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by

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In recent years, most of the major industrialized countries have adopted some form of monetary growth target as a guide or intermediate objective of monetary policy. For all but the United States, this approach has involved picking one aggregate from the two or more "money supply" totals regularly compiled, and focusing policy primarily on that measure. The aggregates thus selected range from very narrow (Swiss monetary base) to very broad (U.K. sterling M3). A puzzling feature common to most industrialized countries in recent years (1979-1981) is the markedly divergent behavior of the various monetary aggregates in each country, which made the setting, implementation, and interpretation of a growth target for a particular monetary aggregate extremely difficult. In general, narrow monetary aggregates grew much more slowly than did broader monetary aggregates. The U.S. experience in 1981 is an example of this phenomenon: in the twelve months to December, M1-B (shift adjusted) increased only 3-1/2 percent while M2 rose 10 percent. There are much more dramatic examples in foreign countries. Between December 1979 and December 1980, M1 in the United Kingdom grew 6-1/2 percent and sterling M3 increased nearly 20 percent; during the same period, Swiss M1 actually fell slightly while M2 rose 13-1/2 percent.

In this paper, recent monetary growth in the United States, Japan, Germany, the United Kingdom, Canada, and Switzerland is examined. The implications of the general pattern of divergent monetary growth rates are then discussed. Perhaps the two most dramatic instances of divergent monetary growth in recent years occurred in the United Kingdom and Switzerland. The U.K. and Swiss cases are particularily interesting because these two countries have taken their monetary growth targets quite seriously in recent years, and because in the U.K. case the targeted aggregate was the one showing buoyant growth. In this paper, disaggregated demand for money functions derived in separate studies (Howard and Johnson) are used to examine in detail the U.K. and Swiss experiences. It is concluded that although the behavior of interest rates played an important role in the determination of the paths of the monetary aggregates in the United Kingdom and Switzerland, several other factors also were operating. The disaggregated demand functions, by allowing differential adjustment speeds, impact effects, and structural shifts, enable the analyst to assess more accurately the forces at work during recent years.

I. Historical Experience

In Table 1, annual monetary growth rates in the United States, Japan, Germany, the United Kingdom, Canada, and Switzerland are presented for the 1979-1981 period. The general pattern mentioned earlier in this paper is clear: in every country included in the table, growth of the narrow monetary aggregate (M1) is exceeded by that of the wider aggregate. The differences in growth rates vary and at times are substantial.

Divergent monetary growth is not necessarily remarkable; different trend growth rates can, of course, produce such a result. However, when monetary aggregates are used as indicators and/or targets of monetary policy, divergent monetary growth across aggregates may create problems for the setting, implementation, and interpretation of monetary policy. For example, in Canada, Germany, and Switzerland, consumer prices rose in each of the twelve-month periods reported in Table 1 at a rate in between the rates of growth of narrow and broad money. Thus if one used the rate of growth of the "real" money supply as a criterion, one could characterize recent monetary policy in those three countries as being either restrictive -- using a narrow monetary aggregates measure -- or expansionary -- using a wider measure. For Japan, the United Kingdom, and the United States, such a criterion is ambiguous in one or two of the years reported in Table 1.[1/] Alternatively, one might look at the direction of the change in money growth from one interval to the next as an indication of tightening (if growth slows) or easing (if growth

Table 1

Monetary Growth in Major Industrialized Countries

		Percentage Change over Twelve Months Earlier		
		December 1979	December 1980	December 1981
U.S.:	M1-B (shift adjusted)	7.1	6.6	3.4
	M2	8.2	9.0	10.0
Japan:	M1	3.0	-1.7	10.8
	M2	9.2	7.5	11.1
Germany:	M1	3.9	4.4	-0.9
	M2	8.2	8.8	8.4
U.K.:	M1	8.7	6.4	8.1
	STGM3	12.4	19.9	13.7
Canada:	M1	3.3	10.2	-2.4
	M2	17.7	16.0	16.9
Switzerland:	M1	-7.0	-0.2	-7.3
	M2	12.2	13.7	12.6

increases). By this criterion, monetary policy in the United States and the United Kingdom was tighter in 1980 than it was in 1979 if the narrow aggregate is used, but easier if the broad measure is the standard. This is again the case for the United States in comparing 1981 to 1980. Just the opposite is true for Canada for 1979 to 1980 and for the United Kingdom from 1980 to 1981.

For the most part, M1 excludes interest-bearing deposits while the broader aggregates include such deposits. This fact suggests that the general increases in nominal interest rates in recent years may be largely responsible for the generally sluggish growth of (primarily non-interest-bearing) M1 relative to the growth of the broader monetary aggregates. However, many other factors are also likely to have been at work, and it is necessary to examine these possible influences systematically before any conclusions can be drawn. In this paper, the monetary experiences of two countries -- the United Kingdom and Switzerland -- are studied, and the roles played by the various factors are ascertained. The experiences of the other four countries discussed in this section are beyond the scope of the present paper.

II. Divergent Monetary Growth

One implication of divergent monetary growth is that the decision concerning which particular monetary aggregate to use as an intermediate target is an important one. Extensive analysis is required before the aggregate and its target are chosen. Furthermore, after the aggregates policy is underway, it is necessary to monitor developments for any behavioral changes induced by the new policy which may have a bearing on the choice of target(s).2/ In fact, when rates of growth diverge for the various measured aggregates as much as they have in recent years, the implementation, as well as justification, of a monetary policy focused on the path of the money stock may be called into question. For both the policymaker and the outside observer the usefulness of the rate of money growth, or changes in the rate of money growth, as an indicator of monetary policy is lessened when different measures of money growth provide different signals.

The 1980 experience of the United Kingdom is an example of the policy problem that can result when one measure (sterling M3) is growing rapidly while another (M1) is growing slowly. The fact that sterling M3 was expanding so rapidly was used as evidence by some critics that the Bank of England was not pursuing a tight monetary policy. The slow growth of M1 led others to claim that the Bank of England was tightening monetary policy. The British experience in 1980 is particularly interesting because in 1980 the United Kingdom was in a severe and prolonged recession. Since sterling M3 was the U.K.'s targeted aggregate and its 1980 growth exceeded the target by a wide margin, achievement of the monetary growth target presumably would have implied a significant tightening of policy during a recession. In fact, the British authorities accepted the overshooting and justified this decision in part by referring to the much slower growth of M1. A similar policy dilemma confronted the U.S. monetary authorities in 1981. David Lindsey, of the Federal Reserve Board's staff, states (p. 12) the problem succintly:

> The other major episode in which M1-B has strayed from its annual range has been in 1981, when it has generally been below its lower bound. However, M2 has been near or above its upper bound in every month since February. Is one to conclude that the [monetary authorities] should have expanded nonborrowed reserves more rapidly over this period in an attempt to attain the lower bound for M1-B sooner, but in so doing drive M2 above its upper bound? Or should growth of nonborrowed reserves have been more restrained so as to bring M2 well within its range, but in the process forcing M1-B further below its lower bound?

