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How Controllable is Money Growth?

ANATOL B. BALBACH

IT is becoming increasingly popular to assert that money growth cannot be controlled and, therefore, that monetary policy should stop targeting monetary growth and try to control other variables that may affect economic activity and the rate of inflation. Many argue that, although excessive long-run monetary growth is clearly the dominant cause of inflation, attempts to control it are so weak and uncertain that they create more problems than benefits. Even casual observation seems to support these arguments: in the United States, the Federal Reserve System has announced monetary growth targets since 1973, but has achieved only questionable success in reaching them; in many foreign countries, such as the United Kingdom and Germany, targets were established, but were either persistently or occasionally violated; in Switzerland, monetary control has been successful, but is viewed as an aberration due to the country's small size and other uniquely favorable conditions.

For most of the '70s, this lack of success was caused by the monetary authorities' desire to simultaneously stabilize short-term interest rates and control money growth. Whenever interest rate and money growth targets became inconsistent, most central banks preferred to abandon money growth targets, producing erratic and generally excessive monetary growth. In October 1979, however, the Federal Reserve heralded a change in operating procedure, announcing that it would place more emphasis on the control of monetary aggregates as opposed to the stabilization of the federal funds rate.[1] Still, during 1980, U.S. money growth turned out to be both considerably more erratic and somewhat higher than originally desired.

It is not surprising, therefore, that many analysts have become convinced that a monetary policy designed to stabilize the growth of monetary aggregates is neither desirable nor achievable.[2] This criticism usually has taken four separate lines of thought:

1. Money growth doesn't matter. The relationship between the growth of gross national product (whose steady expansion is the ultimate goal of any macroeconomic stabilization policy) and monetary growth is too variable; successful control of monetary growth cannot mitigate fluctuations in economic activity and the rate of inflation.

2. Money growth does matter, but should not be controlled because it would cause greater volatility in other crucial economic variables (such as interest or exchange rates). This, in turn, would produce economic disruptions far worse than those created by rapid and erratic money growth.

3. Monetary base growth doesn't matter. The relationship between the monetary base (which consists of bank reserves and currency held by the public, and which the central bank can control directly) and the quantity of money in the economy is both highly variable and unpredictable; tight control of the base will not produce stable growth of money.

4. Monetary base growth cannot be controlled. This is so, either because the central bank must supply currency on demand or because some of the Federal Reserve balance sheet items are determined by transactions outside its control. Since base growth underlies money growth, money growth cannot be controlled.

Assertions 1 and 2 address the issue whether monetary growth *should* be controlled; there is a substantial body of literature already dealing with the issue.[3]

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[1]The federal funds rate is the interest rate at which depository institutions borrow reserves from each other.

[2]"The Pitfalls of Mechanical Monetarism," *The Morgan Guaranty Survey* (February 1981), pp. 8-13.

[3]Examples of literature dealing with the relationships between money growth and income growth include: Milton Friedman, ed., *Studies in the Quantity Theory of Money* (Chicago: University of Chicago Press, 1956); Lyle E. Gramley and Samuel B. Chase, Jr., "Time Deposits in Monetary Analysis," *Federal Reserve Bulletin* (October 1965), pp. 1380-1404; Karl Brunner and Allan H. Meltzer, "Predicting Velocity: Implications for Theory and Policy," *Journal of Finance* (May 1963), pp. 319-54; Bryon Higgins and V. Vance Roley, "Monetary Policy and Economic Performance: Evidence From Single Equation Models," Federal Reserve Bank of Kansas City *Economic Review* (January 1979), pp. 3-12; Charles R. Nelson, "Recursive Structure in U.S. Income, Prices and Output," *Journal of Political Economy* (December 1979), pp. 1307-27; Leonall C. Anderson and Keith M. Carlson, "A Monetarist Model for Economic Stabilization," this *Review* (December 1979), pp. 3-14.

This article addresses the question whether monetary growth *can* be controlled and thus deals with assertions 3 and 4 above.

What is Money and How is it Created?

Money is usually defined as those objects that are *generally* accepted in payment for goods, services and debts. In the United States, these consist of currency and checkable deposits.[4] This definition of the money stock, which excludes U.S. Treasury and interbank deposits, is referred to as M1B. It consists of currency and checkable deposits in the hands of the private nonbank public, and state and local governments.

When the public wants more money, it obtains it from those institutions whose liabilities are acceptable as money. These consist of commercial banks, whose liabilities include demand deposits, automatic transfer accounts (ATS) and negotiable orders of withdrawal (NOW); thrift institutions, which issue NOW accounts; and credit unions, which issue credit union share drafts. Federal Reserve Banks, whose liabilities also include money, do not deal with the public and, therefore, do not *directly* contribute to the creation of money.

When the public as a whole desires more money (and the monetary authorities supply the necessary reserves), it sells a variety of assets, including promissory notes (i.e., loans) to the banking system as a whole (all private institutions whose liabilities are money), receiving payment in currency or in checkable deposits. As these receipts are spent and respent, a portion winds up as someone's currency holdings or checkable deposits, and the money stock will increase.

It is crucial to understand, however, that an increase in loans by the banking system does not *necessarily* result in an increase in the money stock. For example, if an individual puts $100 from his checking account into his savings account, thus *decreasing* the stock of money by $100, and the bank lends the resulting excess reserves to a second individual who adds it to his checkable deposits, thus *increasing* the money stock, bank loans and the total amount of credit will have increased, but not the money stock.[5]

Although the expansion of loans by the banking system is the mechanism through which the money stock increases, not all loans result in money growth.

Since bank loans and investments are a source of bank profits, and since banks are profit-maximizing institutions, we should and do observe that they make loans to the full extent that they are able. What then constrains their ability to make loans and expand the stock of money?

Bank Reserves and Their Role in Money Creation

In the United States, all financial institutions that create checking deposits are legally required to hold reserves against these deposits either in their vaults or in accounts with Federal Reserve Banks. These reserve requirements are imposed as a percentage of various deposits. Thus, if the average reserve requirement is 10 percent and the banking system wished to create new checkable deposits of $100, it must obtain reserves of $10. Since both currency and deposits with Federal Reserve Banks are Federal Reserve liabilities, the banking system can obtain reserves by selling securities to, or borrowing from, the Federal Reserve System.

In principle, the Federal Reserve could always refuse to buy securities or to make loans. It would thus restrict the availability of reserves and the banking system's ability to create new checkable deposits. Similarly, the Federal Reserve can buy securities at an attractive price or make loans on attractive terms, inducing the banking system to acquire excess reserves.[6] Since excess reserves do not produce income for the bank's stockholders, banks will expand their loans, creating deposits and adding to the money stock.

Currency in the hands of the nonbank public represents another source of bank reserves which may also account for the expansion of the money stock. For example, if an individual deposits $100 in currency into his checking account, the bank's vault cash (part of its reserves) rises by $100. Because the bank must hold only $10 as a reserve for the newly created $100 of deposits, it now has $90 of excess reserves with which to expand its loans and deposits. Thus, the constraint on monetary expansion is not only the availability of bank reserves (deposits at Federal Reserve Banks and vault cash), but also the amount of cur-

[4]Time deposits or money market mutual fund shares are not money since they cannot be spent without conversion into currency or checkable deposits. Credit cards represent either existing checkable deposits or deposits that will be created by a bank.

[5]If one were to deposit currency into a savings account, the resultant increase in excess reserves would cause an expansion of loans *and* money. But loans would increase by more.

[6]Excess reserves are reserves over and above required reserves.

rency in the hands of the public. The sum of these two is referred to as the *monetary base.*[7] It will be viewed as *the* constraining magnitude of bank deposit expansion or contraction for the remainder of this article.

Problems in Controlling the Monetary Base and Money Growth

The discussion so far seemingly implies that control of money growth is a relatively simple matter. Since the monetary base is a liability of the Federal Reserve System, it can be tightly controlled by the System; since monetary expansion is dependent on the availability of monetary base, money growth can be expected to follow a desired path. Yet much of the criticism leveled at monetary policy rests on the premise that money growth cannot be controlled.

Given the prior description of the mechanics of money creation, monetary control problems will exist only if the monetary base cannot be controlled with sufficient precision or, given a specific path of monetary base growth, if money growth is unpredictable. For instance, analysts often argue that many items on the Federal Reserve balance sheet vary with the vagaries of bank and public behavior. Or, that the relationship between the monetary base and the money stock is so volatile, that even if the monetary base *is* controlled, money growth will refuse to behave in the desired manner.

It is true, of course, that the use of an additional dollar of reserves is determined by banks and the public. Banks, through their willingness to hold excess reserves, and the public, through its willingness to hold currency, time deposits or checkable deposits, both affect the amount of money created out of each additional dollar of reserves.

Whether these are serious problems is an empirical issue. If the Federal Reserve System cannot control certain items on its balance sheet, can it offset these items with relative ease? If bank and public decisions *can* vary substantially, *do* they in fact do so? Are these changes offsetting? Are they predictable? These questions must be answered before one can decide if money stock control is impossible.

Control of the Monetary Base

A simplified balance sheet of the Federal Reserve System is shown in table 1.

Because the balance sheet must balance, it can be rewritten as:

Monetary base = Gold certificates
+ Foreign currencies
+ Security holdings
+ Loans to financial institutions
+ Float
+ Other assets
− Treasury deposits
− Foreign central bank deposits
− Other liabilities and capital.

