers' durable equipment. These estimates allow us to focus on interest rate effects, but they can not be used to examine the demand shift between domestic and foreign goods—the principal influence of exchange rates and openness on domestic economic activity [4] Total expenditures obscure the exchange rate effect because they include domestic spending on both domestic and

[4]Estimates of total domestic expenditures as opposed to expenditures on domestically produced goods are preferable for evaluating the role of interest rates for at least two reasons First, buyers' (or users') financing cost considerations are independent of the supply source Second, since domestic output and import components of total domestic demand for all goods are difficult to identify, especially at the sectoral level, estimates of demand for domestic goods are subject to greater measurement errors

Chart 3

Expenditures on Consumer Durable Goods, Producers' Durable Equipment, and Housing as a Share of GNP, and Nominal and Real Interest Rates*

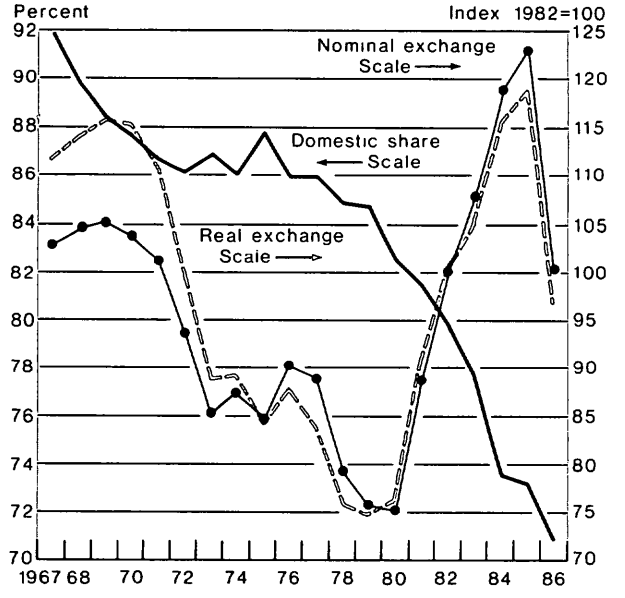


* The nominal interest rate is Moody's AAA corporate bond rate, and the real interest rate is constructed by subtracting the eight-quarter percent change in the implicit GNP deflator

Sources U S Department of Commerce, National Income and Product Accounts, Moody's Investor Service

Chart 4

Domestic Share of Expenditures on Durables, and Nominal and Real Exchange Rates*



*The domestic share is the percent of total expenditures on domestically produced consumer durable goods and producers durable equipment The exchange rate variables are in units of foreign currency per dollar Precise definitions are given in Appendix 2

Sources U S Department of Commerce, National Income and Product Accounts, Federal Reserve Board, Federal Reserve Bulletin, Table A68, various issues

foreign goods and exclude foreign spending on domestically produced goods. We do attempt to test for the offsetting effects of exchange rates which, as noted above, apply to domestic demand for all goods and may offset a part of the principal influence of exchange rates.

The second approach drops the non-trade housing sector and explores the exchange rate influence on the demand shift between domestic and foreign goods in the other two sectors For this purpose, we consider three different definitions of the dependent variable. domestic demand for home produced goods, domestic demand for foreign goods (i e , imports), and foreign demand for domestically produced goods (i.e , exports)

Interest Rate Effects

Estimates of total expenditures in each of the three sectors are based on quarterly data, and cover several different specifications and a range of sample periods over 1960-86. Details of these estimates as well as the results for the full sample period and two subperiods are reported in Box 1

Expenditures in all three sectors show a significant long-run response to interest rate movements over the full sample period, 1960-86 (Table 1) This finding is immune to moderate changes (up to three years) in the investigation period, at the beginning or the end point of the sample More generally, the estimated equations appear to be quite reliable in terms of both the standard statistical criteria and theoretical considerations about

Table 1

Long-Run Interest Rate Sensitivity*

	Weight†	1960-86	1960-74	1975-86
Consumer Durable Goods	9 59	−1 36‡	−0 85	−1 66‡
Producers' Durable Equipment	8 62	−2 44‡	−1 72	−2 37‡
Residential Construction	4 94	−8 10‡	−9 28‡	−8 72‡
Total§	23 16	−3 20 (−26 6)	−2 97 (−24 7)	−3 43 (−28 5)

*Percent change in private spending in response to a 10 percent change in interest rates (see Appendix 2 and Box 1) The minus sign refers to the direction of change in expenditures

†Share of total private expenditures in 1985

‡The underlying elasticity estimates are significant at the 95 percent or higher levels of confidence

§Average of the three component elasticities, weighted by their shares in 1985 total private expenditures The numbers in parentheses are changes in billions of 1982 dollars

Box 1: Regression Estimates for the Expenditure Equations

In the text we have concentrated on the long-run interest elasticities and their policy implications This box presents details of the empirical models Specifically, we compare the elasticities of the non-policy variables, present tests for robustness to changes in the sample period or explanatory variables, and report formal tests of structural shift

The elasticities reported in the text are based on regression models developed with two general criteria in mind First, they are consistent with the theoretical framework outlined in Appendix 1 In particular, they are part of a Keynesian style "IS" curve, which allows policy variables such as interest and exchange rates to play a direct role in determining real expenditures without an explicit consideration of changes in the price level Second, considerable specification search was done to ensure "reasonable" estimates By reasonable we mean (1) the coefficients are statistically significant and are consistent with economic theory, (2) the equations explain a large amount of the variation in the dependent variable, and (3) the reported results are representative of the broader body of work done

The expenditure equations for consumer durables (CON), residential structures (HOUSE), and producers' durable equipment (PDE) are of the following form

(1) $CON = a_0 + a_1\ INCOME + a_2\ CHUN + a_3\ INTER + a_4\ DUM1 + a_5\ CON(-1)$,