The fact that the monetary aggregates of a particular country are growing at widely differing rates means that as the aggregation proceeds from the narrowest to the broadest measure, at least some of the assets that are included at each step are behaving very differently from those already included. One possible explanation for this divergent behavior is that different economic processes are determining the paths of the individual components of the monetary aggregates. This explanation suggests that the components are not homogeneous, that the aggregates defined over them are somewhat arbitrary, and, therefore, that one would not necessarily expect such aggregates, per se, to play a stable role in the transmission mechanism through which monetary policy affects the economy or to be suitable as intermediate targets for policy. Alternatively, widely divergent behavior among the assets may result from failure to recognize that two assets are very close substitutes and that a small change in the own rate of return on one asset relative to that of the other induces very large shifts in portfolios. If the process of aggregation at some point includes one of these assets and not the other, the aggregate so defined may vary a great deal without that variation having any implications for the future path of nominal income. In order to know whether this is the case, one must have detailed information about the demand for money function and the mechanism that links monetary developments to nominal income.

In order to resolve the ambiguities resulting from the disparate behavior of the various aggregates, it is necessary first to understand what is causing this behavior, and then to examine the questions of appropriate definitions for the aggregates and the proper role of the aggregates in monetary policy formulation. Since divergent behavior over time of the aggregates clearly must indicate even more divergent behavior for at least some of the component assets, and since the current definitions of the aggregates also are in question, it would seem that the appropriate way to proceed is to explore the properties of the individual component assets. In general, these assets are currency in the hands of the public, demand deposits, and one or more categories of time deposits.3/

In order to compare the properties of these assets and to understand how a given set of market conditions can induce very different responses in different assets, it is necessary to estimate the demand function for each asset. These demand functions have interacted over time with the money supply process (including policy actions) and external economic forces to produce the observed path of the outstanding stocks of monetary assets. With such estimated functions, one can compare interest rate responses across assets in order to see if and in what way interest rate changes are a suitable explanation for the recently observed divergence of the aggregates. On the basis of the resulting estimated coefficients, it is possible to infer whether two assets are similar in their response to changes in the rate of return on some third asset (and are therefore somewhat homogeneous). It is also possible to look directly for the very high cross-rate elasticities that can signal the presence of very close substitution between two assets.4/ In addition, disaggregated demand functions allow the analyst to identify the roles of various other factors such as differential adjustment speeds, structural changes, and rates of return on other assets, including assets denominated in foreign currencies, in determining the behavior of the components of the monetary aggregates.

Elsewhere this disaggregated approach is used to estimate demand functions for monetary assets in the United

Kingdom and Switzerland (see the papers by Howard and by Johnson). The experiences of these two countries are especially relevant to the issues being raised in this paper because growth rates of the monetary aggregates in each country have diverged sharply in recent years (see Table 1) and because during the 1970s both the British and Swiss monetary authorities adopted monetary aggregate growth rates as the intermediate target for monetary policy. Moreover, these two examples should provide insights into the general problem of explaining divergent growth among monetary aggregates.

III. The Demand for Monetary Assets

A. Methodology

In the general case, there are n assets, a_i, $i = 1, \ldots, n$, where a_i is the real value of the stock of asset i, and each asset has an expected rate of return, R_i. There are n demand functions:

$$(1) \qquad a_i^* = \alpha_{i0} + \sum_{j=1}^{n} \alpha_{ij} R_j + \alpha_{iy} y + u_i, \qquad i = 1, \ldots, n$$

where the asterisk denotes what demand for a_i would be if adjustment to changes in the various right-hand-side variables were complete in one period, y is a scale variable such as real income, and the u_i are error terms. In order to allow for partial adjustment, it is specified that:

$$(2) \qquad a_i - a_{i_{-1}} = \lambda_i (a^*_i - a_{i_{-1}}) + w_i, \qquad i = 1, \ldots, n$$

where the subscript denotes a lag of one period, the λ_i are the adjustment parameters, and the w_i are error terms. Equations (1) and (2) can be combined to yield:

$$(3) \qquad a_i = \alpha_{i0}\lambda_i + \sum_{j=1}^{n} \alpha_{ij}\lambda_i R_j + \alpha_{iy}\lambda_i y + (1 - \lambda_i)a_{i_{-1}} + \lambda_i u_i + w_i, \qquad i = 1, \ldots, n.$$

Thus in general the demand functions are of the form:

$$(4) \qquad a_i = \beta_{i0} + \sum_{j=1}^{n} \beta_{ij} R_j + \beta_{iy} y + (1 - \lambda_i)a_{i_{-1}} + v_i, \; i = 1, \ldots, n.$$

Equation (4) is a standard specification of a demand for money function and is the specification used in this study for the demand for monetary assets in the United Kingdom and Switzerland. In some instances, it is necessary to supplement this equation with a trend term and variables representing various structural changes.

In this study, two of the alternatives to domestic currency denominated monetary assets are considered to be foreign currency denominated notes and coin, that is, foreign currency, _per se_, and foreign currency denominated Eurodeposits. It is useful to examine the nature of the expected nominal rates of return in these cases: the expected nominal return on foreign notes and coin is simply the expected rate of appreciation of the foreign currency, and that on Eurodeposits is the sum of their nominal rate of interest and the expected appreciation. Thus, if asset n - 1 is a foreign currency Eurodeposit and asset n is foreign notes and coin,

$$R_{n-1} = r + e,$$
$$R_n = e,$$

where r is the nominal rate of interest on the Eurodeposit and e is the expected rate of appreciation of the foreign currency. Equation (4) can be rewritten as:

$$(5) \qquad a_i = \beta_{i0} + \sum_{j=1}^{n-2} \beta_{ij}R_j + \beta_{i,n-1}r + (\beta_{i,n-1} + \beta_{in})e$$
$$+ \beta_{iy}y + (1 - \lambda_i)\, a_{i_{-1}} + v_i, \quad i = 1, \ldots, n.$$

In equation (5), the coefficients of r and e are expected to be negative for all assets denominated in domestic currency.

Since e is not observable, a proxy for it must be used. Several alternative measures for e are used in this study. One possible method is a calculation of e based on the actual path of the exchange rate, which enables equation (5) to be estimated directly. Another specification for such a proxy is $e = R_{n-2} - r$, where R_{n-2} is the interest rate on a bank deposit similar to

a_{n-1} but denominated in domestic currency. In this case equation (5) becomes:

$$(6)\qquad a_i = \beta_{i0} + \sum_{j=1}^{n-3} \beta_{ij}R_j + (\beta_{i,n-2} + \beta_{i,n-1} + \beta_{in})R_{n-2}$$

$$-\beta_{in}r + \beta_{iy}y + (1 - \lambda_i)a_{i_{-1}} + v_i, \qquad i = 1, \ldots, n.$$

In equation (6), the coefficients of R_{n-2} and r are predicted to be negative and positive, respectively, for all assets denominated in domestic currency other than a_{n-2}, and indeterminate and positive, respectively, for that asset. Note that in equation (6) the coefficient on r refers to the effect of the rate of return on foreign notes and coin (asset n), not to that of a foreign currency denominated Eurodeposit (asset n-1). Alternatively, Richard Meese and Kenneth Rogoff argue that the best predictive model of the exchange rate is a random walk time series model. If such a model is used to generate exchange rate expectations, then e = 0 and equation (5) becomes:

$$(7)\qquad a_i = \beta_{i0} + \sum_{j=1}^{n-3} \beta_{ij}R_j + \beta_{i,n-2}R_{n-2} + \beta_{i,n-1}r$$

$$+ \beta_{iy}y + (1 - \lambda_i)a_{i_{-1}} + v_i, \qquad i = 1, \ldots, n.$$

In contrast to equation (6), in equation (7) the coefficients of R_{n-2} and r are both negative for domestic currency assets other than a_{n-2}, and positive and negative, respectively, for a_{n-2}. In addition, in equation (7), the coefficient of r refers to the effect of the rate of return on foreign currency Eurodeposits rather than that of foreign notes and coin as in equation (6).