Any change in the monetary base must equal the change in the sum of all other items. Thus, the control of the monetary base depends upon the ability to control the sum of the remaining items.

Consider, first, those items that change only at the discretion of the Federal Reserve:

(a) Foreign currencies

(b) Security holdings

(c) Loans to financial institutions

(d) Other assets

(e) Other liabilities and capital.

Clearly, the Federal Reserve can decide the amount of foreign currencies or securities it wishes to buy or sell.[8] It can decide, except as a lender of last resort in a national liquidity crisis, the amount that it will

[7]For more detailed discussions of the definition and use of the monetary base, see Karl Brunner and Allan H. Meltzer, "A Credit Market Theory of the Money Supply and an Explanation of Two Puzzles in U.S. Monetary Policy," *Essays in Honour of Marco Fanno,* (Padua, Italy: Cedam, 1966), pp. 151-76; Karl Brunner and Allan H. Meltzer, "Some Further Investigations of Demand and Supply Functions for Money," *The Journal of Finance* (May 1964), pp. 240-83; Albert E. Burger, *The Money Supply Process* (Belmont, California: Wadsworth Publishing Co., 1971); and Anatol B. Balbach and Albert E. Burger, "Derivation of the Monetary Base," this *Review* (November 1976), pp. 2-8.

[8]Of course, there are those who maintain that since sales and purchases of foreign currencies temporarily affect foreign exchange rates, and since sales and purchases of securities, including bank promissory notes, temporarily affect interest rates, the Federal Reserve is not free to engage in these transactions at will. But this is irrelevant to the issue whether the Federal Reserve *can* control the monetary base. These arguments would be relevant in a discussion whether the Federal Reserve *should* control monetary base and money growth, as contrasted with control of exchange and interest rates, but it is of no concern here.

Table 1

Simplified Federal Reserve Balance Sheet (in millions of dollars)

Assets	Level Nov. 5, 1980	Average weekly variation in 1980	Net average weekly variation in 1980
Gold certificates	$ 11,163	$ .28	$–.21
Foreign currencies	3,158	103	50
Federal Reserve credit:			
Security holdings	130,674	3,271	36
Loans to financial institutions	3,371	1,777	– 5
Float	5,217	1,271	– 83
Other assets	7,235	267	22

Liabilities	Level Nov. 5, 1980	Average weekly variation in 1980	Net average weekly variation in 1980
Monetary base:			
Deposits of financial institutions	$ 33,177	$3,510	$–142
Federal Reserve notes	119,416	563	207
Treasury deposits	3,064	746	– 17
Foreign central bank deposits	236	59	.62
Other liabilities and capital	4,922	257	– 28

lend to financial institutions.[9] And it can certainly control the other assets it wishes to acquire and the other liabilities it wishes to incur.[10]

Balance sheet items that are *not* subject to Federal Reserve discretionary actions are:

(a) Gold certificates

(b) Float

(c) Treasury deposits

(d) Foreign central bank deposits.

Gold certificates are issued by the U.S. Treasury and must be bought by the Federal Reserve System. Whenever the gold stock changes, the Treasury issues or withdraws gold certificates at some prescribed official price. Since, for the past decade, there have been few official transactions in gold, this account is virtually dormant.

Float represents an interest-free loan from the Federal Reserve to financial institutions. It arises from the time difference between the Federal Reserve schedule for crediting banks for checks in the collection process and the actual flow of checks. Once the check is deposited and placed in the clearing system, the payee's bank is credited with a deposit on a certain schedule. If the payer's bank is not yet debited within that same scheduled time, the banking system has more reserves until the check actually clears. Thus, the level of float fluctuates with transportation, computing and other problems. Fluctuations in Treasury and foreign central bank deposits result from Treasury and foreign central bank decisions, just as individuals' bank deposits are affected by their decisions.

The controllability of the monetary base depends primarily on the fluctuations of these nondiscretionary accounts and the degree to which the Federal Reserve can offset these fluctuations through changes in its discretionary accounts. In other words, are weekly changes in nondiscretionary accounts sufficiently great that they cannot be offset by transactions in discretionary accounts?

In table 1, column 1 shows the dollar amounts for each of the accounts in the week ending November 5, 1980. Column 2 shows the average absolute weekly variation in each of the accounts during 1980. Column

[9]It is frequently argued that because of lagged reserve accounting, in any given week the Federal Reserve *must* make loans to financial institutions if they are deficient in required reserves. This indeed has been the tradition. But to say that this is *necessary* assumes that there are no deficiency and carryover provisions, and that banks are incapable of learning that the extension of loans must be based, among other things, on the availability of reserves. If such an argument is pushed to its logical conclusion, then the central bank has no control over money growth.

[10]Other assets are the sum of: special drawing rights certificates, coin, loans to other than depository institutions, acceptances, federal agency obligations, bank premises, and miscellaneous assets. Other liabilities are the sum of: deposits of international organizations, the Exchange Stabilization Fund and miscellaneous private and governmental agencies, accrued dividends and payables, and capital accounts.

Table 2
Annual Movements in the M1B Multiplier

Year	Average level of monthly M1B multiplier	Year-to-year changes of column 1	Maximum multiplier in the year	Minimum multiplier in the year	Difference between maximum and minimum
1970	2.913		2.950	2.891	.059
1971	2.881	–.032	2.900	2.862	.038
1972	2.875	–.006	2.897	2.862	.035
1973	2.852	–.023	2.891	2.822	.069
1974	2.763	–.089	2.817	2.706	.111
1975	2.685	–.078	2.717	2.649	.068
1976	2.636	–.049	2.675	2.612	.063
1977	2.622	–.014	2.640	2.606	.034
1978	2.596	–.026	2.619	2.583	.035
1979	2.583	–.013	2.599	2.568	.031
1980	2.543	–.040	2.573	2.504	.069
1970-79		Average = –.037			Average = .061

3 depicts the average weekly *net* variation (where decreases are subtracted from increases).

The Federal Reserve's ability to offset variations in nondiscretionary accounts on a weekly basis depends on the variability of the *sum* of all nondiscretionary accounts. In 1980 this sum varied on average, in absolute terms, $1,409 million per week. Since the average weekly absolute variation in security holdings alone was $3,271 million, it is clear that changes in nondiscretionary accounts can be easily offset. Moreover, one need not be concerned that these nondiscretionary accounts may vary all in one direction, thus producing a need for large *cumulative* offsetting transactions. The average *net* weekly variation in the sum of nondiscretionary accounts was a decrease of $71 million, again, a trivial change in the Fed's security portfolio.[11]

This discussion demonstrates that the Federal Reserve can control the monetary base *even on a weekly basis* if it so desires. There is, of course, no question that it can do so over longer periods of time.

Does Control of the Monetary Base Imply Control of Money Growth?

As indicated previously, the banking system and the nonbanking public decide how each additional dollar of the monetary base will be used. The banking system may hold it as excess reserves or lend it to borrowers. The public may hold all of the newly generated loans in time deposits, or as currency or checkable deposits. Each of these decisions affect money growth differently. The magnitude that describes the net result of these decisions is referred to as the *monetary base multiplier* and is measured by the ratio of the money stock to the monetary base.[12] If the multiplier is highly variable and unpredictable, then a tight control of the monetary base may still produce highly variable money growth. As an example, let us look at the variability of this multiplier, and what it would have implied about money growth in 1980.

Table 2 shows the annual behavior of the monetary base multiplier from 1970 to 1980. Column 1 lists annual average levels of the monthly multiplier, column 2 presents year-to-year changes of these averages, columns 3 and 4 show the maximum and minimum levels of the monthly multiplier in any given year, and column 5 lists the differences between these maximum and minimum levels.

Suppose that M1B is $384.8 billion in the fourth quarter of 1979, and we want it to grow at a 5.5 per-

[11]The Federal Reserve knows its daily balance sheet with a one-day lag. Thus, knowledge of changes in nondiscretionary accounts can initiate offsetting transactions the next day.

[12]This can be expressed as $M = mB$, where M and B are the levels of M1B and monetary base, respectively, and m is the monetary base multiplier. It is clear from this relationship that if m is stable or predictable, control of monetary base implies control of the money stock.

Table 3

M1B Growth Resulting from Injection of Constant Amounts of Base (billions of dollars)

Month	Desired M1B levels	Resultant base levels	Actual multiplier	Resultant M1B levels monthly	Resultant M1B growth rate		Actual M1B growth rate	
					monthly	quarterly	monthly	quarterly
January	$388.2	$151.16	2.573	$388.9	6.4%		4.4%	
February	390.0	151.99	2.573	391.1	7.0	5.7%	10.0	5.8%
March	391.7	152.82	2.555	390.5	–1.8		–0.6	
April	393.5	153.65	2.517	386.7	–11.1		–14.0	
May	395.2	154.48	2.504	386.8	0.3	–2.0	–0.6	–2.4
June	397.0	155.31	2.518	391.1	14.2		17.4	
July	398.8	156.14	2.526	394.4	10.6		13.7	
August	400.6	156.97	2.546	399.6	17.0	11.8	24.2	15.5
September	402.4	157.80	2.556	403.3	11.7		17.0	
October	404.2	158.63	2.567	407.2	12.2		12.4	
November	406.0	159.46	2.552	406.9	–0.9	7.8	9.1	11.3
December	407.8	160.29	2.535	406.3	–1.8		–8.6	

Resultant M1B growth rate: 4th quarter 1979 through 4th quarter 1980 = 5.7 percent

Actual M1B growth rate: 4th quarter 1979 through 4th quarter 1980 = 7.3 percent

cent annual rate. This means that M1B should equal $406 billion in the fourth quarter of 1980, an increase of $21.2 billion. How much monetary base should be supplied in order to achieve this growth? Consider the results obtained by using two alternative, simple and "mechanistic" procedures. In the first procedure, monetary base is supplied at a *constant* monthly rate; in the second, monetary base growth varies each month to achieve a *monthly* M1B growth of 5.5 percent (at an annual rate).

