FEDERAL RESERVE BANK
OF SAN FRANCISCO
ECONOMIC REVIEW

FISCAL POLICY: INFLUENCE ON MONEY, SAVING AND EXCHANGE RATES

WINTER 1982

The Federal Reserve Bank of San Francisco's **Economic Review** is published quarterly by the Bank's Research and Public Information Department under the supervision of Michael W. Keran, Senior Vice President. The publication is edited by William Burke, with the assistance of Karen Rusk (editorial) and William Rosenthal (graphics). Opinions expressed in the **Economic Review** do not necessarily reflect the views of the management of the Federal Reserve Bank of San Francisco, or of the Board of Governors of the Federal Reserve System.

For free copies of this and other Federal Reserve publications, write or phone the Public Information Section, Federal Reserve Bank of San Francisco, P.O. Box 7702, San Francisco, California 94120. Phone (415) 544-2184.

Fiscal Policy: Influence on Money, Saving and Exchange Rates

Fiscal Policy: Influence on Money, Saving and Exchange Rates

Proper harnessing of monetary- and fiscal-policy objectives is the key problem facing policymakers in this bitter winter of 1982. Two articles in this issue of the *Economic Review* contribute to the policy discussion by examining the domestic and international aspects, respectively, of the controversy. A third article, on household-saving decisions, ties in with this broader theme because of the importance of household savings for financing Federal deficits in a non-inflationary manner.

William Dewald raises the question whether budget deficits and monetary growth have been in fact related in the United States. The economics literature yields no conclusive answer, but he re-examines the question by introducing the concept of fiat money as a way of disentangling monetary from fiscal-policy actions. Fiat money is that part of the total monetary base—currency plus depository-institution reserves—which is directly controlled by Federal Reserve actions.

Dewald's analysis of data over a number of business cycles supports the view that deficits have led to faster money growth in the United States since World War II. He notes two potential avenues whereby fiscal policy may affect monetary policy: "Deficits may apply upward pressure on interest rates which automatically induces increases in the uncontrolled part of the monetary base, leading to faster money growth. The other potential link may occur as the Federal Reserve increases the controlled part of the base (fiat money) leading to more rapid money growth." The former factor was most evident prior to 1970, while the second factor dominated the money-deficit relation after 1970.

Dewald argues that without monetary accommodation, via one or another of these approaches, fiscal policy would have had only a transitory effect on nominal GNP in the last several decades, "Thus, in order to prevent fiscal deficits from being inflationary, the Fed must use the controlled part of the money supply to offset the automatic accommodation of the deficits by the induced part of the money supply." He concludes that the likelihood of non-inflationary deficits has improved in recent years—now that the Fed is focusing on controlling monetary aggregates, rather than interest rates, in its policy decisions.

Turning to the international scene, Joseph Bisignano and Kevin Hoover test the proposition that the mixture of monetary and fiscal policies significantly affects exchange rates. Since exchange-rate floating began in March 1973, the countries cited in their study followed very different domestic economic policies—and exhibited very different exchange-rate patterns. Over the period covered by their estimations, the rate against the U.S. dollar appreciated sharply for Germany and Japan, and depreciated sharply for Canada and Italy. Their estimations thus suggest that asset-market models help explain these movements, which means that different mixtures of economic policies can explain such developments.

Bisignano and Hoover caution against accepting the model results too literally—especially since their portfolio models are short-run models, whose long-run implications have not been empirically described. "Nonetheless, the estimated portfolio models suggest that the dollar exchange rate against the German mark, Italian lira, and Japanese yen will appreciate in the short run should the U.S. run a sizable government-deficit which is financed in the private market. Our evidence suggests that in the short run, at least, a combination of large Federal deficits and slow monetary-base growth will result in a major appreciation of the U.S. dollar."

Substantial and prolonged deviations from purchasing-power parity apparently had occurred in recent years between the U.S. and other major industrial countries. In the preceding issue of the *Economic Review*, Charles Pigott attributed such deviations to shifts in relative prices. Bisignano and Hoover claim, however, that these deviations could also be due to the behavior of real interest rates, caused by changes in the monetary-fiscal policy mix among major countries. ''A large increase in U.S. government debt in 1982, combined with low monetary growth, would thus continue to keep the effective (trade-weighted) U.S. dollar exchange rate away from its purchasing-power value, as has occurred since late 1980.''

Brian Motley turns to a key element in the Administration's program for higher productivity and growth—the encouragement of personal saving. Specifically, he investigates the effects of inflation, interest rates, and taxes on the consumption and saving behavior of households. However, Motley's study differs from most others in that its primary focus is on *saving* rather than on consumption. He treats the act of saving as a demand for various kinds of assets—both financial and tangible—which are expected to yield returns in the future, so that total saving depends on all the factors which influence the public's purchases of assets.

As Motley notes, economic theory suggests that decisions to consume or to save are likely to be influenced by changes in interest rates, inflation, and tax rates. But theory frequently cannot predict which way these effects will go. His results indicate, however, that increases in real after-tax interest rates on securities are likely to encourage current consumption, but to discourage purchases of both household durables and financial assets. ''Thus, if real interest rates can be brought down from current high levels, the flow of financial savings available to finance business investment and government deficits should expand.'' However, Motley also finds that the direct effect of a reduction in the inflation rate would be to increase current consumption and to reduce total saving, because households would not have to set aside funds to offset the ravages of inflation.

A major finding of Motley's study is a strong association between saving behavior and the personal tax rate. ''During the sample period, tax-rate increases stimulated current consumption as well as purchases of homes and consumer durables, and led households to assume more debt to finance these outlays.'' This finding was predictable: interest payments on household debt are tax-deductible, so that higher tax rates reduce the net cost of borrowing to finance both tangible-goods purchases and current consumption. He thus concludes, ''Lower tax rates, whether brought about by legislation or by a slower movement of families into higher tax brackets, conversely should reduce the demands which households make on the nation's resources, both real and financial, and thus should release funds for the financing of business investment and government deficits.''

Disentangling Monetary and Fiscal Policy

William G. Dewald*

Fiscal year 1982 began amid widespread concern that the Federal budget deficit would exceed the Reagan Administration's original estimate of $42.5 billion. This concern, which helped hold interest rates at historically high levels, was reinforced when the Administration itself announced new estimates of a $99 billion deficit in 1982, $92 billion in 1983, and $83 billion in 1983 and 1984. The projected deficit in 1982, for example would be around 3½ percent of a consensus forecast of GNP, the largest such percentage since World War II. However, this percentage is not large by comparison with those in some countries which have had comparatively low inflation and interest rates. In Japan, for example, the 1981 deficit also was about 3½ percent of GNP, while inflation was about 5½ percent, and money-market interest rates were around 7½ percent.

Why, then, the concern about deficits in the United States? Investors fear that future large deficits foreshadow a future acceleration of monetary growth, and in turn a reacceleration of inflation. Such expectations apparently held interest rates up through most of 1981. This fear that growing deficits will lead to rising inflation apparently did not operate in Japan because the monetary authorities there held monetary growth rates to noninflationary levels for years despite large deficits.

But is it even true that budget deficits and monetary growth have been in fact related in the United States? Surprisingly, the professional economics literature yields both yes and no answers to that question. This paper reexamines the question by introducing the concept of "fiat" money as a measure of monetary-policy actions, and as a way to disentangle monetary from fiscal-policy actions. Fiat money is that part of the total monetary base which is directly controlled by Federal Reserve actions. It is also that part of the monetary base which must increase if the Federal Reserve is going to finance Federal budget deficits directly.

The analysis of data for entire business cycles supports the view that deficits have led to faster money growth in the United States since World War II. Prior to 1970, the association between money and deficits occurred to some extent because *uncontrolled* sources of monetary growth were positively related to interest rates, which tend to rise with deficits, thereby inducing monetary growth. But since 1970, controlled sources of monetary growth (i.e. fiat money) appear to have been closely linked to deficits. Thus the Federal Reserve partly financed the large Federal government deficits during the 1970s through changes in its controlled policy variable, fiat money.

The paper also examines the effect of monetary and fiscal-policy impulses on nominal spending (GNP) growth in the U.S. economy. This analysis shows that high-employment government spending, a measure of fiscal-policy impulses, has had a significant long-run influence on nominal GNP, but mainly *through* an induced effect on monetary growth. In contrast, monetary-policy actions as measured by fiat money are shown to have exerted a significant *independent* effect on total spending. Thus, to prevent an automatic accommodation of deficits by monetary policy, the Fed must actively reduce growth in fiat money. It is important that the Fed do so over the next few years to prevent the possibility of another round of inflation being induced by the large government deficits currently projected.

Section I of this paper defines fiat money and

---

*The author is Professor of Economics, Ohio State University, and Editor, *Journal of Money, Credit, and Banking*. This article was written while he was Visiting Scholar, Federal Reserve Bank of San Francisco. Research assistance was provided by Mary Byrd Nance.

discusses its relationship to the monetary base. Section II examines the historical relationship between Federal deficits and monetary growth in the United States on the basis of the concept of fiat money. Section III analyzes the impact of monetary fiscal-policy impulses on aggregate demand, and Section IV presents conclusions and policy implications.

I. Fiat Money and the Monetary Base

The monetary base consists of bank reserves plus currency held by the public, i.e., the net monetary liabilities of the Federal Reserve and Treasury held by the public and financial institutions. The monetary base is important for the conduct of monetary policy because growth in the base is closely associated with growth in the monetary aggregates, the main conduit of Federal Reserve policy.

Fiat money is essentially that part of the monetary base not issued against private liabilities or international monetary assets. Specifically, it is that part of the monetary base that is matched by the Federal Reserve's holdings of Treasury securities, plus Treasury currency outstanding (less deposits issued by the Fed to the Treasury and Treasury holdings of cash).[1] Most of the rest of the monetary base is matched by Fed and Treasury holdings of gold and the debt of foreign governments and the borrowings of U.S. commercial banks (see Table 1).

The concept of fiat money (as opposed to base money) is of interest, first, because it is part of the Federal government's budget constraint. When the government spends more than it collects through taxes and sales of assets, the resulting deficit *must* be financed either by selling interest-bearing securities to the public or by increasing fiat money. The latter is accomplished mainly when the Federal Reserve buys government securities through its open-market operations, issuing reserves to banks in exchange for government securities.

Second, fiat money is the main exogenous or controlled part of the monetary base: i.e., if a government deficit is financed by increases in fiat

Table 1
Fiat Money and the Monetary Base
Outstanding in Fourth Quarters
(Billions of Dollars)

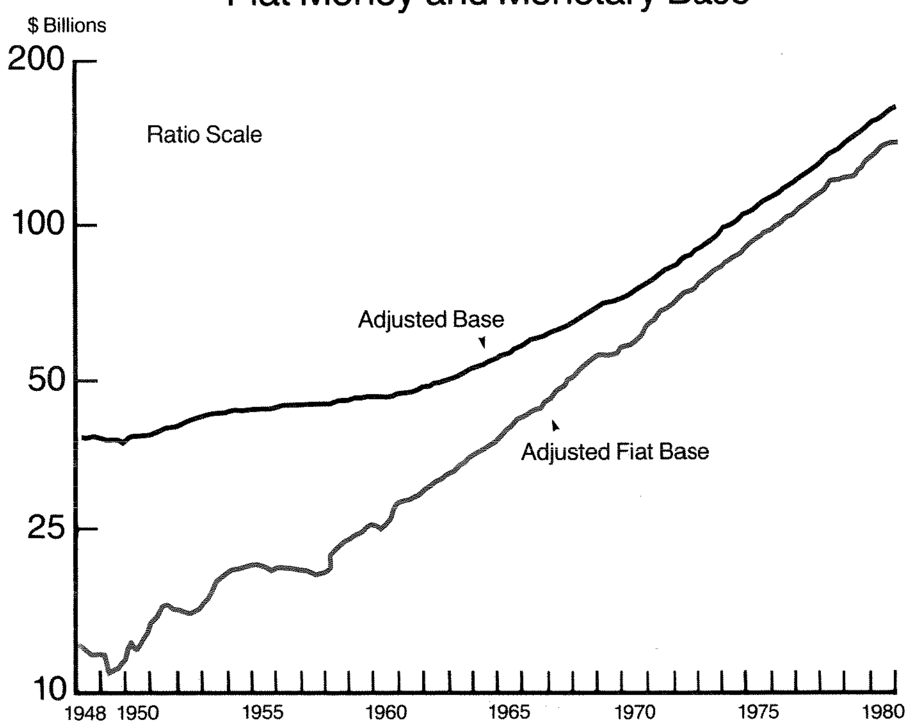
Sources of Fiat Money	**1980**	**1970**	**1960**
Federal Reserve Holdings of:			
U.S. Government Securities	$120.4	$60.5	$27.4
Federal Agency Securities	9.0	—	—
Treasury Currency Outstanding	13.4	7.1	5.4
Less:			
Treasury Deposits	3.0	.9	.5
Treasury Cash	.5	.4	.4
Fiat Money	139.3	66.3	31.9
Less: Reserve Adjustment Magnitude	1.9	5.4	4.0
Fiat Money Adjusted	$137.4	$60.9	$27.9
Other Sources of Monetary Base (not in Fiat Money)			
Gold Stock & Foreign Exchange Holdings of the Federal Reserve	$ 16.2	$10.9	$17.7
Loans to Commercial Banks	1.8	.3	—
Float	4.5	4.3	1.9
Foreign Deposits	.4	.3	.2
Miscellaneous	-1.5	-2.6	-2.1
SUBTOTAL	$ 21.4	$13.2	$17.7
MONETARY BASE	$158.8	$74.1	$45.6

money, this can be regarded as a conscious policy action of the Federal Reserve. The part of the base not included in fiat money, the "uncontrolled" portion, is positively related to interest rates. Thus government deficits also may induce increases in this endogenous part of the base by applying upward pressure on interest rates. These increases in the base can occur without a conscious policy action of the Federal Reserve.

The monetary aggregates will grow more rapidly in response to faster growth in either fiat money or the uncontrolled part of the base. Thus there is a potential direct link from deficits to fiat money to growth in the monetary aggregates, and an indirect link from deficits to higher interest rates to induced increases in the base and money growth. The latter linkage works more or less automatically. The former linkage need not work at all unless the Federal Reserve chooses to finance government deficits by increasing its holdings of government securities. Thus, deficits financed by increases in fiat money are "acts" of commission, whereas those financed by induced increases in the uncontrolled part of the base are "acts" of omission.

What are these induced or noncontrolled sources of growth in the monetary base? The part of base money not included in fiat money is about 15 percent of the monetary base, as compared with 39 percent in 1960 (see Table 1 and Chart 1). The uncontrolled items included in base money are mainly member-bank borrowing from the Federal Reserve, the international monetary-reserve holdings of the monetary authorities, and Federal Reserve Float. These noncontrolled sources vary directly and significantly with respect to interest rates.[2] First, a higher Federal funds rate relative to the discount rate induces banks to borrow more from the Federal Reserve. Second, attracted by comparatively high interest rates, foreign investors and governments would have an incentive to sell their currencies and gold to get dollars to buy U.S securities. If U.S. monetary authorities take actions to stabilize exchange rates, they would buy the foreign currencies in exchange for newly created

Chart 1
Fiat Money and Monetary Base



dollars of base money. Thus, an increase in a government deficit (and associated higher interest rates) tends to induce increases in the monetary base, which then lead to higher money growth.

In summary, it makes no difference in money-growth terms whether base money is created through the issuance of fiat money and direct financing of Federal deficits, or through induced increases in the uncontrolled part of base money. Both cause the money supply to grow faster, leading ultimately to more inflation. But for the purpose of evaluating Federal Reserve reactions to deficits, fiat money represents the principal magnitude that can be manipulated by the monetary authorities, and thus it may provide some clues about how monetary and fiscal policy have been related.

II. Federal Deficits and Monetary Growth

As noted earlier, there is no *necessary* association between deficits and monetary growth. Whatever the deficit, the monetary authorities could always take sufficiently contractionary actions in reducing fiat money to prevent monetary growth. This reduction could be accomplished by the Fed selling Treasury securities and thereby lowering bank reserves. The question is not whether mone-

Table 2
Federal Budget Deficits and Monetary Growth in Business Cycle Expansions and Contractions

	Federal Budget Deficit (DEF)* ($Billions)	DEF / PXF[1]	Annual Rate of Change in M-1B[2]	Annual Rate of Change in M-2[2]	Annual Rate of Change in A[2]
Contractions					
1948:4 - 1949:4	1.46	.53	-.55	-.18	-1.44
1953:3 - 1954:2	8.73	2.38	.59	2.32	.48
1957:3 - 1958:2	4.50	.95	.49	3.72	1.52
1960:2 - 1961:1	-.03	-.01	1.41	4.11	1.77
1969:4 - 1970:4	9.10	.88	3.87	5.59	4.86
1973:4 - 1975:1	15.92	1.04	3.59	6.01	6.56
1980:1 - 1980:3	58.97	2.16	3.52	6.69	5.25
All contractions	12.19	1.08	1.89	3.99	2.82
Expansions					
1949:4 - 1953:3	-1.74	-.65	3.68	3.83	3.29
1954:2 - 1957:3	-2.72	-.62	1.62	2.61	.87
1958:2 - 1960:2	2.96	.63	1.84	2.25	.77
1961:1 - 1969:4	2.58	.39	4.06	6.49	4.70
1970:4 - 1973:4	15.25	1.33	6.25	9.17	6.94
1975:1 - 1980:1	42.27	2.24	6.64	8.50	7.53
All expansions	10.45	.60	4.27	5.96	4.49

* Quarterly average

[1] The Federal deficit relative to nominal high-employment output (PXF), i.e., real potential output times the implicit GNP price deflator.

[2] Definitions of monetary aggregates:

M-1B = Money narrowly defined to include currency, demand deposits, travelers checks, and other checkable deposits.

M-2 = Money defined to include currency plus demand deposits plus time deposits at commercial banks other than large negotiable CD's. Values for 1980 were extrapolated on the basis of the growth rates for newly defined M-2.

A = Adjusted monetary base = member-bank reserves plus adjustment for reserve-requirement changes, plus currency held by the public and non-member banks.

F = Fiat money = Federal Reserve holdings of U.S. government securities, plus Treasury currency outstanding, less Treasury deposits with the Federal Reserve Banks and Treasury cash holdings, plus reserve requirement adjustment.

tary growth and deficits have to be related, but whether they *have* been related in the United States.

The divergent cyclical movements in budget deficits and monetary growth have clouded the relationship. Monetary growth—as measured by M-1, M-2, and the monetary base—historically has been most rapid during business-cycle expansions, whereas the deficit has been largest during contractions (see Table 2). Such divergent patterns suggest a negative relationship in the short-run.

However, the long-run relationship is of most interest, because it takes a long-run increase in money growth to raise the underlying rate of inflation. Popular opinion contends that in the long-run, deficits increase the demand for credit and thereby put upward pressure on interest rates. To mitigate the impact of Federal borrowing on interest rates, the Federal Reserve buys government securities and increases monetary growth. However, the professional economics literature is not conclusive in this area.[3] As will be shown, data for the post-World War II period confirm the popular view that monetary growth and deficits have in fact been positively associated.

Secular Evidence

We have used data averaged over entire business cycles (i.e., peak-to-peak or trough-to-trough) to focus on the long-run relationship between deficits and monetary growth. These data allow us to abstract from the inverse relationship between deficits and money growth over business-cycle expansions and contractions, and thus to focus attention on the longer-run trends in both policies.

The data show a close association between monetary growth and deficits over the 1948-80 period (Table 3 and Charts 1-3). We show deficits both in absolute nominal magnitudes and as a percentage of nominal high-employment output (PXF). Monetary growth measures include M-1, M-2, A and F (the monetary base and the fiat monetary base, respectively, both after adjustment for required-reserve ratio changes).