The two main British monetary aggregates -- M1 and sterling M3 -- can be separated into three components: currency, sight deposits (M1 less currency), and other bank deposits (sterling M3 less M1); the two main Swiss aggregates -- M1 and M2 -- similarly can be decomposed into currency, demand deposits (M1 less currency), and term deposits (M2 less M1).5/ In this study, nonbank demand functions for these six monetary assets are estimated and analyzed. Demand functions based on equation (4), in which a and y are specified to be natural logarithms unless otherwise stated, are estimated using a two-stage least-squares technique. The data used in this study are not seasonally adjusted; thus seasonal binary variables are included in the equations. The estimated equations reported in this paper are selected on the basis of the behavior of the error terms and the signs and significance levels of the coefficients, although variables that figure prominently in most demand for money formulations are included regardless of the signs and t-ratios of their estimated coefficients.6/ (See the papers by Howard and by Johnson for more extensive discussions of the estimating procedures used to obtain the equations reported in this study.)

B. The United Kingdom

The "basic" U.K. demand for monetary assets function is specified to include a constant term, the lagged dependent variable, a representative three-month nominal interest rate, the natural logarithm of real GDP, three binary seasonal variables, and, in the demands for sight deposits and other bank deposits, a binary variable reflecting a major change in the method of classifying bank deposits which was instituted in the second quarter of 1975. The dependent variable is the natural logarithm of the real value of the monetary asset. There are several additional variables that might be expected to belong in these demand functions, including other rates of return and various binary variables representing the operation of the Bank of England's supplementary-special-deposits (SSD) scheme (a system of quantitative limits on the expansion of banks' interest-bearing liabilities). An SSD variable in a demand for money function can be interpreted as representing changes in rates of return (implicit as well as explicit) -- other than those specifically included in the function -- which are attributable to the SSD scheme's effects on bank behavior.

As reported elsewhere (Howard), the only supplementary variable added to the basic demand for currency equation is a linear trend term. In the sight deposit equation, the supplementary variables are a binary variable (SSD4) representing each of the three SSD episodes (1974:Q1-1975:Q1, 1976:Q4-1977:Q3, and 1978:Q2-1980:Q2) and the expected rate of change of the exchange rate, proxied by the actual rate of change of the dollar-sterling exchange rate during the subsequent three-month period.7/ For the demand for sterling bank deposits other than sight deposits, a binary variable (SSD5) representing the entire period during which the SSD scheme was available as a policy instrument (1974:Q1-1980:Q2) and the expected nominal yield on equities (including expected capital gains as proxied by the actual outcome) are added to the basic demand function. Table 2 presents the estimated equations, excluding the coefficients of the seasonal variables.

For present purposes, there are three interesting features of the equations reported in Table 2.8/ First, the demands for the two components of M1 display negative interest rate coefficients, and, although the coefficient for currency is not statistically significant, that for sight deposits has a very large t-ratio in absolute value -- 5.440. On the other hand, the demand for other bank deposits, that is, the demand for those deposits that are included in sterling M3 but not in M1, has a positive interest rate coefficient, although its t-ratio is only 0.891. The negative interest sensitivity of the M1 components as well as the positive interest sensitivity of the demand for those assets in sterling M3 but not in M1 strongly suggest that interest rate developments can have an important role in explaining divergent monetary growth, particularly during a period of substantial interest rate changes. Another interesting feature of the Table 2 estimates is the presence of the SSD4 and SSD5 variables. For the second quarter of 1980, these variables equal unity but in the third quarter, that is, after termination of the SSD scheme, they become zero. The negative coefficients reported in the table indicate that the removal of the Bank of England's "corset" -- that is, the SSD scheme -- had important

Table 2

Estimated U.K. Demand for Monetary Assets Equations: 1973-1980

	Sterling M3		
	M1		
Variable	Currency	Sight Deposits	Other Bank Deposits
Constant	-4.001 (1.882)	-0.004 (1.614)	9.735 (4.939)
Lagged Dependent Variable	0.811 (0.117)	0.897 (0.062)	0.677 (0.110)
Local Authority 3-month Interest Rate	-0.192 (0.140)	-0.697 (0.137)	0.262 (0.198)
Real GDP	0.557 (0.232)	0.100 (0.179)	-0.638 (0.392)
Deposit Classification Variable		0.004 (0.015)	-0.069 (0.025)
Expected Rate of Dollar Appreciation		-0.078 (0.036)	
Expected Rate of Return on Equities			-0.031 (0.014)
SSD4		-0.035 (0.011)	
SSD5			-0.045 (0.020)
Trend	-0.003 (0.001)		
$\bar{R}^2$	0.912	0.939	0.972
SE	0.017	0.020	0.029
h	-0.696	-1.012	-1.496
n	32	32	32

Note: Figures in parentheses are the standard errors. The above equations also include seasonal binary variables. Sight deposits include some interest-bearing bank liabilities, such as overnight money, as well as non-interest-bearing demand deposits; other bank deposits are interest bearing and include certificates of deposit. The rates of return used for the U.K. estimates are expressed as decimals; in the Swiss estimates they are expressed in percentage points. Therefore the U.K. rate-of-return coefficients are 100 times greater than comparable Swiss coefficients.

implications for the demand for bank deposits. Therefore, any explanation of the U.K.'s monetary performance in 1980 must take the effects of the termination of the SSD scheme into account. Finally, the significant exchange rate expectations effect in the sight deposit equation is quite interesting because of its implication that U.K. nonbanks appear to engage in some form of "currency" substitution in the sense that when there is a change in expectations about exchange rate changes, U.K. nonbank residents adjust their demand for sterling denominated sight deposits.[9/] Following the discussion of equation (5), the lack of significance of the Eurodollar interest rate and the significance of the exchange rate expectations term would appear to indicate that the relevant substitute for sterling denominated sight deposits is foreign notes and coin only, not Eurodollar deposits.[10/] (It should be noted that a binary variable representing the operation of British exchange and capital controls has no impact on the estimated equations.) Furthermore, the significance of the exchange rate effect in the sight deposit equation means that the behavior of the dollar-sterling exchange rate is another potentially important factor contributing to the recent divergence in U.K. monetary growth.