Procedure I: Monetary Base Grows at Constant Amount Each Month

Table 2 indicates that the average multiplier in 1979 was 2.583, and that over the past 10 years, the multiplier declined on average by .037. Thus, let us "guess" that the multiplier will be 2.546 (2.583 – .037) for 1980. We would, therefore, want monetary base to grow to a level of $159.5 billion ($406.0 billion/2.546) in the fourth quarter of 1980. This translates to monthly growth of the base of $830 million in 1980. Let us further assume that the multiplier, instead of remaining constant at its "guessed" value of 2.546, fluctuated in the same manner as it actually did in 1980.[13]

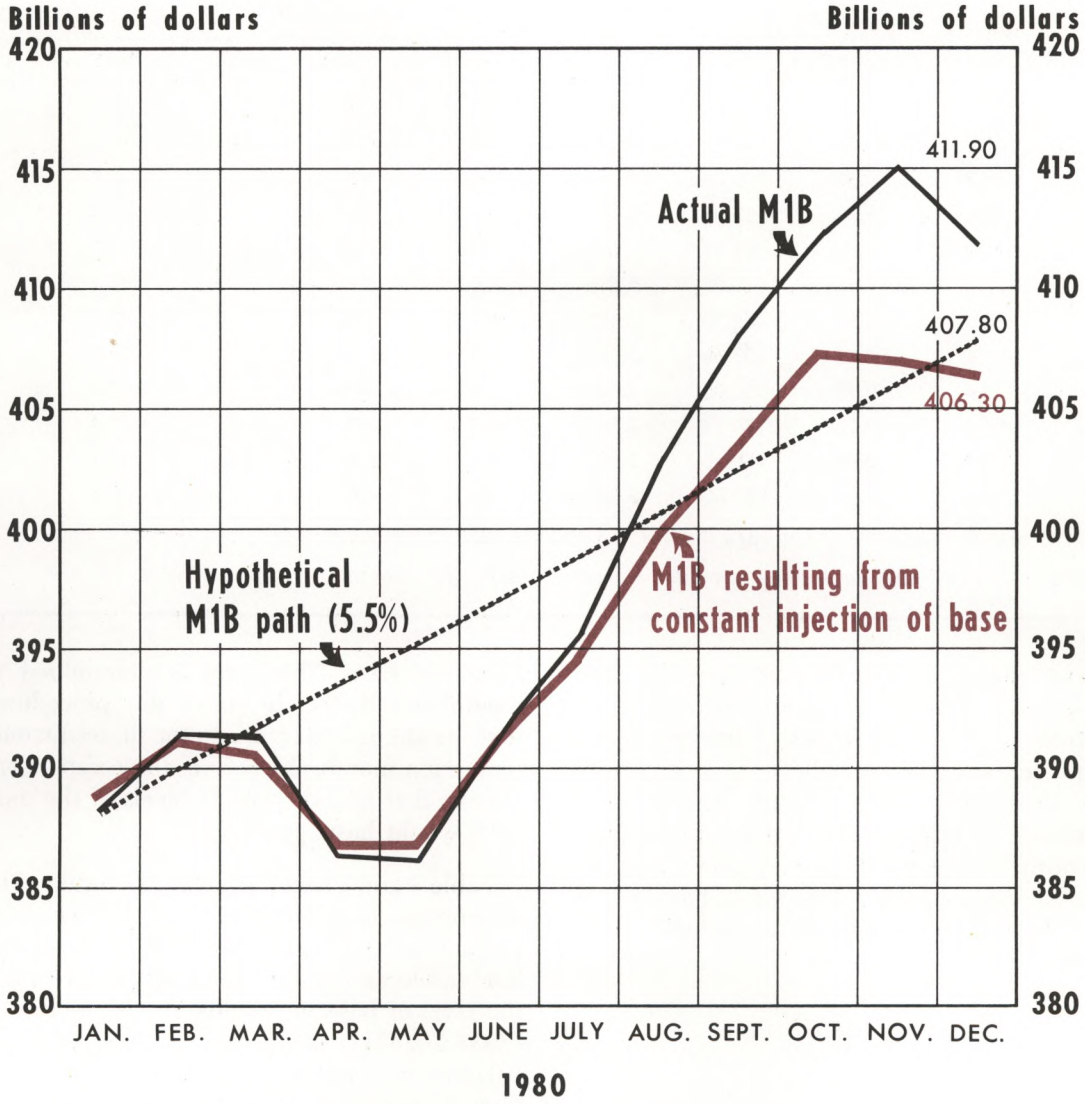
What would have been the resulting growth of M1B? Table 3 shows the resulting levels of monetary base, the resulting levels of M1B (which are computed by multiplying the base level by the *actual* monthly multiplier), and the resulting monthly and quarterly annualized rates of growth of M1B. For comparison, the actual monthly and quarterly annualized rates of growth of M1B in 1980 are also shown.

This procedure would have resulted in a fourth-quarter-to-fourth-quarter M1B growth of 5.7 percent, a shade above the desired growth of 5.5 percent in-

[13]Some analysts allege that one cannot assume that the multiplier would have been the same as it actually existed. They argue that tight control of the monetary base would have produced much larger fluctuations in interest rates, thus affecting bank and the public's behavior, which in turn affects the multiplier. Thus, the multiplier would have been much more volatile. One cannot reject this argument out of hand; however, interest rate fluctuations in 1980 were as large as any experienced over a similar period of time, and the multiplier remained remarkably stable. Until a base stabilization procedure is put into effect, there is no empirical evidence to support the assertion that the multiplier would be more volatile. For a contrary view, see David Lindsey and Others, "Monetary Control Experience Under the New Operating Procedures," *New Monetary Control Procedures*, Federal Reserve Staff Study, Volume II (Board of Governors of the Federal Reserve System, February 1981).

Chart 1

Levels of M1B Resulting from Monetary Control Procedure I



Latest data plotted: December

stead of the actual 1980 growth of 7.3 percent (see chart 1).[14] This indicates that although the multiplier may fluctuate from month to month, it remains relatively stable and predictable on a yearly average basis.

Even such a simple monetary base control procedure would have allowed for the relatively tight control of money growth *over a year*.[15]

[14]Comparisons with actual money growth should not assume that Federal Reserve actions also aimed at 5.5 percent M1B growth (close to the midpoint of the 4-6.5 percent range). The Federal Reserve could have aimed at 6.5 percent or 4 percent; or, after assumed adjustments for shifts into ATS and NOW accounts, at 7.25 or 4.75 percent; or, anywhere in between.

[15]It should be noted, however, that as table 2 indicates, the change in the multiplier from 1979 to 1980 was very close to the average. Our predictions of the multiplier and resultant money growth would not have been as successful in 1972 or 1974 (in those years this procedure would have produced M1B growth of 6.6 percent and 3.5 percent, respectively). Nevertheless, this simple procedure, if used, would have avoided the cumulative increases in money growth that actually occurred.

Table 4

M1B Growth Resulting from Injection of Varying Amounts of Base (billions of dollars)

Month	Desired M1B levels	Base injections	Resultant base levels	Actual multiplier	Resultant M1B levels	Resultant M1B growth rate		Actual M1B growth rate	
						monthly	quarterly	monthly	quarterly
January	$388.2	$ 0.52	$150.82	2.573	$388.0	3.5%		4.4%	
February	390.0	0.75	151.57	2.573	390.0	6.4	4.4%	10.0	5.8%
March	391.7	0.66	152.23	2.555	389.0	–3.0		–0.6	
April	393.5	1.78	154.01	2.517	387.6	–4.2		–14.0	
May	395.2	3.00	157.01	2.504	393.2	18.8	4.5	–0.6	–2.4
June	397.0	1.54	158.55	2.518	399.2	19.9		17.4	
July	398.8	–0.17	158.38	2.526	400.1	2.7		13.7	
August	400.6	0.21	158.59	2.546	403.8	11.7	9.8	24.2	15.5
September	402.4	–0.54	158.05	2.556	404.0	0.6		17.0	
October	404.2	0.09	158.14	2.567	405.9	5.8		12.4	
November	406.0	0.02	158.16	2.552	403.6	–6.6	2.3	9.1	11.3
December	407.8	1.64	159.80	2.535	405.1	4.6		–8.6	

Resultant M1B growth rate: 4th quarter 1979 through 4th quarter 1980 = 5.2 percent

Actual M1B growth rate: 4th quarter 1979 through 4th quarter 1980 = 7.3 percent

What about money growth fluctuations within the year? While most economists agree that month-to-month fluctuations in money growth have no impact on economic activity, some believe that quarterly fluctuations do. Using this criterion, Procedure I did not produce an appreciably better performance. Neither monthly nor quarterly money growth resulting from supplying a constant amount of base would have been substantially smoother than actually transpired during 1980.[16]

Procedure II: Adjusting Multiplier Estimates Monthly

Let us assume again that we want money to grow at the same annual rate as before. In the first procedure, we assumed that the multiplier would remain constant over the year and, thus, we supplied a constant amount of monetary base each month. Suppose, instead, we assume that next month's multiplier will be exactly as it was last month and that we want to have M1B grow at a 5.5 percent annual rate each month. For each month we must now calculate an appropriate level of M1B, then supply a corresponding level of monetary base. This level is determined using last month's multiplier. In effect, this procedure requires that we attempt to return to the desired money growth path each month. As before, for comparison, we will assume that actual monthly levels of the multiplier in 1980 would have prevailed.