The pre-1970 experience suggests at best a weak association between monetary growth and (relatively small) deficits. There were Federal budget surpluses or small deficits over the two cycles from 1948 through 1958 (Cycles 1 and 2 in Table 3). The money supply as measured by the standard aggre-

Table 3
Federal Budget Deficits and Monetary Growth Over Complete Business Cycles

Complete Business Cycles	Federal Budget Deficit (DEF)* ($Billions)	DEF/PXF*	Annual Rate of Change in M-1B	M-2	A	F
Trough to Trough						
1949:4 - 1954:2	0.07	-.13	3.22	3.71	2.87	8.78
1954:2 - 1958:2	-1.02	-.25	1.81	2.45	.88	1.64
1958:2 - 1961:1	2.55	.54	1.85	3.06	1.16	7.19
1961:1 - 1970:4	3.57	.47	4.13	6.51	4.84	7.65
1970:4 - 1975:1	16.09	1.23	5.40	8.17	6.82	7.76
1975:1 - 1980:3	44.70	2.27	6.82	9.00	7.90	8.11
1949:4 - 1980:3	11.43	.72	4.05	5.92	4.51	7.08
Peak to Peak						
1948:4 - 1953:3	-1.22	-.48	2.81	3.02	2.27	6.73
1953:3 - 1957:3	-0.58	-.06	1.48	2.69	.83	.45
1957:3 - 1960:2	2.73	.58	1.54	2.92	1.08	7.12
1960:2 - 1969:4	2.77	.34	3.89	6.38	4.52	8.14
1969:4 - 1973:4	13.30	1.16	5.91	8.66	6.74	8.44
1973:4 - 1980:1	36.07	1.94	5.97	7.94	7.31	7.47
1948:4 - 1980:1	9.70	.61	3.87	5.68	4.22	6.74

*Quarterly average
See Table 2 for definitions of monetary aggregates

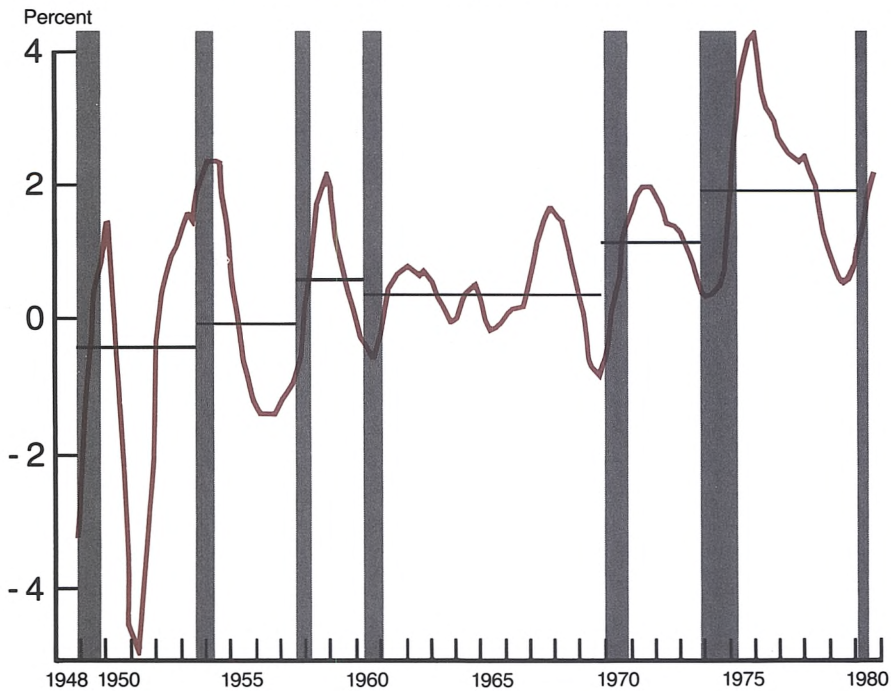
gates M-1, M-2 and A increased roughly at a 3-percent annual rate over the 1948-54 cycle (2) compared with the previous cycle. Annual budget deficits rose to average $2½ to $3½ billion over the two cycles (3 and 4) in 1958-70. Average monetary growth increased somewhat in the 1958-61 cycle, but at a much faster pace in the 1961-70 period.

But the deficit and money-growth changes that occurred in the next two cycles reveal a strong association, not unlike what had been observed during World War I and World War II. Over 1970-74, the average deficit quadrupled and monetary growth accelerated further (see Charts 2 and 3). During the 1974-80 period, deficits increased an additional three-fold and monetary growth accelerated again. Regression analysis confirms the statistically significant relationship between deficits and money growth on a cyclical average basis.[4]

The analysis of quarterly data for the entire 1948-80 period reinforces the significant association between deficits and monetary growth (Table 4). The estimated money-supply model resembles the one estimated previously in the literature. Money growth is explained by a distributed lag on deficits, measured as a ratio to nominal high-employment output (PXF).[5] These estimates indicate a statistically significant relationship, with around 50 percent of the variation in money growth being explained by deficits.

This relationship has generally been attributed to the behavior of the monetary authorities in attempting to damp interest-rate movements associated with Federal deficits and changes in outstanding Federal debt.[6] But the longer-term data for fiat money-base growth suggest that this was not generally the case for the controlled part of money growth

Chart 2
Deficit/High-Employment Output



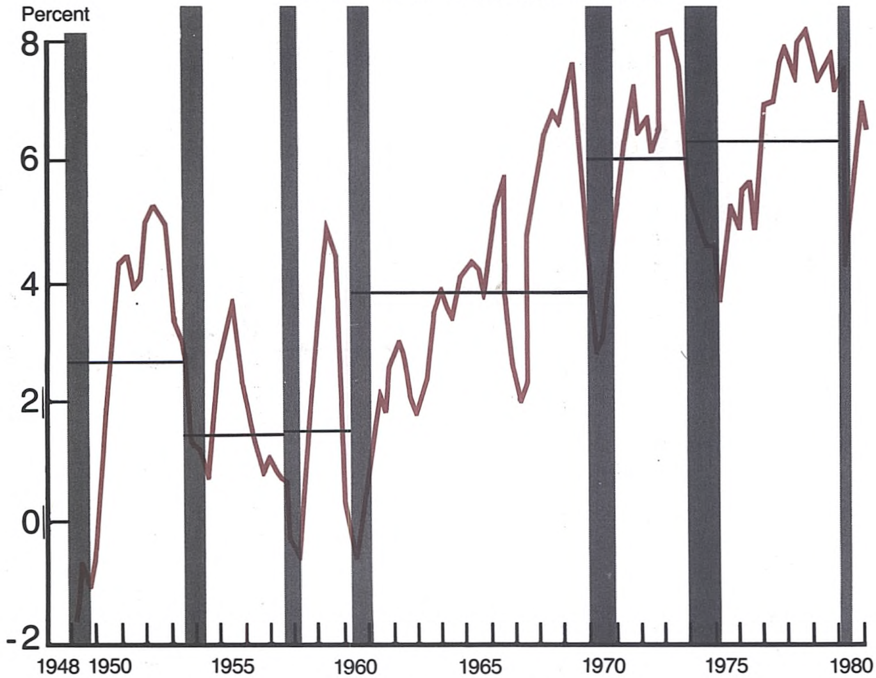
Shaded areas represent business cycle contractions as defined by National Bureau of Economic Research

Table 4
Federal Budget Deficits and Monetary Growth: 1948:3 - 1980:4
M = Constant + a (DEF / PXF) + bM_{-1}

Monetary Aggregate	Constant (T-value)	a (T-value)	b (T-value)	R^2 (SE)	RHO (T-value)	DW
M-1B	1.015 (3.46)	.287 (2.76)	.722 (12.03)	.423 (2.380)	- .246 (- 2.88)	1.998
M-2	1.705 (4.43)	.407 (3.32)	.678 (11.38)	.605 (2.197)	- .011 (- .13)	1.944
A	.707 (3.03)	.186 (2.14)	.831 (17.77)	.574 (2.161)	- .447 (- 5.68)	2.227
F	7.631 (6.41)	- .124 (- .241)	- .057 (- .640)	.101 (7.24)	.338 (4.07)	2.018

See Table 2 for definitions of monetary aggregates

Chart 3
Growth Rate for M-1B

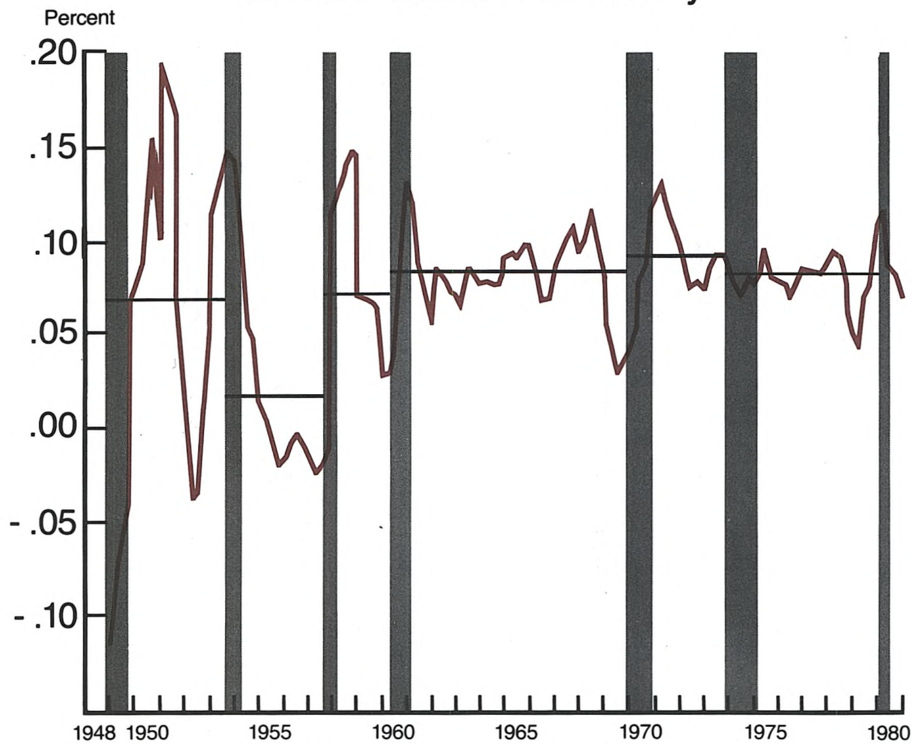


Shaded areas represent business cycle contractions as defined by National Bureau of Economic Research

up to 1970. According to Table 3, fiat base growth was inordinately large relative to monetary growth and to real growth, both during cycles with comparatively small deficits, such as 1948-53 (Cycle 1) or 1957-60 (Cycle 3), and during cycles with comparatively large deficits, such as 1969-73 (Cycle 5) and 1973-80 (Cycle 6). From the late 1950s through 1971, the U.S. monetary authorities pumped in fiat money at a high rate, at least in part to prevent an undesired decline in the uncontrolled part of the monetary base (Chart 1). This decline resulted from sales of gold by the United States to foreign governments to preserve the fixed price of gold under the dollar-gold standard.

But with the relinquishing of the gold standard in 1968 and the adoption of floating exchange rates in 1973, the monetary authority no longer needed to sell gold or foreign exchange to peg the exchange rate. Fiat money growth itself became the main factor explaining high rates of growth in the standard monetary aggregates. This may reflect the Federal Reserve's desire to prevent interest rates from rising during a period of cumulating deficits and rising inflation. Ever since the end of World War II (with the exception of a brief period in the 1950s), fiat-money growth was a highly expansionary factor. But until the 1970s, fiat money growth was partly offset by flows of gold and foreign exchange, and thus was not nearly so expansionary as it subsequently proved to be.

Chart 4
Growth Rate for Fiat Money



Shaded areas represent business cycle contractions as defined by National Bureau of Economic Research

III. Impacts of Monetary and Fiscal Policy on Aggregate Demand

This section focuses on the effects of monetary- and fiscal-policy impulses on aggregate demand for goods and services (i.e., nominal GNP). It examines estimates of so-called St. Louis equations in which the change in nominal GNP (Y) is related to current and past changes in a monetary aggregate (M); a fiscal-policy variable, high-employment government spending (EF); and an international-trade impulse, exports (EX). Increases in each would theoretically increase Y.[7]

The results obtained with certain monetary variables (M-1, M-2 and A) confirm that monetary growth has a permanent long-run impact on spending, whereas the effects of fiscal policy are only transitory (Table 5). This result implies that without monetary accommodation (i.e., with constant monetary-growth rates), larger government spending would not lead to higher inflation rates.

In contrast, the results obtained with a fiat-money monetary variable show a significant long-run effect of increases in the growth of government spending on the growth in nominal GNP. This is to be expected, since the uncontrolled sources of the monetary base are positively associated with interest rates. By implication, the money-supply function for a given setting of fiat money is positively

Table 5
Aggregate Equations: 1953:1 - 1980:4

$$Y_t = \text{CONSTANT} + \sum_{i=o} m_i M_{t-1} + \sum_{i=o} e_i EF_{t-1} + \sum_{i=o} x_i EX_{t-1}^{*}$$

	M-1B		M-2		A		F	
Constant	2.351	(3.435)	.867	(.998)	3.203	(4.210)	1.855	(1.669)
Monetary Impulse: M								
m_0	.673	(5.550)	.290	(1.982)	.395	(1.888)	-.093	(-1.497)
m_1	.217	(1.802)	.370	(2.071)	.310	(1.742)	.044	(1.348)
m_2	.242	(3.207)	.024	(.119)	.228	(1.781)	.106	(2.969)
m_3	.233	(1.827)	.304	(1.892)	.090	(.513)	.115	(3.958)
m_4	-.325	(-2.194)			-.161	(-.760)	.094	(3.389)
m_5							.067	(1.965)
m_6							.056	(1.803)
m_7							.087	(1.541)
Σm_i	1.040	(6.624)	.988	(7.049)	.862	(5.168)	.475	(3.456)
Fiscal Impulse: EF								
e_0	.065	(1.779)	.050	(1.216)	.062	(1.434)	.149	(3.228)
e_1	.060	(2.621)	.058	(2.266)	.044	(1.573)	.111	(3.228)
e_2	.011	(.467)	.009	(.348)	-.004	(-.150)	.047	(1.549)
e_3	-.047	(-2.529)	-.056	(-2.695)	-.057	(-2.492)	-.017	(-.577)
e_4	-.083	(-3.569)	-.099	(-3.782)	-.086	(-3.082)	-.056	(-1.641)
e_5	-.061	(-2.691)	-.080	(-3.165)	-.066	(-2.409)	-.043	(-1.009)
e_6	.051	(1.650)	.039	(1.131)	.030	(.790)		
Σe_i	-.003	(-.052)	-.078	(-1.037)	-.078	(-.894)	.191	(2.504)
Trade Impulse: EX								
x_0	.041	(2.253)	.053	(2.797)	.040	(1.905)	.051	(2.447)
R^2	.566		.473		.394		.359	
SE	.032		.035		.037		.039	
DW	2.062		1.861		1.717		1.672	

*Logarithmic first differences in:
Monetary aggregates (see Table 2 for definitions)
Y = Total spending, i.e., nominal GNP.
EF = High employment government spending.
EX = Exports.

Table 6
Changes in Nominal GNP, High-Employment Government Spending, Exports, and Various Monetary Aggregates: 1953:1 - 1980:4
Annual Rates of Change (Percent)

	Expansions	(Peaks)	Contractions	(Troughs)
Y	8.09	5.17	2.92	4.86
EF	7.66	6.47	6.65	7.65
EX	12.07	16.16	7.76	7.38
M-2	6.68	4.05	5.73	8.75
M-1B	4.54	2.38	2.91	5.50
A	4.90	3.15	4.36	5.24
F	6.81	7.99	9.75	12.37

Table 7
Impacts on Nominal GNP of Various Impulses — High-Employment Government Spending (EF), and Exports (EX): 1953:2 - 1980:4

Monetary Impulse	Expansions			Contractions		
	M	EF	EX	M	EF	EX
M-2	6.65	-.5	.34	4.83	-.60	.24
M-1B	4.46	.002	.34	3.58	-.07	.19
A	4.17	-.55	.32	3.52	.61	.18
F	3.52	1.36	.42	3.18	1.51	.24
	Peaks			**Troughs**		
	M	EF	EX	M	EF	EX
M-2	4.79	-.57	-.22	5.77	-.28	.43
M-1B	5.02	-.03	-.17	1.49	.21	.33
A	4.12	-.58	-.16	3.19	-.38	.32
F	2.43	1.64	-.21	4.24	2.13	.41

associated with the rate of interest. Thus one would expect an increase in government spending, which increases interest rates, to induce an increase in the quantity of money. This in turn would amplify the effect of an increase in government spending on total spending. If, instead, the induced increase in monetary growth had been offset by changes in fiat money, one would expect the expansionary effect of the increase in government spending to be offset at least in part by the contractionary effect of a decrease in fiat money.

As hypothesized, the total effect on nominal GNP of fiat money was smaller, and the fiscal effect was larger, than in the specifications including M-1, M-2 and A. With the fiat-money specification, there was some (although incomplete) crowding out of private spending by government spending; and a significant permanent effect of government spending on total spending was estimated. This result, together with the total fiscal crowding-out obtained with the M-1, M-2 and A monetary variables, suggests that fiscal policy has a permanent effect on spending only when accommodated by monetary growth. Otherwise the effects are transitory. Furthermore, to prevent such monetary accommodation, the Fed must actively use its controlled policy instrument (fiat money) to offset movements in the endogenous part of the money supply.

Policy Impulses and the Cycle

Government expenditures and monetary impulses also affect the pattern of business cycles (Table

6). The government spending data move positively with the business cycle, with average annual growth of 8.09 percent per quarter (at an annual rate) during expansions and 2.92 percent growth per quarter during contractions. With one notable exception, the monetary aggregates grew faster in expansions than in contractions—the familiar procyclical pattern. The exception occurred in the case of fiat-money growth, which was *more* rapid during contractions than during expansion—a countercyclical pattern. In other words, the actions of the monetary authorities, as measured by fiat money, were more expansionary during recessions than expansions, but not enough to change the procyclical pattern in other monetary aggregates.

It is tempting to credit monetary-policy actions for a countercyclical stance on the basis of these data. But this does not take into account lags in the effect of monetary and fiscal policy on nominal GNP. When we take these lags into account (Table 7), monetary and fiscal policy, by every measure, contributed to economic instability.

IV. Conclusions

First, there are two potential avenues whereby fiscal policy may affect monetary policy. Deficits may apply upward pressure on interest rates, and thus automatically induce increases in the uncontrolled part of the monetary base, leading to faster money growth. The other potential link may occur as the Fed attempts to prevent high interest rates by increasing the controlled part of the base (fiat money), leading to more rapid money growth.

Second, growth in the monetary aggregates, especially those parts directly controlled by the Fed, helped finance the large Federal government deficits in the 1970s to a (statistically) significant extent.

Third, without monetary accommodation via one or both of the above methods, fiscal policy would have had only a transitory effect on nominal GNP in the U.S. economy. Thus in order to prevent fiscal deficits from being inflationary, the Fed must use the controlled part of the money supply to offset the automatic accommodation of the deficits by the induced part of the money supply.

Fourth, with large budget deficits looming on the horizon, the Fed should restrict growth in fiat money sufficiently so that M-1 and M-2 growth do not finance a significant part of those deficits. Now that the Fed is no longer focusing on controlling interest rates, having switched more of its attention to the monetary aggregates, the likelihood of noninflationary deficits has improved.

FOOTNOTES

1. Reserve requirements also affect fiat money since the interest-bearing Federal debt in the hands of banks, the public, and foreign investors would tend to decrease if required-reserve ratios were raised. The reason is that deposit decreases otherwise associated with raising required-reserve ratios generally are offset by Federal Reserve open-market purchases of government securities. Such purchases generally decrease the net-interest-bearing Federal debt and increase fiat money enough to permit banks to meet the increased reserve requirements. A precise relationship exists that translates changes in required-reserve ratios into equivalent units of the monetary base that would have the same effect on deposits. Controlled sources of monetary growth thus include not only fiat money, but also the required-reserve adjustment magnitude (RAM), which is the change in base money that would have an equivalent effect on monetary growth as a change in required-reserve ratios. Fiat money adjusted is the sum of fiat money and RAM. It is a policy controlled variable and an important source of monetary growth.

2. This point is substantiated by the following ordinary least-squares regression.

Percent Changes in Noncontrolled Sources
of the Monetary Base (N) and
Long Term Government Bond Rates (R)
Monthly, 1959-80.*

N = - 0.001 + 0.470 R
R^2 = (00058) (4.71)
SE = 4.31
DW = 1.93
N = Monetary Base Less Fiat Money
R = Average U.S. Government Bond Rate with Maturity Greater than 10 Years (percent change in).

* A 16-quarter distributed lag yielded a slightly higher regression coefficient with respect to R, but the same 4.3-percent standard error of the regression.

3. The politics of the process was discussed in detail by Buchanan and Wagner. Nevertheless, in tests of this view, both Barro and Niskanen could not find a significant link between annual M-1 growth and the deficit over the post-World War II period. This finding was reversed when Hamburger and Zwick repeated the exercise for the period since

1960 when, according to Buchanan and Wagner, major changes occurred in the way macroeconomic policy is formulated. This result in turn was reversed when McMillan and Beard used revised GNP data in the calculations.