In Charts 1 and 2 the actual and predicted paths of M1 and sterling M3 are plotted; the predicted values are those implied by the estimated currency, sight deposits, and other bank deposits equations reported in Table 2. The closeness of the fit, especially in the turbulent 1979-1980 period, is heartening and means that the

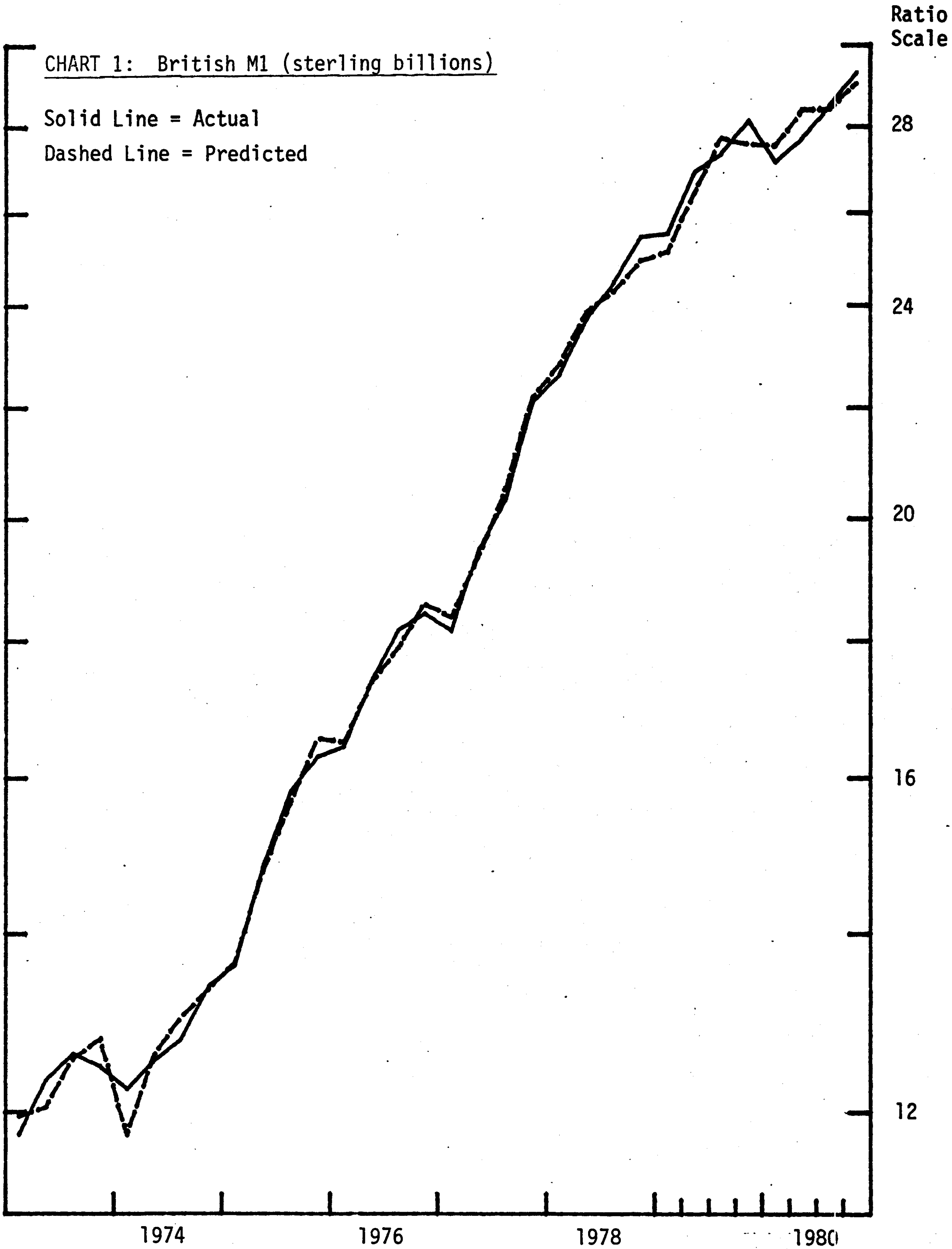


CHART 1: British M1 (sterling billions)
Solid Line = Actual
Dashed Line = Predicted
Ratio Scale
28
24
20
16
12
1974
1976
1978
1980

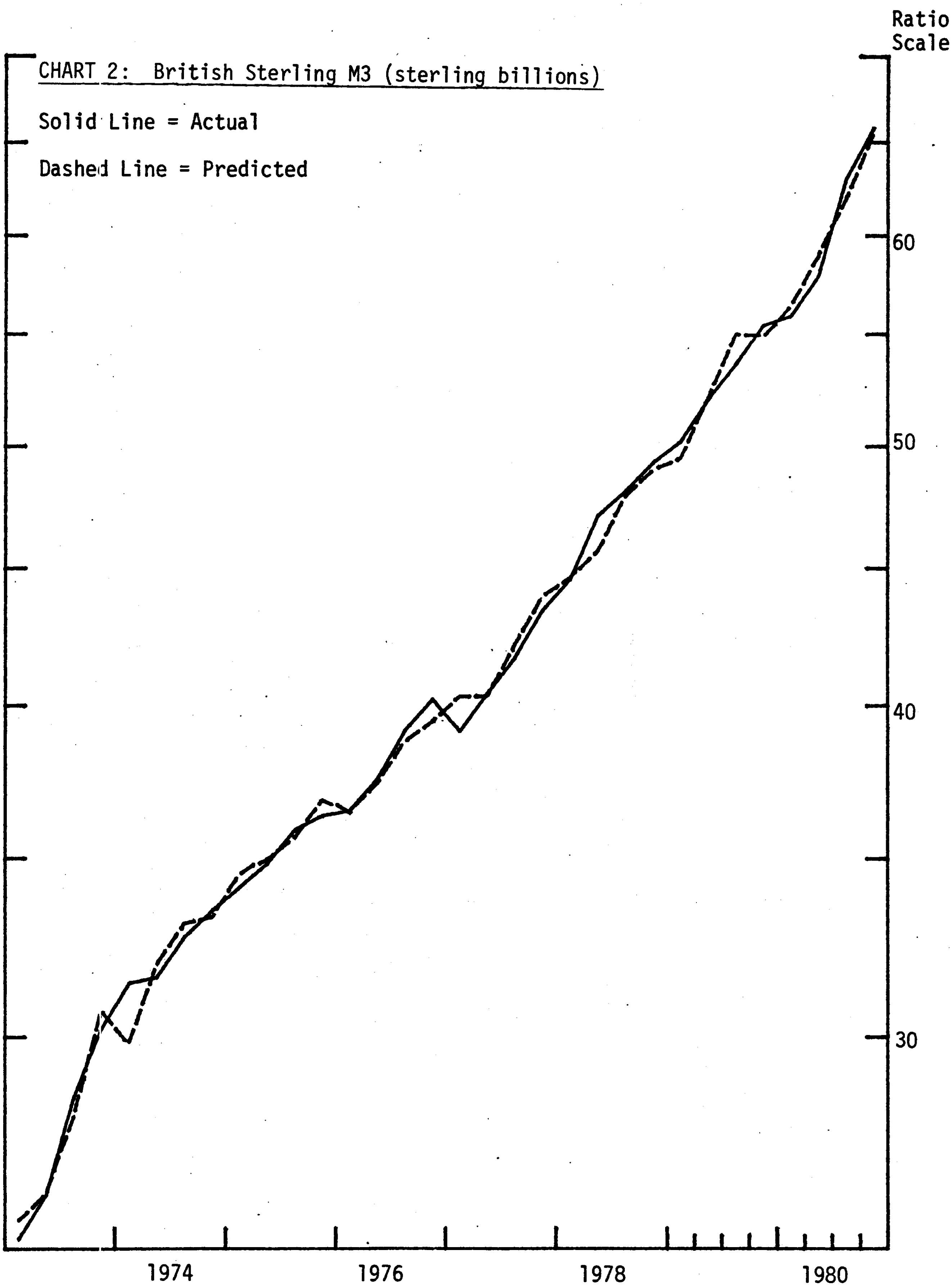


CHART 2: British Sterling M3 (sterling billions)
Solid Line = Actual
Dashed Line = Predicted
Ratio Scale
60
50
40
30
1974
1976
1978
1980

explanatory variables included in the Table 2 equations constitute a reasonably complete list of the factors contributing to the pattern of British monetary growth in 1979-1980.