Table 4 and Chart 2 present the results. The amount of monthly base injection was calculated as follows: In January the *desired* level of M1B was $388.2 billion; in December 1979 the multiplier was 2.574. Thus, the level of base in January should be $150.82 billion ($388.2/2.574), an injection of $520 million. This calculation was repeated for every subsequent month, thus determining the appropriate injection of monetary base. The resulting *monthly* M1B growth again is not substantially better than the actual 1980 outcome, but the *quarterly* growth is significantly more stable. Moreover, the annual M1B growth would have been 5.2 percent instead of the desired 5.5 percent and actual 7.3 percent.[17]

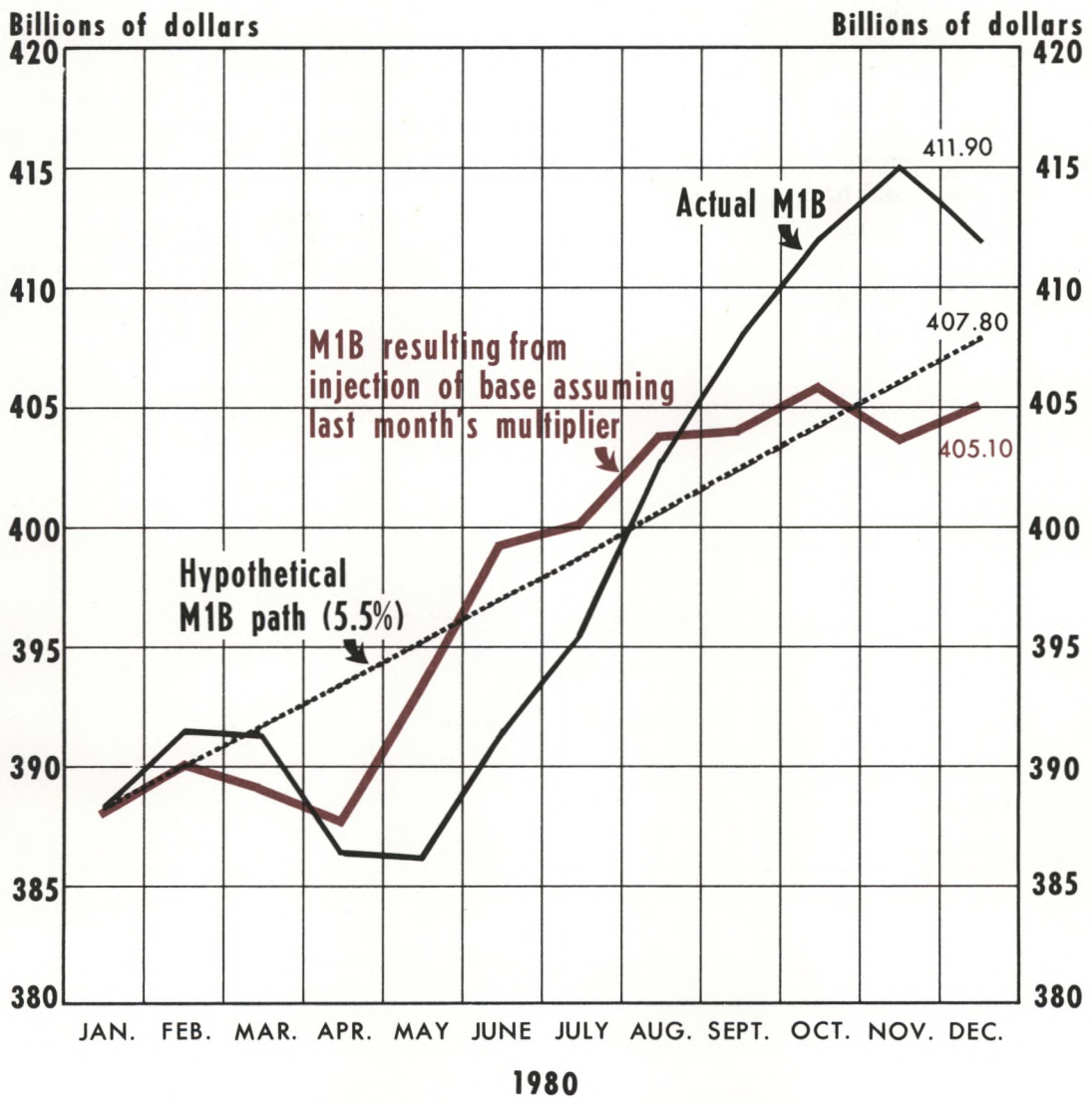
Here, if the multiplier had varied exactly as it actually did in 1980, a simple and "mechanistic" base control procedure would have produced a significantly

[16]In this procedure, the standard deviation of M1B growth declines from 1980 actual by 26 percent on a monthly basis and by 25 percent on a quarterly basis.

[17]Standard deviation of M1B growth declines 26 percent on a monthly basis and 59 percent on a quarterly basis.

Chart 2

Levels of M1B Resulting from Monetary Control Procedure II



Latest data plotted: December

closer achievement of annual targets *and* significantly more stability during the year.

Summary and Conclusions

It has been argued widely that, although excessive monetary growth is a cause of inflation, the tight "mechanistic" control of monetary aggregates is infeasible. This argument is based on allegations that the monetary base cannot be controlled, or that the base multiplier is too variable for the central bank to control monetary growth, particularly over short periods of time.

This article examines this argument by describing the mechanics of money creation, the constraints on money creation and the central bank's ability to impose these constraints. It demonstrates that the basic constraint on money growth — the monetary base — can be controlled with precision. Nondiscretionary accounts in the Federal Reserve's balance sheet are much

smaller, and vary less, than those which it can control directly.

The assertion that control of monetary growth is impossible because the monetary base multiplier behaves erratically is examined by using two simple and "mechanistic" monetary base control procedures and applying them to actual multiplier variations of 1980. Since the multiplier varied more in 1980 than it had on average over the past 11 years, such a simulation constitutes a reasonable test. The results indicate that by using base control and making *no adjustments* during the year, annual growth targets could have been achieved with greater precision although money growth stability *during* the year could have been improved only slightly. When simple adjustments were permitted, annual targets would have been reached with a lower error and greater stability. Since there are several more sophisticated monetary control procedures in existence than the two presented here, an even better method of money growth control can be developed.[18]

The article does not discuss whether tight control of the monetary base would produce larger variability in credit or other markets. However, if control of inflation is the paramount goal of the central bank, perhaps the nation would indeed be well served by "rigid mechanical monetarism."

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[18]See for example, James M. Johannes and Robert H. Rasche, "Predicting the Money Multiplier," *Journal of Monetary Economics* (July 1979), pp. 301-25, and Albert E. Burger, Lionell Kalish III, and Christopher T. Babb, "Money Stock Control and Its Implications for Monetary Policy," this *Review* (October 1971), pp. 7-22.

A Bushel of Wheat for a Barrel of Oil: Can We Offset OPEC's Gains With a Grain Cartel?

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NEAR the end of 1973 the Organization of Petroleum Exporting Countries (OPEC) increased the average price of crude oil to about $10 per barrel, more than four times the prevailing price earlier that year.[1] This price was increased another 10 percent in 1975, nearly 15 percent from 1975 to early 1979, and about doubled from early 1979 to early 1980. By December 1980, the price of United States imported oil averaged $35.63 per barrel, more than 12 times the price in mid-1973. These sharp increases have adversely affected the U.S. economy by reducing both potential output and productivity, raising the general price level and slowing real business investment.[2]

OPEC's actions in raising oil prices and restricting production have given rise to numerous proposals designed to offset the higher petroleum costs. One widely discussed proposal has been for the United States to organize a grain cartel that would significantly raise grain prices to the OPEC nations. Many suggest that the terms of trade between the two cartels should be a bushel of wheat for a barrel of oil, i.e., about the same terms that prevailed in early 1973 when wheat sold for about $2 per bushel and imported oil sold for about $2 per barrel.

This article assesses the potential success of such a grain cartel. It describes the attributes of a cartel and shows why a grain cartel could not succeed. It argues that OPEC's success in influencing petroleum prices results from certain economic conditions in the market for oil that do not exist in the market for grain.[3]

Competitive Firms Versus Cartels: Prices and Output

The impact of a cartel (a combination of firms, states, or groups whose purpose is to restrict output and increase profits) can best be described by contrasting its profit-maximizing operations with those of firms in a competitive industry. Every cartel or competitive firm produces at the rate of output that maximizes its profits. However, given market demands and cost structures, the rate of output consistent with profit maximization will differ between firms organized into a cartel and those in a competitive industry. These different rates of output imply different prices. In a competitive industry, output and price levels are determined by the intersection of the industry demand and supply curves. The demand curve indicates the varying amounts of a commodity that buyers will purchase at each price, while the supply curve indicates the varying amounts of a commodity that sellers will supply at each price. At the point where these curves intersect, competitive producers will supply the quantity of a good that consumers wish to purchase at that price; any firm that attempts to raise its price by producing less will simply lose sales to other firms in the industry.