(2) $HOUSE = b_0 + b_1\ INCOME + b_2\ CHUN + b_3\ INTER + b_4\ DUM2 + b_5\ HOUSE(-1)$,

(3) $PDE = c_0 + d_1\ INCOME + e_1\ INTER + f_1\ PRICE$,

where all variables except CHUN are in log form The variables are defined as follows INCOME is a measure of total activity relevant to each sector, CHUN is the change in the unemployment rate, INTER measures the interest or cost-of-capital effect, DUM1 and DUM2 are dummy variables which account for, respectively, the credit controls of 1980 and credit rationing in housing, PRICE is the relative price of investment goods, and HOUSE(-1) and CON(-1) are lagged dependent variables The precise empirical proxies for each of these variables are reported in Appendix 2 In line with previous research, the equations account for adjustment lags in two ways: the housing and consumer durables equations include lagged dependent variables, whereas in the producers' durable equipment equations each explanatory variable enters as a distributed lag

Table A reports the regression estimates for these equations for the full sample, 1960-I to 1986-II, as well as two sub-samples, 1960-I to 1974-IV and 1975-I to 1986-II All equations are corrected for serial correlation

Box 1: Regression Estimates for the Expenditure Equations *(continued)*

using the Cochrane-Orcutt procedure * Since the variables enter in log form, the elasticities can be read directly off the table In the producers' durables equations, the reported coefficients are the sum of the polynomials, and therefore they should be interpreted as long-run elasticities, in the consumer durables and housing equations the long-run elasticities can be calculated by dividing each coefficient by one minus the coefficient on the lagged dependent variable

On the whole, the full sample estimates are consistent with previous results reported in the literature Each equation explains a large portion of the variation in the dependent variable, with adjusted R-squares close to one. This good fit reflects in part the use of lagged dependent variables and long distributed lags Apparently, spending in these sectors responds slowly to changes in the underlying determinants Spending in each sector is income-elastic in the long-run a one percent change in the income variables results in more than a one percent change in spending for each of these cyclically sensitive sectors.† Both credit rationing variables are highly significant President Carter's credit controls reduced consumer durables purchases by an estimated average of 4 percent in the spring and summer of 1980 Similarly, the immediate effect of credit crunches in the mortgage market in this period was a decline of 5 percent in housing expenditure The most important result for our purposes, however, is that each equation shows significant and economically large interest rate effects. Not surprisingly, the most interest-sensitive sector in our sample is housing The lowest interest sensitivity is for consumer durables, but even that sector plays an important role in the monetary transmission mechanism because of its large share in GNP

When we split the sample in the mid-1970s, the results remain strong for the second half, but become weaker for the first half The overall fit continues to be good, with high adjusted R-squares and low standard errors The long-run income effect is larger in the second half for all three sectors All else equal, this suggests that the income multiplier has increased over time The interest rate is insignificant in the first half for both consumer durables and producers' durables For the second half, however, the interest elasticities are large and highly significant for all three sectors

This impressionistic review of the results suggests that there have been small but economically significant changes in the regression coefficients over time Formal tests show that some of these changes are also statistically significant "Chow" tests were used to detect shifts in the overall structure of each model Although these results are only approximate because of overlapping lags in the models, they provide marginal evidence of a structural shift in the early to mid-1970s for both consumer durables and housing ‡

We also used "dummy variables" to explore the possibility of a shift in the individual coefficients. These tests show only a marginally significant increase in interest sensitivity for consumer durable goods and producers' durable equipment, and no clear pattern for housing They also show that shifts in interest sensitivity are not the only source of structural change in these sectors In particular, income elasticity has increased in all three sectors Comparing samples before and after 1975, there is a significant increase in income elasticity for both consumer durable goods and producers' durable equipment.

Are the results robust? Most important, how sensitive are the interest elasticity estimates to changes in the sample, the choice of interest rate proxy, and the inclusion or exclusion of other variables? The general finding is that the results are not sensitive to changes in the start or end point of the samples, but in some cases they are sensitive to what variables are used For example, the interest elasticity of producers' durable equipment appears to be quite sensitive to the particular proxy used for the interest rate. Complicated cost-of-capital variables, such as the proxy used in the MPS model, did not yield significant results, and measures of the real interest rate were only significant if inflation expectations were modeled as a long distributed lag Similar considerations apply for consumer durables

One final note in addition to testing for interest rate effects we explored the role of exchange rates in our expenditure equations Exchange rates may affect total expenditures through several indirect channels Theoretical models suggest that most of these effects are small and ambiguous It is not surprising, therefore, that our empirical tests of the exchange rate effect yielded insignificant coefficients with changing signs As Box 2 shows, however, the exchange rate does have consistently strong effects through its more traditional channel—substitution in demand between domestic and foreign goods.

*When the equation includes a lagged dependent variable, more complicated correction procedures are needed to ensure consistent parameter estimates This is not a serious problem for our estimates, however, because the serial correlation is relatively small for all of our equations

†In housing the long-run income elasticity is less than one, but the overall sensitivity to the business cycle is quite high, as reflected in the coefficient on CHUN

‡As an added check, we examined each model for structural shift using the cusum squares methodology This approach looks for structural change by estimating the model recursively over the sample to see if successive one-quarter ahead forecast errors "pile up" over time These tests show no evidence of structural shift for housing and consumer durables, but some evidence of a shift for producers' durables in the early 1980s