C. Switzerland

In the Swiss case, the volume of retail sales is used as the scale variable because Swiss GNP is available on an annual basis only. There is little to be gained from converting the monthly retail sales data to quarterly averages and so monthly observations are used to estimate the Swiss equations. The volume of retail sales would seem to be a good choice for the scale variable in the currency demand equation, but perhaps is less suitable in the demands for the other assets. Except for the currency equation, the dependent variable and retail sales variable are natural logarithms of the real value of the variable; in the currency equation, these variables are levels of the real value. Each of the Swiss equations includes eleven binary seasonal variables.

In Table 3, the estimated equations -- derived and discussed in Johnson -- for the Swiss nonbank demands for currency, demand deposits, and term deposits are presented. Two domestic short-term bank interest rates, the rate on thrift accounts and the rate on three-month term deposits in Zurich banks, are used as measures of the opportunity cost involved in holding currency and demand deposits, respectively. The term deposit rate is, of course, used as the own rate in the demand for term deposits. The three-month Eurodollar interest rate is included in all three equations and in the term deposit equation the expected rate of dollar appreciation -- proxied by the annualized actual rate of change in the dollar-Swiss franc exchange rate in the subsequent three months -- is included also.

A possible source of the divergent growth of the narrow and broad Swiss monetary aggregates is a structural change in one or more

Table 3

Estimated Swiss Demand for Monetary Assets Equations: 1973-1980

Variable	M2 / M1 / Currency	M2 / M1 / Demand Deposits	M2 / Term Deposits
Constant	16.973 (6.753)	0.858 (0.236)	2.369 (0.429)
Lagged Dependent Variable	0.778 (0.063)	0.843 (0.043)	0.519 (0.082)
Thrift deposit interest rate	-0.791 (0.194)		
3-month term deposit interest rate		-0.012 (0.003)	0.037 (0.009)
3-month term deposit rate 1978-1980			0.048 (0.015)
3-month Eurodollar rate	0.106 (0.057)	0.0016 (0.0015)	-0.0046 (0.0034)
Expected rate of dollar appreciation			-0.0006 (0.0003)
Real Retail Sales	4.055 (2.262)	0.159 (0.082)	-0.049 (0.220)
Trend		0.0004 (0.0002)	-0.0007 (0.0007)
$\bar{R}^2$	0.969	0.974	0.978
S.E.	0.864	0.022	0.036
h	0.291	0.952	1.109
n	96	96	66

Note: Figures in parentheses are standard errors. The above equations also include monthly binary variables. Unlike the other equations, the currency demand equation is not in logarithmic form. Term deposit equation is estimated over the interval June 1975-December 1980 because monthly data on term deposits are not available for January 1973-April 1975. These components are as defined in the Swiss National Bank Monthly Bulletin, except that the label "term deposits" is used to refer to the component "quasi-money", which includes in addition to term deposits foreign currency deposits held by Swiss residents at Swiss banks. The rates of return are expressed in percentage points; see note to Table 2.

of the underlying behavioral functions. The extraordinary appreciation of the Swiss franc during 1978 suggests the possibility that at about that time some major shift in the demand for Swiss franc assets occurred. However, of the three equations reported in Table 3, there is a significant shift in an interest rate coefficient in the term deposit equation only. Finally, trend terms are included in both deposit equations.

In Table 3 both currency and demand deposits are significantly inversely related to short-term Swiss interest rates, but superior results are obtained when different rates are used in each.11/ Term deposits are positively related to the (own) short-term rate, and there is strong evidence of a shift to even greater interest elasticity in early 1978. These three assets display quite different speeds of adjustment, with term deposits completing approximately one half of the response to a change in interest rates in the first month. Charts 3 and 4 show the paths of actual M1 and M2 and the fitted values over the sample period that are implied by the equations reported in Table 3. The closeness of the fit suggests that the forces identified in the estimated equations can account for the divergent behavior of M1 and M2 during the sample period.

The Eurodollar rate appears positively in both the currency and demand deposit equations and in each its coefficient is about one-eighth the magnitude of the Swiss interest rate coefficient. The t-ratio for the Eurodollar rate is much higher in the currency equation. (Recall that only the currency equation reflects the response of nonresident as well as resident asset-holders to the opportunity to substitute foreign currency assets for Swiss currency and vice