For these discussions, see D.R. Francis, "How and Why Fiscal Actions Matter to a Monetarist," **Federal Reserve Bank of St. Louis Review** (May 1974), 4-7; J.A. Buchanan and R.E. Wagner, **Democracy in Deficit: The Political Legacy of Lord Keynes**. New York: Academic Press, 1977; R.J. Barro, "Comment from an Unreconstructed Ricardian," **Journal of Monetary Economics** (August 1978), 564-81; W.A. Niskanen, "Deficits, Government Spending, and Inflation: What is the Evidence?" **Journal of Monetary Economics** (August 1978), 591-602; M.J. Hamburger and B. Zwick, "Deficits, Money and Inflation," **Journal of Monetary Economics** (January 1981), 141-50; W.D. McMillan and T.R. Beard, "Deficits, Money and Inflation: Comment," **Journal of Monetary Economics** (forthcoming).

4. This point is substantiated by the following ordinary least-squares regression.

Federal Budget Deficits and Monetary Growth Over Six-Post-World War II Business Cycles, 1948-80

M = a + b (DEF/PXF)

Monetary Growth Rate	Constant (t-value)	Coefficient (t-value)	R^2	SE	DW
		(Trough to Trough)			
M-1B	2.36	1.92	.77	1.15	2.00
	(3.87)	(3.64)			
M-2	3.65	2.50	.77	1.51	2.16
	(4.55)	(3.61)			
A	2.19	2.57	.74	1.69	2.11
	(2.45)	(3.33)			
F	5.97	1.20	.20	2.60	2.65
	(4.33)	(1.00)			
		(Peak to Peak)			
M-1B	2.54	1.72	.57	1.47	1.80
	(3.37)	(2.32)			
M-2	3.80	2.39	.61	1.9	1.96
	(3.91)	(2.51)			
A	2.23	2.53	.63	1.92	1.88
	(2.28)	(2.62)			
F	5.49	1.47	.19	3.00	2.40
	(3.58)	(.98)			

Note: **Significant at 95-percent level.
*Significant at 90-percent level.

5. See Hamburger and Zwick, 1981.

6. See, for example, S.E. Hein, "Deficits and Inflation," **Federal Reserve Bank of St. Louis Review** (March 1981), 3-10; and M.W. Keran and T. Babb, "An Explanation of Federal Reserve Actions (1933-68)," **Federal Reserve Bank of St. Louis Review** (July 1969), 7-20.

7. In this paper, the original St. Louis spending equation was modified by specifying the relationship in percent changes, by not constraining the ends of a third-degree polynomial lag distribution to zero, and by adding exports as an autonomous variable based on a spending equation that fit the experience of other countries as well as that of the United States.

See L.C. Andersen and K.M. Carlson, "A Monetarist Model for Economic Stabilization," **Federal Reserve Bank of St. Louis Review** (April 1970), 7-25; and L.C. Andersen and J.L. Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," **Federal Reserve Bank of St. Louis Review** (November 1968), 11-24.

Both Feldstein and Benjamin Friedman, in evaluating theoretical models that included not only bonds and money but also real capital, found that whether government deficits were inflationary or not (i.e., the degree of financial crowding out) depended on the comparative substitutability of money for bonds and bonds for real capital. If bonds resemble money, then deficits are inflationary and can be offset only by tax policies or debt-management policies that raise the net real yield on capital and lower real output and growth. See M. Feldstein, "Fiscal Policies, Inflation, and Capital Formation," **American Economic Review** (September 1980), 636-50; and B.M. Friedman, "Crowding Out or Crowding In? Economic Consequences of Financing Government Deficits," **Brookings Papers on Economic Activity** (1978), 593-641.

Wallace and Bryant have taken the extreme position that government bonds and money are perfect substitutes—and thus only deficits matter and open-market operations don't matter at all. J. Bryant and N. Wallace, "Open Market Operations in a Model of Regulated, Insured Intermediaries," **Journal of Political Economy** (February 1980), 146-73; and N. Wallace, "A Modigliani-Miller Theorem for Open Market Operations," **American Economic Review** (June 1981), 267-74. This paper's argument that fiat money (mainly open-market operations) independently affects total spending tends to refute the Bryant-Wallace proposition. That government spending (and hence the deficit) is estimated to exert an independent effect on spending for a given setting of fiat money tends to confirm the Feldstein-Friedman proposition—namely, that a deficit independently increases inflation and concomitantly raises real interest rates and induces growth in the standard monetary aggregates.

The best-fit spending equation was the one that included M-1B as the monetary impulse. The estimated larger spending effect of M-1B growth than F growth, and the better fit, both reveal that monetary growth (regardless of its source) affects spending. This result tends to disconfirm the Sargent-Wallace hypothesis that *only* fiat monetary growth increases spending growth and inflation. T.J. Sargent and N. Wallace, "The Real Bills Doctrine vs. the Quantity Theory: A Reconsideration," Federal Reserve Bank of Minneapolis, Staff Report 64 (January 1981); T.J. Sargent, "The Ends of Four Big Inflations," Federal Reserve Bank of Minneapolis Working Paper 158 (December 1980); and T.J. Sargent, "Stopping Moderate Inflation: The Methods of Poincaré and Thatcher," Processed (May 1981).

Monetary and Fiscal Impacts on Exchange Rates

Joseph Bisignano and Kevin D. Hoover*

This paper describes and tests the proposition that the mixture of monetary and fiscal policies significantly affects exchange rates. We begin with the historical background describing the major shift in policy mix since the 1973 oil crisis. We then test two models of exchange-rate determination for four currencies vis-a-vis the U.S. dollar. Finally, we consider the policy implications of the shift in U.S. policy mix—expanding government debt and contracting money growth—for the behavior of the dollar-exchange rate, the conclusion.

Many analysts argued during the early 1970s that individual countries would gain greater independent control over their domestic stabilization policies if they adopted a system of floating exchange rates. Two problems related to fixed exchange rates commanded a good deal of attention before generalized floating actually began in 1973.

First, rapid economic expansion in an open economy often tended to increase imports and decrease exports, leading to deficits in the balance of payments. A current-account imbalance which was not offset by capital flows had to be met out of official foreign-exchange reserves. When pressure on these reserves increased, a country had to choose between a politically unpopular devaluation or politically unpopular deflationary measures.

Second, the United States, as the principal reserve currency country, could "export" its inflation under fixed exchange rates. Attempting to maintain fixed exchange rates required that any excess supply of U.S. dollars, putting downward pressure on the dollar, had to be absorbed in the foreign exchange market by countries within the fixed rate system. Purchasing these dollars at a fixed rate tended to expand foreign money supplies and, over time, to lead to additional inflation. Attempts to offset this expansion in foreign money supplies by individual "sterilization" operations usually proved to be only moderately effective.

Floating exchange rates promised to do away with these problems. Instead of reducing a country's international reserves, an incipient balance-of-payments deficit would trigger an appropriate exchange rate depreciation. Such a depreciation, it was hoped, would no longer be unpopular because it would represent an automatic market response—a smooth adjustment, rather than a decision by politicians to devalue by a discrete amount. Furthermore, U.S. inflation could no longer be exported because U.S. monetary expansion would depreciate the dollar, alleviating the incipient price pressure in other countries. Floating exchange rates thus would permit independent domestic stabilization policies, because any domestic move which would have encountered international constraints under the fixed exchange-rate regime would now only produce automatic and—it was thought—less painful adjustments in exchange rates.[1]

Since the advent of floating, the industrial countries have indeed followed independent domestic economic policies, in the sense that policies have differed radically both between countries and between the pre- and post-floating periods in any given country. The quadrupling of oil prices in late 1973 severely strained the industrialized countries, forcing most into recession in 1974 and 1975. Sev-

*Bisignano is Vice-President and Associate Director of Research, and Hoover was Research Assistant, Federal Reserve Bank of San Francisco. Hoover is currently a research fellow at Nuffield College, Oxford University. Preliminary work on this paper was begun while Joseph Bisignano was at the Bank for International Settlements on sabbatical. Professor Jeffrey Frankel (University of California, Berkeley), David King (OECD), and Paul R. Masson (Bank of Canada) provided useful comments on an earlier version of this paper.

eral countries ran large budget deficits in the hope of stimulating economic growth and getting out of the recession. The distinguishing feature between countries, however, was their choice of means to finance these deficits.

An expansionary budget deficit must be financed. If the central bank buys government bonds by increasing the reserve base of the banking system, the debt is *monetized* resulting in *monetary expansion*. If the debt is sold directly to the public, however, the policy may be characterized as *fiscal expansion*. In either case, the debt is ultimately held by the public either as money or as government debt.

Wary of kindling rapid inflation, some countries—notably Japan—shifted their policy stance in the 1974-75 recession away from monetary expansion towards fiscal expansion. Others maintained the previous balance between monetary and fiscal policy, while some shifted toward monetary expansion.

The United States showed a fairly consistent rate of monetary expansion between the 1968-73 and 1973-79 periods—slightly lower after floating began than before (Table 1). Germany, the United Kingdom and (especially) Japan showed lower monetary growth between the two periods, while Canada and Italy showed increasing rates of growth.

The disparities in fiscal expansion were even greater (Table 2). Every country in our sample displayed a major increase in total government debt between 1968-73 and 1973-79. In the latter period, government debt increased between 94 percent (the U.S.) and 667 percent (Japan), with the increases elsewhere spread between 100 and 300 percent.

The expansion of government debt was particularly noticeable in Japan. Following the 1973 oil crisis, Japan's sectoral saving behavior changed dramatically. According to flow-of-funds statistics, the public-sector deficit as a percent of nominal GNP rose from 2 percent to 9 percent between 1973 and 1978, while the corporate-sector deficit dropped from about 6 percent of nominal GNP in 1973 to almost zero in 1978. According to the Bank of Japan, following the oil crisis, Japan and other countries "resorted to fiscal measures in an attempt to stimulate business activity, which caused the substantial increase in the financial deficit of the public sector. Subsequently, the financial deficit of the public sector in leading Western countries has tended to decrease, while in Japan it has accelerated, necessitating massive issues of public bonds, mostly government bonds, which caused the inevitable increase of the stock of public bonds."[2]

Table 1
Annual Average Growth of M-2 Money Supply (Percent)

	1968-73	1973-79
Canada	12.3	17.0
Germany	11.1	8.6
France	14.2	14.4
Italy	16.9	20.9
Japan	20.2	12.0
U.K.	15.8	11.4
U.S.	9.2	8.5

SOURCE: *International Financial Statistics*, IMF, November 1981 Data Tape, Lines 34 and 35.

Table 2
Percentage Increase in Total Government Debt (Percent)

	1968-73	1973-79
Canada	29.1	139.2
Germany	30.0	230.2
France	- 14.1	186.9
Italy	127.1	301.7
Japan	102.1	666.8
U.K.*	10.6	134.2
U.S.	21.4	93.9

SOURCE: *International Financial Statistics*, IMF, November 1981 Data Tape, Lines 88 and 88b. *U.K. figures are for national debt in sterling; *CSO Financial Statistics*, February 1979 and February 1981.

I. Monetary-Fiscal Mix

One way of capturing the monetary-fiscal policy mix is to compare the ratio (sigma) of government bonds held by the public to the central bank's reserve money stock. An increase in sigma implies a financing of new government debt by an increase in the direct holdings of the public; it represents greater reliance on fiscal policy than on monetary policy.

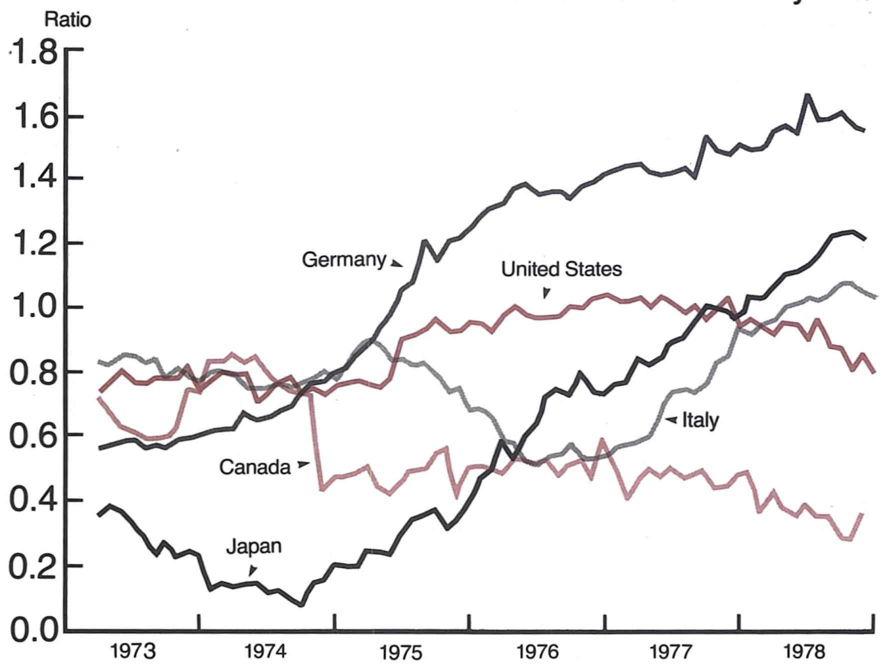
As a rough indicator of fiscal-monetary policy mix, the sigma ratios revealed a major shift in policy emphasis among major industrial countries after 1974 (Figure 1). Canada, Germany, Italy and the U.S. all had sigma ratios roughly between .6 and .8 during the 1973-74 period, with Japan's sigma ratio considerably lower. But a dramatic shift occurred after 1974. Germany and Japan displayed a rapid increase between 1975 and 1978, with Japan moving from the lowest ratio of the five countries to the second highest. The sigma ratio rose slightly for the U.S. in 1975-76 but declined thereafter. Canada's sigma ratio fell in 1974 but then remained rather stable, while Italy's sigma rose rapidly after 1976.

Obviously, then, industrialized countries have employed widely different mixtures of monetary and fiscal policies in the past decade. The promise of floating exchange rates has been in that sense fulfilled. But since exchange rates are now designed to reconcile policies which would have been inconsistent under the earlier regime, there arises a question of just how different mixtures of monetary and fiscal policy interact to affect exchange rates.

This question takes on heightened significance for the United States, for obvious reasons. This country has now adopted essentially a policy followed by Japan after the first oil price shock: one of curtailing monetary growth while incurring an expansion in government debt. In early 1982, the Federal Reserve was continuing its anti-inflationary policy by attempting to reduce the growth rate of the narrowly-defined money stock, M-1, while fiscal

Figure 1

Ratio of Government Bonds to Reserve Money



policy promised to produce record deficits over the 1982-84 fiscal years. The result of such a change in monetary-fiscal policy mix is the focus of this paper.

Early theories of the determination of exchange rates emphasized their role as equilibrators of trade flows between countries. Recent theories, however, have insisted on a wider role: the exchange rate in the short-run must equilibrate the demand and supply of financial assets denominated in different currencies. Equilibrium between supply and demand, according to recent theories, occurs much more quickly in financial-asset markets than in goods-and-services markets. The exchange rate thus may be viewed as the equilibrium relative price of financial assets in the short run but only as the equilibrium relative price of goods in the long run.

In this article, we will consider two *asset-market* approaches to the determination of exchange rates. The first and simplest approach is a *monetary model*. It maintains that, given the nature of international capital markets, only relative monetary policies are relevant to determining exchange rates. Thus we specify and estimate a monetary model for the rates of Canada, Germany, Italy and Japan against the U.S. dollar. This simple model does not provide an adequate explanation of exchange-rate movements, however. Thus we estimate a more general model, a *portfolio-balance model*, which maintains that both monetary and fiscal policy are relevant to the determination of exchange rates. Empirical results for the four currencies vis-a-vis the U.S. dollar help support this model, by showing that the exchange rate is affected both by the stock of money and the amount of government debt. The mix of monetary and fiscal policy thus is important to exchange-rate determination in the short run.

II. Monetary Model

The most popular theory of exchange-rate determination in the post-floating period has been the monetary approach.[3] The exchange rate, as the value of one country's currency expressed in units of another's currency, thus may be viewed as a measure of the relative price of goods between the two countries, for the value of a country's currency is just the inverse of its price level.

This monetary approach is distinguished by three key assumptions. First, there is continuous equilibrium in money and goods markets. Second—a related point—there is also purchasing power parity, since a unit of one's home currency always buys as much at home as that same unit buys abroad when converted into foreign currency.[4] Third, there is perfect substitutability among all bonds, foreign and domestic—"there is only one bond in the world." Thus the only way in which foreign and domestic asset markets are distinguished is by their different currencies. Furthermore, different mixtures of monetary and fiscal policy do not affect the exchange rate, because by this assumption bonds issued by any government simply increase the world bond stock. U.S. dollar denominated bonds are perfect substitutes for yen denominated bonds in private portfolios.

As a necessary consequence of these assumptions, there is interest-rate parity—or, equivalently, perfect capital mobility. Abstracting from expectations of appreciation or depreciation, any deviation of a country's interest rate from the rest of the world's is reversed by a capital inflow or outflow.

Given these assumptions, the monetary approach suggests that monetary equilibrium exists in each country at the intersection of the aggregate supply and demand curves for money. Because continuous equilibrium is assumed, one need in theory only attend to the demand curve (or equally to the supply curve), for the country is always on both of the curves.[5] The monetary approach is fundamentally a hypothesis of the stability of demand for money functions across countries.

Money demand is usually thought to be a function, among other things, of the price level, real income and interest rates. Equilibrium, then, guarantees a unique price level in each country for given amounts of those variables, and with all other influences on money demand held constant. Purchasing-power parity requires—again as an equilibrium condition, not as a theory of causation—that the exchange rate between any two countries be at a level which preserves the value of one currency measured in goods when it is converted into the other.

Formally, let the money-demand function of the home country be written:

$$m = c + p + \alpha y - \beta i \qquad (1)$$

where m is money; p is prices; y is real income; and c is a constant, all written in natural logarithms: i is the rate of interest, and α and β are parameters. This relationship is assumed to hold contemporaneously for all variables.

Similarly, let the money-demand function for the foreign country be written:

$$m^* = c^* + p^* + \alpha^* y^* - \beta^* i^* \qquad (2)$$

Purchasing-power parity requires that:

$$e = p - p^* \qquad (3)$$

where e is the logarithm of the exchange rate in units of home currency per unit of foreign currency.

Making the further assumptions that $\alpha = \alpha^*$ and $\beta = \beta^*$—that is, that the money-demand functions are identical between countries—and subtracting equation (2) from equation (1), yields:

$$(m - m^*) = (c - c^*) + (p - p^*) + \alpha(y - y^*) - \beta(i - i^*) \qquad (4)$$

Substituting equation (3) into equation (4) and rearranging gives

$$e = C + (m - m^*) - \alpha(y - y^*) + \beta(i - i^*) \qquad (5)$$

where $C = c^* - c$.

The assumption of identical coefficients in both money-demand functions greatly simplifies the development of the model. This is arbitrary, however, and a slightly more complicated version could be developed without imposing such a restriction.

Equation (5) is the fundamental equilibrium condition of the simple monetary model of exchange-rate determination. It suggests three testable hypotheses: first, the estimated coefficient (elasticity) with respect to changes in relative money supplies is positive and unity; second, the coefficient on relative real income is negative; and, third, the coefficient on relative interest rates is positive. An increase in e is a depreciation of the home currency. Thus, other things constant, an increase in the domestic money supply should produce an equiproportional depreciation of the exchange rate; an increase in domestic real income should produce an appreciation; while an increase in the domestic rate of interest should produce a depreciation.

This last result may seem illogical: commonly it is thought that a country supports its exchange rate by forcing interest rates up. In this model the opposite result holds because, given real income and money, and given the assumption of money-market equilibrium, an increase in interest rates reduces the demand for money, producing incipient excess supply. By equation (4) prices of goods must rise in order to equate money demand to the existing supply, or else the equilibrium assumption will be violated. This price rise produces a depreciation because of purchasing-power parity.

We can make the model dynamic by assuming further that purchasing-power parity holds only in the long run because prices adjust only slowly. Some such assumption must be made in practice to explain extended departures from purchasing-power parity.

