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Alternative Measures of the Monetary Base

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BECAUSE this Bank has long considered the monetary base an important variable in economic analysis, it has published monetary base data since August 1968 and has published numerous articles explaining the derivation of the monetary base and its uses in monetary analysis.[1] Several months ago, the Board of Governors of the Federal Reserve System (BOG) began publishing monetary base data in their H.3 and H.9 Statistical Releases and in the Federal Reserve *Bulletin*. Beginning on March 16, 1979, they published two monetary base series: a *level* series which did not incorporate the effects of reserve requirement changes and a *growth rate* series which incorporated such effects. Since the St. Louis series is adjusted for these effects, this Bank designated it the "Adjusted Monetary Base" to facilitate a clearer public differentiation between the alternative monetary base levels then being published. On June 15, 1979, the BOG began publishing the adjusted monetary base from which their previously published growth rate series had been derived.

There are several important differences among the various monetary base series now being published. This article explains the key distinctions between the series in order to clarify the public's understanding of these differences.

Computation of the Unadjusted Monetary Base: Similarities and Differences

The St. Louis unadjusted base and the unadjusted monetary base initially published by the BOG have much in common. The basic components of both are (1) member bank deposits at Federal Reserve Banks and (2) currency in circulation, which consists of currency held by the nonbank public and vault cash in commercial banks. Also, as shown in Table I, the largest "source" of the unadjusted monetary base is Federal Reserve holdings of Government securities, which accounts for about 80 percent of the total.

Two minor ways in which computation of the St. Louis and the BOG unadjusted monetary base differ are in the methods of (1) treatment of member bank vault cash and (2) seasonal adjustment of data. They differ primarily in the degree of emphasis placed on the "sources" relative to the "uses" of the monetary

[1]This Bank publishes monetary base data in its weekly publication, "U.S. Financial Data," and its monthly publication, "Monetary Trends." See also Leonall C. Andersen and Jerry L. Jordan, "The Monetary Base — Explanation and Analytical Use," this *Review* (August 1968), pp. 7-11; Albert E. Burger, Lionel Kalish III, and Christopher T. Babb, "Money Stock Control and Its Implications for Monetary Policy," this *Review* (October 1971), pp. 6-22; Albert E. Burger, "Explanation of the Growth of the Money Stock: 1974-Early 1975," this *Review* (September 1975), pp. 5-10; Albert E. Burger, "The Relationship Between Monetary Base and Money: How Close?" this *Review* (October 1975), pp. 3-8; Leonall C. Andersen, "Selection of a Monetary Aggregate for Economic Stabilization," this *Review* (October 1975), pp. 9-15; Anatol B. Balbach and Albert E. Burger, "Derivation of the Monetary Base," this *Review* (November 1976), pp. 2-8; Albert E. Burger and Robert H. Rasche, "Revision of the Monetary Base," this *Review* (July 1977), pp. 13-23; and Leonall C. Andersen and Denis S. Karnosky, "Some Considerations in the Use of the Monetary Aggregates for the Implementation of Monetary Policy," this *Review* (September 1977), pp. 2-7.

Table I

Sources and Uses of the Unadjusted Monetary Base[1]

(Millions of Dollars)

Sources[2]		Uses	
Federal Reserve Credit		Member Bank Deposits at Federal Reserve Banks	$ 29,844
Holdings of Government Securities	$114,963	Currency in Circulation	
Discounts and Advances	1,396	Currency Held by the Public	101,700
Float	6,407	Vault Cash of Banks	14,100
Other Federal Reserve Assets	6,288	Unadjusted Monetary Base	$145,644
Other Sources of Monetary Base			
Gold Stock	11,328		
Special Drawing Rights	1,800		
Treasury Currency Outstanding	12,349		
Treasury Deposits at Federal Reserve Banks	—3,270		
Treasury Cash Holdings	— 378		
Foreign Deposits with Federal Reserve Banks	— 284		
Other Liabilities & Capital Accounts	—4,293		
Other Federal Reserve Deposits	— 662		
Unadjusted Monetary Base	$145,644		

[1]Monthly averages of daily figures for June 1979, not seasonally adjusted.

[2]The sign attached to each item indicates its direction of influence on the monetary base. For example, the item Treasury deposits at Federal Reserve Banks has a negative sign attached to it because an increase in these deposits reduces bank reserves and currency held by the public.

base (Table I). In general, these differences result in only small divergences between the growth rates of the two unadjusted monetary base series, as shown in Table II.

Vault Cash — The BOG unadjusted monetary base series includes the vault cash that member banks can use to meet their reserve requirements in the current week. Under the present system of lagged reserve accounting, this consists of vault cash held by member banks two weeks earlier (the member bank vault cash component of member bank reserves as reported in the Federal Reserve *Bulletin*). Since the St. Louis unadjusted monetary base is computed from a balance sheet identity (the sources of the base equal its uses), the current week's member bank vault cash appears in this series.