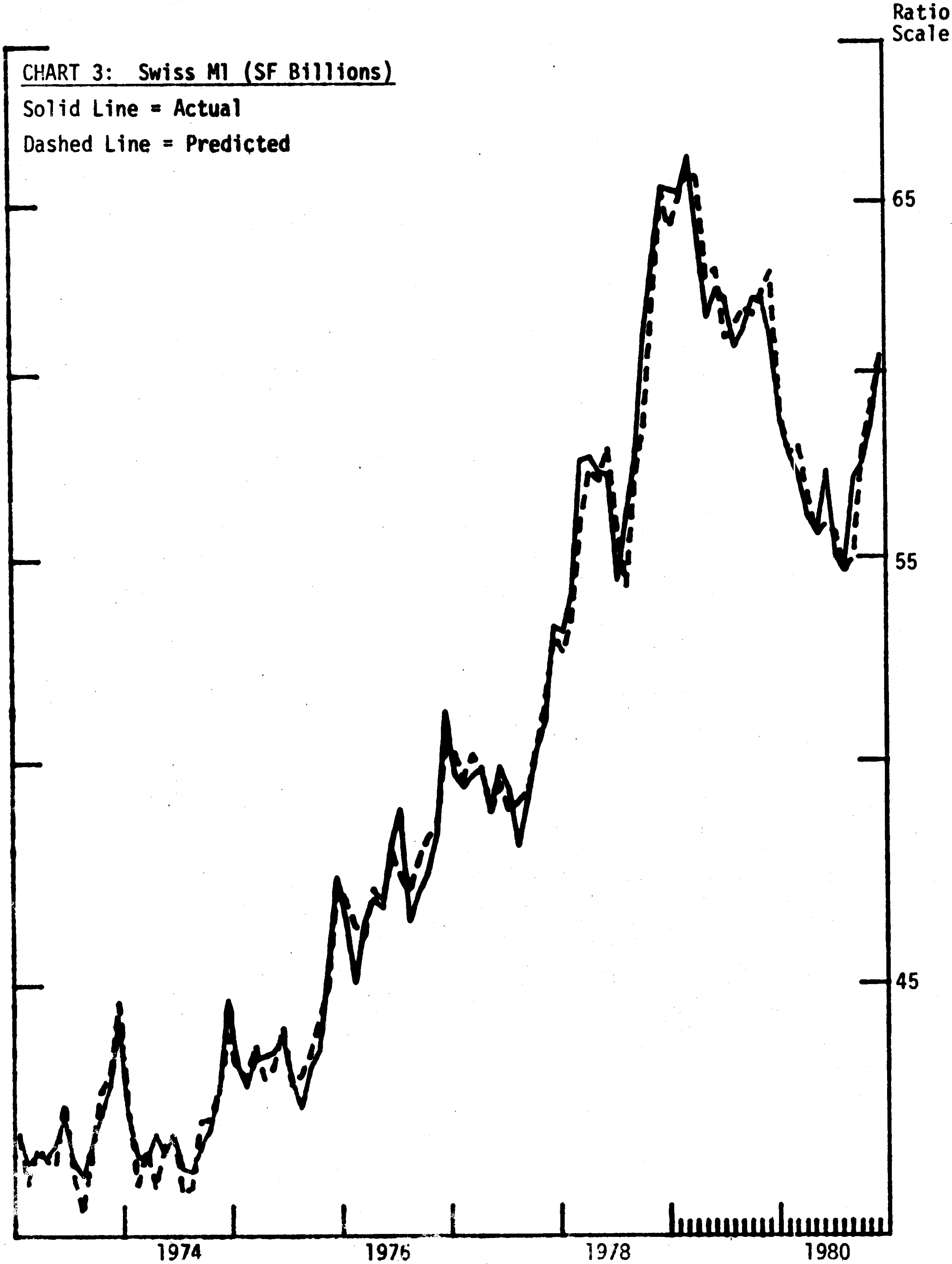
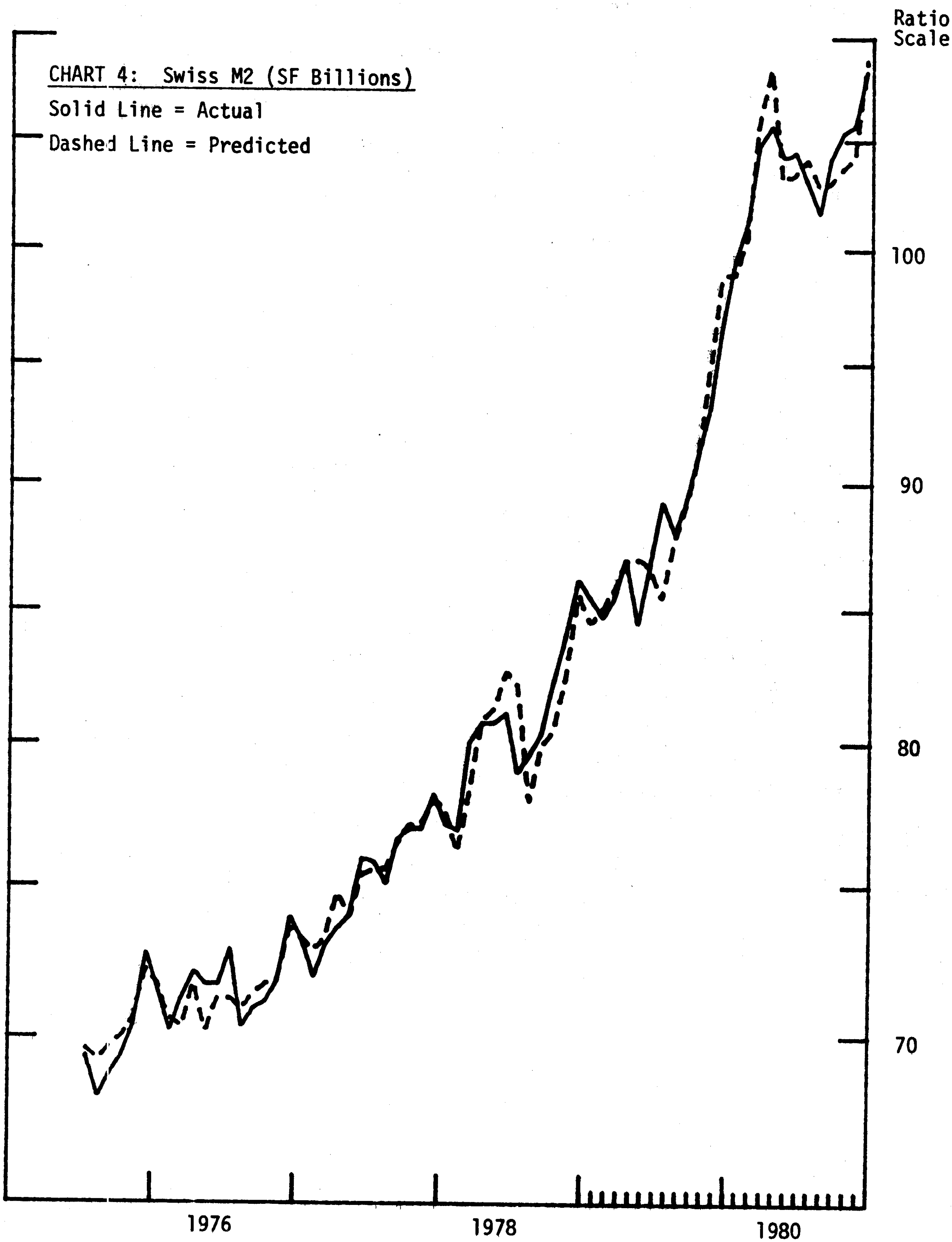


CHART 3: Swiss M1 (SF Billions)
Solid Line = Actual
Dashed Line = Predicted
Ratio Scale
65
55
45
1974
1976
1978
1980


Ratio Scale
CHART 4: Swiss M2 (SF Billions)
Solid Line = Actual
Dashed Line = Predicted
100
90
80
70
1976
1978
1980

versa.) Following the discussion of equations (5) - (7), the positive signs of the coefficients for the Eurodollar rate in the currency and demand deposit equations suggest that the relevant foreign currency substitute is foreign currency, per se, rather than foreign currency denominated interest-bearing bank deposits. In contrast, the negative coefficient for the Eurodollar rate in the term deposit equation along with the negative coefficient for the exchange rate expectations variable indicates that Eurodollar deposits, and perhaps dollar currency as well, are relevant substitutes for term deposits. This interpretation of the coefficients is interesting but, unfortunately, it implies that exchange rate expectations proxies differ across equations. Nevertheless, the roles of the external variables in all three of the Swiss monetary assets equations suggest that currency substitution between Swiss francs and foreign currency denominated monetary assets cannot be dismissed. Further work on this question in both the Swiss and U.K. cases is warranted, particularly with regard to measuring the expected rate of exchange rate appreciation; expansion of the set of possible currencies might also be useful.[12/]