The monetary approach is deceptively simple. Without any further assumptions, the simple model of equation (5) can be extended to include expectations of exchange-rate movements. The interest-rate parity assumption is equivalent to an assumption of completely effective arbitrage—that is, any sustained difference in interest rates must be reflected in the difference between spot and expected future exchange rates. Formally, for small differentials in interest rates:

$$i - i^* = \tilde{e} - e \qquad (6)$$

where $\tilde{e}$ is the forward exchange rate over the period equal to the time of maturity of the bonds to which i and i* correspond. Substituting equation (6) into equation (5) and rearranging:

$$e = \frac{C}{1+\beta} + \frac{1}{1+\beta}(m_t - m_t^*) - \frac{\alpha}{1+\beta}(y_t - y_t^*) + \frac{\beta}{1+\beta}\tilde{e}_t + u_t \qquad (7)$$

Equation (7) suggests that an expectation of an appreciation reflected in a fall in the forward rate would be reflected in a spot depreciation as well. The spot rate, then, is not independent of the forward rate. However, if we assume the forward rate is the expectation of the future spot rate, conditioned on past and current values of the spot rate, then the forward rate is itself not independent of the spot rate.[6] Random errors in determining the current spot rate—the u_t in equation (7)—will be correlated with the forward rate. This violates the assumption that the error terms be uncorrelated with the independent variables, which is necessary if ordinary least-squares estimates are to be unbiased and consistent.

In the estimations which follow, we make no assumptions about expectations of exchange-rate changes; indeed we estimate the simple model of equation (5). Nevertheless, because of the interest-rate parity condition in equation (6), errors in determining e_t are transmitted to the interest-rate differential, $(i_t - i_t^*)$. This again introduces a correlation between an independent variable and the error term, rendering ordinary least-squares estimates biased and inconsistent.

In order to secure consistent estimates of equations (5), we resort to an instrumental-variables technique in which the instrument for $(i - i^*)$ is $(\sigma - \sigma^*)$, where $\sigma = \ln(B/RM)$, the ratio of government bonds in private hands to central-bank reserve money (monetary base). This should be closely correlated with $(i - i^*)$ because σ represents the mixture of government stabilization policies—i.e., the balance between outside bonds and outside money. A rise in σ must result either from a rise in bonds or a fall in reserve money, either of which tends to raise interest rates. Similarly, a fall in σ would be associated with a fall in rates. This bond-money ratio, being under government control, therefore is exogenous and uncorrelated with the error term in equation (5).[7]

The results of the exchange-rate estimations (Table 3 and Chart 1) vary somewhat from country to country, but they give little support on the whole for the simple monetary approach. In three of the four cases, the coefficient on the money differential is positive as predicted. For Japan it is negative but statistically insignificant, while in Germany it is correctly positive though insignificant nonetheless. In the remaining two cases, the coefficients are of

Table 3
Monetary Model for Currencies of
Canada, Germany, Italy and Japan Against the U.S. Dollar
(Monthly, March 1973 – December 1978)

Dependent Variable	Independent Variables				Summary Statistics			
	Constant	$\ln(^m us/m)$	$\ln(^y us/y)$	$(i_{us}\text{-}i)$	$\bar{R}^2$	DW	RHO	SER
$\ln\frac{(U.S.\ \$)}{(Canadian\ \$)}$	-1.27 (9.5)	.54** (9.2)	.07[w] (0.6)	-.03[a] (5.8)	.948	1.78	.73	.013
$\ln\frac{(U.S.\ \$)}{(German\ DM)}$	-.99 (9.8)	1.51[c] (1.4)	.07[w] (.28)	.033** (2.8)	.888	1.94	.86	.034
$\ln\frac{(U.S.\ \$)}{(Italian\ Lira)}$	-3.06 (6.5)	.67** (7.3)	.02[w] (.19)	.02** (4.8)	.971	1.96	.79	.027
$\ln\frac{(U.S.\ \$)}{(Japanese\ Yen)}$	-8.50 (3.6)	-.52[w] (1.19)	-.30[c] (1.04)	-.04[a] (5.5)	.958	2.12	.83	.028

t-statistics in parentheses under the coefficients.
All estimates use the FAIR technique with $\ln(\sigma - \sigma^*)$ as an instrument (see footnote 7).

** Significantly different from zero at the 99-percent confidence level and of the predicted sign.

[c] Insignificant, but of the predicted sign.

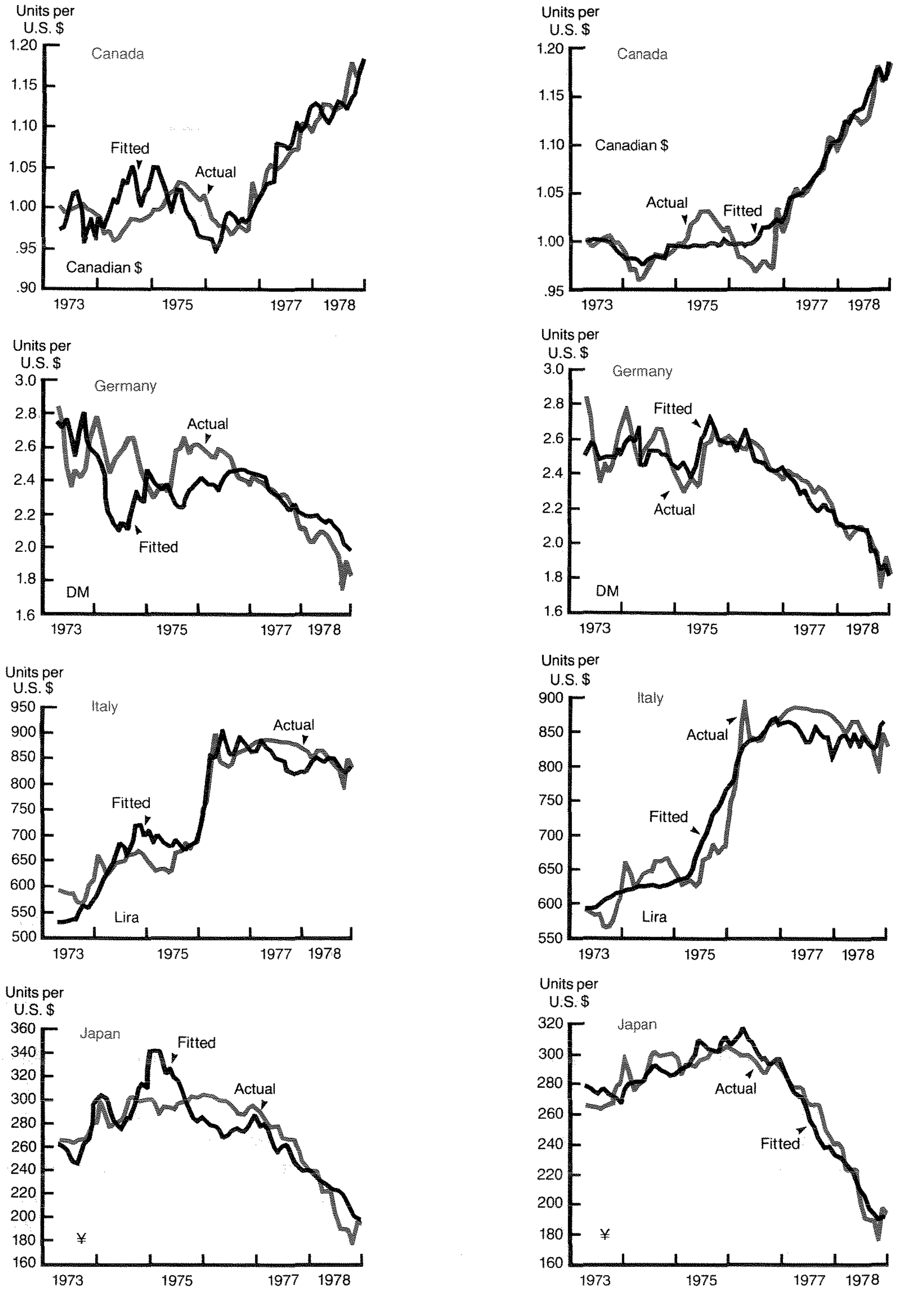
[w] Insignificant and not of the predicted sign.

[a] Significant at the 99-percent confidence level, but not of the predicted sign.

See data appendix for a description of the data.

Chart 1

Monetary Models / *Portfolio Balance Models*



the correct sign and significantly different from zero. Contrary to the prediction of the simple monetary approach of equation (5), however, they are also significantly different from unity.

The coefficient on the income differential is of the wrong sign in every case but Japan, and it is insignificant in every case. In contrast, the coefficient on the interest-rate differential is significant in every case, of the correct sign for Germany and Italy and of the incorrect sign for Canada and Japan.

In all, the U.S. dollar/Italian lira rate offers the best support for the monetary approach: it carries a significant coefficient with the correct sign on both the money and interest-rate differentials, while its incorrectly signed coefficient on the real-income differential is insignificant. Still, the coefficient on the money differential is significantly different from unity, violating a crucial prediction of the simple monetary model. The U.S. dollar/Japanese yen rate is the least supportive of the monetary approach: every coefficient carries the incorrect sign or is insignificant. The remaining pair of exchange rates show mixed results. The results were littled improved with the removal of the assumption of identical money-demand coefficients, or with a greater role given to real interest-rate differentials in the short-run determination of the exchange rate.

The mixed results for the monetary approach may reflect the instability in U.S. money demand observed over the 1974-75 period. Instability in money-demand coefficients would create difficulties even for a more sophisticated form of the monetary approach, such as one distinguishing between real and nominal interest rates or one permitting short-run deviations from purchasing-power parity.

III. Portfolio-Balance Model

Some of the empirical failings of the simple monetary model of exchange-rate determination can be explained if we relax some of the model's assumptions. The beauty of the monetary model is its simplicity; but what it loses in simplicity when these assumptions are relaxed, it gains in greater realism. Abandoning the assumption of perfect substitutability between domestic and foreign bonds implicitly introduces portfolio-balance considerations into the monetary model. In this section, we set out a fuller model of international portfolio balance and estimate it.

With this approach, we widen the scope of the model to include the demand functions for money, domestic bonds and foreign bonds, each dependent on the domestic and the foreign rate of interest for a given expected future exchange rate. In the short run, the supplies of all three assets are fixed. Domestic bonds and money are determined by the monetary and fiscal authorities. Domestic holdings of foreign bonds represent cumulated current-account surpluses and deficits. Total wealth denominated in domestic currency equals the sum of these asset stocks, with the foreign bond stock converted at the current exchange rate. The interest rates and the exchange rate must simultaneously adjust in order to bring the demands for these stocks into accord with the fixed supplies.

As with the monetary approach, the portfolio-balance approach models private sector behavior. Unlike that model, however, it refers to outside rather than inside assets, that is, liabilities created by the public sector rather than the private sector. In the monetary model, the asset markets of the two countries are linked by the direct effect of money on the goods market: money as purchasing power determines the price of goods, and the exchange rate insures parity between the currencies given these prices. For such a mechanism, money is whatever can be used to buy goods—currency, of course, but also demand deposits and other sufficiently liquid assets (i.e., inside money).

In contrast, in the portfolio-balance approach the goods market is pushed into the background. The exchange rate adjusts the domestic currency value of foreign financial assets in private portfolios to the level considered optimal by portfolio holders, given interest rates and asset stocks. Money and bonds are treated as forms of wealth. Since inside assets (e.g., demand deposits or corporate bonds held domestically) are at once the asset of some private entity and the debt of some other private entity, they cancel out when all private-sector assets and liabilities are added up. Only the liabilities of the government-currency, central-bank reserves, and treasury debt—and of the foreign sector are net financial wealth to the private sector. A change in interest rates may force an individual to alter his holdings of inside as well as outside assets, yet taken as a whole the private sector is in equilibrium once it willingly holds all the outside assets supplied to it by the government.

The portfolio-balance approach directly models financial markets. The price level of the home or foreign country plays no direct part in the short run, yet the goods market still influences financial equilibrium in this approach. From the home country's view, higher prices abroad encourage domestic exports and discourage imports. A resulting current-account imbalance must be counterbalanced by capital flows into the home country. These capital flows are simply newly-acquired foreign assets, which increase domestic wealth and require interest-rate and exchange-rate changes to rebalance domestic portfolios.

From this general discussion, we next turn to a simple portfolio-balance model suggested by Branson, Halttunen and Masson.[8] This model shares with the monetary model the fundamental assumption of continuous financial market equilibrium, which simply means that it is a static and not a dynamic model. Its equations specify the shares of wealth willingly held by the private sector in various assets for given interest rates. These equations do not specify the adjustment process followed by interest rates or exchange rates as they move from one equilibrium to another with a change in any of the asset stocks.

The fundamental distinction between the two models concerns the substitutability between domestic and foreign bonds; domestic and foreign bonds are perfect substitutes in the monetary model but are not in the portfolio model. Purchasing-power parity need not hold even when prices have fully adjusted, since changes in domestic asset supplies can alter interest rates so as to drive the exchange rate away from its purchasing-power parity value over a sustained period.

A further assumption, useful in simplifying the model and peculiar to it, is that the home country is small—i.e., it cannot affect the foreign country's rate of interest. Consequently, the foreign rate of interest can be assumed to be exogenous.

The formal structure of the model is:

$$RM = m(i,i^*)W \quad \text{Central Bank Reserve Money Equilibrium} \qquad (8)$$

$$B = b(i,i^*)W \quad \text{Domestic Government Bonds Equilibrium} \qquad (9)$$

$$eF = f(i,i^*)W \quad \text{Domestically Held Foreign Bond Equilibrium} \qquad (10)$$

$$RM+B+eF \equiv W \quad \text{Wealth Constraint} \qquad (11)$$

where RM is central-bank reserve money (monetary base), B is privately-held domestic government bonds, F is domestically-held foreign assets denominated in foreign currency, e is the exchange rate expressed in units of domestic currency per unit of foreign currency (e.g., dollar per Deutschemark), i is the rate of interest on B, i^* is the rate of interest on F, and W is total wealth defined by the identity, equation (11). RM and B are assumed to be nontraded assets. The desired fraction of wealth held as money is m; held as domestic bonds, b; and held as foreign assets denominated in foreign currency, f.

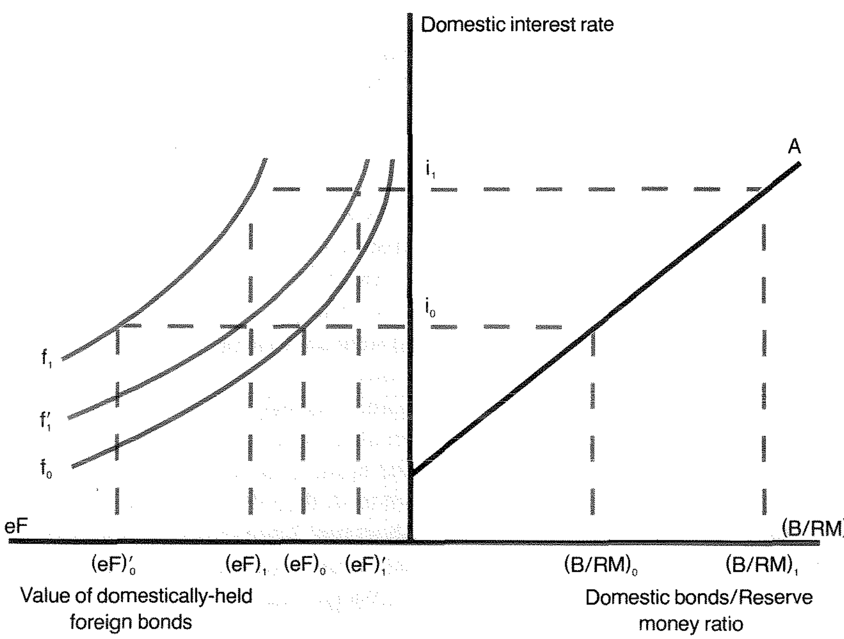
Although expectations of future exchange-rate changes are theoretically important in the portfolio-balance model, they are assumed to be static for simplicity in this exposition. Moreover, because of the wealth constraint, equation (11), equations (8)-(10) are not independent. Given W and any two of RM, B or F, the remaining one can be calculated from equation (11); equivalently, any one of equations (8)-(10) can be eliminated from the system. For example, with equation (10) eliminated, the system as written has only two equilibrium equations, but three variables—i, i^* and e. It is, therefore, formally undetermined. Here is where the small-country assumption helps simplify things. If the home country cannot affect the foreign rate of interest, then $i^* = \bar{i}^*$, some fixed rate in the extreme short run. Then only equations (8) and (9) are needed to determine the domestic rate of interest and the exchange rate.

Let us examine the mechanism through which this formal model determines the exchange rate. In the right-hand panel in Figure 2, the ratio of domestic government bonds to outside money (B/RM) is plotted against the domestic interest rate (i) for a constant domestic rate of inflation and a constant foreign rate of interest (i*). The shape of A depends on the functions m and b. For simplicity we will assume it to be linear. In the model with equation (10) eliminated and $i^* = \bar{i}^*$, dividing equation (9) by equation (8) yields $(B/RM) = b(i,i^*)/m(i,i^*) = \phi(i)$. Hence for each value of i there is a value of (B/RM), and vice versa, which is independent of W and F: for any value of i*, the ratio of domestic bonds to outside money *alone* determines the domestic interest rate.

The left-hand panel plots the domestic currency value of private holdings of foreign assets (eF) against the domestic interest rate for constant inflation, foreign interest rate and the stocks of domestic bonds and outside money. The curve (f_1) slopes downward because domestic and foreign bonds are substitutes in domestic portfolios. An increase in the domestic interest rate, other things equal, increases the demand for domestic bonds and decreases the demand for foreign bonds as shares in total wealth. An increase in domestic bonds stocks and outside money shifts the curves (f) up and to the left. To understand this point, consider an equiproportional increase in B and RM: the ratio (B/RM) remains constant and therefore for a given i* and f(i,i*), i remains constant; nevertheless, W has increased [see equation (11)]; and, therefore, by equation (10), eF must be greater by the amount $f \cdot \Delta w$.

Now let us consider the effects of changes in various asset stocks (Figure 2). Begin with a bond/money ratio $(B/RM)_1$, an interest rate i_1 and—reading off curve f'_1—the value of holdings of foreign assets $(eF)'_1$. Now, holding B and F constant, allow RM to rise so that the bond/money ratio moves left to $(B/RM)_0$. The new interest rate is i_0. At the same time the increase in the stock of money shifts the curve f'_1 outward to f_1, because total wealth is now greater. The intersection of f_1

Figure 2
Determination of Domestic Interest Rate and Exchange Rate



with i_0 corresponds to $(eF)'_0$, which is greater than $(eF)'_1$. According to our initial assumption, F has not changed, therefore e must be greater: the exchange rate *depreciates* as the stock of outside money increases. (Recall that F represents the domestic holdings of foreign assets accumulated through the current account. In the short run with wealth fixed, the current account is in balance, and hence F is a given. Any change in domestic assets then alters the domestic interest rate and the *value* of the fixed stock of foreign assets.)

The effect of an expansion of the domestic bond stock is trickier to gauge. Begin with the domestic bond/money ratio at $(B/RM)_0$, on interest rate i_0 and value of holdings of foreign assets $(eF)_0$ on curve f_0, and let the domestic bond stock expand until it moves to $(B/RM)_1$, holding RM and F constant. The interest rate increases from i_0 to i_1. Wealth increases, shifting the curve f_0 outward. It is crucial, however, just how far f shifts. In the case in which f shifts only to f'_1, the new value of foreign-asset holdings $(eF)'_1$ is less than the initial $(eF)_0$. With F constant, e must fall in order for (eF) to reach this level: in this case, an increase in the stock of bonds *appreciates* the exchange rate. On the other hand, when f shifts further out to f_1, the new value of foreign-asset holdings $(eF)_1$ is greater than $(eF)_0$, and therefore e must rise: in this case, an increase in the stock of bonds *depreciates* the exchange rate.

A change in the stock of domestic bonds can thus either appreciate or depreciate the exchange rate, depending upon the relative size of two effects—the one shifting the curve f outward, and the other moving upward along the given f curve. The situation is familiar in economic analysis: a wealth effect conflicting with a substitution effect. As the wealth effect dominates, the exchange rate depreciates; as the substitution effect dominates, it appreciates.

Branson has shown that if domestic bonds and money are better wealth substitutes than domestic bonds and foreign bonds, the wealth effect will dominate and the exchange rate will depreciate, and vice versa. To understand this condition, consider once again the expansion of the domestic-bond stock leading to the shift from $(B/RM)_0$ to $(B/RM)_1$. The increase in domestic bonds initially tends to increase wealth, which in turn increases the demand for both money and foreign assets at an unchanged rate of interest. The domestic interest rate must rise in order to increase the demand for domestic bonds until it equals the new greater supply—and in order to decrease the demand for money until it equals its unchanged supply.