Seasonal Adjustment — The monetary base is "used" by commercial banks as member bank reserves and vault cash held by nonmember banks, and is also "used" by the nonbank public as currency. These items represent the *demand* for the base. The Board of Governors seasonally adjusts each of these three use components of the base separately, then totals them to obtain its unadjusted monetary base. In contrast, the Federal Reserve Bank of St. Louis focuses on the "sources" of the monetary base, which reflect the factors that change the total amount of base *supplied* to the public and banks. Consequently, the source components of the base are first totalled (with appropriate sign), then this total is seasonally adjusted.

The Rationale for Adjusting the Monetary Base for Changes in Reserve Requirements

The monetary base has three main characteristics that make it useful in monetary analysis. First, it comprises the set of assets that constrain the amount of money supplied to the public. Second, it can be measured and controlled on a short-term basis by the Federal Reserve. Finally, it can be used as a summary measure of the *net* effect of Federal Reserve actions on the money stock.[2]

The monetary base incorporates the effects of two of the three major direct Federal Reserve actions that influence the money stock: open market operations (changes in Federal Reserve holdings of Government

[2]In the Report of the Advisory Committee on Monetary Statistics, "Improving the Monetary Aggregates," Board of Governors of the Federal Reserve System (June 1976), p. 8, the Advisory Committee on Monetary Statistics acknowledged the importance of the monetary base, noting that "it is the total among those considered here that can probably be most accurately measured and most precisely controlled by the Fed [and] . . . this total does have the great advantage of being less subject to influence by financial innovations than are broader totals. Hence, we recommend that the Fed regularly publish figures on the base . . ."

Table II

Growth Rates of the St. Louis and Board of Governors Unadjusted Monetary Base Series: Selected Periods of Reserve Requirement Changes

(Compounded Annual Rates)

Period	St. Louis Unadjusted Monetary Base Series	Board of Governors Unadjusted Monetary Base Series[1]	Difference
II/62-I/63	1.7%	1.6%	0.1%
I/63-II/66	5.4	5.4	0.0
II/66-IV/66	5.4	5.7	−0.3
IV/66-II/67	3.8	4.2	−0.4
II/67-IV/67	7.2	7.0	0.2
IV/67-I/68	9.0	8.7	0.3
I/68-I/69	7.1	7.0	0.1
I/69-II/69	6.0	6.2	−0.2
II/69-III/69	1.5	2.8	−1.3
III/69-IV/69	7.6	6.7	0.9
IV/69-III/70	5.6	5.9	−0.3
III/70-I/73	6.4	6.3	0.1
I/73-IV/73	9.8	10.1	−0.3
IV/73-I/77	6.3	6.2	0.1
I/77-III/78	8.8	8.9	−0.1
III/78-I/79	12.2	12.0	0.2

[1]These growth rates are computed from the levels of monetary base initially published by the Board of Governors in the March 16, 1979 Statistical Release H.3.

Table III

Growth Rates of the St. Louis Adjusted and Unadjusted Monetary Base Series: Selected Periods of Reserve Requirement Changes

(Compounded Annual Rates)

Period	St. Louis Adjusted Monetary Base Series	St. Louis Unadjusted Monetary Base Series	Difference	Amount of Reserves Released by Changes In Legal Reserve Requirement Ratios
II/62-I/63	4.3%	1.7%	2.6%	$ 770
I/63-II/66	5.8	5.4	0.4	0
II/66-IV/66	3.5	5.4	−1.9	−865
IV/66-II/67	5.9	3.8	2.1	850
II/67-IV/67	6.8	7.2	−0.4	0
IV/67-I/68	7.3	9.0	−1.7	−550
I/68-I/69	6.5	7.1	−0.6	0
I/69-II/69	3.0	6.0	−3.0	−660
II/69-III/69	3.6	1.5	2.1	0
III/69-IV/69	5.4	7.6	−2.2	−415
IV/69-III/70	6.4	5.6	0.8	0
III/70-I/73	8.0	6.4	1.6	3,700
I/73-IV/73	7.6	9.8	−2.2	−1,315
IV/73-I/77	8.3	6.3	2.0	4,135
I/77-III/78	9.3	8.8	0.5	0
III/78-I/79	8.0	12.2	−4.2	−3,000

securities) and Federal Reserve Bank loans to member banks. However, it excludes the effects on the monetary aggregates of the third major direct policy action, changes in legal reserve requirement ratios. *If the monetary base is to be used as a measure that summarizes the effects of all Federal Reserve actions on the monetary aggregates, the effects of reserve requirement changes must also be included in the computation of the base.*

If legal reserve requirement ratios were never changed and were uniform for all banks and all sizes of deposits, growth rates of both an adjusted and an unadjusted monetary base would be virtually the same. For example, there were no changes in legal reserve requirement ratios that noticeably affected required reserves from I/63 to II/66 and from I/77 to III/78. During these periods, the growth rates of all of the monetary base series, both adjusted and unadjusted, were approximately the same (Tables II and III).