Box 1: Regression Estimates for the Expenditure Equations *(continued)*

Table A

Regression Results for the Expenditure Equations*

	Consumer Durables			Housing			Producers' Durable Equipment†		
	1960-86	1960-74	1975-86	1960-86	1960-74	1975-86	1960-86	1960-74	1975-86
Constant	−1 49	−1 28	−2 32	0 33	0 17	−0 56	−9 14	−7 88	−8 30
	(6 7)	(3 4)	(5 4)	(2 0)	(0 5)	(1 4)	(17 21)	(6 1)	(6 3)
Income	0 37	0 32	0 53	0 16	0 29	0 28	1 92	1 74	1 81
	(6 7)	(3 3)	(6 2)	(6 5)	(4 2)	(4 3)	(23 6)	(9 0)	(10 2)
Interest	−0 03	−0 02	−0 05	−0 20	−0 34	−0 21	−0 24	−0 17	−0 24
	(4 0)	(1 1)	(5 2)	(4 5)	(2 8)	(4 6)	(4 8)	(1 5)	(4 6)
Lagged Dependent	0 77	0 80	0 70	0 76	0 64	0 76	—	—	—
	(21 0)	(11 6)	(15 9)	(22 6)	(7 9)	(26 4)			
Chunemp	−0 05	−0 07	−0 04	−0 06	−0 05	−0 08	—	—	—
	(8 1)	(6 5)	(5 8)	(4 1)	(2 3)	(5 3)			
Other‡	−0 03	—	−0 04	−0 05	−0 06	−0 04	0 41	0 88	0 32
	(2 2)		(3 2)	(4 0)	(3 5)	(2 5)	(2 4)	(1 8)	(1 8)
Long-run Interest Elasticity§	−0 136	−0 085	−0 166	−0 810	−0 928	−0 872	−0 244	−0 172	−0 237
$\bar{R}^2$	998	995	990	962	931	978	987	973	980
SEE	025	025	022	040	038	036	018	017	019
Rho	− 346	− 260	− 491	078	211	− 314	585	645	209

*All equations are estimated with Cochrane-Orcutt correction for first-order serial correlation All variables except Chunemp, and "Other" enter in log form See Appendix 2 for definitions of variables

†The reported results are the sum of the lagged coefficients

‡"Other" is a dummy for credit controls in 1980 for consumer durables, a dummy for credit rationing in housing, and the ratio of output price to capital price in the producers' durables equation

§For consumer durables and housing this is calculated by dividing the short-run interest elasticity by one minus the coefficient on the lagged dependent variable

the role of the main explanatory variables. Interest rate effects are particularly large in the housing sector, indicating that a 10 percent decrease (increase) in the mortgage rate—e.g., from 10 to 9 percent—would gradually lead to about an 8 percent rise (decline) in expenditures on residential construction. The interest sensitivity of expenditures in the other two sectors is also substantial but well below that for the housing sector. Together, the results for the three sectors imply that a 10 percent decline in the general level of interest rates would augment expenditures in the long run by 3.2 percent, or about $27 billion in 1982 prices, using 1985 as the base.[5]

For all three sectors, the short-run interest rate effects are substantially smaller, but they are also less certain and more difficult to quantify precisely We have, therefore, made no systematic attempt to explore interest rate effects for the short run or for any period less than the "long run."

[5]These and other estimates discussed here refer only to the direct effect of interest rates, in fact, however, there are multiplier or feedback effects as demand and income in each sector respond to initial growth in the other sectors

The estimates for the more recent sample period, 1975-86, are broadly similar to the full period estimates. In particular, the long-run interest rate effects remain significant in all three sectors. For the first part of the sample period, however, interest rates are statistically significant for the residential construction sector but not for the other two sectors.

A comparison of the subperiod results suggests that the interest sensitivity of expenditures on consumer durables and producers' durable equipment may have risen over time The estimates for various cut off points in the 1970s confirm this impression. While the estimated effects over the subperiods are somewhat sensitive to moderate changes in the sample size, they do suggest that the interest sensitivity of the two sectors has been greater over the last 10-15 years than in the 1960s.

The housing sector results, by contrast, do not reveal a trend in the interest sensitivity, which has remained strong throughout the period. The subperiod estimates for the housing sector are more sensitive to changes in the sample size than those for the other two sectors: the coefficients of the explanatory variables and their

significance vary considerably for small changes in the sample period This problem may reflect, in part, uneven changes in the importance of various components of capital costs and credit rationing, and their interaction with one another as well as with the activity variables.

Formal statistical tests to examine the significance of any shift in interest sensitivity are broadly in line with our impressions based on results for various subperiods (Box 1). They indicate a small but significant upward shift during the 1973-76 period for the consumer durables and the producers' durable equipment sectors but not for the housing sector. Of course, even without a shift in the interest elasticity, the *whole* structure underlying our estimates may have shifted over time. Statistical tests to explore this possibility are inconclusive: they suggest a shift in the housing and consumer durables sectors but not in the producers' durable equipment sector

The expenditure equations also give some insight into the changing role of credit rationing We test for two kinds of credit rationing. First, we find that the credit controls imposed by President Carter in 1980 directly reduced spending on consumer durables by about 3 or 4 percent. Second, and more important, as we argued earlier, periods of tight monetary policy were often associated with restrictions in the quantity of credit available to the housing and small business sectors [6] Our estimates show that credit crunches in the housing sector directly reduce spending by about 5 percent on average for the sample period as a whole. The results from dividing the sample confirm the view that credit rationing plays a smaller role in recent years.

To sum up, there is significant evidence that the interest sensitivity of spending on consumer durables and producers' durable equipment has risen since the mid-1970s. The evidence for the housing sector is ambiguous it suggests a shift in the overall structure but not in the interest sensitivity of expenditures. The average interest elasticity for the three sectors appears to have risen over time, as the impact of credit rationing has declined More generally, in all three sectors, the long-run influence of interest rates on private spending developments has been important, at least since the mid-1970s.