If domestic bonds and foreign bonds are better wealth substitutes than domestic bonds and money, the rise in the interest rate that restores the equality between money demand and supply will produce a greater drop in the demand for foreign assets than in the demand for money at the new level of wealth. The value of the unchange stock of foreign assets $(eF)_0$ would then be greater than demand for them. Thus with F constant, e must fall—that is, the exchange rate must appreciate—to bring the value of the supply of foreign assets into line with demand. A fall in the value of foreign assets, all else constant, reduces wealth. The curve f, although shifting outward in line with the wealth increase in the domestic bond stock, thus exhibits less of a shift than that increase by itself would warrant.[9]

On the other hand, if domestic bonds and money are better wealth substitutes than domestic bonds and foreign bonds, the rise in the interest rate from i_0 to i_1 (which makes money demand equal money supply) produces a smaller drop in the demand for foreign assets. That demand at the new level of wealth exceeds the value of the unchanged stock $(eF)_0$, and e thus must increase—that is, the exchange rate must depreciate—to adjust the supply of foreign assets to the demand. This increase in the value of the supply of foreign assets, all else constant, increases wealth. Thus the curve f shifts farther out than the increase in the stock of bonds by itself would warrant.

The effect of an increase in F, the stock of foreign assets denominated in foreign currency, is straightforward. An increase in F does not change the bond/money ratio, so the interest rate remains unchanged. At a fixed exchange rate, the increase in F would increase (eF), the stock of foreign assets denominated in domestic currency. This in turn would increase wealth, and thereby increase the demand for bonds and money beyond the fixed stocks of each. Hence, wealth must not increase if the supply and demand of money and domestic bonds are to be equal. Therefore, (eF) must fall to its former level. Since F is fixed at its new level, only e can fall. It will fall in the exact proportion that F increased: an increase in the stock of foreign assets denominated in foreign currency, appreciates the exchange rate by the same proportion (i.e., the elasticity of e with respect to F is -1).

We have seen the effects of changes in each of the foreign asset stocks on the exchange rate, other things held constant. The system of equations (8) - (11) can be solved to yield the reduced form:

$$e_t = (RM_t, B_t, F_t, i_t^*) \qquad (12)$$

The exchange rate depends on the three asset stocks and the exogenous foreign interest rate. Following Branson and his colleagues, we estimate a linear equation in which i* is replaced by the asset stocks of the foreign country (indicated by stars), which are the determinants of i*. The substitution of RM*, F* and B* for i* now eliminates the "small country assumption" for the U.S.; that is, we cannot assume that other countries' interest rates are insensitive to the monetary-fiscal policy mix of the foreign country.

$$e_t = c + \overset{(+)}{\alpha_1} RM_t + \overset{(\pm)}{\alpha_2} B_t + \overset{(-)}{\alpha_3} F_t + \overset{(-)}{\beta_1} RM_t^* + \overset{(\mp)}{\beta_2} B_t^* + \overset{(+)}{\beta_3} F_t^* + u_t \qquad (13)$$

where c is a constant and the u_t are random errors.[10] The (+) or (−) signs over the coefficients indicate the expected direction of change of the exchange rate resulting from an increase in the corresponding asset stock, based on the analysis above.

Our estimation results are reasonably supportive of the portfolio-balance approach, especially when contrasted with the estimations of other investigators (see Table 4 and Chart 1). Five of eight coefficients on the domestic-bond stock variables are

Table 4
Portfolio-Balance Model for Currencies of Canada, Germany, Italy and Japan Against the U.S. Dollar (Monthly, March 1973 – December 1978)

	Independent Variables							Summary Statistics			
Dependent Variable	Constant	B^{US}	B^f	RM^{US}	RM^f	F^{US}	F^f	$\bar{R}^2$	DW	RHO	SER
U.S. $ / Canadian $	1.128	$.00003^{c}$	.0072**	$.00076^{c}$	$-.0105^{c}$	$.00274^{WW}$	$.256(10^{-5})^{c}$	.960	2.16	.76	.0109
	(16.25)	(.06)	(3.02)	(.86)	(.61)	(4.01)	(.73)				
U.S. $ / German DM	.0578	-.00183**	$.195(10^{-3})^{c}$	.00196*	$.00235^{W}$	$-.749(10^{-3})^{c}$	$.714(10^{-6})^{c}$	.920	1.90	.44	.0129
	(.54)	(3.32)	(.52)	(2.36)	(2.08)	(.96)	(1.66)				
U.S. $ / Italian Lira	.00221	$-.382(10^{-5})$*	$.766(10^{-8})^{c}$	$-.995(10^{-6})^{w}$	$-.23(10^{-7})$**	$-.228(10^{-5})^{c}$	$-.771(10^{-8})^{w}$	.973	1.86	.80	.0362
	(7.03)	(2.48)	(1.55)	(.44)	(3.35)	(.64)	(1.16)				
U.S. $ / Japanese Yen	.0024	$-.991(10^{-5})$*	$.453(10^{-7})$*	$.465(10^{-5})^{c}$	$.945(10^{-7})^{w}$	$-.152(10^{-4})^{c}$	$.141(10^{-6})$*	.963	2.04	.65	.0001
	(3.3)	(2.33)	(2.03)	(.61)	(1.34)	(1.45)	(2.05)				

t-statistics in parentheses under the coefficients.

All estimates use the FAIR technique with RM^f assumed endogenous.

f- superscript indicates foreign-country variables; US superscript indicates United States' variables.

* Significantly different from zero at the 95-percent confidence level and of the predicted sign.

** Significantly different from zero at the 99-percent confidence level and of the predicted sign.

c Insignificant, but of the predicted sign.

w Insignificant, and not of the predicted sign.

W Significantly different from zero at the 95-percent confidence level, but not of the predicted sign.

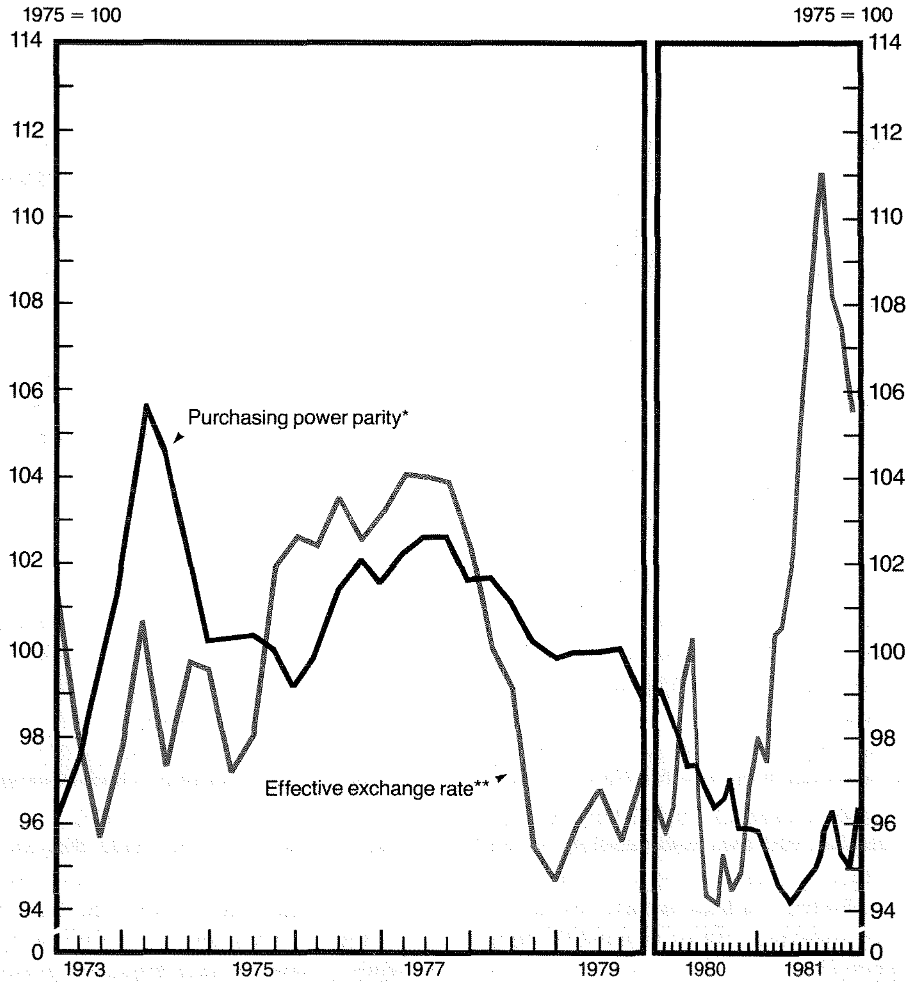
WW Significantly different from zero at the 99-percent confidence level, but not of the predicted sign.

See data appendix for a description of the data.

significant, which suggests that the simple monetary model errs in omitting consideration of nonmonetary assets. We have shown above that the coefficients on domestic-bond stocks could take either sign in theory. Interestingly, there is great consistency in the sign pattern: negative coefficients on the United States' bond stock, B^{us}, and positive coefficients on the foreign-bond stock, B^f. In other words, an increase in the domestic-bond stock *appreciates* the exchange rate from a country's own viewpoint, which is consistent with domestic bonds and foreign bonds being better substitutes than domestic bonds and money.

Only for the U.S. dollar/German DM equation is the coefficient on the United States' reserve-money stock significant and of the correct sign. In the other equations it is insignificant and, in the case of the U.S. dollar/Italian lira rate, of the wrong sign as well. The foreign reserve-money stock shows mixed results. It is insignificant in two cases—of

Chart 2
U.S. Effective Exchange Rate and Purchasing Power Parity



* Trade-weighted index of foreign wholesale prices relative to U.S. wholesale prices.
** Trade-weighted value of the U.S. dollar in terms of the currencies of fifteen trading partners.
Source: Morgan Guaranty *World Financial Markets*.

the correct sign with respect to Canada and of the wrong sign with respect to Japan. It is significant and of the correct sign in the case of the Italian lira, but significant and of the incorrect sign in the case of the German DM.

The coefficient on the United States' foreign-asset stock is significant and of the wrong sign in the case of Canada—but of the correct sign, though insignificant, for the other rates. The coefficients on the foreign countries' foreign-asset stock are again mixed: of the correct sign but insignificant for Canada and Germany; of the wrong sign though still insignificant for Italy; and of the correct sign and significant for Japan.

In all, the equations for the U.S. dollar/Japanese yen and the U.S. dollar/Italian lira best support the portfolio-balance approach—in both equations, the only coefficients with incorrect signs are statistically insignificant—yet these equations tell different stories. The lira equation provided the most support for the monetary approach. In the portfolio-balance model, the U.S. bond stock and Italian reserve money are significant in explaining the exchange rate. The significance of these two factors—because bonds are a direct influence on the interest-rate differential and reserve money on the inside-money differential—is broadly consistent with the relative success of the Italian monetary equation.

The Japanese yen equation provided the least support for the monetary approach. With the portfolio-balance model, both domestic bond stocks and the Japanese foreign-bond stock are significant, while both reserve-money stocks are not. This suggests that non-monetary, financial variables are crucial in determining this rate. To the extent that the monetary model assumes these variables away, then one would expect it to fail.

The Canadian and German equations are flawed in having significant coefficients with the wrong sign. The German reserve-money stock carries a positive, rather than the expected negative sign. U.S. foreign-asset stock in the Canadian equation carries the incorrect, positive sign. Canada is a difficult country to model, however, because of the close integration of the U.S. and Canadian financial markets. A significant amount of Canadian debt is denominated in U.S. dollars, which muddies the distinction between domestic and foreign assets for both countries and probably confuses the estimation of such simple models as those presented here.[11]

When we compare the $\bar{R}^2$s reported for each equation in Tables 3 and 4, we clearly see that portfolio-balance models generally track actual exchange rates better than the simple monetary model. (For Italy they do about the same.) A casual inspection of the charts strikingly reveals the same point. (For convenience, Chart 1 presents fitted and actual values of the exchange rate expressed as units of foreign currency per dollar, rather than as estimated.)

IV. Conclusions and Policy Implications

In the period since floating began in March 1973, the five countries in our study followed very different domestic economic policies and exhibited very different exchange-rate patterns. Over the period covered by our estimations, the rate against the U.S. dollar appreciated sharply for Germany and Japan and depreciated sharply for Canada and Italy. Our estimations suggest that asset-market models help explain these movements. So it is fair to say that they are explained—at least in part—by different mixtures of economic policies adopted by these various countries.

To be sure, the monetary model—even in the best case, Italy—is not well supported. But the portfolio-balance model generally is moderately well supported, and does strikingly well in the cases of Italy and Japan. The portfolio-balance model is a more general model, since it includes more assets and does not restrict the degree of substitutability between them. Other technical differences notwithstanding, the monetary model can be thought of as a portfolio-balance model in which domestic and foreign bonds are perfect substitutes.

The argument can be made that the monetary approach was not given a fair test. All exchange rates estimated were vis-a-vis the U.S. dollar and, as is now well known, a "shift" in U.S. money demand appears to have taken place around 1974-75. Thus the assumption of stable money-demand functions may not have held over the estimation period. Nevertheless, when cross-exchange rates not involving the dollar were estimated—e.g., the

DM/yen exchange rate—the monetary approach still did not perform any better.

Our results should be interpreted cautiously. The estimations cover a limited period, and the quality of the data is often poor—especially for the foreign-bond stocks in the portfolio-balance models. Still, our estimations are favorable enough to encourage further research emphasizing the effects of financial-policy mixtures on the behavior of exchange rates.

The policy implications must also be viewed cautiously. The portfolio models estimated here are short-run models whose long-run implications have not been empirically described. Nonetheless, the estimated portfolio models suggest that the dollar exchange rate against the German mark, Italian lira and Japanese yen will appreciate in the short run should the U.S. run a sizable government deficit which is financed in the private market. Our evidence suggests that, in the short run at least, a combination of large Federal deficits and slow monetary-base growth will result in a major appreciation of the U.S. dollar.

As Charles Pigott has shown in the Fall 1982 issue of this *Review*, substantial and prolonged deviations from purchasing-power parity occurred in recent years between the U.S. and other major industrial countries.[12] (See Chart 2.) Pigott attributes the deviations to shifts in relative prices. Such deviations could also be due to the behavior of real interest rates, caused by changes in the monetary-fiscal policy mix among major countries. A large increase in U.S. government debt in 1982, combined with low monetary growth, would thus continue to keep the effective (trade-weighted) U.S. dollar-exchange rate away from its purchasing-power value, as has occurred since late 1980.

If the dollar remains strong, U.S. goods exports could remain weak for some time, primarily because 98 percent of U.S. exports are denominated in dollars. However, a strong dollar does not necessarily imply that other countries' net exports will improve at our expense. Such a development would depend on the currency composition of various countries' exports. In 1980, for example, Japan denominated 61 percent of its exports in dollars, and 93 percent of its imports.[13] For Germany the U.S.-dollar denominations were 7 percent for exports and 33 percent for imports. Hence, in the short run, a strong dollar could hurt the net export earnings of some of our trading partners as well as the U.S.

The strength of the dollar also affects other countries by the valuation effects on their financial wealth denominated in dollars. Many European countries and middle-Eastern oil exporters have a large portion of their net financial wealth denominated in dollars. A continued strong dollar in 1982 could provide positive wealth effects to countries which otherwise would be weakened by that factor. The exchange value of the dollar thus affects a country's net wealth position as well as its demands for exports and imports. Testing alternative theories of exchange rates helps to improve our understanding of how macroeconomic policy affects trade flows and the value of national wealth.

Data Appendix

Data for both the monetary and the portfolio models cover five countries—Canada, Germany, Italy, Japan and the United States. Except where noted in other sections, all data come from the following sources:

— Board of Governors of the Federal Reserve system, *Statistical Release H.6* (FRB), various issues.
— International Monetary Fund, *International Financial Statistics* (IFS), February 1980.
— Morgan Guaranty Bank, *World Financial Market* (WFM), various issues.

Unless otherwise noted all series run from 1972 to September 1979, even though the estimation period is generally March 1973 to December 1978.

Seasonally adjusted (SA) data are used. Unless noted differently, all seasonally adjusted data are adjusted over the period January 1972 to September 1979 (or, for IFS data, to latest available date), with the use of the X11 (multiplicative) method. For series that are sums or differences of component series, the components are seasonally adjusted before computations are made.

All stock data are expressed in billions of the national currencies of each country, except for the foreign asset stock (F) for Canada and Germany, which are expressed in millions.

Variable Names and Definitions

B = net private claims on government (private ownership of government debt) = IFS line 32an (Monetary Survey: Claims on Government (net) (SA)-IFS line 12a (Central Bank: Claims on Government) (SA)

e = end-of-period exchange rate (U.S. dollars per foreign unit) = 1/(IFS line ae (Market Rate/Par or Central Rate))

F = net private financial claims on foreigners ((total foreign assets held less official reserves and government holdings of foreign debt less direct investment in foreign countries) less total liabilities to foreigners less official holdings by foreigners of home country's debt-direct investment in home country)). Generally, we accumulated surpluses (deficits) on current account less changes in reserves over annual benchmarks for net foreign-asset positions. We then interpolated this quarterly series to monthly. Sources for benchmark data were:

— *Bank of Canada Review*, February 1980, Table A15.
— *Monthly Report of the Deutsche Bundesbank*, October 1979, pp. 27-34.
— Bank of Japan, private communication.
— Bank of Italy, *Annual Report*, 1976, Tables G 15, G 20, G 21.
— Department of Commerce, "International Investment Position of the United States," Table 3, *Survey of Current Business*, September 1977 and August 1979.

For further details, see data appendix of J. Bisignano and K. D. Hoover, "Alternative Asset Market Approaches to Exchange Rate Determination," Federal Reserve Bank of San Francisco *Working Papers in Applied Economic Theory and Econometrics*, No. 105, August 1980.

i = short-term interest rate = WFM representative money-market rate.

m = widely defined money stock = IFS line 34 (Money) (SA) + IFS line 35 (quasi-money) (SA). This obtained for all countries except the U.S., for which m = FRB M-2 (old definition) (SA).

RM = central-bank money (monetary base) = IFS line 14 (Reserve Money) (SA).

y = real income proxied by the index of industrial production = IFS line 66..C (Industrial Production) (SA).

σ = ratio of net private financial claims on government to central-bank money = B/RM.

1. See for example H. G. Johnson, **The Case for Flexible Exchange Rates**, Institute for Economic Affairs, London 1969, or Egon Sohmen, **Flexible Exchange Rates**, University of Chicago Press, 1969. The advocates of floating of course carried the day; nevertheless, the battle was pitched: see for instance Paul Einzig, **The Case Against Floating Exchanges**, Macmillan, St. Martin's Press, 1970, and a retrospective survey of the debate in H. Fournier and J. E. Wadsworth (eds.) **Floating Exchange Rates—Lessons of Recent Experience**, Leyden: A. W. Sijthoff, 1976. With the turbulent experience of the 1970's behind us, the lines of battle are joined once more: see Gottfried Haberler, "Flexible-Exchange Rate Theories and Controversies Once Again," American Enterprise Institute Reprint No. 119, January 1981.

2. "Recent Trends in the Flow of Funds in Japan—Centering on the Expansion of Public Sector Deficit," The Bank of Japan, Economic Research Department, Special Paper No. 79, p. 1, December 1978. Examination of the individual country summaries in the various issues of the O.E.C.D. **Economic Outlook** also confirm that public debt expanded in major industrial countries following the 1973 oil crisis, especially in Japan.

3. Two useful reviews of general asset-market and specific monetary-models approaches may be seen in Michael Mussa, "Empirical Regularities in the Behavior of Exchange Rates and Theories of the Foreign Exchange Market," in **Policies for Employment, Prices, and Exchange Rates**, North-Holland Publishing Company, 1979, and John F. O. Bilson, "Recent Developments in Monetary Models of Exchange Rate Determination," International Monetary Fund, **Staff Papers** (January 1979). A representative selection of estimated monetary/exchange-rate models is contained in Jacob A. Frenkel and Harry G. Johnson, eds., **The Economics of Exchange Rates: Selected Studies**, Addison-Wesley Publishing Company (1978). An important extension of the monetary approach stressing real interest rates is found in Jeffrey Frankel, "On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Differentials," **American Economic Review**, September 1979.

4. Abstracting of course from transportation costs and barriers to trade.

5. In practice, this is possible only if the demand curve is more stable than the supply curve—that is, if the supply curve is subject to more shocks or random error than the demand curve—or if econometric identification can be secured in some other way.

6. See Bilson (note 3 above) for an illustration of the use of rational expectations in the monetary approach, where the forward rate is equated to the mathematical expected value of the future spot rate. The now-common procedure showing that the current spot rate is a function of the entire future history of expectations of the exogenous variables originates with Thomas J. Sargent and Neil Wallace, "Rational Expectations and the Dynamics of Hyperinflation," **International Economic Review** (June 1973).