However, whenever legal reserve requirement ratios are changed, the growth rates of a monetary base that incorporates these effects and one that does not incorporate these effects usually diverge markedly. This is what happened, for example, at the end of 1978. During the first ten months of that year, the growth rate of the "base" was about 10 percent regardless of the base measure used. However, from October 1978 to February 1979, an adjusted series indicates a *deceleration* in base growth to a 6.3 percent rate. In sharp contrast, a growth rate calculated using the levels of an unadjusted series, shows an *acceleration* in base growth to a 12.7 percent rate. This difference occurred in the November-December period when a change in reserve requirement ratios on time deposits (Table IV) increased member bank required reserves by about $3 billion. A monetary base that incorporates the effect of higher reserve requirements indicates that the base grew at a 6.6 percent rate during this period. A monetary base that does not include such an adjustment indicates a 21.8 percent rate of growth.

This is not an isolated instance of the importance of incorporating the impact of changes in reserve requirements into a monetary base measure. Between mid-1960 and early 1977, the Board of Governors made

Table IV

Changes in Legal Reserve Requirement Ratios

Effective Date	Change
September 1, 1960	The reserve requirement of central reserve city banks against their net demand deposits was reduced from 18 percent to 17½ percent. This action reduced required reserves approximately $120 million.
November 24, 1960	The reserve requirement of country banks against their net demand deposits was increased from 11 percent to 12 percent. This action increased required reserves approximately $380 million.
December 1, 1960	The reserve requirement of central reserve city banks against their net demand deposits was reduced from 17½ percent to 16½ percent. This action reduced required reserves approximately $250 million.
October 25, 1962	The reserve requirement of reserve city banks against their time deposits was reduced from 5 percent to 4 percent. This action reduced required reserves approximately $410 million.
November 1, 1962	The reserve requirement of country banks against their time deposits was reduced from 5 percent to 4 percent. This action reduced required reserves approximately $360 million.
July 14, 1966	The reserve requirement of reserve city banks against time deposits (other than savings deposits) in excess of $5 million was increased from 4 percent to 5 percent. This action increased required reserves approximately $350 million.
July 21, 1966	The reserve requirement of country banks against time deposits (other than savings deposits) in excess of $5 million was increased from 4 percent to 5 percent. This action increased required reserves approximately $70 million.
September 8, 1966	The reserve requirement of reserve city banks against time deposits (other than savings deposits) in excess of $5 million was increased from 5 percent to 6 percent. This action increased required reserves approximately $370 million.
September 15, 1966	The reserve requirement of country banks against time deposits (other than savings deposits) in excess of $5 million was increased from 5 percent to 6 percent. This action increased required reserves approximately $75 million.
March 2, 1967	The reserve requirement of all member banks against savings deposits and the first $5 million of time deposits was reduced from 4 percent to 3½ percent. This action reduced required reserves approximately $425 million.
March 16, 1967	The reserve requirement of all member banks against savings deposits and the first $5 million of time deposits was reduced from 3½ percent to 3 percent. This action reduced required reserves approximately $425 million.
January 11, 1968	The reserve requirement of reserve city banks against net demand deposits in excess of $5 million was increased from 16½ percent to 17 percent. This action increased required reserves approximately $360 million.
January 18, 1968	The reserve requirement of country banks against net demand deposits in excess of $5 million was increased from 12 percent to 12½ percent. This action increased required reserves approximately $190 million.
April 17, 1969	The reserve requirement of all member banks against net demand deposits was increased ½ percentage point. This action increased required reserves approximately $660 million.
October 16, 1969	A 10 percent marginal reserve requirement was established on certain foreign borrowings, primarily Eurodollars, by member banks and on the sale of assets to their foreign branches. This action increased required reserves approximately $415 million.
October 1, 1970	The reserve requirement of all member banks against time deposits (other than savings deposits) in excess of $5 million was reduced from 6 percent to 5 percent. At the same time, a 5 percent reserve requirement was imposed against funds obtained by member banks through the issuance of commercial paper by their affiliates. This action reduced required reserves approximately $500 million (net).

30 adjustments to legal reserve requirement ratios, as shown in Table IV. Twenty-five of these adjustments took place in the approximately 10-year period from mid-1966 to early 1977. Table III shows that these changes frequently resulted in a divergence of 2 to 3 percentage points between the growth rates of an adjusted and an unadjusted measure of monetary base. More important, the *direction* of change was usually different — one measure indicating an acceleration in the base, the other measure indicating a deceleration or no change in the growth rate.