Exchange Rate Effects

Estimates of total expenditures for the producers' durable equipment and consumer durables sectors, as noted earlier, do not allow us to examine the substitution between foreign and domestic goods resulting from changes in exchange rates. In this section, we explore this "substitution effect" in two ways: first, we test how exchange rates affect the division of expenditures between imports and domestically produced goods; and second, we estimate the effect of exchange rates on exports. Measures of relative prices and trade-weighted exchange rates were tried as proxies for the exchange rate variable. In our primary estimates, the exchange rate influence appears through relative prices—the ratio of import prices to prices of competing domestic goods and the ratio of export prices to prices of competing foreign goods, all expressed in dollars.

Because of data limitations and our desire to focus on a period with significant exchange rate movements, the estimates in this section cover only the period from around 1970 to the present. We are therefore unable to examine possible shifts in the external sector influence on the economy during the early or mid-1970s.

The equations for domestic demand for home produced goods—constructed by subtracting imports from total domestic expenditures for each sector—are similar to the expenditure equations, with the addition of exchange rate variables Details of the estimates along with four representative equations are reported in Box 2. The results are broadly consistent with our earlier findings for total expenditures: spending in both sectors is sensitive to economic activity and interest rate variables. In addition, demand in both sectors also appears to be quite sensitive to changes in exchange rates However, these results are considerably less robust than our estimates of total expenditures The interest and exchange rate variables are not consistently significant, and in most cases are sensitive to small changes in the sample period. As noted above, the interest and exchange rate effects are difficult to separate empirically presumably because the two variables tend to move together over time. More fundamentally, the relative weakness of these estimates may be due to the difficulties of measuring and identifying domestic demand for home production and its explanatory variables.

Given the mixed results for expenditures on domestic output, it is useful to estimate import demand *directly*, and thereby infer spending on domestically produced goods In addition, to round out our results, we estimate the exchange rate effect on the demand for exports.

Import and export demand equations for consumer durables and producers' durable equipment were estimated for a number of overlapping sample periods from 1970 to 1986. Details of the equations as well as estimates for two sample periods, 1971-86 and 1975-86, are reported in Box 2 Judged in terms of the standard statistical criteria, these estimates appear to be reliable,

[6] We limit our empirical tests to the housing sector because it is difficult to separate small business investment from large business investment This limitation is not likely to have serious consequences for our results for two reasons (1) the results for housing should be indicative of broader credit rationing effects, and (2) in equations that exclude measures of credit rationing, its effect should be at least partially captured by the interest rate variable

Box 2: Regression Estimates for the Tradeable Goods Sectors

In this box we present the details of our empirical estimates for the external sector, as well as additional evidence on the robustness of our results Exchange rate effects are estimated for two sectors—consumer durable goods and producers' durable equipment—using three different dependent variables—domestic goods demand, imports, and exports To give an idea of how sensitive the results are to changes in sample period, estimates for both the 1971-86 and 1975-86 periods are reported

The domestic goods demand equations are shown in Table B The results are somewhat weaker than the expenditure equations, but they provide us some insight into the role of exchange rates The overall fit is not as good but there is less serial correlation The interest rate effect remains strong and significant in the consumer durables equation, but becomes smaller and insignificant in the producers' durables equation Finally, the exchange rate effects are economically large in both equations, but only marginally significant in the consumer durables equation

These mixed results are probably due to two problems with the data First, domestic demand is measured with error because the trade and expenditure data classify final demand in different ways Furthermore, our measure of domestic final products includes an unknown quantity of imported materials and supplies These measurement errors bias our exchange rate elasticities toward zero The second problem is that interest and exchange rates are closely related both behaviorally and statistically This multicolinearity may explain the low t values for some of our interest and exchange rate elasticity estimates

By directly estimating import equations we can avoid the problem of measurement error The import and export equations are of the following form

(1) TRADE = a + b_i INCOME + c_i RELPRICE + d OTHER,

where all variables except the change in unemployment are in log form and both INCOME and RELPRICE enter as long polynomial lags TRADE is the constant dollar value of imports and exports for both consumer durable goods and producers' durable equipment INCOME is a measure of overall economic activity. In the import equations it measures domestic activity, and in the export equations it is a weighted average of foreign income. RELPRICE is a sector-specific measure of the relative price of foreign versus domestic goods OTHER is the change in unemployment in the consumer durable imports equation and a dock strike dummy in the producers' durables import equation More precise definitions of the empirical proxies are given in Appendix 2

Table C reports the estimates for both imports and exports * The reported coefficients are the sums of the lagged coefficients and should be interpreted as long-run elasticities All the equations have good overall fit and reasonable autocorrelation estimates The income and exchange rate elasticities are in line with previous work Note in particular the high income elasticity for both import equations

We also tested the robustness of our results to changes in sample period and to different proxies for the exchange rate effect. Varying the sample starting point from 1971 to 1975 and the end point from 1983 to 1986 confirms that the reported elasticities are representative, but it also shows that the parameters are unstable Using the real exchange rate—the exchange rate adjusted for inflation differentials—yields similar results As expected, the real exchange rate elasticities are generally lower than the relative price elasticities The real exchange rate elasticities are also more variable, reflecting the instability of the relationship between real exchange rates and relative prices

Table B

Regression Estimates for Demand for Domestic Goods*

	Consumer Durables		Producers' Durable Equipment†	
	1971-86	1975-86	1971-86	1975-86
Constant	−0 58	−0 69	−9 82	−9 76
	(1 4)	(1 7)	(9 8)	(3 6)
Income	0 33	0 38	1 68	1 66
	(4 5)	(4 6)	(15 8)	(6 6)
Interest	−0 05	−0 06	−0 12	−0 09
	(4 3)	(3 7)	(1 7)	(0 9)
Relprice	−0 10	−0 15	−0 46	−0 46
	(2 3)	(1 7)	(5 8)	(2 4)
Chunemp	−0 04	−0 04	—	—
	(4 5)	(3 6)		
Lagged Dependent	0 65	0 61	—	—
	(11 1)	(9 2)		
Credit	−0 05	−0 06	—	—
	(2 5)	(3 0)		
Summary Statistics				
$\bar{R}^2$	976	957	969	942
SEE	032	030	023	026
Rho	− 428	− 478	083	058