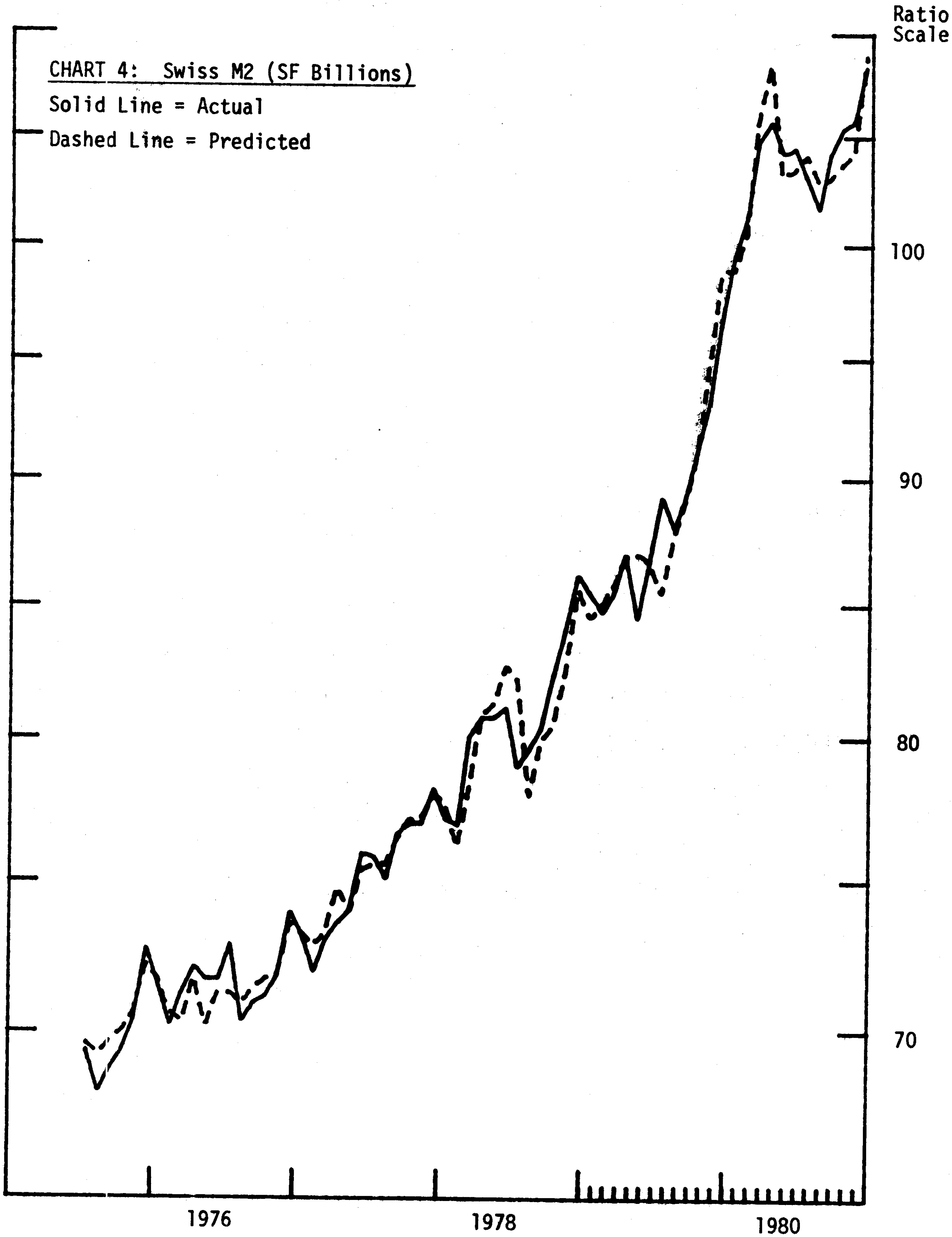


CHART 4: Swiss M2 (SF Billions)
Solid Line = Actual
Dashed Line = Predicted
Ratio Scale
100
90
80
70
1976
1978
1980

versa.) Following the discussion of equations (5) - (7), the positive signs of the coefficients for the Eurodollar rate in the currency and demand deposit equations suggest that the relevant foreign currency substitute is foreign currency, per se, rather than foreign currency denominated interest-bearing bank deposits. In contrast, the negative coefficient for the Eurodollar rate in the term deposit equation along with the negative coefficient for the exchange rate expectations variable indicates that Eurodollar deposits, and perhaps dollar currency as well, are relevant substitutes for term deposits. This interpretation of the coefficients is interesting but, unfortunately, it implies that exchange rate expectations proxies differ across equations. Nevertheless, the roles of the external variables in all three of the Swiss monetary assets equations suggest that currency substitution between Swiss francs and foreign currency denominated monetary assets cannot be dismissed. Further work on this question in both the Swiss and U.K. cases is warranted, particularly with regard to measuring the expected rate of exchange rate appreciation; expansion of the set of possible currencies might also be useful.[12]

D. Summary and Comparison

The results shown in Tables 2 and 3 confirm the appropriateness of estimating separate equations for each component asset. The two components of M1 in each country are inversely related to short-term interest rates, but to differing extents. While in the U.K. currency demand equation the interest rate coefficient is not significant, it is impressively so in the Swiss equation; in both cases, demand or sight deposits are significantly negatively related to interest rates. In each country the M1 component assets combine with assets that are positively related to the short-term interest rate to form the broader aggregates of sterling M3 and Swiss M2. Since the speed of adjustment (as measured by the coefficient for the lagged dependent variable) differs across the components as well, the interest rate response of the broader aggregates results from the complex interaction of all these factors in both the United Kingdom and Switzerland.

In addition to the differences in estimated interest elasticities, the demand functions for the component assets in each country reflect different structural shifts during this period (as measured by the differential effects of the SSD variables for the United Kingdom and by the significant shift of the interest rate coefficient in one equation in the Swiss case). A trend variable is present significantly in one U.K. function and one Swiss function. For both countries the effects of other variables, such as the expected rate of return on equities, the expected exchange rate change, and the interest rate on foreign-currency deposits, differ importantly across the estimated demand functions as well. The degree of disaggregation in this study is limited by the availability of data.13/ It may be that even further disaggregation, if possible, would reveal additional differences in the structure of the underlying demand functions.

IV. The Responsiveness Over Time of British and Swiss Money Demands to Changes in Interest Rates

The demand for monetary assets functions reported in the preceding section do not provide directly a simple measure of the interest rate semi-elasticity of the demands for narrow and broad money. This is the case primarily because the monetary aggregates are the sum of the component assets for which demand functions are estimated in this study. Since percentage change (i.e., change in natural logarithms) is not a linear operator, the percentage effect of a change in the interest rate on M1, for example, does not equal the sum of the estimated coefficients of the effects on currency and demand (sight) deposits. In the Swiss case, the fact that the currency equation is estimated in level form while the deposit equations are in logarithmic form further complicates the calculation of an elasticity measure from the estimated coefficients reported in Tables 2 and 3. Furthermore, because of the lagged adjustment specification, the effect of a change in the domestic interest rate is distributed over time. There is an initial impact effect and then continued additional effects until the long run is reached and adjustment is complete.

Altogether these various factors mean that the equations reported above imply that there is no single constant interest rate semi-elasticity. In this paper, in order to obtain some sense of the size of the net impact of a change in the interest rate on the narrow and broad aggregates, the estimated equations are used to calculate the effects over time on the component assets of a change in the interest rate. The implied effects on the monetary aggregates are then computed and expressed as a percentage deviation from the actual level so that an elasticity-like number is obtained.

In the U.K. case, the actual path of money is compared to that implied by the equations if the U.K. local authority rate (and, implicity, foreign interest rates 14/) had been 1 percentage point lower than the actual path starting in 1979:Q3.15/ The effect of the change -- expressed as a percentage deviation -- is traced through to the end of 1980 in Table 4. The effects by the end of the six quarters are an M1 some 2-1/2 percent higher than actual M1 and a sterling M3 about 1/2 percent higher than the actual sterling M3 outcome. Thus interest rates have a substantial effect on the U.K. demand for M1, but only a small effect on sterling M3 demand. The modest interest sensitivity of sterling M3 is attributable to the positive interest elasticity in the demand for the bank deposits that are included in sterling M3 but not in M1.