The data in Table III show a consistent relationship between the difference in the growth rates of the two base series and changes in legal reserve requirements. For example, during a period when reserve requirement ratios were increased (denoted in Table III by a minus sign preceding the amount of

Effective Date	Change
January 7, 1971	The reserve percentage required to be maintained against certain foreign borrowings, primarily Eurodollars, by member banks, and the sale of assets to their foreign branches was raised from 10 percent to 20 percent. This action had little effect on required reserves.
November 9, 1972	Regulations D and J were revised to (1) adopt a system of reserve requirements against demand deposits of all member banks based on the amount of such deposits held by a member bank, and (2) to require banks — member and nonmember — to pay cash items presented by a Federal Reserve Bank on the day of presentation in funds available to the Reserve Bank on that day. These changes reduced required reserves approximately $2.5 billion, effective November 9; $1.0 billion, effective November 16; and increased required reserves $300 million, effective November 23.
June 21, 1973	The Board amended its Regulation D to establish a marginal reserve requirement of 8 percent against certain time deposits and to subject to the 8 percent reserve requirement certain deposits exempt from the rate limitations of the Board's Regulation Q. In addition, reserves against certain foreign branch deposits were reduced from 10 percent to 8 percent. These changes had little effect on required reserves.
July 12, 1973	Reserve requirements were imposed against finance bills. This action increased required reserves approximately $90 million.
July 19, 1973	The reserve requirement against all net demand deposits, except the first $2 million, was increased ½ percentage point. This action increased required reserves approximately $760 million.
October 4, 1973	The marginal reserve requirement against certain time deposits was increased from 8 percent to 11 percent. This action increased required reserves approximately $465 million.
December 27, 1973	The marginal reserve requirement against certain time deposits was reduced from 11 percent to 8 percent. This action reduced required reserves approximately $360 million.
September 19, 1974	The marginal reserve requirement against time deposits in denominations greater than $100,000 and more than four-month maturity was eliminated. This action reduced required reserves approximately $510 million.
December 12, 1974	The reserve requirement against all time deposits with an original maturity of six months or longer was reduced from 5 percent to 3 percent; the reserve requirement against all time deposits with an original maturity of less than six months was increased from 5 to 6 percent; and the reserve requirement against net demand deposits over $400 million was reduced from 18 percent to 17½ percent. In addition, the 3 percent marginal reserve requirement on large certificates of deposit with an initial maturity of less than four months was removed. This action reduced required reserves approximately $710 million.
February 13, 1975	The reserve requirement against all categories of net demand deposits up to $400 million was reduced by ½ percentage point, and the reserve requirement against net demand deposits of more than $400 million was reduced 1 percentage point. This action reduced required reserves approximately $1,065 million.
May 22, 1975	The reserve requirement against foreign borrowings of member banks, primarily Eurodollars, was reduced from 8 percent to 4 percent. This action reduced required reserves approximately $80 million.
October 30, 1975	The reserve requirement against member bank time deposits with an original maturity of four years or more was reduced from 3 percent to 1 percent. This action reduced required reserves approximately $360 million.
January 8, 1976	The reserve requirement on time deposits maturing in 180 days to 4 years was reduced from 3 percent to 2½ percent. This action reduced required reserves by approximately $500 million.
December 30, 1976	The reserve requirement against net demand deposits up to $10 million was reduced by ½ percentage point, and the reserve requirement against net demand deposits over $10 million was reduced by ¼ percentage point. This action reduced required reserves by approximately $550 million.
November 2, 1978	A supplementary reserve requirement of 2 percentage points was imposed on time deposits of $100,000 or more. This action increased required reserves approximately $3.0 billion.

reserves released), an unadjusted monetary base exhibits a faster growth rate than one which has been adjusted. The opposite is clearly the case when reserve requirement ratios are lowered.

The growth rates of the two monetary base series diverge primarily because the Federal Reserve tends to use open market operations to offset the effects of changes in reserve requirement ratios. An increase in reserve requirement ratios, by itself, leads to a sharp rise in the Federal funds rate. Since the Federal Reserve usually follows a policy of preventing sharp fluctuations in the Federal funds rate, it engages in open market operations (increases its rate of purchases of Government securities) to offset the impact of the rise in reserve requirement ratios on interest rates. The effect of open market operations is included in an unadjusted base series, but the opposite effect of

the increase in reserve requirement ratios is not. Consequently, an unadjusted series shows an acceleration in base growth. When reserve requirement ratios are lowered, the opposite prevails: the unadjusted series shows a reduction in the growth rate of the monetary base.

Therefore, during periods when legal reserve requirement ratios are changed, an unadjusted series gives a misleading indication of both the "intent" and the "effect" of Federal Reserve policy actions. It would be hard to argue that the intent of raising reserve requirement ratios is to "ease" monetary policy, or the intent of lowering them is to "tighten" policy. Furthermore, the only way one can actually judge the effect of such actions on the monetary aggregates is to balance them against the impact of contemporaneous open market operations.

Alternative Adjustments for Reserve Requirement Changes

This Bank uses the reserve adjustment magnitude (RAM) to incorporate into the monetary base measure the effects of changes in legal reserve requirement ratios on the monetary aggregates. In general, the computation of RAM involves the following steps:[3]

(1) Determine the distribution of member bank demand and time deposits subject to reserve requirements according to reserve requirement categories two weeks earlier.