*All equations are estimated with Cochrane-Orcutt correction for first-order serial correlation All variables except Chunemp enter in log form See Appendix 2 for definitions of variables

†The reported results are the sum of the lagged coefficients

*Consumer durables exports excludes auto exports to Canada Auto trade with Canada is determined more by trade agreements and marketing considerations than by macro-variables such as income and exchange rates When we included Canadian autos in our export data, the overall fit deteriorated and the income variable became insignificant

Box 2: Regression Estimates for the Tradeable Goods Sectors *(continued)*

Table C

Regression Estimates for Imports and Exports*

	Imports				Exports			
	Consumer Durables		Producers' Durable Equipment		Consumer Durables		Producers' Durable Equipment	
	1971-86	1975-86	1971-86	1975-86	1971-86	1975-86	1971-86	1975-86
Constant	−31 66	−27 27	−28 74	−30 18	8 43	−4 68	−1 29	−3 68
	(14 4)	(19 9)	(7 4)	(8 9)	(11 1)	(3 6)	(1 4)	(2 9)
Income	4 64	4 06	4 83	5 03	1 94	1 21	1 85	2 37
	(16 3)	(22 7)	(12 8)	(16 1)	(13 3)	(4 9)	(12 6)	(9 2)
Relprice	−1 55	−1 00	−1 22	−1 27	−1 61	−1 42	−0 94	−1 00
	(8 0)	(4 7)	(4 6)	(5 6)	(17 3)	(13 2)	(7 1)	(6 5)
Other†	−0 07	−0 06	−1 17	−0 70	—	—	—	—
	(4 2)	(2 8)	(5 1)	(0 9)				
Summary Statistics								
$\bar{R}^2$	894	971	930	987	871	898	813	702
SEE	039	038	045	038	074	059	034	027
Rho	679	282	766	433	173	− 074	699	750

*All equations are estimated with Cochrane-Orcutt correction for first-order serial correlation The reported coefficients are the sum of the lagged coefficients Each variable, except "Other," enters in log form See Appendix 2 for definition of variables

†"Other" is the change in unemployment in the consumer durables equation and a dock strike dummy in the producers' durables equation

although the explanatory power of some variables is moderately sensitive to changes in the sample period.

The relative price variables are highly significant in all import and export equations (Table 2). The price elasticity estimates for imports are roughly similar in the two sectors They imply that a 10 percent increase in the relative price of imports will gradually reduce imports of consumer and producers' durables by about $22 billion in 1982 prices, using 1985 as the base. On the export side, the price elasticity is considerably larger for consumer durables than for producers' durable equipment, but both estimates are substantial. These results imply that a 10 percent increase in relative export prices will eventually lower the combined exports of the two sectors by about $10 billion in 1982 prices, using the 1985 base level As with the interest rate effects, the short-run influence of changes in relative prices and exchange rates is much smaller, quite uncertain, and difficult to quantify

The relative price variables take into account not only price changes due to nominal exchange rate changes but also price changes unrelated to exchange rate movements To estimate the influence of exchange rates on imports and exports, it is necessary to determine the extent to which exchange rate changes affect import and export prices as well as prices of competing domestic and foreign goods

No significant evidence about exchange rate effects on prices exists at a level comparable to disaggregate categories in this article Recent studies at a much higher level of aggregation suggest, however, that in the long run exchange rate changes lead to large but usually less than equal percentage changes in import and export prices Moreover, studies also indicate a considerable influence of exchange rate changes on domestic prices here and abroad Using certain plausible assumptions based on these studies, Table 2 provides the likely effects of exchange rate changes on imports and exports of the two sectors under consideration Since the same assumptions are used for both sectors, the estimated exchange rate effects preserve the underlying relative pattern of the price elasticities reported in the table [7]

The estimated exchange rate effects on imports and exports, though smaller than the relative price effects, are substantial On the import side, combining the two sectors, a 10 percent decline in the trade-weighted

[7]For a review of the evidence on exchange rate effects on prices, see M Goldstein and M S Khan, "Income and Price Effects in Foreign Trade" in *Handbook of International Economics*, edited by P B Kenen and R W Jones (Amsterdam North-Holland, 1983) Incidentally, note that only in the extremely unlikely case where exchange rate changes have equal percentage effects on import prices but no significant effect on export prices and on prices of competing goods would the exchange rate elasticity be the same as the price elasticity Also note that the sign for the exchange rate effect is positive for imports, the opposite of that for the relative import price effect, since changes in import prices are inversely related to changes in the dollar exchange rate

nominal exchange value of the dollar is estimated to reduce the volume of imports by 7-8 percent in the long run. Using the 1985 base level, this implies a reduction of about $13 billion in 1982 prices. On the export side, the long-run exchange rate effect is considerably smaller than for imports but it is statistically and economically significant.

Due to considerable uncertainty about exchange rate effects on prices of imports, exports, and domestic goods, these results should be viewed not as precise estimates, but as evidence of strong exchange rate influence on U.S. international trade in consumer and capital goods. Some caution in interpreting exchange rate results is also suggested by the fact that the magnitude of the underlying price elasticities is somewhat sensitive to moderate changes in the sample, although those elasticities remain substantial and important regardless of the estimation period.