7. Initial estimates of equation (5) for several countries showed the presence of substantial first-order serial correlation. Consequently, we now estimate it using the FAIR technique, an estimation method which guarantees consistent estimates when using Cochrane-Orcutt corrections for first-order serial correlation with instrumental variables. See Ray C. Fair, "The Estimation of Simultaneous Equation Models with Lagged Endogenous Variables and First Order Serially Correlated Errors," **Econometrica** (May 1970).

8. "Exchange Rates in the Short Run: The Dollar Deutschemark Rate," **European Economic Review**, 10, (1977) pp. 303-324. For other expositions, see W. H. Branson and H. Halttunen, "Asset-Market Determination of Exchange Rates: Initial Empirical and Policy Results," in J. P. Martin and A. Smith (eds.), **Trade and Payments Adjustment under Flexible Exchange Rates**. London: Macmillan, 1979; W. H. Branson, "Asset Markets and Relative Prices in Exchange Rate Determination," **Sozialwissenschaftliche Annalen**, Band 1, 1977, pp. 69-89; and Joseph Bisignano and Kevin Hoover, "Alternative Asset Market Approaches to Exchange Rate Determination," Federal Reserve Bank of San Francisco, **Working Papers in Applied Economic Theory and Econometrics**, No. 105, August 1980.

9. H. Genberg and H. Kierkowski, in "Impact and Long-Run Effects of Economic Disturbances in a Dynamic Model of Exchange Rate Determination," **Weltwirtschaftliches Archiv** (1979), provide a very similar analysis with a diagram quite like Figure 3.

10. See Bisignano and Hoover ("Alternative Asset Market Approaches . . ."). Branson, *et al.*, in fact, drop the domestic bond stocks, B and B*, for the econometrically spurious reason that the sign of their coefficients cannot be determined *a priori* (Branson, *et al.*, 1977, p. 311). Whether or not the sign of the coefficient is known in advance, an omitted variable biases the regression. The portfolio-balance model presented here is a model of private behavior. Of course, it is well known that governments intervene in foreign-exchange markets to support their own or another country's currency. We do not plan to model this process here. Nevertheless, we must mark its effect: buying and selling foreign exchange produces changes in the monetary base; if these transactions are related to the exchange rate (e.g., the domestic government sells foreign exchange when the exchange rate depreciates, decreasing its monetary base, and buys when the rate appreciates, increasing its monetary base), then errors in determining e, the u_t in equation (13), will be correlated with RM. Such a correlation violates the conditions necessary for ordinary least-squares estimates to be unbiased and consistent. Consistency can be obtained by using an instrumental variable technique. Preliminary estimations showed that the u_t in equation (13) have substantial first-order serial correlation. Consequently, we have estimated equation (13) using the FAIR technique, an instrumental variable estimator with Cochrane-Orcutt corrections for first-order serial correlation described earlier.

11. In a forthcoming paper, "Some Suggested Improvements to a Simple Portfolio Balance Model of Exchange Rate Determination with Special Reference to the U.S. Dollar/Canadian Dollar Rate," **Weltwirtschaftliches Ar-**

chiv, (Heft 1, 1982), we attempt to improve the portfolio-balance model for Canada by: 1) using bilateral data for the holdings of foreign asset stocks; 2) explicitly dealing with the problems of currency of denomination; and 3) setting out a more general portfolio-balance model which does not make the small-country assumption. In addition, we use tests of Granger/causality to test the appropriateness of the small-country assumption for the case of Canada.

12. See Charles Pigott, "The Influence of Real Factors on Exchange Rates," Federal Reserve Bank of San Francisco **Economic Review** (Fall 1981).

13. See S.A.B. Page, "The Choice of Invoicing Currency in Merchandise Trade," **National Institute Economic Review** (November 1981). Page notes that invoicing some portion of exports and imports in both domestic and foreign currencies tends to smooth the adjustment to exchange-rate changes, and results in less severe J-curves than would result when all export transactions are denominated in the exporters' home currency.

REFERENCES

Bilson, John F. O. "Recent Developments in Monetary Models of Exchange Rate Determination," International Monetary Fund, **Staff Papers**, January 1979.

Bisignano, J. and Hoover, K.D. "Alternative Asset Market Approaches to Exchange Rate Determination," Federal Reserve Bank of San Francisco, **Working Paper in Applied Economic Theory and Econometrics**, No. 105, August 1980.

"Some Suggested Improvements to a Simple Portfolio Balance Model of Exchange Rate Determination with Special Reference to the U.S. Dollar/Canadian Dollar Rate," forthcoming, **Weltwirschaftliches Archiv**, (Heft 1, 1982).

Branson, W. H. "Asset Markets and Relative Prices in Exchange Rate Determination," **Sozialwissenschaftliche Annalen**, Band I, 1977.

Branson, W. H. and Halttunen, H. "Asset Market Determination of Exchange Rates," in Martin, J. P., and Smith, A. (eds.), **Trade and Payments Adjustment under Flexible Exchange Rates**, London: Macmillan, 1979.

Branson, W. H., and Halttunen, H. and Masson, P. "Exchange Rates in the Short-Run: The Dollar Deutschmark Rate," **European Economic Review**, 1977.

Einzig, Paul **The Case Against Flexible Exchanges**, London: Macmillan and St. Martin's Press, 1970.

Fair, Ray C. "The Estimation of Simultaneous Equation Models with Lagged Endogenous Variables and First Order Serially Correlated Errors," **Econometrica**, May 1981.

Fournier, H. and Wadsworth, J. E. (eds.), **Floating Exchange Rates—Lessons of Recent Experience**, Leyden: A. W. Sijthoff, 1976.

Frankel, Jeffrey, "On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Differentials," **American Economic Review**, September 1979.

Frenkel, Jacob A. and Johnson, Harry G. (eds.), **The Economics of Exchange Rates: Selected Studies**, Cambridge: Addison-Wesley, 1978.

Genberg, H. and Kierkowski, H. "Impact and Long-Run Effects of Economic Disturbances in a Dynamic Model of Exchange Rate Determination," **Weltwirtschaftliches Archiv**, 1979.

Haberler, Gottfried "Flexible Exchange Rate Theories and Controversies Once Again," American Enterprise Institute Reprint No. 119, January 1981.

Johnson, H. G. **The Case for Flexible Exchange Rates**, London: Institute for Economic Affairs, 1969.

Mussa, Michael "Empirical Regularities in the Behavior of Exchange Rates and Theories of the Foreign Exchange Market," in **Policies for Employment Prices and Exchange Rates**, Amsterdam: North-Holland, 1979.

Organization of Economic Cooperation and Development, **Economic Outlook**, various issues.

Sargent, Thomas J. and Wallace, Neil "Rational Expectations and the Dynamics of Hyperinflation," **International Economic Review**, June 1973.

Sohmen, Egon **Flexible Exchange Rates**, Chicago: University of Chicago Press, 1969.

Consumption, Saving and Asset Accumulation

Brian Motley*

Personal-consumption expenditures account for almost 64 percent of U.S. gross national product. Hence the collective decisions of the nation's consumers whether to spend or to save have a powerful impact on its economic health. High and rising levels of consumption translate into prosperity for the nation's retailers, and through them into higher output and more jobs in the industries producing consumer goods. On the other hand, economists worry that if too many of the nation's resources are channeled into current consumption, capital formation will be slighted, so that productivity growth will slow and future living standards will be hurt. In recent years there has, in fact, been a marked decrease in the rate of growth of overall productivity. At the same time, households have been saving a smaller proportion of their incomes than they used to. Although economists do not fully understand all the reasons for the productivity slowdown, the simultaneous decline in the saving rate probably has been a contributing cause. In any event, a key objective of the Administration's economic program is to boost productivity growth by encouraging personal saving.

This article investigates the aggregate consumption-saving decision in the United States. Although the determinants of household consumption have been studied intensively, the present study differs from most others in that its primary focus is on *saving* rather than on consumption. The act of saving is treated as a *demand* for various kinds of assets which are expected to yield returns in the future, so that total saving depends on all the factors which influence the public's purchases of assets. In addition, we consider "saving" to include purchases not only of financial assets but also of all types of tangible assets, including homes and consumer durables.[1] Thus, the term "consumption" refers only to household purchases of non-durable goods and services.

The study pays particular attention to the effects of changes in inflation and unemployment on saving decisions, in order to discover whether the faster inflation and higher unemployment experienced in recent years can explain the observed reduction in saving rates. It also examines the effect of changes in tax rates and finds that these have a significant impact on the saving-consumption decision.

In Section I, the accounting relations between the household's saving-consumption decisions and its balance sheet are described. It is argued that because of these accounting relationships, decisions to spend on current consumption and to purchase various kinds of assets are likely to be interdependent. Section II examines the main factors influencing saving decisions, with particular emphasis on the role of changes in tax rates and in the rate of inflation. In Section III the ideas of the preceding sections are developed into a formal model suitable for econometric estimation. Sections IV and V take up some technical econometric issues and describe the data used in the empirical work. Section VI presents the empirical results and their policy implications, and Section VII provides a summary and conclusions.

---

*Economist, Federal Reserve Bank of San Francisco. Brian Dvorak provided research assistance for this article.

I. Saving and Asset Accumulation

The approach to saving behavior developed in this article begins with the household's balance sheet, which shows its assets, liabilities and net worth on a particular date. Assets include not only financial assets such as bank accounts, securities and life-insurance policies, but also tangibles such as homes, cars and household durables. Net worth is defined as the difference between total assets and total liabilities. To illustrate these concepts, Table 1 shows the aggregate balance sheet of the household sector at the beginning of 1980.

During any period a household may use its current income either for current consumption or for saving. In turn, the portion of its income devoted to saving may be used either to add to its assets or to reduce its liabilities. If the household saves but makes no explicit asset purchase or debt repayment, its holdings of money—the medium of exchange—will rise. Table 2 thus shows that the total income of the household sector during 1980 was equal to its consumption expenditures plus additions to its holdings of tangible and financial assets minus additions to its liabilities.

Because of this *accounting* relation, a household's decisions to consume or to save will be influenced by the stocks of assets which it presently owns relative to the stocks which it wishes to own, given its current and prospective future income. If a household wants to add to its net stock of assets, it must spend less on current consumption, while if it wants to increase its consumption, it must hold fewer assets or incur more debts.

Moreover, saving-consumption decisions depend not only on the *total* stock of assets but also on the amounts of each *kind* of asset which a household owns relative to the amounts which it wishes to own. The *composition*, as well as the total value, of its asset-portfolio influences its saving decisions. This is because there are costs involved in buying and selling assets, and these costs differ as between different types of assets. Holdings of money, for example, may be promptly increased or decreased at no cost since money is the medium of exchange, whereas altering one's holdings of real estate frequently is costly and time-consuming.

The relevance of this second consideration may be illustrated by an example. Suppose a household experiences an unexpected reduction in its disposable income but wants to maintain its level of consumption spending. For this to be possible, the household must either reduce its asset-holdings or increase its liabilities. Alternatively, suppose it wants to buy a new car but would prefer not to lower its regular consumption outlays. In this case, the household must reduce its holdings of other assets or go into debt. In the first case the household's *total* stock of assets is reduced, while in the second case its total stock remains unchanged but the *types* of assets in that stock are altered. However, in either case, the required changes in its asset-holdings will be relatively easy to accomplish if the household has large holdings of money or other liquid assets, but will be more difficult and costly if its assets are mostly illiquid (such as a home) or if it has substantial debts outstanding. Thus the household's ability

Table 1:
Household Balance Sheet: January 1, 1980
($ Billions)

Total Tangible Assets	3,760	Total Liabilities	1,494
Total Financial Assets	6,237	Net Worth	8,503
Total Assets	9,997	Total Liabilities and Net Worth	9,997

SOURCE: Board of Governors of the Federal Reserve System

Table 2:
Disposition of Household Income: 1980
($ Billions)

	Gross Disposable Income	1911.4
=	Expenditures on Nondurables and Services	1508.5
+	Purchases of Tangible Assets	313.1
+	Purchases of Financial Assets	279.5
−	Additions to Liabilities	110.1
+	Statistical Discrepancy*	−79.6

*Separate data on consumption and saving do not precisely sum to income. The discrepancy item is added to close the identity.

SOURCE: Board of Governors of the Federal Reserve System.

to finance a given spending plan depends not only on the total value of its assets but also on whether these assets may be sold easily and cheaply. Indeed, if the household holds only relatively illiquid assets, it may prefer to reduce its current consumption temporarily rather than dispose of those holdings.

Because of these considerations, most households make their consumption and asset-purchase decisions simultaneously rather than sequentially. In deciding how much to spend on consumption, a household must pay attention to the implications of these decisions for its balance-sheet position. Conversely, household decisions to add to holdings of particular assets may have *short-run* implications for its consumption expenditures, even though in the *long run* it plans only to rearrange its asset-portfolio and does not contemplate any permanent increase in its *total* asset-holdings.

II. Determinants of Asset Demand

According to the basic hypothesis of modern consumer theory, the main determinant of a household's consumption level is its long-run expected income. In other words, the household plans its consumption over a relatively long time horizon, on the basis of the after-tax income it expects to receive over that period and the opportunities it has to delay or accelerate consumption by the purchase and sale of assets. By using more of its current income to purchase assets, the household is able to delay consumption into the future. If it buys financial assets it can use them later to purchase consumer goods, while if it buys real assets such as a car or a house, it receives a future flow of consumption services from those assets. Conversely, by buying fewer assets in the present, the household can enjoy more current consumption at the expense of less future consumption.

Household decisions on the allocation of their resources between present and future consumption depend on their preferences and on the asset prices and yields which they face. If the prices of assets fall—which means that asset yields rise—a household can obtain more future consumption for each dollar's worth of present consumption which it gives up. However, the resultant effect on saving cannot be predicted *a priori* on the basis of economic theory alone. At higher yields, every dollar which is saved in the present and used to buy assets produces a larger addition to future consumption. This effect tends to encourage households to save more and consume less. On the other hand, an increase in asset yields makes it possible for a household to save somewhat less today (and consume somewhat more) and still be able to enjoy the same level of consumption in the future. This is so because the effect of the lower level of current savings is offset by the higher rate of return earned by those savings. This effect tends to encourage households to save less and consume more now. There appears to be no consensus among economists as to which of these two effects—the substitution effect and the income effect—will dominate household behavior. If the substitution effect dominates, an increase in asset yields will serve to increase saving and reduce current consumption, whereas the opposite will be true if the income effect is dominant.

Other factors also affect returns on assets and thus household saving-consumption decisions. Reductions in tax rates increase the after-tax returns on financial assets as well as the net costs of going into debt. However, they do not change the returns on tangible assets since those returns—being in the form of services—are not subject to taxation. Thus tax-rate decreases are likely to encourage financial savings and to discourage the purchase of consumer durables and homes financed by borrowing. As in the case of nominal-yield changes, however, the effect of tax-rate changes on total saving and consumption depends on the relative strength of the substitution and income effects.

Changes in the inflation rate also influence the returns yielded by various kinds of assets. In this case, however, people's responses generally differ according to whether or not the inflation-rate change was expected. Given the *nominal* rate of interest, an increase in the *expected* rate of inflation implies a decline in the expected *real* rate of return on financial assets. Tangible assets such as cars and homes provide their return in the form of consumption services, which are not influenced by a change

Table 3
Expected Effects on Saving and Consumption of Changes in Independent Variables

Independent Variables	Total Consumption	Dependent Variables: Net Purchases of Tangible Assets	Net Purchases of Financial Assets	Net Additions to Liabilities
General Increase in After-Tax Real Yields on Assets	?	?	?	?
Decrease in Tax Rates	?	–	+	–
Expected Increase in Inflation	?	+	–	+
Unexpected Increase in Inflation	–?	+	+?	–?
Increase in Unemployment	?	?	+	–

in the rate of inflation. Hence, the expectation of more rapid inflation will tend to encourage the accumulation of tangible assets at the expense of financial assets. In other words, an increase in the expected inflation rate with no change in the nominal rate of interest makes it more attractive to sell financial assets or to borrow in order to buy tangible assets which yield consumer services. Conversely, an expectation of decelerating inflation will tend to discourage purchases of tangibles. Again, the existence of substitution and income effects means that the effect of expected inflation on *aggregate* saving cannot be predicted unambiguously.

So much for changes in the *expected* rate of inflation. But what of *unexpected* inflation? Juster and Wachtel (1972) and Bisignano (1977) have argued that when prices increase unexpectedly, households become more uncertain about their future real incomes. Wage earners become concerned about their wage rates keeping up with the cost of living, while older persons begin to worry about their retirement savings being eroded by inflation. Since most households are risk averse,[2] this greater uncertainty about future real incomes may lead households to consume less in the present in order to accumulate assets for the future. Thus, according to these writers, unexpected inflation will encourage personal saving.

However, unexpected inflation not only makes households more uncertain about the real value of their future incomes but also increases the difficulty of predicting the real rate of return on financial assets. The additional consumption obtained in the future by giving up a dollar's worth of consumption now becomes less predictable if future consumer-goods prices are made more uncertain by inflation. The effect of this type of uncertainty on current saving cannot be predicted unambiguously because, like the effects of changes in asset yields, it involves both a substitution effect and an income effect.[3] When future consumer-goods prices become more uncertain, the household may choose to consume more in the present, when prices are known, and less in the uncertain future. This substitution effect thus tends to *decrease* current saving. On the other hand, greater uncertainty encourages households to save more and accumulate more assets to protect themselves against the possibility of sharply rising consumer-goods prices. This income effect thus tends to *increase* current saving.

Economic theory thus provides no way of predicting the "uncertainty effects" of unexpected inflation on purchases of financial assets. With regard to purchases of tangible assets, theory provides more guidance. Since the consumption services provided by a house or a car do not depend on the rate of inflation, the uncertainty effect does not affect their real rates of return but only household real incomes. In this case, therefore, theory predicts that unexpected inflation will cause households to stock up on tangible assets against the possibility of even faster price rises in the future.

Apart from the effects of inflation and taxes, we expect saving behavior also to be influenced by the rate of unemployment. High jobless rates, like unexpected inflation, tend to increase uncertainty about future real incomes. Such uncertainty will cause households to reduce the share of their current incomes allocated to consumption expenditures in order to accumulate more financial assets and to draw down debt. This "uncertainty effect" of unemployment is separate from the effect coming via current income. Higher levels of unemployment will generally be associated with decreases in current income relative to long-term expected income. Such decreases tend to cause households to reduce their savings in order to maintain their accustomed consumption levels. The income and uncertainty effects on savings decisions thus are opposite in sign. In our estimating equations, however, the income effect will be captured by a current-income variable. Hence we expect higher levels of unemployment to be associated with larger purchases of financial assets and smaller additions to debt.

III. Model of Consumption and Asset Purchases

In this section we develop these various concepts into a theoretical model suitable for empirical testing. This model consists of a set of equations which describe purchases of each type of asset and expenditures on current consumption, in terms of the factors influencing the desired stock of each asset and the rate at which actual stocks are adjusted to desired levels. These equations appear as Equations (7) and (8) below. The non-technical reader may, with no loss of continuity, proceed directly to those equations.

Suppose there are M classes of assets which households may purchase and hold. These classes include financial assets[4] such as money or securities, as well as tangible assets such as homes and consumer durables. The household may use its current income, Y, either to buy consumer goods or to add to its holdings of assets. Thus, if consumption expenditure is denoted c and purchases of the m^{th} asset q_m,

$$Y = c + q_1 + \dots + q_m + \dots + q_M \qquad (1)$$

As was argued earlier, the household's desired stock of each asset, S^*_m, depends on its long-run expected income, YE, and on K other variables, $x_1, \dots, x_k, \dots, x_K$. These x_k variables include the expected and unexpected inflation rates, the tax rate, the unemployment rate and the real interest rate. It is convenient to assume that the desired stocks are proportional to expected income with this proportion depending on the x_k variables:

$$S^*_m/YE = a_{m1}x_1 + \dots + a_{mk}x_k + \dots + a_{mK}x_K \qquad (2)$$

$$(m = 1, 2, \dots, M)$$

Between any two dates, say t and t+1, the value of a household's actual stock of any asset may change for one of three reasons. First, the household may purchase more of the asset; second, the price of the asset may rise so that the household receives a capital gain; third, previous holdings may depreciate. Hence the asset stock at date t+1 is equal to the stock at date t plus new purchases and capital gains minus depreciation. Assuming that depreciation is a constant proportion of the stock, this accounting identity may be written:

$$\begin{aligned} S_{mt+1} &= S_{mt} + q_{mt} + g_{mt}S_{mt} - \delta_m(1 + g_{mt})S_{mt} \\ &= q_{mt} + (1 + g_{mt})(1 - \delta_m)S_{mt} \qquad (3) \end{aligned}$$

$$(m = 1, 2, \dots, M)$$

where q_{mt} represents new purchases in the period between t and t+1, and g_{mt} is the rate of capital gains. For assets (such as money) with fixed prices, g_{mt} is identically zero. δ_m is the depreciation rate; for physical assets this represents physical deterioration and obsolescence, while for financial assets it may be interpreted as representing the change in market value associated with the approach of the maturity date. For irredeemable and deposit-type financial assets, δ_m is identically zero.