(2) Compare the current reserve requirement ratio with the corresponding 1929 equivalent ratio for each reserve requirement category. Multiply the difference between the 1929 equivalent ratio and the current ratio by the amount of deposits in that category two weeks earlier. If the current reserve requirement ratio exceeds the 1929 ratio, RAM is reduced. If the current ratio is less than the 1929 ratio, RAM is increased.

(3) Subtract the amount of required reserves on all deposits subject to special reserve requirements.

(4) Add the amount of waiver privileges.

(5) Add the amount of vault cash held by member banks two weeks earlier.

The BOG uses an alternate approach to computing RAM for the adjusted monetary base series they began publishing on June 15, 1979. The BOG computation involves the following steps:[4]

(1) For the week in which reserve requirements against deposits, net demand or time and savings, change due to a change in Regulation D, required reserves are calculated on both the old and the new reserve requirement basis for the type of deposits affected.

(2) The ratio of "new" required reserves to "old" required reserves for the particular deposit type is calculated and this ratio is applied to actual required reserves for that deposit type for all weeks prior to the change in Regulation D.

(3) As the ratio is applied back through time, it is adjusted for earlier breaks in series due to changes in Regulation D by multiplying the current ratio by the ratio calculated at the time of the previous change in Regulation D. (This procedure is carried back, weekly, to January 1959; monthly averages are derived from prorations of the weekly data.)

(4) Adjustments for breaks in series due to changes in Regulations D and M affecting other reservable liabilities (i.e., commercial paper, finance bills, Eurodollar borrowings, and marginal reserve requirements against large denomination ($100,000 or more) CDs in effect from mid-1973 to late 1974) are made additively. That is, required reserves for earlier periods are raised or lowered by the estimated difference in reserve requirements that would have been implied if the regulation had been in effect in earlier periods.

The major difference between these two alternate procedures is that the BOG method requires that a new historically adjusted series which reflects the latest reserve requirement be constructed each time Regulation D or M changes. In contrast, the St. Louis approach leaves the *past* data unaltered.

[3]The derivation and computation of RAM is described in detail in Burger and Rasche, "Revision of the Monetary Base," p. 22.

[4]For a technical description of the method used by the BOG to adjust their monetary base, contact the Banking Section of the Division of Research and Statistics at the Board of Governors in Washington, D. C.

Do Rising U.S. Interest Rates Imply A Stronger Dollar?

DOUGLAS R. MUDD

RECENT U.S. monetary actions have been viewed, in part, as a reaction to the rapid depreciation of the U.S. dollar on foreign exchange markets over much of last year. Typical of this view is the statement: "The U.S. Federal Reserve . . . confirmed its determination to push U.S. money market interest rates higher to support the dollar."[1] This view interprets rising U.S. interest rates as both an incentive for investors to purchase U.S. financial assets instead of foreign securities and a deterrent to U.S. residents' spending on goods and services, including imports.

Such an interpretation may be consistent with short-run analysis. Over an extended period of time, however, rising U.S. interest rates are not *necessarily* accompanied by a rising foreign exchange value of the dollar. Moreover, this short-run view of the relationship between changes in U.S. interest rates and movements in the foreign exchange value of the dollar is not supported by a casual examination of recent data. For example, both long- and short-term U.S. interest rates rose, on average, relative to foreign interest rates from late 1977 to late 1978. In addition, U.S. interest rates generally were higher than foreign interest rates during this period. Yet, the weighted-average foreign exchange value of the dollar declined 17 percent between September 1977 and October 1978 (see Chart I).[2]

This article examines the relationship between changes in the U.S.-foreign interest rate differential and movements in the foreign exchange value of the dollar. The analysis is consistent with recent events and emphasizes the role of monetary disturbances in determining movements in both exchange rates and interest rates.