Table 2

Long-Run Relative Price and Exchange Rate Effects*

	Imports		Exports	
	Percent	$ 1982 (billions)	Percent	$ 1982 (billions)
Consumer Durable Goods				
Price Effect†	−12 75	$−12 63	−15 15	$−1 83
Exchange Rate Effect‡	+7 64	+7 57	−6 06	−0 73
Producers' Durable Equipment				
Price Effect†	−12 45	−9 49	−9 70	−8 02
Exchange Rate Effect‡	+7 47	+5 69	−3 88	−3 19
Total§				
Price Effect	−12 61	−22 12	−10 40	−9 80
Exchange Rate Effect†	+7 57	+13 26	−4 16	−3.92

*Change in imports or exports in response to a 10 percent change in the relative price variable or in the trade-weighted nominal exchange rate The real or 1982 dollar figures use the 1985 average for each series as the base The signs refer to the direction of changes in imports and exports

†The price elasticities are the average of two estimates reported in Box 2 All estimates are statistically significant at the 99 percent level

‡For a 10 percent decline in the trade-weighted nominal dollar exchange rate, we assume the following effects on various prices (all expressed in dollars) 7 5 percent for import prices, 4 0 percent for export prices, and 1 5 percent for domestic prices In addition, prices abroad are assumed to decline by 2 0 percent in foreign currency terms These assumptions imply that relative import prices will change by 6 0 percent and relative export prices by −4 0 percent Of course, all signs would be reversed for appreciation of the dollar

§The elasticity estimates represent the average of the two component elasticities, weighted by their share in 1985 total private expenditures The dollar figures are the sum of changes for the two components

Further Analysis and Conclusions

Our empirical work indicates substantial long-run interest rate effects on spending in all three sectors. These effects are particularly large for the housing sector. We also find evidence of strong long-run exchange rate effects on consumer durables and producers' durable equipment.

To get an impression of the quantitative importance of interest and exchange rates, consider the effect of simultaneous changes in the two variables on domestic output. A 10 percent increase in both interest rates and the trade-weighted exchange value of the dollar would eventually lead to nearly a 6 percent drop in the combined output of the three sectors (Table 3). This is equivalent to nearly 1 1/3 percent of GNP and 1 2/3 percent of total private expenditures. As noted elsewhere in this article, this is only the direct effect; the actual long-run GNP outcome would also include multiplier or indirect effects.

Our work also provides some evidence of a rise in the interest sensitivity of spending in the early or mid-1970s.

Table 3

Long-Run Interest and Exchange Rate Effects on Domestic Output*

	Total†		Contribution of‡	
	Percent	$ 1982 (billions)	Interest Rate	Exchange Rate
Consumer Durable Goods	−4 8	−12 4	32 8	67 2 (91 2)
Producers' Durable Equipment	−4 6	−14 4	38 3	61 7 (58.4)
Residential Construction	−8 7	−15 4	100.0	0
Total	−5 6	−42 2	59 3	34 8 (87 1)

*Based on the interest rate elasticities for the sample period 1975-86 in Table 1 and the exchange rate elasticities in Table 2

†Change in domestic output (i e , expenditures minus imports plus exports) in response to a simultaneous 10 percent change in interest and exchange rates, using 1985 as the base year The sign refers to the direction of change in domestic output Note that the table assumes no net change in inventories over the sample period

‡Percent of total contribution The numbers in parentheses refer to the portion of the exchange rate effect due to imports

The upward shift appears to be significant in the consumer durable and producers' durable equipment sectors. On the exchange rate side, data limitations prevent us from exploring the possibility of a shift in the exchange rate sensitivity. But the relevant price and exchange rate elasticities are likely to have been greater since the mid-1970s than in the earlier period, as suggested by empirical analyses at the aggregate level. Even without any change in the underlying elasticities, the exchange rate effects on domestic economic activity may have risen over time, because of larger exchange rate movements and the increased scale of international financial and non-financial transactions of the U.S. economy.

These findings suggest that monetary policy continues to have powerful long-run effects on the economy. The declining impact of credit rationing seems to have been offset by the increasing sensitivity to interest rates and the greater role of exchange rates. On balance, the long-run link between monetary policy variables and output appears to be stronger today than in the past. But such a conclusion would tend to overreach our results for at least three reasons: first, our empirical analysis does not cover all sectors of the economy; second, our analysis of credit rationing effects, with focus only on the most important of those effects, is not comprehensive and may understate the role of credit rationing in the 1960s and the 1970s; and third, given that the financial and economic environment has continued to undergo significant changes in recent years, uncertainty about our results may be greater than would normally be the case in such estimates.[8]

The strong long-run link between financial variables and economic activity by itself suggests but does not necessarily imply efficacious monetary policy. For policy actions to be effective, the relationship between policy instruments and financial variables must also be reliable and sufficiently predictable. This aspect of the transmission mechanism, as noted in the introduction, is beyond the scope of our investigation. It should be emphasized, however, that policy implications of our findings are best appreciated by keeping in mind that recent changes in the financial system are widely believed to have made the link between policy instruments and financial variables less reliable than before. Many economists have argued, for example, that the increased role of market forces and international financial integration have weakened the ability of monetary policy to exert a significant and predictable influence on interest and exchange rates

The implications of the results in this study are considerably less favorable for monetary policy over the short- to medium-term. The channels of policy influence are complex and operate with long and variable lags. The increased importance of exchange rates and the external sector has added further complexity and uncertainty to the workings of the policy channels. Our results suggest that the extent and timing of the lagged interest and exchange rate effects are uncertain, making it difficult to assess the short- to medium-term influence of monetary policy on economic activity.

These unfavorable implications aside, our main findings are encouraging for the role of monetary policy. In particular, the breakdown of credit rationing mechanisms seems not to have weakened the long-run monetary policy influence on the economy. To be sure, because of uncertain lags, interest rate effects on economic activity do not appear as quickly as credit rationing effects. Over a longer period, however, the average increase in interest rates needed to restrain demand is unlikely to be higher than in the past.