If the firms form a cartel, however, they can influence market price in their favor by restricting output.

[1]The OPEC nations were originally composed of Saudi Arabia, Iran, Iraq, Kuwait and Venezuela; Qatar, Indonesia, Libya, Algeria, Nigeria, Ecuador, Gabon and the United Arab Emirates later became members. *OPEC: Questions and Answers* (New York: Exxon Corporation), pp. 7, 12; *Middle East Oil*, 2nd ed. (New York: Exxon Corporation, 1980), pp. 34-36; U.S. Department of Energy, *Monthly Energy Review* (December 1980), p. 72.

[2]See John A. Tatom, "Energy Prices and Short-Run Economic Performance, this *Review* (January 1981), pp. 3-17.

[3]The OPEC cartel may not meet the strict definition of a cartel in all respects, but this term is used to facilitate discussion. An alternative analysis, not pursued here, would treat OPEC as the dominant firm that sets and lets the small producers sell all they want at that price.

The profit-maximizing rate of output will thus be less and the price higher than would prevail in a competitive industry.

Cartels Are Typically Unstable

A cartel, however, is unlikely to survive unless its rules are enforced by government sanction. Historically, cartels have been fragile, lasting only a short time. Unless all producers in the industry are members of the cartel, the higher price of the good caused by the cartel's restriction of output provides a great incentive for nonmembers to increase their own output.[4] Moreover, firms have a powerful incentive not to join the cartel. The higher price resulting from the restrictions on output by the cartel will increase nonmembers' profits even more since they can expand their rates of output. Consequently, each potential member of the cartel faces essentially the same incentive not to join, and actual cartel members will find their share of the market and profits reduced as nonmembers increase their production and sales.

The length of time that a cartel can survive depends in part on the elasticity of the supply curve of the industry's output. The less elastic the supply curve, the longer the cartel is likely to survive. If a large increase in price elicits only a small increase in output by non-cartel firms, there will be less pressure on the cartel.

Likewise, the more inelastic the demand curve for the cartel's product, the higher the price can be raised without drastically reducing the quantity demanded and the greater the potential cartel profit. If good substitutes are available for the cartel's product, however, this will not occur; sizable increases in the price of the cartel's product will result in larger purchases of these substitute goods. In this case, the cartel is unlikely to increase its profits for long by restricting output and raising prices.

Although both the demand and supply relationships may appear to be quite inelastic in the short run, demand and supply conditions will change over time in response to higher prices. These changes will reduce the stability of the cartel. First, over time, substitutes will always be found for the cartel's product. As the price of petroleum rises, people learn how to substitute other goods (e.g., coal, alcohol, nuclear energy, etc.) as sources of energy. Furthermore, greater economies in the use of a good, which also reduce the quantity of the good demanded, can be achieved over the long run. For example, the increased use of smaller automobiles and insulation have reduced the quantity of petroleum demanded for gasoline and heating. Consequently, the quantity demanded decreases more drastically over time.

Second, new techniques of production, new discoveries and new investments will increase the quantity of the cartel's product (e.g., petroleum) supplied by others.

If the cartel is initially successful in raising prices sufficiently to increase profits, rivalry will arise between the cartel members over how the reduced output and the increased profits are to be allocated. Each member will want to sell more as the price is increased through general production restrictions — that is, each member has an incentive to cheat on the cartel's sales quotas. Intense rivalry for greater market shares will develop among cartel members. Therefore, it becomes increasingly difficult for cartels to exist for extended periods.

OPEC Not Immune from Pressures

The OPEC cartel has not been immune to these pressures. It is presently in the throes of relatively severe adjustments in output in response to market forces. It has already lost much of its international market to non-OPEC suppliers as shown in table 1. OPEC countries produced an *increasing* portion of the world's petroleum output until 1973, at which time they accounted for 55.5 percent of the total, up from 52.6 percent in 1972, 48.3 percent in 1970 and 37.6 percent in 1960. Their annual rate of production rose in excess of 8 percent per year through 1974, well above that of non-OPEC countries. Following the first major price increase in late 1973, total OPEC output dropped somewhat for two years and then rose moderately through 1977. Then, from 1977 to 1979 its output declined somewhat. Since late 1979, following the latest round of major price increases, OPEC's output has declined rapidly, dropping about 22 percent in the latest 12 months. Its share of the market, which totaled 55.5 percent in 1973, declined slowly to 49.6 percent in 1979. The decline has recently accelerated: OPEC's market share dropped to 44 percent by September 1980.

Higher oil prices have induced the non-OPEC world to increase output. Output in non-OPEC nations rose from 24.9 million barrels per day in 1977 to 32.6 mil-

[4]See George J. Stigler, *The Theory of Price*, 3rd ed. (New York: The Macmillan Company, 1966), pp. 230-38; and Jack Hirshleifer, *Price Theory and Applications* (Englewood Cliffs, New Jersey: Prentice-Hall Inc., 1980), p. 362.

Table 1
World Crude Oil Production (thousand barrels per day)

	OPEC	Growth Rate[1]	Rest of World	Growth Rate[1]	OPEC Share
1960	7,874		13,067		37.6%
1961	8,497		13,923		37.9
1962	9,954	10.8%	14,383	5.5%	40.9
1963	10,865		15,253		41.6
1964	12,082		16,081		42.9
1965	13,177		17,115		43.5
1966	14,217		18,693		43.2
1967	15,630	10.9	19,732	6.7	44.2
1968	17,660		20,983		45.7
1969	20,341		21,341		48.8
1970	22,134		23,692		48.3
1971	25,092		23,255		51.9
1972	26,711	8.5	24,070	1.5	52.6
1973	30,961		24,869		55.5
1974	30,683		25,192		54.9
1975	27,134	0.6	25,856	4.1	51.2
1976	30,711		26,684		53.5
1977	31,230		28,380		52.4
1978	29,800	–0.5	30,390	5.3	49.5
1979	30,928		31,472		49.6
1980[2]	26,743	–13.5	32,558	3.5	45.1
November 1979	30,770		32,370		48.7
		–21.8		–0.1	
November 1980	24,015		32,335		42.6

[1]Annual rates of change

[2]Estimated for November and December

SOURCE: U.S. Department of Energy, *Monthly Energy Review*, (March 1981), American Petroleum Institute, *Basic Petroleum Data Book* (June 1977).

lion barrels per day in mid-1980 and has apparently maintained its pre-1973 rate of growth despite some decline in late 1980 in Mexico, and earlier declines in the United States and Canada where, until recently, price controls have reduced the incentive for oil production.[5]

OPEC's cutback on production to maintain the cartel price clearly caused stress among the colluding nations. Though the reduction in output is absorbed by the group, each nation's share in the reduction will differ. Per capita revenues also differ among individual nations. For example, oil revenue per capita varied from $480 in Iran to $17,300 in the United Arab Emirates in 1979.[6] Such differences engender conflicts

[5]The profits accruing to OPEC were enhanced and extended over a longer period of time than they might otherwise have been by ill-advised U.S. policies. In attempting to cushion the impact of the sharply higher OPEC prices on the domestic economy, the U.S. government has subjected the oil industry to varying degrees of price controls, the last of which were lifted only this year. The industry was then subjected to an "excess" profits tax which will continue to retard its incentive to explore and develop petroleum.

These controls delayed the adjustment of domestic consumption to the higher oil price, reduced the incentive for domestic production and led to greater reliance on imports, thereby enhancing OPEC's ability to influence prices. For a further discussion of this topic, see Hans H. Helbling and James E. Turley, "Oil Price Controls: A Counterproductive Effort," this *Review* (November 1975), pp. 2-6.

[6]*Middle East Oil*, p. 39.

about how additional reductions are to be shared. In addition, non-OPEC, producer/exporters like Mexico and Norway can obtain the existing high world price without resorting to output reduction. The OPEC cartel will face future problems in maintaining profit as the United States and other nations eliminate price and marketing controls in the oil industry.

WHY OPEC HAS BEEN SUCCESSFUL FOR SO LONG

OPEC's actions have led to a rapid rise in petroleum prices and revenues for all oil producers, both OPEC and non-OPEC. From 1973 to 1979, receipts from petroleum sales by Middle East governments rose about tenfold.[7] Hence, OPEC has clearly succeeded in achieving its main objective.

An analysis of the supply of and demand for petroleum in the non-OPEC nations shows why OPEC has been so successful. First, there has been only a small increase in petroleum output by non-OPEC members following the sharply higher prices in 1973, indicating that supply of petroleum in non-OPEC nations is relatively price inelastic. Although, the price of petroleum has increased about twelvefold during this period, petroleum output in non-OPEC nations has increased only 24 percent.[8] It is estimated that the long-run price elasticity of the non-OPEC oil supply is between .33 and .67. In other words, a 1 percent increase in price of oil will cause output to increase about .5 percent.[9]

Part of the reason for the short-run inelastic supply of petroleum by non-OPEC nations is the dominant position of OPEC in the petroleum industry. From 1945 to 1979, about three-fourths of world oil discoveries were in the Middle East (largely the OPEC area).[10] In 1973, when OPEC began restricting production, it was producing about 31 million barrels of oil per day, more than four-fifths of which was exported. OPEC supplied 83.4 percent of all petroleum exports in 1978 (table 2).