Changes in Money Stock Growth and Interest Rate Movements

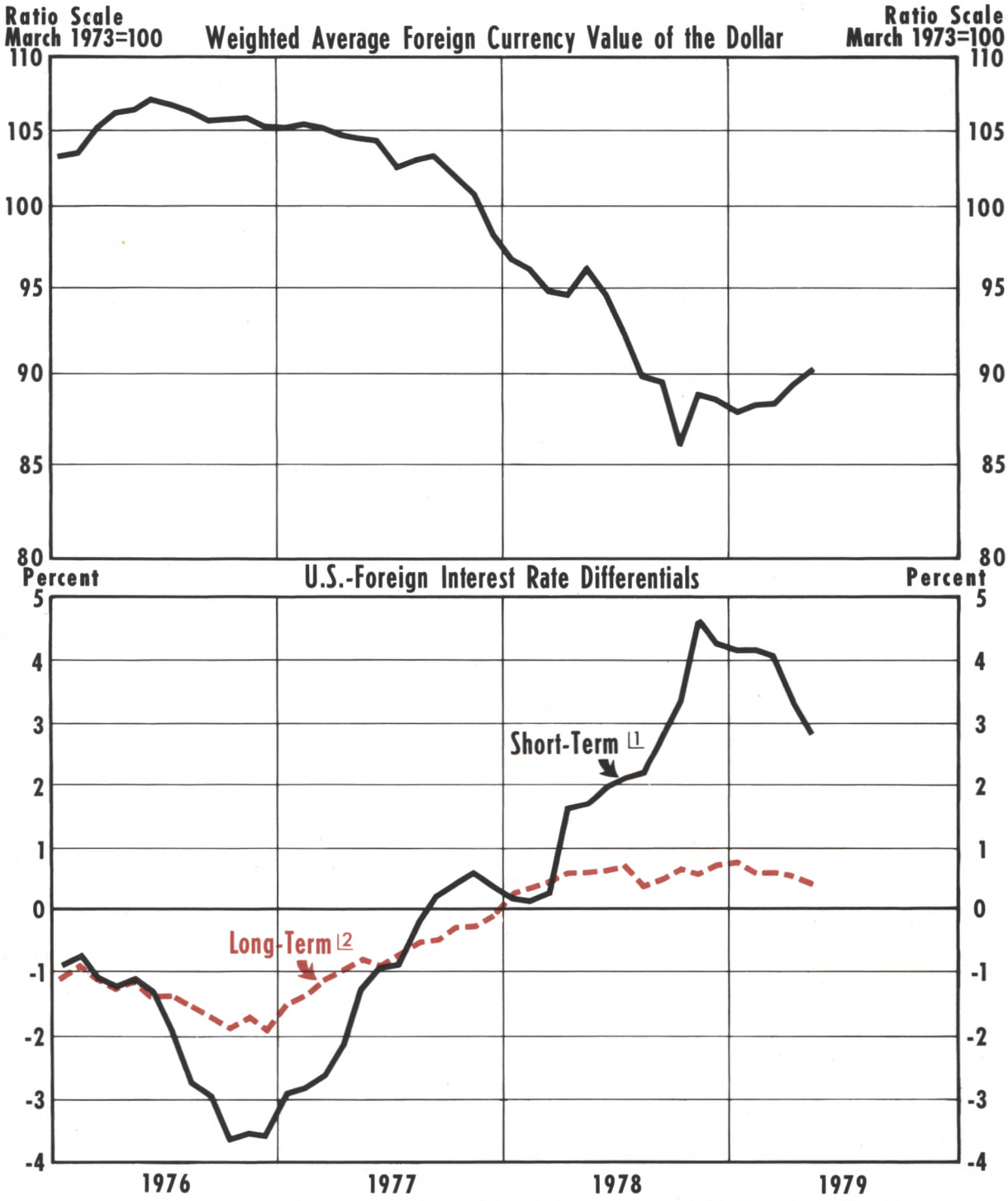
The nation's money stock grows primarily through Federal Reserve purchases of government securities. To induce holders of securities to sell, the Federal Reserve offers them more than the currently prevailing market price for their securities. As a result, the price of government securities rises and the interest

[1]Stewart Fleming and Peter Riddell, "Fed Confirms Aim to Raise Interest Rates in Aid of $," *Financial Times*, July 24, 1979. Also see Robert A. Bennett, "Fed Raises Rates to Aid Dollar," *New York Times*, July 21, 1979.

[2]The countries included in the weighted-average foreign interest rate and exchange rate series are Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, and the United Kingdom. The weights and formula used in constructing these series are from "Index of the Weighted-Average Exchange Value of the U.S. Dollar: Revision," Federal Reserve *Bulletin* (August 1978), p. 700.

Chart I

Foreign Exchange Value of the U.S. Dollar and Interest Rate Differentials



Sources: Federal Reserve Statistical Release H.13; Federal Reserve Bulletin; International Monetary Fund, International Financial Statistics.

1 Secondary market rates for 90-day large certificates of deposit in the United States less the weighted average of foreign three-month money market rates.

2 U.S. long-term government bond yields less the weighted average of foreign long-term government bond yields.

Latest data plotted: May

rate declines. Thus, an acceleration in money stock growth is associated, at least initially, with a decline in interest rates. Conversely, a deceleration in money stock growth initially is accompanied by a rise in interest rates.

An acceleration in money stock growth, however, is unlikely to produce permanently lower interest rates. One factor that would produce upward pressure on interest rates following an acceleration in money stock growth is an acceleration in the growth of aggregate spending. The acceleration in spending growth could be viewed as a direct result of the acceleration in money stock growth or as a result of the stimulation of consumption and investment spending by the initial decline in interest rates. In either case, an acceleration in spending would be accompanied by an acceleration in the growth of the quantity of credit demanded (to finance the accelerated pace of investment and consumption spending). If the rate at which the quantity of credit demanded grows more rapidly than the rate at which credit is being supplied, the price of credit (the interest rate on loans) rises.

The longer-term impact of faster money stock growth on the rate of inflation is another factor which would exert upward pressure on interest rates. Over longer periods of time, a sustained acceleration in the growth of aggregate spending will increase the rate of inflation (given that output growth is constrained in the long run by real factors which are unaffected by monetary disturbances).