M.A. Akhtar
Ethan S. Harris

[8]Standard econometric techniques are not satisfactory for estimating relationships in the face of on-going structural changes or for detecting *uneven* effects of those changes

Appendix 1: The Theoretical Framework

The analysis in the text is based on the open economy framework developed by Mundell and Fleming Before presenting the model, however, it is useful to review some of the basic accounting of open economy macro GNP is equal to expenditure (aggregate spending by domestic residents), minus the portion of expenditure devoted to imports, plus exports (purchases of home goods by foreign residents)·

(1) $Y = E - M + X.$

In addition it is useful to consider spending on domestic goods by domestic residents.

(2) $DD = E - M.$

Combining (1) and (2) we see that GNP is the sum of demand for home goods by residents and by foreigners

(3) $Y = DD + X$

The Mundell-Fleming model divides the economy into three markets, represented graphically by an IS, LM, and BOP curve [1] These are shown in the graph below. The IS curve plots points at which the goods market is in equilibrium In algebraic terms, it sets output equal to the sum of private expenditure, government spending, and net exports

(4) $y = E(\overset{+}{y},\overset{-}{r},\overset{+}{C}) + G + X(\overset{+}{y^f},\overset{+}{e}) - M(\overset{+}{y},\overset{-}{e}),$

where r is the nominal interest rate, C is a measure of credit availability, G is government spending, y^f is foreign income, and e is the exchange rate (in dollars per unit of foreign currency, so that an increase in the exchange rate means a depreciation of the dollar) The signs of the partial derivatives are shown above each right-hand variable. The IS curve slopes downward because lower interest rates encourage higher spending in the interest sensitive sectors of the goods market and this tends to increase income The IS curve shifts up and to the right when government spending increases, when the exchange value of the dollar falls, and when credit constraints are relaxed.

The LM curve plots points of equilibrium in the money market

(5) $M/P = L(\overset{+}{y},\overset{-}{r}),$

where M is the nominal money stock and P is the price level The LM curve slopes up and to the right higher income increases money demand and higher interest rates reduce money demand, so income and interest rates must move together to maintain money demand equal to a fixed money supply Increases in the money stock shift the LM curve down and to the right

[1]Several heroic assumptions are made to keep the exposition simple For example, we assume static expectations and fixed prices and we do not fully take into account stock and flow distinctions

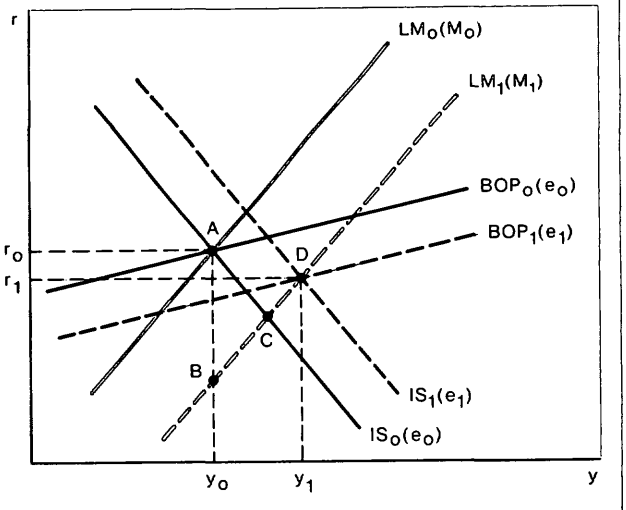
The Balance of Payments curve (BOP) traces points at which there is no net flow of foreign exchange out of the United States. The Mundell-Fleming model assumes perfect capital mobility, here we generalize the framework by assuming that capital is partially mobile between countries This means that increases in U.S. interest rates will cause some increase in capital flows into the United States Algebraically,

(6) $0 = K(\overset{+}{r}) + X(\overset{+}{y^f},\overset{+}{e}) - M(\overset{+}{y},\overset{-}{e}),$

where K is net capital inflows The BOP curve slopes upward because with a given exchange rate higher incomes stimulate imports, worsening the balance of payments, while higher interest rates cause capital inflows, improving our balance of payments The BOP curve shifts down and to the right if the exchange value of the dollar declines or if foreign incomes rise

With this model it is simple to show the macroeconomic effects of monetary policy (see graph). An increase in the money supply shifts the LM curve down

Monetary Policy in an Open Economy Under Flexible Exchange Rates



Note Initial equilibrium is $A(r_0,y_0,e_0)$ The increase in the money supply shifts $LM_0(M_0)$ to $LM_1(M_1)$ causing interest rates to fall towards B Lower interest rates stimulate spending, pushing income toward C This causes the exchange rate to increase, shifting $IS_0(e_0)$ to $IS_1(e_1)$ and $BOP_0(e_0)$ to $BOP_1(e_1)$ Final equilibrium is at $D(r_1,y_1,e_1)$

Appendix 1: The Theoretical Framework *(continued)*

and to the right This stimulates expenditure in the interest-sensitive sectors of the economy, causing income to rise In addition, the increase in the money supply may help relax credit restraints, shifting the IS curve up and to the right With lower interest rates and higher income, however, there is upward pressure on the exchange rate, causing both the IS curve and the BOP curve to shift to the right At the final equilibrium, income is higher for several reasons (1) lower interest rates have encouraged spending in interest-sensitive sectors, (2) the weaker dollar has caused demand to shift away from foreign goods in favor of home goods, and (3) with greater liquidity in the economy there may be less rationing of credit to the housing and small business sectors.