Also, petroleum demand by non-OPEC nations is clearly price inelastic, at least in the short run. The large increase in price has resulted in a relatively small decrease in quantity demanded as confirmed by petroleum consumption in the major free-world industrialized countries from 1973 until mid-1980. Although petroleum prices have risen about twelvefold, consumption in these nations has declined only 10 percent, from 34.2 to 31.1 million barrels per day.[11]

Not surprisingly, most of the more developed nations are highly dependent on imports for their supply of petroleum. Western Europe, for example, produced only 12 to 14 percent of its domestic consumption. South Africa and Japan imported essentially all of their petroleum (table 3). Even the United States, one of the world's largest petroleum-producing nations, imported more than 50 percent of its petroleum. Furthermore, most of the less-developed, non-OPEC nations depend largely on imports for petroleum supplies. Thirty-seven of these nations produced an average of only 12 percent of their consumption. Among the non-OPEC nations, only Egypt, Syria and Mexico have sizable quantities of petroleum exports, and the combined exports of these countries totaled less than 10 percent of U.S. imports in 1978. Given OPEC's predominant position and the length of time required for the exploration and development of petroleum resources or substitutes for petroleum, the slow response of output by the non-OPEC world to the higher price of oil is to be expected. Hence, OPEC's ability to increase profits by restricting output is not surprising.

WHY A U.S. GRAIN CARTEL WOULD FAIL

The U.S. grain industry does not possess the attributes necessary for a strong cartel. Both the world demand for and supply of U.S. grain are relatively elastic. On the demand side, the price elasticity of foreign demand for U.S. output of food and feed has been estimated to be –1.9 in the intermediate run

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[7]Ibid, p. 31.

[8]*Monthly Energy Review* (December 1980), pp. 88-89 and *Middle East Oil*, p. 26. Part of the apparent inelasticity, however, reflects the impact of the price controls in the United States and Canada.

[9]Michael Kennedy, "A World Oil Model," in Dale W. Jorgenson, ed., *Econometric Studies of U.S. Energy Policy*, (Amsterdam: North Holland Publishing Company, 1976), p. 139. On the demand side, the long-run price elasticity of demand for gasoline in the United States has been estimated at about –.8, which indicates that an increase in price of 1 percent causes a reduction of about .8 of a percent in quantity demanded, p. 132.

[10]*Middle East Oil*, p. 37.

[11]*Monthly Energy Review* (December 1980), p. 90. These data overstate the inelasticity of petroleum demand at any one point in time since demand has been increasing (the demand curve was shifting to the right). Another factor contributing to the relatively high rate of oil consumption has been the price controls which assured gasoline to U.S. and Canadian consumers at less than world prices.

Table 2
Crude Oil Production and Exports, Selected Countries (millions of barrels)

OPEC Members	Production	Percent of World Production	Net Exports	Percent of World Exports
Algeria	401.5	1.8%	366.0	3.2%
Ecuador	74.8	0.3	44.8	0.4
Gabon	917.9	4.2	870.3	0.6
Indonesia	596.8	2.7	503.4	4.4
Iran	1,898.0	8.7	1,645.4	14.3
Iraq	918.0	4.2	870.3	7.6
Kuwait	764.7	3.5	642.8	5.6
Libya	720.9	3.3	677.0	5.9
Nigeria	697.2	3.2	677.0	5.9
Qatar	176.5	0.8	175.2	1.5
Saudi Arabia	3,027.7	13.8	2,812.7	24.5
United Arab Emirates	667.9	3.1	663.1	5.8
Venezuela	790.2	3.6	453.4	3.9
TOTAL OPEC	10,810.7	49.4	9,595.1	83.4
Other Major Producing Nations[1]				
Argentina	165.2	0.8%	14.9	0.1%
Australia	157.0	0.7	–69.7	—
Canada	480.0	2.2	–127.5	—
Egypt	169.5	0.8	47.8	0.4
Mexico	443.5	2.0	133.2	1.2
Norway	127.2	0.6	71.8	0.6
Oman	115.0	0.5	115.0	1.0
United Kingdom	394.2	1.8	–315.1	—
United States	3,178.1	14.5	–2,278.1	—
Sino-Soviet Area	4,978.0	22.8	130.0	1.1
TOTAL	10,207.7	46.7	–2,277.7	—
WORLD TOTAL	21,874.5		11,501.8[2]	

[1]Those producing 100 million barrels or more per year
[2]Total exports

SOURCE: U.S. Department of Energy, *International Petroleum Annual 1978.*

(three to four years) and –6.4 in the longer run. Thus, a price hike of 1 percent would result in a decrease of 1.9 percent in quantity demanded in three to four years and a 6.4 percent decrease in the longer run.[12]

The supply of grain is also relatively elastic. On the basis of real prices, Peterson found that a 1 percent increase in the real price of farm products leads to an increase of about 1.5 percent in total world output.[13] Similar results have been observed in the United States. For example, one study found that for each

[12]*The Demand for United States Farm Output*, reprinted from *Food Research Institute Studies* (Stanford, California: Stanford University, 1967), pp. 360, 363.

[13]Willis L. Peterson, "International Farm Prices and the Social Cost of Cheap Food Policies," *American Journal of Agricultural Economics* (February 1979), pp. 15-16.

Table 3
Self-Sufficiency in Grain and Petroleum Consumption (1978[1])

Region	Grain Consumption			Petroleum Consumption		
	Number of Countries	Million Metric Tons	Production as Percent of Consumption	Number of Countries	Million Barrels	Production as Percent of Consumption
More-Developed Areas						
United States	1	178.4	152%	1	6,879	46%
Canada	1	22.6	183	1	634	76
European Community[2]	9	119.3	98	9	4,010	12
Other Western Europe[3]	8	43.7	84	8	1,018	14
South Africa	1	9.2	110	1	107	0
Japan	1	34.4	35	1	1,877	0
Oceania[4]	2	6.7	394	2	257	63
Centrally Planned Countries[5]	10	564.2	97	10	4,376	100
OPEC Nations	13	59.4	73	13	817	1,323
Other Less-Developed Nations With Grain Production of:						
90+ percent of consumption	30	233.4	108	11	818	136
80-89 percent of consumption	13	70.7	73	1	57	83
70-79 percent of consumption	6	11.2	76	0	—	—
60-69 percent of consumption	7	8.1	64	0	—	—
0-59 percent of consumption	21	36.1	51	37	1,395	12

[1]Petroleum data for calendar year, and grain data (wheat, coarse grains and milled rice) for marketing year 1978-79.

[2]Belgium, Denmark, France, West Germany, Ireland, Italy, Luxemburg, Netherlands, United Kingdom

[3]Austria, Finland, Greece, Norway, Portugal, Spain, Sweden, Switzerland

[4]Australia, New Zealand

[5]Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Rumania, Yugoslavia, USSR, China

SOURCE: U.S. Department of Agriculture, *Global Food Assessment, 1980,* and U.S. Department of Energy, *International Petroleum Annual 1978.*

1 percent increase in price, crop output would rise about 1.5 percent in the long run.[14]

Given the elastic export demand for and an elastic world supply of grain in the long run, the effectiveness of a U.S.-enforced grain cartel in increasing profits to U.S. farmers or to the nation for more than a year or two is unlikely. In the longer run of four to five years, such a cartel would be disastrous.

Similar Policies Have Failed in the Past, . . .

The United States has had some experience with cartel-type policies in the farm sector. Production restrictions and commodity loan programs have been used since 1933 to raise farm prices and increase returns to U.S. farmers for a number of major exported crops, such as wheat, cotton, tobacco and rice. These programs were successful in increasing farm profits for a few years. The higher price of these commodities increased profits to the U.S farm producers and foreign producers, and food prices to U.S. and foreign consumers. However, these farm production control and price support programs have been considered failures by many people over the long run.[15]

The United States accounted for 62 percent of world cotton exports and its share of world cotton produc-

[14]Luther G. Tweeten, *Foundations of Farm Policy* (Lincoln: University of Nebraska Press, 1970), p. 244.

[15]See, for example, George Leland Bach, *Economics: An Introduction to Analysis and Policy,* 8th ed. (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1974), pp. 292-303.

tion had risen slightly during the 10 years prior to the adoption of these programs for cotton in 1933 (table 4). Following the adoption of the cotton program, the United States became the residual supplier of cotton (as OPEC has become the residual supplier of oil). Other cotton-exporting nations such as Mexico, Peru and Egypt sold all of their cotton output at the higher world prices, while the United States exported the remainder of world imports. The higher world cotton price predictably induced other nations to increase cotton production and induced consumers to increase their use of cotton substitutes such as rayon and other synthetic fibers.