It is generally accepted that movements in interest rates are, to some extent, influenced by changes in the expected rate of inflation.[3] If, for example, the interest rate is 6 percent and the price level is constant (that is, the inflation rate is zero), then the "real interest rate" would be 6 percent. Now, suppose inflation is widely expected to increase from zero to a 3 percent rate. Lenders would then require a 9 percent return on funds loaned (to prevent the real value of interest income and principal from falling) and borrowers would generally be willing to accept a 9 percent interest rate.[4] Thus, factors that cause an increase in the expected rate of inflation also produce upward pressure on interest rates. One such factor is a sustained acceleration in money stock growth.

Within the context of this discussion, an acceleration in money stock growth initially will be associated with a decline in interest rates. If, in the long-run, however, the real interest rate is unaffected by monetary disturbances and the acceleration of money stock growth is sustained, interest rates ultimately will rise.[5] In other words, changes in money stock growth initially are related inversely to changes in interest rates, but, in the long-run, money stock growth, the inflation rate, and interest rates all move in the same direction.

Changes in Money Stock Growth and Exchange Rate Movements

When a currency is traded in foreign exchange markets, the exchange rates which evolve are the prices of that currency in terms of each of the other currencies traded. Thus, relative changes in the total amounts of these national moneys supplied and demanded will determine exchange rate movements. Only if the amounts of all national moneys demanded increase at the same rate would relative changes in money stock growth rates alone determine exchange rate movements.

For example, suppose that growth in both the U.S. and German money stocks equal the rates at which the amounts of these national moneys demanded increase. Assume that interest rates in both countries are equal and that neither central government intervenes in the foreign exchange market. Now let U.S. money stock growth accelerate. As previously discussed, this acceleration, at first, will be accompanied by a decline in U.S. interest rates. Initially, given interest rates in Germany, U.S. capital outflows will be encouraged (that is, the rate at which U.S. residents invest in German securities will rise) and German capital outflows would be discouraged (the rate at which German residents invest in U.S. securities will fall). This results in an increase in the amount of dollars supplied in the foreign exchange market (by U.S. residents wishing

[3]See Irving Fisher, *The Theory of Interest* (New York: Kelley & Millman, Inc., 1954), pp. 36-44.

[4]This example is oversimplified in several respects. However, the basic point that an increased value of the expected rate of inflation raises nominal interest rates remains valid. For a concise theoretical discussion, see Robert Mundell, "Inflation and Real Interest," *Journal of Political Economy* (June 1963), pp. 280-83.

[5]For a more technical theoretical discussion of this relationship, see Milton Friedman, "Factors Affecting the Level of Interest Rates," in John T. Boorman and Thomas M. Havrilesky, *Money Supply, Money Demand, and Macroeconomic Models* (Northbrook, Ill.: AHM Publishing Corporation, 1972), pp. 200-18. For empirical support of this view, see William E. Gibson, "Interest Rates and Monetary Policy," *Journal of Political Economy* (May/June 1970), pp. 431-55.

to purchase marks to invest in German securities) relative to the amount of dollars demanded (by German residents desiring dollars to spend in the United States). Therefore, the U.S. dollar price of one German mark will be subject to upward pressure — the dollar will fall in value on the foreign exchange market.

The stimulative effect of the U.S. monetary expansion on the growth of U.S. income and spending will also contribute to this downward pressure on the value of the dollar. In other words, the rate at which U.S. residents purchase both domestic and German goods and services will rise. This acceleration in U.S. import growth will also contribute to the acceleration in the rate at which dollars are supplied on foreign exchange markets.[6]

If the faster pace of U.S. money stock growth continues, the U.S. inflation rate will eventually rise. Thus, the faster U.S. money stock growth will tend to increase the expected future rate of U.S. inflation. This, in turn, will cause U.S. interest rates to rise relative to German interest rates. The increase in the U.S.-German interest rate differential, however, will not *necessarily* produce capital flows from Germany into the United States. Instead, the foreign exchange value of the dollar might depreciate at the same time that U.S. interest rates are higher than, and rise relative to, German interest rates.

Interest Rate Differentials and Exchange Rate Movements

The preceding analysis indicates that U.S. interest rates could be both higher than, and rise relative to, foreign interest rates without providing an incentive for foreign investors to increase their purchases of U.S. securities (or U.S. investors to decrease their purchases of foreign securities). The reason for this is that the difference between U.S. and foreign interest rates is, in fact, not the relevant factor in inducing capital flows. Rather, the interest rate differential *adjusted for expected future exchange rates* is the relevant factor inducing international capital flows.

Exchange rate expectations, interest rate differentials, and exchange rates will, in the absence of controls on international capital flows, be related according to the equilibrium condition,

$$(1) \qquad (1 + r_{us}) = \frac{1}{x} \cdot (1 + r_f)\, x^e,$$

where,

r_{us} = the U.S. interest rate

r_f = the foreign interest rate

x = the spot (currently prevailing) U.S. dollar/foreign currency exchange rate

x^e = the expected future value of the U.S. dollar/foreign currency exchange rate.