Relaxing some of the strict assumptions of the model complicates the exposition and may alter some of the conclusions. For example, if the domestic price level is allowed to change in response to an increase in the money supply, this will reduce the real money supply, offsetting some of the short-run increase in GNP. Indeed, if the economy is near full employment, prices may rise one-for-one with the money supply, completely offsetting the stimulative effect of the monetary expansion As a further example, if traders anticipate a loosening of monetary policy the exchange rate may overshoot, initially jumping above its new long-run level These short-run adjustments can have long-run implications because they have long-lasting effects on the stock of foreign assets

Using this framework we can also explore the impacts of financial innovation and the increased openness of the economy on policy effectiveness Financial innovation may have reduced the role of credit rationing in transmitting monetary policy to the economy This means a smaller sympathetic shift in the IS curve in response to stimulative monetary policy If spending is also relatively insensitive to interest rates, so that there is a steep IS curve, then monetary policy has lost its effectiveness On the other hand, our results suggest that financial innovation and other structural changes in the economy have increased the interest sensitivity of aggregate demand, flattening the IS curve and enhancing policy effectiveness

The opening up of the economy may have increased the power of monetary policy As we pointed out earlier, under flexible exchange rates the balance of payments curve shifts to the right when monetary policy eases. This shift will be larger if imports and exports are more sensitive to exchange rates Greater capital mobility may also increase the effect of a change in the money supply by flattening the BOP curve It is worth reiterating, however, that the increased openness of the U S economy has probably increased the unpredictability, as well as the magnitude, of policy effects That is, although the slopes of the various curves may now be more favorable to policy makers, the curves may also have become more unstable

Appendix 2: Empirical Proxies

This appendix provides detailed descriptions of the variables used in this study The explanatory variables can be divided into four general categories aggregate activity, interest rates, exchange rates and trade prices, and dummy variables Most of the data comes from either the National Income and Product Accounts (NIPA) or the Federal Reserve Board's MPS model of the United States Economy (MPS) [1]

Dependent variables

With one important exception, the dependent variables are taken directly from the NIPA (Tables 1 2 and 4 4) The exception is exports of consumer durable goods, which includes autos. Because of the special nature of auto trade with Canada, however, we decided to net-out Canadian autos This, in turn, required constructing quarterly Canadian auto data from annual data for the period before 1977 Most of the other series are available back to the late 1940s, but the disaggregated trade data does not start until 1967

Activity variables

Each expenditure equation includes measures of general activity that are in some way specific to the individual sectors The producers' durable equipment expenditure equations capture "accelerator" or activity effects using real gross private domestic business product (NIPA) Both consumer durables and housing include a measure of permanent income. real disposable income, averaged over eight quarters (NIPA). They also include the effect of temporary liquidity constraints on spending, measured by the change in the unemployment rate (See Bureau of Labor Statistics, *The Employment Situation—Household Survey*, various issues)

In the tradeable goods equations, somewhat more elaborate income variables are used The import and domestic goods demand equations use the same activity variables as the expenditure equations, except consumer durable imports uses current real disposable income

[1]The National Income and Product Accounts are published by the U S Department of Commerce in the *Survey of Current Business*, the MPS model is described in an unpublished manuscript, Flint Brayton and Eileen Mauskopf, *The MPS Model of the United States Economy* (February, 1985)

Appendix 2: Empirical Proxies *(continued)*

rather than permanent disposable income Both export equations use the Federal Reserve Board's weighted average of foreign GNP (MPS).

Interest rates

In theoretical models, interest rate effects often appear through complicated cost-of-capital variables. These variables serve as proxies for the price of a unit of services from a durable good, taking into account physical depreciation, taxes and relative prices, as well as the financial (or interest) cost of investment For each sector, we experimented with several cost-of-capital variables, but in many cases the best fit resulted from the simplest measure—a nominal interest rate

The consumer durable goods and producers' durable equipment equations use the six-month commercial paper rate and Moody's AAA corporate bond rate, respectively. The commercial paper rate is a proxy for the short-term borrowing cost of households, and the bond rate captures the long-run financing cost of business investment Cost-of-capital effects are also captured in the producers' durables equation by including the ratio of the price of output to the price of new capital (FMP) The commercial paper rate is from Board of Governors of the Federal Reserve System, *Federal Reserve Bulletin*; the corporate bond rate is from Moody's Investor Service.

In contrast to these simple measures, the housing equations use a complicated measure which is a weighted average of the cost-of-capital for owner-occupied and rental housing. These cost-of-capital variables take the general form.

$$(1)\ \text{Cost} = (P^h/P) \cdot [d + i \cdot (1-t) - \dot{P}^h] \cdot TAX,$$

where P^h/P is the price of housing relative to a general consumer price index, d is the rate of physical depreciation, i is the effective interest rate on fixed rate mortgages, $\dot{P}^h$ is distributed lag on past housing inflation, t is the marginal income tax rate, and TAX is an amalgam of other tax effects This measure is adopted from the MPS model.

Exchange rates and trade prices

Exchange rates affect output primarily by altering the relative price of domestic versus foreign goods In the regressions reported in the text, these relative price variables are constructed from implicit deflators (NIPA) For the import and domestic goods demand equations,

$$(1)\ \text{Relprice1} = \frac{M/M82}{(E-M)/(E82-M82)},$$

where M is imports, E is expenditure, and the suffix "82" designates a constant dollar figure. The relative price variable is similar in the export equation, except that a general price index is used to represent the price of the foreign country's home goods·

$$(2)\ \text{Relprice2} = \frac{(X/X82)\ e}{FCPI},$$

where X is nominal exports, X82 is real exports, and e and FCPI are the Federal Reserve Board's measure of the effective exchange rate and foreign consumer prices (where each variable is weighted by the volume of multilateral trade for our principal trading partners)

Dummy variables

We used three different dummy variables. In the consumer durables equations, the dummy variable accounts for President Carter's restrictions on credit cards It has a value of one in the second and third quarters of 1980, and zero otherwise. The housing dummy takes a value of one in periods when deposits declined at savings and loan institutions (MPS). These credit rationing episodes occurred in the following periods· 1966-III to 1966-IV, 1969-III to 1970-III, 1973-IV to 1975-I, 1979-IV to 1980-III, and 1981-I to 1982-II. The third dummy captures the effect of dock strikes on imports (MPS). It takes non-zero values in 1962-65, 1968-69, and 1977-78.