The higher price likewise induced U.S. growers to increase domestic cotton production. Production controls were necessary to limit output to domestic consumption and export levels at the fixed prices. As a result of this program, the U.S. share of world cotton production declined steadily, dropping from 56 percent in 1930-32 to 42 percent in 1940-42, 36 percent in 1950-52, 31 percent in 1960-62 and 20 percent in 1970-72. Exports declined from 8.4 million bales in 1930-32 (62 percent of world exports) to 4.4 million bales in 1952 (36 percent of world exports).[16]

The International Wheat Agreement, initiated in 1949 and renewed at intervals until 1965, resulted in an organization that included both net-exporting and net-importing nations.[17] The stated purpose of the agreement was to stabilize the price and quantity of wheat in international trade. Originally, each exporter was to furnish a specific quantity of wheat for export and each importer to purchase a specific quantity. The organization soon evolved into a cartel with the United States and Canada as the price leaders. The United States supplied the residual wheat demanded at the specified price. The cartel broke down in 1964, when the United States decided to regain the Japanese market captured earlier by the Canadians. Although U.S. production controls and price supports to farmers were maintained, the breakdown of the cartel and a reduction of U.S. wheat prices were quickly followed by accelerating U.S. wheat exports. U.S. wheat exports through commercial channels had averaged 141.2 million bushels per year during 1955-59, 12 percent of total world wheat exports. By 1964, when the cartel was dismantled, such exports totaled 157.7 million bushels, only 9 percent of world wheat exports. By 1970, such exports had risen to 508.0 million bushels or 26 percent of world wheat exports.[18]

Table 4

World Production of Cotton (annual average 1,000 bales)

	Production		United States as Percent of World	
	United States	Foreign Countries	Production	Exports
1920-22	10,376	8,497	55.0%	57.1%
1930-32	14,677	11,439	56.2	62.3
1940-42	12,042	16,776	41.8	23.6
1950-52	13,434	23,441	36.4	36.0
1960-62	14,449	31,860	31.2	31.6
1970-72	11,378	44,967	20.2	22.3

SOURCE: U.S. Department of Agriculture, *Statistics on Cotton and Related Data 1920-1973*, October 1974, Washington, D.C.

A grain cartel composed of a number of the major grain-producing nations might increase profits from grain exports for a somewhat longer period than the U.S. could acting alone. However, within a few years, demand for the cartel-produced grain would become more elastic, profit from grain sales by the cartel would decline sharply and the problem of allocating production among the nations would become more intense.

. . . the Potential for Punishing OPEC Nations Is Limited . . .

A U.S.-sponsored grain cartel will not succeed in punishing OPEC because there is a relatively small demand for grain imports in most OPEC nations. Incomes in some OPEC nations are sufficient to purchase large quantities of grain. Most OPEC members, however, have relatively small populations and/or small per capita incomes and, hence, relatively small demand for grain; those with large populations such as Algeria, Indonesia, Iran, Iraq and Nigeria have relatively small incomes per capita, and grain demand is relatively small because of low income (table 5). In contrast, Saudi Arabia with a population

[16]U.S. Department of Agriculture, *Statistics on Cotton and Related Data 1920-1973* (GPO, 1974), pp. 40 and 49-50.

[17]See Alex McCalla, "A Duopoly Model of Wheat Pricing," *Journal of Farm Economics* (August 1966), p. 711. The U.S. wheat surplus that could not be sold at the established price was transferred to the less-developed nations through major government subsidy programs.

[18]U.S. Department of Agriculture, *Agricultural Statistics*, (GPO, 1966 and 1972).

Table 5

Population and Per Capita Income, Selected Nations

OPEC	Population[1]	Per Capita Income[2]
Algeria	18,145,000	$ 780
Ecuador	7,763,000	741
Gabon	637,000	3,725
Indonesia	148,085,000	304
Iran	37,430,000	1,986
Iraq	12,906,000	1,561
Kuwait	1,277,000	11,431
Libya	2,920,000	6,335
Nigeria	74,595,000	682
Qatar	210,000	12,500
Saudi Arabia	9,292,000	6,089
United Arab Emirates	871,000	11,000
Venezuela	14,529,000	2,772
Other Nations		
Argentina	27,210,000	1,388
Australia	14,417,000	7,515
France	53,478,000	7,908
Italy	56,877,000	3,076
United Kingdom	55,901,000	4,955
United States	222,020,000	8,612
West Germany	61,302,000	9,278

[1]Data are 1980 estimates for the United States and 1979 estimates for all others.

[2]Years for which estimates were made vary from 1974 for Qatar to 1978 for nine nations.

SOURCE: *The World Almanac and Book of Facts 1981.*

of 9.3 million and an income per capita of $6,089 has both a relatively large population and high income per capita; Venezuela, with a 14.5 million population is likewise not far behind Western European nations with per capita income of $2,772.

Commercial demand for imported grain by the group is a relatively small portion of the world total. In 1978, the OPEC nations consumed only 59 million metric tons of grain, less than one-third of U.S. consumption, and they produced almost three-fourths of their consumption domestically, importing only about 16 million metric tons. At this level of imports, the approximate grain price that a cartel would have to charge in order to offset the wealth transfers achieved by OPEC would be astronomical. U.S. petroleum imports from the OPEC nations totaled about 1.6 billion barrels in 1980, which cost about $34 per barrel and totaled about $54.4 billion. In 1973, prior to the cartel, imports from OPEC totaled about 1.1 billion barrels, which at $2 per barrel totaled $2.2 billion. Excluding the impact of inflation, the cartel gained $52.2 billion in revenue from its petroleum sales to the United States alone.

In early 1973, a bushel of wheat and a barrel of petroleum were selling for about the same price ($2); hence, if a food cartel attempted to maintain this relationship, it would require a wheat price from the OPEC nations of about $34 per bushel or about eight times the January 1981 average of $4.21. The 16 million metric tons of grain imports (588 million bushels) by OPEC (assuming it was all wheat and all supplied by the United States) totaled only $1.2 billion in revenue at the $2 per bushel price. Even at $34 per bushel and with no change in bushels purchased, revenues would total only $20.0 billion. Thus, the gains from the grain cartel ($20.0 billion – $1.2 billion) of $18.8 billion would still be less than two-fifths of the OPEC revenue gains of $52.2 billion ($54.4 billion – $2.2 billion). To offset this level of OPEC gains would require a wheat price in excess of $100 per bushel.

Furthermore, if the objective of the grain cartel is to offset total OPEC gains, it would require an even higher wheat price. Assuming that 83.4 percent of 1980 OPEC petroleum production was exported (the same percent as in 1978), exports would have totaled 8.24 billion barrels. At $34 per barrel this equals $280.2 billion in revenue compared with 9.42 billion barrels at $2 per barrel or $18.8 billion in 1973. This difference in OPEC's revenue of $261.4 billion would require a wheat price to OPEC of $445 per bushel.[19]

. . . And a U.S. Grain Cartel Would Cause Famine in Some Nations

One factor generally ignored in a discussion of an anti-OPEC grain cartel is its impact on the well-being of the non-OPEC world, especially the less-developed areas. As this nation has recently discovered with its Russian grain embargo, it would be futile to attempt to sell grain only to the OPEC nations at cartel prices. If a U.S.-sponsored grain cartel sold grain at lower prices to non-OPEC areas, the OPEC group would buy the grain from these other nations at a lower

[19]*Middle East Oil*, p. 26; U.S. Department of Agriculture, *U.S. Wheat Industry*, Agricultural Economic Report No. 432 (August 1979), pp. 51-52; and *Monthly Energy Review*.

price while reducing their purchases from the grain cartel.

There are only two ways to deal with this problem. One way is to have a grain cartel consisting of *all* non-OPEC nations of the world. But just as with the oil cartel, every nation, especially the less-developed ones heavily affected by OPEC price increases, would have a tremendous incentive to remain outside the cartel. They could then sell the OPEC nations *all* their wheat at a price slightly below the cartel's price. The other possibility of a successful grain cartel, even in the short run, is for a few nations to somehow limit total world exports. This policy would cause starvation and famine in many non-OPEC nations. Although OPEC has largely ignored its impact on the well-being of non-OPEC nations, this is not an acceptable political possibility for the United States.

SUMMARY

Forming a grain cartel to retaliate against OPEC's oil cartel would be ineffective. The OPEC cartel has been successful because of special supply and demand conditions for petroleum, which assured an increase in profits to cartel members when production was restricted.

A grain cartel composed of the United States alone or the United States and a few other leading food-exporting nations would not succeed. Although it might raise world grain prices and increase profits to the cartel members for a year or two, the higher prices would soon lead to increased production in the rest of the world and sharp reductions in the quantity of grain exported by the cartel members. Hence, revenue to the cartel would soon decline to less than pre-cartel levels.

Moreover, the United States and other nations have had unfavorable experience with cartel-type farm export programs. Attempts to maintain cotton prices at artificially high levels after 1932 resulted in reduced exports as the United States became the residual supplier, while other producing nations profited from our production control and price support programs. Similarly, the International Wheat Agreement collapsed under increased competition by member nations.

Another factor limiting the ability of a food cartel to punish OPEC is that a food cartel cannot be effective without doing great injury to people in less-developed nations. Attempts to provide less-developed, non-OPEC nations with food on more favorable terms than the rest of the world would result in reshipment to OPEC members, thereby nullifying the objectives of the cartel. A food cartel would, thus, reduce food supplies for the near destitute masses of people in the less-developed nations.