The household makes its consumption and asset-purchase decisions simultaneously. In deciding how much to buy or sell of any asset, the household compares the stock it desires to hold with the amount it has inherited from the past—after taking account of depreciation and capital gains. However, as was argued earlier, the inherited stocks of *other* assets may also influence this decision, since assets differ in the ease and cost with which they can be bought and sold. Further, as Equation (1) makes clear, asset purchases must compete not only with each other but also with consumption for a share of current income. This income constraint implies that current income influences expenditures on each asset class, and conversely implies that current-consumption expenditures depend not only on current and expected income but also on the inherited stocks of each class of asset relative to the amounts desired.

The preceding argument implies that asset purchases and consumption expenditures may be written

$$q_{mt} = \sum_{i=1}^{M} e_{mi} \left[S^*_{it+1} - S_{it}(1 + g_{it})(1 - \delta_i) \right] + f_m Y_t \quad (m = 1, 2, \ldots, M) \quad (4)$$

$$c_t = \sum_{i=1}^{M} e_i \left[S^*_{it+1} - S_{it}(1 + g_{it})(1 - \delta_i) \right] + f Y_t \quad (5)$$

In each of these M + 1 equations, the terms in square brackets represent the differences between the targeted and actual stocks of the M assets. Since consumption plus total asset purchases are necessarily equal to current income,[5] Equation (5) also may be written as

$$c_t = Y_t - \sum_{m=1}^{M} q_{mt}$$

$$= -\sum_{i=1}^{M} \sum_{m=1}^{M} e_{mi} \left[S^*_{it+1} - S_{it}(1 + g_{it})(1 - \delta_i) \right] + \left(1 - \sum_{m=1}^{M} f_m \right) Y_t \quad (6)$$

The formal derivation of this stock-adjustment model is due to Purvis (1978), but earlier versions may be found in Motley (1968) and Wachtel (1972).

To estimate the parameters of Equations (4) and (6), the unobservable S^*_i variables, which represent the desired asset stocks, must be eliminated. This is done by substituting Equations (2) into (4) and (6). This yields a system of equations in which consumption and asset purchases (each expressed as a proportion of expected income) depend on the x_k variables in Equation (2), on current income, and on the inherited stocks of assets. Systems of equations of this type have been estimated by a number of researchers.[6]

This approach suffers, however, from the weakness of the data on stocks of assets—particularly tangible assets. Hence, in this study, the equations were further transformed so as to eliminate the inherited asset-stocks. The details of this transformation are provided in Appendix A. Essentially, the method[7] involves taking the first differences of Equation (4) and then using Equation (3) to replace the terms representing the lagged first differences of the asset stocks by the lagged asset purchases. This yields a system of equations in which consumption and purchases of each asset class depend on the current *and lagged* values of income and of the x_k variables, and on the lagged *purchases* (rather than the lagged stocks) of each asset class. Thus:

$$\frac{q_{mt}}{YE_t} = \sum_{k=1}^{K} \alpha_{mk} x_{kt} + \sum_{k=1}^{K} \beta_{mk} x_{kt-1} \frac{YE_{t-1}}{YE_t} + \phi_m \frac{Y_t}{YE_t} + \psi_m \frac{Y_{t-1}}{YE_t} + \sum_{j=1}^{M} \mu_{mj} \frac{g_{jt} S_{jt}}{YE_t} + (1 - \lambda_{mm}) \frac{q_{mt-1}}{YE_t} - \sum_{\substack{j=1 \\ j \neq m}}^{M} \lambda_{mj} \frac{q_{jt-1}}{YE_t} \quad (7)$$

$$(m = 1,2,\ldots,M)$$

$$\frac{c_t}{YE_t} = \sum_{k=1}^{K} \alpha_k x_{kt} + \sum_{k=1}^{K} \beta_k x_{kt-1} \frac{YE_{t-1}}{YE_t} + (1 - \phi) \frac{Y_t}{YE_t} + \psi \frac{Y_{t-1}}{YE_t} + \sum_{j=1}^{M} \mu_j \frac{g_{jt} S_{jt}}{YE_t} - \sum_{j=1}^{M} (1 - \lambda_j) \frac{q_{jt-1}}{YE_t} \quad (8)$$

Equations (7) and (8) represent a system of M + 1 equations to be estimated.[8] However, the fact that in every period consumption plus total asset purchases completely exhaust current income implies that the coefficients of these equations are not independent of one another. The coefficients on current income sum to one across the M + 1 equations, because if current income increases by one dollar, the sum of consumption plus asset purchases must also rise by one dollar. The coefficients on each of the other variables sum to zero across equations, because if current income is constant, a change in any one of the dependent variables must be matched by equal and opposite changes in the others. Thus the coefficients of Equations (7) and (8) must satisfy the following "adding-up" restrictions.

$$\sum_{m=1}^{M} \alpha_{mk} = -\alpha_k \qquad \sum_{m=1}^{M} \beta_{mk} = -\beta_k$$

$$\sum_{m=1}^{M} \phi_{m} = \phi \qquad \sum_{m=1}^{M} \psi_{m} = -\psi$$

$$\sum_{m=1}^{M} \mu_{mj} = -\mu_j \qquad \sum_{m=1}^{M} \lambda_{mj} = \lambda_j$$

IV. Estimation Problems[9]

The adding-up restrictions on Equations (7) and (8) imply that the coefficients of any one equation may be deduced from those of the other M equations. As long as the same independent variables appear in each equation, single-equation ordinary least-squares estimation preserves these adding-up restrictions. Hence the estimated parameters of any one equation may be derived from the parameters of the others, and the results do not depend on which M out of the M + 1 equations the researcher chooses to estimate. If all M + 1 equations are estimated by ordinary least squares, their residuals sum to zero at each observation, and hence the sums of the actual and fitted values of the dependent variables are equal. Thus the fitted values of the dependent variables satisfy the same accounting identity [Equation (1)] as do the actual values.

Preliminary least-squares estimates indicated the presence of significant serial correlation in the residuals from the regression equations. The usual method of dealing with this problem is to use these residuals to estimate ρ, the autocorrelation coefficient, to transform the dependent and each of the independent variables to the form $y_t - \rho y_{t-1}$, and to apply least-squares estimation to the transformed equations. However, when this technique is applied to a set of equations such as (7) and (8), it yields a set of estimated parameters which do not, in general, obey the adding-up restrictions. This is because, when transformed, the independent variables are no longer the same in each equation. This means that the estimated coefficients will differ according to which M out of the M + 1 equations we choose to estimate. The problem can be avoided only if the autocorrelation coefficients are the same in each of the M + 1 equations, but the preliminary estimates suggested that in fact these coefficients differed significantly across equations.[10]

To avoid this difficulty, the M + 1 equations were estimated simultaneously rather than singly. A distinct autocorrelation coefficient was estimated for each equation, but the parameter estimates were constrained to satisfy the adding-up restrictions across equations. These restrictions ensure that the untransformed fitted values of the dependent variables satisfy the accounting identity, although the residuals in the transformed equations do not sum to zero across equations. Appendix B explains how these constraints were imposed.

V. Data Sources

The flow-of-funds accounts provide the basic source of data for the dependent variables. Four balance-sheet categories were distinguished for this study: financial assets, financial liabilities, residential capital[11] and consumer durables. Gross additions to these four categories[12] plus expenditures on nondurables and services in principle sum to gross income after tax.

In the flow-of-funds accounts, the consumption and asset-purchase series do not exactly sum to measured income. For econometric estimation purposes, however, the data should satisfy the theoretical accounting identities. To deal with this problem, we assumed that each of the dependent variables is measured with error and that the sum of these errors is the statistical discrepancy shown in the accounts. The variables q_m and c in equations (4) and (6) are replaced by $q_m + \gamma_m d$ and $c + \gamma_{M+1} d$, respectively, where d represents the discrepancy and the γ's are the proportions of the discrepancy representing errors in each of the M + 1 dependent variables. When the arithmetic operations of Appendix A are applied to these modified variables, the result is a system of equations in which the current and lagged values of the discrepancy enter as additional independent variables.[13]

As for the independent variables, we derive expected income from gross current disposable income using a method[14] suggested by Michael Darby (1972). Expected inflation comes from the series derived by Carlson (1977) from the Livingston price-expectations data. Unexpected inflation is simply the difference between the actual and expected rates of inflation. We used a six months' unit of observation because that represented the frequency of the expectations data.

We computed the real after-tax interest rate by first multiplying the long-term Treasury-bond rate by one minus the average personal-income tax rate, and then subtracting the Carlson expected-inflation series. This method implies that the interest-rate variable measures the expected real return rather than that which actually materialized.

The average tax rate[15] represents the ratio of total personal-tax payments to total personal income. We entered this tax rate as a distinct independent variable, as well as using it to construct the after-tax bond rate, because household decisions respond to a whole series of after-tax rates of return and not only to the bond rate. Inclusion of the tax rate as a separate variable captures its effects via these other rates.

VI. Empirical Results

The results of estimating equations (7) and (8), shown in Table 4, are based on a sample of 48 semi-annual observations over the 1955-79 period. The discussion of these results focuses first on the factors thought to influence households' long-run consumption and asset-holding decisions, and then turns to the adjustment of asset portfolios in the short run.

Our previous argument suggested that long-run decisions depend primarily on real tax-adjusted rates of return—and also on uncertainty about both future real income and future asset yields. In the estimating equations, these effects are captured by five principal variables.[16] The real after-tax yield on long-term Treasury bonds proxies for the terms on which households can substitute between present and future consumption through marketable-securities purchases. Although this yield incorporates both the expected inflation rate and the average tax rate, these two variables also are entered into the equations as separate variables because households may hold their savings in other forms besides securities. During the sample period, for example, Regulation Q rate ceilings effectively limited the yields on money and other depository-institution liabilities, so that changes in their real yields mainly reflected changes in the expected rate of inflation. Similarly, the real costs of borrowing for the financing of consumer-durable and home purchases varied in response to tax-rate changes, reflecting the tax-deductibility feature of nominal borrowing costs.

In interpreting the results, one should be aware that the distinction between the effects of expected and unexpected inflation (a proxy for uncertainty) may be less clear-cut in practice than in theory. This is because the expected-inflation series measures the public's inflation expectations at the beginning of each six-month period, which are then probably modified in the light of actual inflation during the period.

Consider first the effects of the three variables which represent the real rates of return on financial assets: the real after-tax interest rate on securities, the expected inflation rate (representing the negative of the real return on money), and the average tax rate (which influences the real cost of household debt). Each of these variables has a significant effect on consumption and asset-purchase decisions, corresponding in most cases with theoretical expectations.

An increase in the real after-tax yield on securities and a decrease in the expected rate of inflation[17]—which corresponds to a rise in the real yield on money and other fixed-rate financial assets—both have the effect of significantly increasing current consumption and reducing total saving. This result implies that the income effects outweigh the substitution effects: the same amount of future consumption requires less current savings when real rates of return are high, so that current consumption increases and saving decreases. Correspondingly, this negative effect on saving of higher bond rates and lower inflation expectations also shows up in the form of a statistically-significant reduction in purchases of financial assets. An increase in the after-tax real rate of return on securities also significantly reduces saving through the purchase of consumer durables; this is what theory would predict.

Economic theory also predicts that expectations of higher inflation will be associated with increased purchases of homes and consumer durables and with a corresponding expansion of debt. This would be expected because more rapid inflation does not affect the real services provided by these tangible assets but reduces the real cost of borrowing to finance their purchase. The results support these predictions, though the relevant coefficients are not statistically significant. This may be because the effects of changes in inflation expectations are confounded with those of changes in average tax rates. When inflation accelerates, households are pushed into higher tax brackets so that the average tax rate rises at the same time.[18] Increases in tax rates and faster inflation both act to reduce the after-tax real interest rate on those financial assets and liabilities which have institutionally fixed nominal interest rates, and hence would be expected to have similar effects on asset purchases.

The results discussed so far have important implications for the current economic situation. Any success achieved by the Administration and Federal Reserve in reducing the current high level of real interest rates would tend to reduce current consumption and increase saving, as households would find they must accumulate more financial assets to achieve given targets for future consumption. Although this effect would be partly offset by increased demand for household durables, the results suggest that there should be a significant increase in the supply of savings available to purchase financial assets and thus to finance both business investment and government deficits.

On the other hand, any success by policy-makers in reducing the rate of inflation could also tend to reduce the supply of financial savings, since households would no longer have to set aside resources to counter the effect of future increases in living costs. However, with inflation slowing, this negative effect could be at least partially offset by the reduced tendency for households to be driven into higher tax brackets through bracket creep. In fact, the effects on consumption and asset purchases of changes in average tax rates—whether brought about by legislation or by inflation—are perhaps the most dramatic of this study's results. As Table 4 shows—and as theory suggests—a higher average tax rate leads to significant increases in debt-financed purchases of homes and consumer durables. This is because higher tax rates reduce the effective cost of borrowing but do not change the real returns to household capital goods which accrue in the form of untaxed consumption services.

Consequently, *reductions* in tax rates should significantly reduce the household sector's claims on the nation's resources for capital in the form of homes, cars and other durables. The corresponding reduction in the demand for consumer and mortgage credit should release funds to finance both business plant-and-equipment purchases and government deficits. This "supply-side" argument for the President's tax-reduction program thus receives strong support from these results.

The equation describing household consumption implies that a reduction in the average tax rate—which increases the real cost of borrowing—also would significantly reduce total consumption and thus increase total savings. This means that a tax cut's tendency to reduce saving in the form of tangible assets would be more than offset by its tendency to discourage household additions to debt liabilities, so that *total* saving would rise. This result suggests that the tax deductibility of interest payments operates as a powerful incentive to both current consumption and tangible-asset purchases, so that lower tax rates would reduce expenditures both on current consumption and on tangible assets. As pointed out earlier, the consumption equation also implies that an increase in the real return on securities would increase consumption and reduce total saving. The difference between the effects of an increase in the real return on securities and a decrease in the average tax rate (i.e., an increase in the real cost of borrowing) apparently can be explained by the fact that tax changes significantly affect household decisions with respect to debt-financed purchases of tangible assets, whereas

Table 4
Regression Results

Independent Variables	Consumption of Nondurables and Services	Purchases of Household Durable Goods	Purchases of Residences	Net Purchases of Financial Assets	Net Increase in Liabilities
	Dependent Variables / Expected Income				
CONTEMPORANEOUS VARIABLES					
Constant	- 0.780	0.308	0.026	2.168	1.723
	(1.838)	(1.502)	(0.122)	(2.436)	(2.088)
Expected Inflation	- 0.326	0.579	0.078	0.577	0.387
	(2.408)	(0.899)	(1.174)	(2.100)	(1.508)
Unexpected Inflation	- 0.260	0.273	0.021	0.360	0.148
	(5.067)	(1.119)	(0.812)	(3.447)	(1.519)
Real After-Tax Interest Rate	0.120	- 0.042	0.024	- 0.144	- 0.042
	(3.669)	(2.711)	(1.490)	(2.208)	(0.693)
Average Tax Rate	0.778	1.192	1.811	- 0.059	3.721
	(2.062)	(6.405)	(9.459)	(0.072)	(4.938)
Unemployment Rate	- 0.00003	- 0.0019	0.002	0.0072	0.007
	(0.024)	(2.828)	(2.868)	(2.428)	(2.665)
LAGGED VARIABLES					
Constant	0.695	- 0.173	- 0.018	- 2.130	- 1.626
	(1.849)	(0.950)	(0.097)	(2.690)	(2.219)
Expected Inflation	0.075	0.063	- 0.140	- 0.317	- 0.320
	(0.593)	(1.049)	(2.243)	(1.228)	(1.329)
Unexpected Inflation	- 0.048	- 0.045	- 0.006	- 0.082	- 0.181
	(0.874)	(1.730)	(0.204)	(0.738)	(1.741)
Real After-Tax Interest Rate	- 0.084	0.014	- 0.0031	0.118	0.046
	(2.522)	(0.906)	(0.188)	(1.713)	(0.715)
Average Tax Rate	- 1.063	0.394	- 0.900	3.418	1.848
	(0.845)	(0.636)	(1.413)	(1.254)	(0.739)
Unemployment Rate	- 0.0011	0.0002	- 0.0002	0.0027	0.0015
	(0.864)	(0.249)	(0.343)	(0.955)	(0.570)
INCOME VARIABLES					
Disposable Income	0.233	0.138	0.038	0.608	0.016
	(3.261)	(3.897)	(1.056)	(3.903)	(0.114)
Lagged Disposable Income	0.802	- 0.070	- 0.004	- 0.363	0.364
	(7.982)	(1.385)	(0.082)	(1.569)	(1.739)
LAGGED DEPENDENT VARIABLES					
Purchases of Household Durables	- 0.702	0.205	0.007	- 0.734	- 1.224
	(1.804)	(4.144)	(0.033)	(0.867)	(1.576)
Purchases of Residences	- 0.754	- 0.471	0.790	- 1.483	- 1.918
	(2.083)	(2.624)	(1.140)	(1,863)	(2.637)
Net Purchases of Financial Assets	- 0.865	0.019	- 0.009	0.377	- 0.478
	(9.031)	(0.402)	(0.176)	(2.996)	(2.504)
Net Increase in Liabilities	1.033	- 0.035	- 0.017	- 0.023	0.958
	(13.44)	(0.906)	(0.430)	(0.128)	(0.263)
DISCREPANCY VARIABLES					
Statistical Discrepancy	1.994	- 0.056	0.039	- 0.957	0.020
	(20.25)	(1.175)	(0.793)	(4.670)	(0.107)
Lagged Statistical Discrepancy	- 0.868	- 0.022	0.043	0.425	0.422
	(6.733)	(0.344)	(0.657)	(1.520)	(1.646)

changes in security yields do not.

We turn now to the effects of unexpected inflation, which (as we argued) should influence behavior by making households more uncertain of their future real incomes and of the real yields on financial assets. The results indicate that unexpected inflation reduces current consumption and increases purchases of financial assets. Concern about the erosion of real incomes and savings by inflation apparently induces households to reduce current consumption in order to accumulate more financial assets for the future. This occurs in spite of the fact that the real return on those assets is also made more uncertain by inflation. There is also some evidence that unexpected inflation encourages households to accept more debt to build up their stocks of consumer durables and homes. This is what economic theory would predict, though these results are not significant at conventional confidence levels.

Although the theoretical distinction between expected and unexpected inflation is difficult to make in practice, both appear to affect household decisions in the same direction. Hence we can conclude with a fair degree of confidence that more rapid inflation discourages current consumption and encourages asset accumulation and debt accumulation. A slowing of inflation should have the opposite effect.

We should consider also the second variable used to capture the effects of uncertainty—the unemployment rate. The empirical results support the premise that more joblessness would make households concerned about their future incomes and thus induce greater saving—although this effect appears to be intertwined with other kinds of effects of higher unemployment levels.

The coefficient on the unemployment rate is negative in the consumer-durable equation and positive in the financial-asset equation, which suggests that unemployment-caused uncertainty induces households to delay purchases of consumer durables and to build up their holdings of financial assets. However, the positive coefficient on unemployment in the residential-capital equation implies, contrary to expectation, that higher unemployment is associated with increased purchases of residences. This effect probably reflects the countercyclical movement of residential construction, which reflects the tendency of market interest rates to decline during recessions, so that mortgage-financing institutions find it easier at such times to attract funds and thus to lower mortgage rates.

We turn now to the evidence with regard to the adjustment of asset-holdings in the short run. This evidence is contained in the coefficients on the variables representing lagged asset purchases. The estimated equations provide support for the basic hypothesis that households do not fully adjust their asset-holdings within a single observation period, which in this study was six months. However, there is less evidence for the additional hypothesis regarding the interdependence of spending decisions among various classes of assets. This may be because the six-month observation period is too long to pick up these short-run considerations.