Consider the following example. Suppose the spot U.S. dollar/German mark exchange rate is \$.33/DM and that the value of the dollar in terms of the mark is expected to decline to \$.36/DM during the next year (an expected depreciation of 9 percent). Suppose the interest rate on one-year German Treasury bills was 5 percent, so that \$1.00 could be used to purchase 3.03 marks which would yield 3.18 marks (DM3.03 · (1 + .05)) after one year. When the marks are converted back to dollars, U.S. investors expect to receive \$1.14 (DM3.18 · (\$.36/DM)). If U.S. investors could earn \$1.14 on a \$1.00 investment in U.S. Treasury bills, the U.S. interest rate would be 14 percent and no capital flows would occur. Thus, in equilibrium, the differential between U.S. and foreign interest rates equals the *expected* dollar-denominated return on investments in foreign securities.[7] This can be expressed

$$(2) \qquad r_{us} - r_f = \left(\frac{x^e}{x} - 1\right) \cdot (1 + r_f),$$

where $\left(\frac{x^e}{x} - 1\right)$ is the expected change in the foreign exchange value of the dollar.

If U.S. interest rates rise relative to foreign interest rates and equation (2) holds, the foreign exchange value of the dollar could decline (that is, x could rise), but the expected future foreign exchange value of the dollar could decline even faster (x^e could rise faster). In other words, for given levels of foreign interest rates, a rising U.S. interest rate could be offset by progressively larger declines in the expected foreign exchange value of the dollar.

[6]The acceleration in U.S. import growth would accelerate income growth in the German export sector. However, from a monetarist viewpoint, German aggregate income growth would remain constant since German money stock growth is constant. This implies a deceleration in income growth in other sectors of the German economy.

[7]Although this relationship does not hold exactly, the differences between the interest rate differential and the forward premium or discount (the expected change in the exchange rate) may reflect the existence of transactions costs and political risk (for example, the likelihood that a country will impose exchange controls). See Jacob A. Frenkel and Richard M. Levich, "Covered Interest Arbitrage: Unexploited Profits?" *Journal of Political Economy* (April 1975), pp. 325-38 and Robert Z. Aliber, "The Interest Rate Parity Theorem: A Reinterpretation," *Journal of Political Economy* (*November/December* 1973), pp. 1451-59.

One explanation for the occurrence of this situation is that monetary disturbances dominate both changes in interest rates and exchange rates. As previously discussed, a sustained acceleration in U.S. money stock growth will ultimately result in an increase in the expected rate of inflation. This, in turn, produces an increase in U.S. interest rates. Given the expected foreign rate of inflation, the differential between U.S. and foreign interest rates will be rising. Simultaneously, the faster rate of U.S. spending growth would produce a declining foreign exchange value of the dollar. In addition, if U.S. money stock growth and inflation are expected to continue at the faster pace, the expected future value of the dollar on foreign exchange markets will tend to decline faster.[8]

Summary

The assertion that rising U.S. interest rates (relative to foreign rates) produce an increase in the foreign exchange value of the dollar has not been supported by recent experience. If monetary disturbances are important determinants of changes in both interest rates and exchange rates, a widening positive differential between U.S. and foreign interest rates and a declining foreign exchange value of the dollar are consistent developments. If the expected rate of U.S. inflation increases because of a sustained acceleration in U.S. money stock growth (while foreign expected rates of inflation remain relatively stable), U.S. interest rates will rise relative to foreign interest rates. The faster pace of U.S. money stock growth also will produce an increase in U.S. spending growth, which, in turn, will result in a depreciating foreign exchange value of the dollar. If the higher expected rate of U.S. inflation also results in an offsetting decline in the *expected* value of the dollar on foreign exchange markets, no capital inflow will be induced by the rising differential between U.S. and foreign interest rates.

Conversely, a sharp deceleration in U.S. money stock growth (not matched by equally restrictive foreign monetary developments) will produce an appreciation of the dollar. In this case, initially U.S. interest rates will rise relative to foreign rates and U.S. spending growth will slow. As a result, the supply of dollars on foreign exchange markets will fall (as U.S. residents reduce spending for foreign goods, services, and securities) relative to the demand for dollars (as foreign investors increase purchases of U.S. securities in response to the higher U.S. interest rate). However, if the slower U.S. money stock growth is sustained and the expected rate of U.S. inflation is revised downward, U.S. interest rates will decline relative to foreign rates. Further, if the restrictive U.S. monetary actions also produce large upward revisions in the expected future value of the dollar, no capital outflow will result from the declining U.S.-foreign interest rate differential. In this case, an appreciation of the dollar on foreign exchange markets will initially be associated with a rising U.S.-foreign interest rate differential. Eventually, however, the interest rate differential will decline while the dollar continues to appreciate.

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[8]These results have been derived by assuming that current accelerations in U.S. money stock growth and inflation are important variables in the formulation of increases in the *expected* rate of inflation which, in turn, is important in determining changes in the *expected* foreign exchange value of the dollar.

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