For Swiss M1 and M2, the hypothetical path is calculated starting in January 1979. In this calculation, the thrift deposit rate, term deposit rate, and Eurodollar rate are postulated to have values 1 percentage point lower than their actual historical values. Table 4 also presents the percentage deviations implied by the estimated equations for such an interest rate path. The lower level of term deposits implied by the lower interest rates dominates the higher level of M1 and produces an absolute decline in M2 (from the historical path) throughout the 24-month period. Because the full effect of the lower rates is approached much sooner for term deposits than for the

Table 4

Effect of a 1 Percentage Point Decrease in Interest Rates

United Kingdom:

Quarter	Percentage Deviation in M1	Percentage Deviation in Sterling M3
1 (1979:Q3)	0.5	0.1
3	1.4	0.4
6	2.4	0.7

Switzerland:

Month	Percentage Deviation in M1	Percentage Deviation in M2
1 (January 1979)	0.9	-1.1
5	3.3	-1.7
10	4.6	-1.8
15	5.0	-4.3
20	5.2	-4.3
24	5.2	-3.9

other components (owing to the differences in adjustment parameters), the continued increases in M1 during the last third of the period cause the percentage effect of the lower interest rates on M2 to decline toward the end of the period.

V. Conclusion

In this paper, the recent behavior of the monetary aggregates in several of the major industrialized countries is examined, and the pattern of markedly slower growth of narrow money relative to the growth of broad money in each country is discussed. Two interesting examples -- the United Kingdom and Switzerland -- are chosen for closer analysis. It is found that the behavior of interest rates is an important factor in determining the behavior of narrow and broad monetary growth. Between mid-1979 and mid-1980, short-term nominal interest rates in both the United Kingdom and Switzerland rose some 5 percentage points. Thus it is clear that an important part of the explanation of the recent divergence in monetary growth rates has been the behavior of interest rates. The disaggregated demand for monetary assets functions that are used in this study enable the analyst to model some of the complexity of the process by allowing adjustment speeds and interest rate elasticities to differ across monetary assets. The implicit demand for money equations thus exhibit a more detailed transmission mechanism between interest rates and the monetary aggregates than would equations estimated using the narrow or broad monetary aggregates directly. It is found that variables other than interest rates also contributed importantly to the determination of recent monetary growth in the United Kingdom and Switzerland; it is noteworthy that in both countries these additional explanatory variables include structural shifts (the removal of the Bank of England's supplementary-special-deposits scheme in the U.K. case) and external variables such as exchange rate expectations.

One of the interesting features of recent monetary experience in the major industrialized countries is the problem confronting policymakers when divergent monetary growth transmits conflicting signals about the restrictiveness of monetary policy. The empirical results reported in this paper indicate that the demand functions for the narrow monetary aggregates in the United Kingdom and Switzerland are quite sensitive to interest rate changes. Whether this interest sensitivity constitutes a problem for the use of M1 as a monetary target or indicator depends on the nature of the interest rate effect involved as well as on the relationship between M1 and ultimate policy goals. If the interest rate effect is simply reflecting a shift between close substitutes that happen to fall on different sides of the dividing line between narrow and broad money, then perhaps a more useful monetary aggregate would include the substitutes; that is, a measure broader than M1 would be appropriate. In present circumstances, however, the broader aggregates include more than just very close substitutes for sight deposits: in the U.K. case, certificates of deposit and time deposits of all sizes are included in sterling M3; in Switzerland, term deposits of all sizes and maturities are included in M2. Thus, it might well be the case, in the United Kingdom and Switzerland, that M1 is too narrow and the broader aggregates are too broad to be useful as monetary targets or indicators. In this regard, it is interesting to note that the Bank of England is now collecting data on "retail deposits" in order to be able eventually to construct and publish a monetary aggregate somewhere in between M1 and sterling M3,16/ and that the Swiss National Bank switched from an M1 target to a monetary base target in part because of the problems with M1 that are discussed in this paper.

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Footnotes

*/ International Finance Division, Federal Reserve Board. This paper represents the views of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or other members of its staff. We would like to thank our colleagues in the International Finance Division for their many helpful comments and suggestions.

1/ The sign of the rate of growth of real money is not a satisfactory criterion for monetary policy because, among other things, it does not take trend rates of monetary growth into consideration and ignores income growth. The real money criterion can be misleading -- e.g., during a hyperinflation, when velocity is increasing rapidly, negative real money growth does not necessarily imply a restrictive monetary policy -- and is used here for illustrative purposes only.

2/ On the general point that significant changes in behavioral relationships can be induced by changes in policy, see Robert Lucas.

3/ This disaggregated approach to the estimation of demand for money equations is used in the Federal Reserve Board's monthly model. See Helen Farr for a summary of the Federal Reserve Board's model. An early version of a disaggregated monthly model is reported in Thomas Thomson, James Pierce, and Robert Parry. For an alternative approach see Myron Slovin.

4/ However, measurement and collinearity problems often make it difficult to estimate these cross-rate elasticities with much reliability or precision.

5/ In the United Kingdom, M1 consists of sterling denominated notes and coin in circulation with nonbanks (including, presumably, some nonresidents) plus sterling sight deposit liabilities of U.K. banks held by the U.K. nonbank private sector (that is, U.K. residents only). In addition to demand deposits, sight deposits include money at call and money placed overnight, which are interest bearing. Sterling M3 consists of M1 plus all other sterling deposit liabilities (including certificates of deposit) of U.K. banks held by U.K. nonbank residents, including the public sector. In Switzerland, M1 consists of Swiss franc notes and coin in circulation (including that held by nonresidents) plus Swiss franc sight deposits held by residents at Swiss banks. M2 adds to these Swiss franc term deposits plus foreign currency deposits held by residents at Swiss banks.

6/ In most cases, a t-ratio of 2 or more is used as the criterion for statistical significance, although there are some exceptions made to this rule of thumb.

7/ Under rational expectations, this measure should differ from the true expected rate of exchange rate change by an error term that is independent of information available at the time of the observation. The error will not, however, be independent of the asset demands and rates of return being determined simultaneously. The expected rate of exchange rate change (as measured by the actual change) is treated in this study as an endogenous variable.

8/ See Howard for a more detailed discussion of the equations.

9/ Recent papers on currency substitution include Marc Miles, Lance Girton and Don Roper, Bruce Brittain, Michael Bordo and Ehsan Choudhri, and Ronald McKinnon. See also Rudiger Dornbusch, and others.

10/ The Eurodollar interest rate has a t-ratio of less than unity in absolute value when added to the equations reported in Table 2. See Howard for further discussion of the evidence of currency substitution as well as possible alternative explanations for these results.

11/ Note that the Swiss currency equation is in levels, not natural logarithms, and that the estimated coefficients must be interpreted accordingly.

12/ Other empirical studies have included external variables in the demand for money in some countries. See, for example, the papers by Michael Hamburger and by James Boughton.

13/ The U.K. data now separate interest-bearing and non-interest-bearing sight deposits, but these data are not available for the entire sample period.

14/ This implicit assumption is made so that it is reasonable to leave the path of the exchange rate term unchanged.

15/ Because of the nature of the calculation, the result depends on the starting points as well as the subsequent actual paths of the component assets over the interval. This, of course, is also true for the Swiss case.

16/ William Allen presents the definition being used for retail deposits.