If households adjusted their asset-holdings instantaneously, each of the "own-adjustment" coefficients would be unity, implying that the coefficients on past purchases [which represent $(1 - \lambda_{mm})$ in Equation (7)] would be zero.[19] Hence, the hypothesis of incomplete adjustment implies that the coefficients on lagged asset purchases would be significantly greater than zero. The hypothesis also implies that the level of current income relative to its expected level will influence asset-purchase decisions: higher-than-expected income levels will induce households to add to their assets or reduce their debts more rapidly than otherwise. The results bear out both of these implications.

Since the own-adjustment coefficients enter the estimated equations in the form $(1 - \lambda_{mm})$, the implied values of λ_{mm} are 0.623 for financial assets,

TABLE 4 (continued)

NOTES

(1) Figures in parentheses are t-statistics. In case of "own-adjustment" coefficients, these test the hypothesis that parameter is different from one. In all other cases, that parameter is different from zero.

(2) Both Current and Lagged Disposable Income are expressed as ratios to current expected income.

(3) All lagged variables, including lagged discrepancy, are multiplied by YE_{t-1} / YE_t

(4) All lagged dependent variables are expressed as ratios to current expected income.

0.042 for financial liabilities, 0.795 for consumer durables and 0.210 for residential capital. These coefficients are of the expected order of magnitude, with stocks of consumer durables and financial assets being adjusted most rapidly, and the residential-capital adjustment taking longer.

In the household-debt equation, the own-adjustment coefficient is small (0.042) and not statistically significant. This suggests that households' debt holdings are essentially a residual item between current income and total outlays, since it implies that changes in debt in any period are unaffected by the events of the preceding period. This interpretation is supported by the fact that the "cross-adjustment" coefficients on lagged purchases of *other* assets are large, negative and statistically significant in the debt equation. These coefficients imply that substantial acquisitions of tangible or financial assets in the preceding six-month period will encourage households to reduce their debt liabilities in the current period. Clearly this is a very plausible result, and strikingly illustrates the interdependence of asset and liability decisions.

However, the only other statistically significant cross-adjustment coefficients in the asset-purchase equations are the negative coefficients on lagged home purchases in the consumer-durable and financial-asset equations. This result—in conjunction with that on the effect of past home purchases on household debt—may mean that households seek to reduce their debt in the period following high levels of home purchases—and hence delay purchases of consumer durables and acquisitions of financial assets.

The lack of instantaneous adjustment of asset-stocks to target levels also implies that asset purchases will depend on the level of current income relative to its expected level. If assets were adjusted instantaneously, variations in current income relative to its long-run expected level would necessitate corresponding variations in current consumption. But the empirical results find that current income significantly affects asset purchases. The large and significant coefficient (0.61) on current income in the financial-asset equation implies that greater-than-expected increases in income are primarily channelled into financial assets. Significant shares also flow into consumer durables (0.14) and current consumption (0.23). Unexpected income changes do not influence decisions to increase or decrease debt liabilities. The large and significant positive coefficient on *lagged* income in the consumption equation implies that unexpected receipts invested in financial assets later find their way into consumption expenditures. The negative coefficient on lagged income in the durables equation suggests that unexpected income gains increase durable-goods expenditures only temporarily: that is, unexpected increases in income lead only to a change in the *timing* of such purchases as households take advantage of higher incomes to make up deficiencies in their tangible-asset stocks more rapidly.

VII. Summary and Conclusions

This article has investigated the effects of inflation, interest rates and taxes on the saving and consumption behavior of households. In our model, the household determines its purchases of various (tangible and financial) assets and consumption goods simultaneously, subject to an overall income constraint. The empirical results suggest that this is a useful way of viewing household behavior, and provide valuable information on the determinants of such purchases, and thus of aggregate saving.

Economic theory suggests that decisions to consume or to save are likely to be influenced by changes in interest rates, inflation and tax rates, but frequently it cannot predict which way these effects will go. The results tell us that increases in real after-tax interest rates on securities tend to encourage current consumption and to discourage purchases of financial assets. Thus, if real interest rates can be brought down from their current high levels, the flow of financial savings available to finance business investment and government deficits should expand.

The direct effect of a reduction in the inflation rate would be an increase in current consumption and a reduction in total saving, because households would not have to set aside funds to offset the ravages of inflation. This impact would be reduced, however, by the fact that fewer households would be driven into higher tax brackets by inflation.

A major finding of the study was a strong association between saving behavior and the personal-tax rate. During the sample period, tax-rate increases stimulated current consumption as well as purchases of homes and consumer durables, and led households to assume more debt to finance these outlays. This finding was predictable: interest payments on household debt are tax deductible, so that higher tax rates reduce the net cost of borrowing to finance both tangible-goods purchases and current consumption. Lower tax rates, whether brought about by legislation or by a slower movement of families into higher tax brackets, conversely should reduce the demands which households make on the nation's resources, both real and financial—and thus should release funds for the financing of business investment and government deficits.

Appendix A

The complete model represented in Equations (7) and (8) is derived in this Appendix. For this derivation it is convenient to write Equations (2), (3), and (4) in matrix form.

$$\frac{S^*_{t+1}}{YE_t} = Ax_t \tag{A1}$$

$$\frac{S_{t+1}}{YE_t} = \frac{q_t}{YE_t} + (I + G_t)(I - \Delta)\frac{S_t}{YE_t} \tag{A2}$$

$$\frac{q_t}{YE_t} = E\left[\frac{S^*_{t+1}}{YE_t} - (I + G_t)(I - \Delta)\frac{S_t}{YE_t}\right] + F\frac{Y_t}{YE_t} \tag{A3}$$

The terms on the left sides of these equations are (M x 1) vectors, x_t is a (K x 1) vector and Y_t/YE_t is a scalar. A, E, and F are respectively (M x K), (M x M) and (M x 1) matrices of coefficients. Finally, G_t and Δ are (M x M) diagonal matrices of capital gains and depreciation rates and I is the (M x M) identity matrix.

By substituting Equation (A1) into Equation (A3) one obtains

$$\frac{q_t}{YE_t} = EAx_t - E(I + G_t)(I - \Delta)\frac{S_t}{YE_t} + F\frac{Y_t}{YE_t} \tag{A4}$$

This is the equation to be estimated after the lagged asset-stock variables have been eliminated. To do this, one begins by taking first differences of this equation:

$$\begin{aligned}\frac{q_t - q_{t-1}}{YE_t} = {} & EAx_t - EAx_{t-1}\frac{YE_{t-1}}{YE_t} \\ & - E(I - \Delta)\left[(I + G_t)\frac{S_t}{YE_t} - (I + G_{t-1})\frac{S_{t-1}}{YE_t}\right] \\ & + F\frac{Y_t - Y_{t-1}}{YE_t}\end{aligned} \tag{A5}$$

Lagging (A2) one period, rearranging terms, and adding G_tS_t/YE_t to both sides yields:

$$(I + G_t)\frac{S_t}{YE_t} - (I + G_{t-1})\frac{S_{t-1}}{YE_t} = \frac{q_{t-1}}{YE_t} + \frac{G_tS_t}{YE_t} - (I + G_{t-1})\Delta\frac{S_{t-1}}{YE_t} \tag{A6}$$

Notice that the left side of this equation appeared in the second term on the right side of Equation (A5). Also, by lagging (A4) one period and solving for S_{t-1}/YE_t one obtains

$$\frac{S_{t-1}}{YE_t} = (I + G_t)^{-1}(I - \Delta)^{-1}E^{-1}\left[EAx_{t-1}\frac{YE_{t-1}}{YE_t} + F\frac{Y_{t-1}}{YE_t} - \frac{q_{t-1}}{YE_t}\right] \tag{A7}$$

When (A7) is substituted into the last term on the right side of (A6) and the result into the second term on the right side of (A5), one finally obtains

$$\begin{aligned}\frac{q_t - q_{t-1}}{YE_t} &= EAx_t + (E\Delta A - EA)x_{t-1}\frac{YE_{t-1}}{YE_t} \\ &+ F\frac{Y_t}{YE_t} + (E\Delta E^{-1}F - F)\frac{Y_{t-1}}{YE_t} \\ &- E(I - \Delta)\frac{G_tS_t}{YE_t} - \left[E(I - \Delta) + E\Delta E^{-1}\right]\frac{q_{t-1}}{YE_t}\end{aligned} \tag{A8}$$

The first component of the vectors x_t and x_{t-1} in Equation (A8) represents the constant term. It is convenient to show this component separately and to write (A8) in slightly different form:

$$\begin{aligned}\frac{q_t}{YE_t} &= Ea + (E\Delta a - Ea)\frac{YE_{t-1}}{YE_t} \\ &+ E\bar{A}\bar{x}_t + (E\Delta\bar{A} - E\bar{A})\bar{x}_{t-1}\frac{YE_{t-1}}{YE_t} \\ &+ F\frac{Y_t}{YE_t} + (E\Delta E^{-1}F - F)\frac{Y_{t-1}}{YE_t} \\ &- E(I - \Delta)\frac{G_tS_t}{YE_t} \\ &+ \left[I - E(I - \Delta) - E\Delta E^{-1}\right]\frac{q_{t-1}}{YE_t}\end{aligned} \tag{A9}$$

where a is the first column of the matrix A, $\bar{A}$ is the matrix A with the first column omitted, and $\bar{x}$ is the vector x with the first component omitted. This matrix equation corresponds to the system of equations (7) in the text of this article.

The corresponding equation for consumption is now readily derived. Since all income not used to acquire assets necessarily is allocated to consumption:

$$\frac{C_t}{YE_t} = \frac{Y_t}{YE_t} - u'\frac{q_t}{YE_t} \tag{A10}$$

where u is a (M x 1) vector of 1's.

Hence, the consumption equation is obtained by substituting (A9) into (A10) which yields, after some rearranging of terms,

$$\begin{aligned}\frac{C_t}{YE_t} = & - u'Ea - u'(E\Delta a - Ea)\frac{YE_{t-1}}{YE_t} \\ & - u'E\bar{A}\bar{x}_t - u'(E\Delta\bar{A} - E\bar{A})\bar{x}_{t-1}\frac{YE_{t-1}}{YE_t} \\ & + (1 - u'F)\frac{Y_t}{YE_t} + u'(F - E\Delta E^{-1}F)\frac{Y_{t-1}}{YE_t} \\ & + u'E(I - \Delta)\frac{G_tS_t}{YE_t} \\ & - u'\left[I - E(I - \Delta) - E\Delta E^{-1}\right]\frac{q_{t-1}}{YE_t}\end{aligned} \qquad \text{(A11)}$$

The coefficients on the current-income terms in Equations (A9) and (A11) sum to one, and all other coefficients sum to zero. These accounting restrictions must be satisfied by the estimated coefficients.

Appendix B

The theoretical derivation of the model implies that the estimated coefficients satisfy certain ''adding up'' restrictions (Appendix A). Single-equation ordinary least-squares estimation satisfies these restrictions automatically. However, if the data are transformed to cope with autocorrelation, the restrictions must be imposed on the estimation process. This was achieved by an iterative process.

First the M + 1 equations were estimated by single-equation ordinary least squares and the residuals used to compute initial estimates of the autocorrelation coefficient for each equation, ρ_m (m=1,..., M+1). These coefficients were used to transform both the dependent and each of the independent variables to the form $y_t - \rho_m y_{t-1}$. After this transformation of variables, a typical equation appears thus:

$$v_m = \sum_{i=1}^{I} \zeta_{mi} z_{mi} + \sum_{j=1}^{J} \theta_{mj} w_{mj} \qquad (m = 1, 2, \ldots, M+1) \qquad \text{(B1)}$$

In these equations v_m represents the m^{th} dependent variable after autoregressive transformation, while z_{mi} and w_{mj} represent the similarly transformed independent variables in the m^{th} equation. Since the autocorrelation coefficients are different between equations, these transformed independent variables also differ. The coefficients on each of the z_{mi} sum to one across equations while those on each of the w_{mj} sum to zero. Thus:

$$\sum_{m=1}^{M+1} \zeta_{mi} = 1, \quad \sum_{m=1}^{M+1} \theta_{mj} = 0 \qquad \begin{matrix}(i=1, 2, \ldots, I)\\(j=1, 2, \ldots, J)\end{matrix} \qquad \text{(B2)}$$

Using these restrictions, the $(M + 1)^{th}$ equation may be written as

$$v_{M+1} = \sum_{i=1}^{I}\left[1 - \sum_{m=1}^{M}\zeta_{mi}\right] z_{M+1i} - \sum_{j=1}^{J}\sum_{m=1}^{M}\theta_{mj} w_{M+1j} \qquad \text{(B3)}$$

Rearranging terms and multiplying by -1 transforms this last equation thus:

$$\sum_{i=1}^{I} z_{M+1i} - v_{M+1} = \sum_{i=1}^{I}\sum_{m=1}^{M}\zeta_{mi} z_{M+1i} + \sum_{j=1}^{J}\sum_{m=1}^{M}\theta_{mj} w_{M+1i} \qquad \text{(B4)}$$

Notice that when written in this form, the coefficients of this $(M + 1)^{th}$ equation are the sums of the coefficients of the other M equations.

The complete system of M + 1 equations consisting of B1 and B4 may be written in matrix form as:

$$\begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_m \\ \vdots \\ v_M \\ z_{M+1}u - v_{M+1} \end{bmatrix} = \begin{bmatrix} z_1 & 0 & \cdots & 0 & \cdots & 0 & w_1 & 0 & \cdots & 0 & \cdots & 0 \\ 0 & z_2 & \cdots & 0 & \cdots & 0 & 0 & w_2 & \cdots & 0 & \cdots & 0 \\ \vdots & \vdots & & \vdots & & \vdots & \vdots & \vdots & & \vdots & & \vdots \\ 0 & 0 & \cdots & z_m & \cdots & 0 & 0 & 0 & \cdots & w_m & \cdots & 0 \\ \vdots & \vdots & & \vdots & & \vdots & \vdots & \vdots & & \vdots & & \vdots \\ 0 & 0 & \cdots & 0 & \cdots & z_M & 0 & 0 & \cdots & 0 & \cdots & w_M \\ z_{M+1} & z_{M+1} & \cdots & z_{M+1} & \cdots & z_{M+1} & w_{M+1} & w_{M+1} & \cdots & w_{M+1} & \cdots & w_{M+1} \end{bmatrix} \begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \vdots \\ \zeta_m \\ \vdots \\ \zeta_M \\ \theta_1 \\ \theta_2 \\ \vdots \\ \theta_m \\ \vdots \\ \theta_M \end{bmatrix}$$

where z_m and w_m represent the vectors of transformed independent variables in the m^{th} equation, ζ_m and θ_m the corresponding vectors of coefficients, the 0's represent appropriately-dimensioned vectors of zeros, and u is a (I x 1) vector of 1's.

This matrix equation represents one observation for each of M + 1 separate equations, each having (I + J) independent variables. However, it also may be interpreted as representing M + 1 observations for a single equation having M x (I + J) independent variables. Hence the method of ordinary least squares may be applied to the complete system to generate new estimates of the parameters. Since the adding-up restrictions are incorporated in the form of the equations, the estimated parameters will satisfy those restrictions. Moreover, these parameter estimates do not depend on which equation in the original system is treated as the $(M + 1)^{th}$.

Having generated these new parameter estimates, the equation residuals were used to obtain revised estimates of the autocorrelation coefficients. A new set of transformed variables was constructed and the process repeated until the parameter estimates stabilized.

FOOTNOTES

1. This corresponds to the concept of saving used in the flow-of-funds accounts, rather than to that in the national income and product accounts, in which purchases of consumer durables are treated as part of consumption but purchases of houses as part of saving.

2. As it happens, the assumption that the household is averse to risk is necessary but not sufficient to demonstrate that greater uncertainty with regard to its future income will cause the rational household to save more. For a discussion of a sufficient condition—in the context of a complete analysis of the effects of various kinds of uncertainty on saving decisions—the reader is referred to Sandmo (1970).

3. For a complete analysis see Sandmo (op. cit.) p. 357.

4. In the following discussion, liabilities will be regarded as negative assets and hence not separately distinguished.

5. Since expenditures on assets are defined gross of depreciation, income must also be defined gross in order to preserve this identity. This is done in the flow-of-funds accounts, but in the national income accounts personal income is defined net of depreciation on owner-occupied housing.

6. See, for example, David Backus and Douglas Purvis (1980).

7. The method used is an adaptation of one originally suggested by Houthakker and Taylor (1966).

8. In Equations (7) and (8), the term $g_{jt}S_{jt}$ represents capital gains accruing on the j^{th} asset. Only in the case of equities are data available on these gains. Preliminary tests disclosed that this variable had no significant effect on consumption or on asset purchases. The economic interpretation of this result would be that—at least initially—households leave capital gains invested in the assets in which they accrue. Hence this variable was excluded from the remaining analysis.

9. The reader not interested in econometric and data issues may skip this and the following section and proceed directly to the empirical results in Section VI.

10. Since the adding-up conditions imply that the autocorrelation coefficient should be the same in each of the M + 1 equations, this finding suggests that the "true" autocorrelation process is more complex than the simple first-order one assumed here.

11. The household sector includes non-profit institutions, and the "residential capital" category also includes a small amount of plant and equipment owned by these institutions.

12. With liabilities treated as negative assets.

13. This definition implies another restriction on the parameters, namely

$$\sum_{m=1}^{M+1} \gamma_m = 1$$

14. In this method expected income in period t is defined by the equation

$$YE_t = bY_t + (1 - b)(1 + \beta_2 + 2\beta_3 t) YE_{t-1}$$

The value of b is estimated by Darby to be 0.1 using quarterly data. The values of β_2 and β_3 are derived from the regression

$$\text{Log } Y_t = \beta_1 + \beta_2 t + \beta_3 t^2$$

The initial value of YE_t is exp (β_1). For complete details the reader is referred to Darby (1972).

15. A more appropriate variable would be the *marginal* rather than the average tax rate, but data on this variable were not readily available.

16. The method of eliminating the asset stocks from the equations means that the lagged values of these five variables also enter the estimating equations. However, the coefficients on these lagged values represent complicated transformations of the contemporaneous coefficients with no obvious economic interpretation. In Table 4, these coefficients are separated from those of primary concern.

17. The coefficients on expected inflation represent the effects of a change in inflation on the dependent variables, assuming that all other independent variables remain unchanged. One of these other variables is the real interest rate, so that this assumption implies that changes in the inflation rate induce corresponding changes in *nominal* interest rates on bonds so that *real* rates remain unchanged. Over an observation period as long as six months, this assumption appears highly plausible. However, the reader who prefers not to make this assumption may compute the effect of a change in the expected rate of inflation as the coefficient on expected inflation minus the coefficient on the interest rate. In no case does this procedure alter the conclusions of this section. Similar considerations apply to the effects of changes in tax rates.

18. The effects of tax-rate changes—which may be caused by legislation or by inflation-induced bracket creep—are discussed below.

19. This ignores the effect of the depreciation rate, but is approximately true if that rate is small. See Appendix A.

REFERENCES

Backus, David and Purvis, Douglas. "An Integrated Model of Household Flow-of-Funds Allocations," **Journal of Money, Credit and Banking**, Volume 12, Number 2 (May 1980).

Bisignano, Joseph. "The Effect of Inflation on Savings Behavior," **Economic Review**, Federal Reserve Bank of San Francisco (December 1975).

Board of Governors of the Federal Reserve System, **Flow of Funds Accounts**, various issues.

Carlson, John A. "A Study of Price Forecasts," **Annals of Economic and Social Measurement**, Volume 6, Number 1 (Winter 1977).

Darby, Michael R. "The Allocation of Transitory Income Among Consumers' Assets," **American Economic Review**, Volume LXII, Number 5 (December 1972).

Houthakker, H. S. and Taylor, Lester D. **Consumer Demand in the United States, 1929-1970**, Cambridge, Mass: Harvard University Press (1966).

Juster, F. Thomas and Wachtel, Paul. "Inflation and the Consumer," **Brookings Papers on Economic Activity**, Number 1 (1972).

Motley, Brian. "Household Demand for Assets: A Model of Short-Run Adjustments," **The Review of Economics and Statistics**, Volume LII, Number 3 (August 1970).

Purvis, Douglas D. "Dynamic Models of Portfolio Behavior: More on Pitfalls in Financial Model Building," **American Economic Review**,. Volume 68, Number 3 (June 1978).

Sandmo, A. "The Effect of Uncertainty on Savings Decisions," **Review of Economic Studies**, Volume 37 (1970).

Wachtel, Paul. "A Model of Interrelated Demand for Assets by Households," **Annals of Economic and Social Measurement**, Volume 1, Number 1 (April 1972).