Foreign Exchange Markets: The Dollar in 1980

DALLAS S. BATTEN

FOREIGN exchange markets during 1980 were dominated by activity in domestic financial markets throughout the world. Dramatic changes in the direction of international capital flows during the year reflected the relatively volatile interest rate movements in the United States. While these interest rate movements appeared to be the major force affecting exchange rates during the period, however, rising rates of inflation and inflationary expectations, as well as midyear recessions in most industrial countries, also influenced exchange rate movements.

This article describes and analyzes what occurred in foreign exchange markets in the past year with special emphasis on changes in the value of the U.S. dollar. First, however, the framework necessary to analyze movements of exchange rates is presented. Next, changes in the value of the U.S. dollar are analyzed in detail. Finally, the activity of U.S. policymakers within foreign exchange markets during the year is investigated.

ANALYTICAL FRAMEWORK

The exchange rate between any two currencies is determined just as any other price is determined — by the interaction of demand and supply. For example, the U.S. dollar/deutschemark exchange rate is a result of the interaction between German consumers and investors demanding dollars (supplying deutschemarks) and U.S. consumers and investors supplying dollars (demanding deutschemarks). If, at the current deutschemark price of a dollar, a larger quantity of dollars is demanded than is supplied, the deutschemark price of a dollar will rise. If the quantity demanded is less than that supplied at the current price, the price of a dollar will fall.

Why do Americans demand deutschemarks? Americans demand deutschemarks simply because they want to purchase goods and services produced in Germany or securities denominated in deutschemarks. On the other hand, Germans are willing to supply deutschemarks (in exchange for dollars) because they want to purchase U.S.-produced goods and services or dollar-denominated securities. Consequently, the determinants of the dollar/deutschemark exchange rate are those factors that determine the demand for goods, services and securities in Germany and in the United States. Two of the most important determinants of the demand for and the supply of goods, services and securities (and consequently of exchange rates) are relative price levels and interest rates between countries.

The Relationship Between Exchange Rates and Price Levels

If prices in the United States rise relative to those in Germany, U.S. demand for goods and services will shift away from those produced in the United States to those produced in Germany, other things equal. German demand will also shift away from U.S.-produced goods and services to domestically produced ones. The result of these shifts is that at every deutschemark price of the dollar, German consumers will want to purchase fewer dollars, while U.S. consumers will be willing to supply more dollars (i.e., demand more deutschemarks) than before. In other words, the demand for dollars has fallen, and the supply of dollars has increased, resulting in a fall in the deutschemark price of a dollar. Thus, a rise in U.S. prices relative to those in Germany causes the dollar to depreciate.

The price level in any country is determined by the relationship between the demand for and the supply of money; that is, it depends on the supply of money relative to the amount that individuals desire to hold.

The quantity of money supplied is essentially a policy variable determined by monetary authorities. The demand for money is the individual's desire to hold a portion of his wealth in the form of money. The latter is determined by income, interest rates, prices and price expectations. The equilibrium price level is the one (given the level of income, interest rates and price expectations) that induces individuals to hold the exact quantity of money that monetary authorities are supplying. Any other price level will motivate individuals to hold more or less money than is being supplied. If individuals are satisfied with the amount of money that they are holding, they will have no desire to increase or decrease their spending on goods, services and securities. In other words, they are in equilibrium and the existing price level is the equilibrium one. If they desire to hold more or less of their wealth in the form of money (or if the money supply changes), however, they will alter their spending habits in order to reach equilibrium again and, consequently, the price level will change.

For example, if the supply of money in the United States is greater than the amount that individuals desire to hold, both an excess supply of money and a concomitant excess demand for goods, services and securities exist. In order to reduce their money holdings, individuals increase their spending on goods, services and securities, causing U.S. prices to rise. Likewise, if foreign individuals experience an excess supply of money, prices must also rise abroad. Other things equal, if *excess* money growth in the United States exceeds that in other countries, then prices will rise relatively more in the United States than they will in other countries.

Since changes in the foreign currency price of a dollar (the dollar exchange rate) are determined among other things by relative changes in the price levels here and abroad, and since price levels reflect relative rates of excess money growth, changes in the dollar exchange rates are caused primarily by differences in the rates of excess money growth across countries. That is, movements in exchange rates are primarily monetary phenomena reflecting relative differences in excess money growth.[1] If money growth exceeds the growth in money demand relatively more in the United States than in other countries, the dollar will depreciate relative to other currencies. Over the long run, the value of currencies should adjust in order to offset relative differences in rates of inflation. This concept, called purchasing power parity, states that if prices in the United States rise by 10 percent relative to those in Germany, then the deutschemark price of a dollar should fall by 10 percent, other things equal.

The Relationship Between Exchange Rates and Interest Rates

This monetary approach to exchange rate determination implicitly assumes that there is sufficient time for commodity markets to clear (reach equilibrium). However, financial markets also reflect relative changes in rates of excess money growth. Since financial markets typically adjust more rapidly than commodity markets, changes in interest rate differentials (i.e., the differences between interest rates in the United States and those in other countries) are usually the major determinants of exchange rate movements in the short run through their impact on the direction of international capital flows. However, it is changes in *real*, not nominal, interest rate differentials that actually motivate the international movement of capital and, therefore, induce changes in exchange rates.

The interest rates that are quoted in financial markets are *nominal* interest rates. Each nominal interest rate contains two components: the real interest rate (or real yield) and a premium for expected inflation. The real interest rate represents the compensation in terms of goods and services paid to the lender for the use of his money over some time period. The inflation premium is the compensation for the erosion of purchasing power during the life of the loan. The nominal interest rate is approximated by the sum of the two.[2] The real interest rate is crucial because it alone influences the decision to lend; lenders are concerned

[1]For a discussion of this topic, see Jacob A. Frenkel, "A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence," in Jacob A. Frenkel and Harry G. Johnson, eds., *The Economics of Exchange Rates* (Reading, Massachusetts: Addison-Wesley Publishing Co., 1978), pp. 1-25.

[2]For example, individual A lends $1,000 to B for one year; A charges B a nominal interest rate of 10 percent on the loan. At the end of one year, B pays A $1,100 (the amount borrowed plus $100 interest). If the prices of goods and services have not changed during the year (i.e., if the inflation rate is zero), then A can purchase 10 percent more goods and services than he could have purchased one year ago. In other words, the nominal interest rate and the real interest rate are the same. However, if prices, in general, have risen by 10 percent during the year, A cannot buy any more today with $1,100 than he could have bought a year ago with $1,000. In essence, A has gained nothing by lending to B at a 10 percent nominal interest rate; B has repaid the loan in dollars that are worth 10 percent less than the ones he borrowed. Even though the nominal interest rate is 10 percent, the real interest rate is zero. However, if A expects prices to rise by 10 percent during the year, he could achieve his desired 10 percent *real* rate of return by lending to B at a nominal interest rate of 20 percent – the desired real interest rate plus the expected inflation premium.

only with how much additional consumption they can obtain in the future in return for foregoing consumption today.

Investors (lenders) in international markets are searching for the market in which they can earn the highest *real* rate of interest.[3] If an increase in inflationary expectations for the United States causes nominal interest rates to rise relative to those in Germany, investors will not transfer their funds from German to U.S. financial markets. These funds will move only if the increase in U.S. nominal interest rates reflects a rise in U.S. *real* interest rates relative to Germany.[4]

The key to understanding short-run changes in the value of the dollar, then, is to distinguish changes in nominal interest rate differentials that are caused by changes in *real* interest rate differentials from those caused by relative changes in inflationary expectations. In particular, increases in nominal interest rate differentials resulting from increases in real interest rate differentials should raise the current value of the dollar, as foreign investors increase their demand for dollars in order to purchase dollar-denominated securities. On the other hand, increases in nominal interest rate differentials due to relatively higher inflationary expectations will not attract inflows of foreign capital and should not, by themselves, affect the current value of the dollar. However, expectations of a relatively higher rate of inflation in the United States will decrease the desire of foreigners to hold dollars for any purpose since they expect the purchasing power of the dollar to fall.[5] Consequently, the current value of the dollar will decline. It is important to note that higher inflationary expectations simultaneously motivate an *increase* in nominal interest rate differentials and a *decline* in the value of the dollar.

The relative importance of this concept is reflected in the movement of the forward exchange rate. In the forward foreign exchange market, currencies are bought and sold for future delivery, typically 30, 90 or 180 days.[6] The dollar exchange rate in the forward market reflects the expectations of market participants about what the spot (current) value of the dollar will be on some date in the future. For example, if the market expects that the value of the dollar will be lower in three months than it is today, the price of a dollar to be received or purchased at the end of three months (i.e., the three-month forward rate) will fall below the current value of the dollar.

If nominal interest rate differentials increase because inflationary expectations accelerate faster in the United States than in other countries, then no new foreign capital will flow into the United States. Because of this relative increase in inflationary expectations, the foreign exchange market will expect the future value of the dollar to fall. Consequently, the forward dollar exchange rate will fall, reflecting this lower expectation. In other words, an increase in nominal interest rate differentials caused by a relative increase in inflationary expectations should result in a decline in the forward exchange rate. Alternatively, if the increase in nominal interest rate differentials reflects an increase in real interest rate differentials, new foreign capital will be attracted into the United States, causing the current value of the dollar to rise. The forward rate should be virtually unaffected, although it could rise marginally, reflecting expectations of a stronger future value of the dollar.

To summarize, exchange rate movements in the long run are essentially monetary phenomena induced by relative changes in price levels across countries, which reflect different rates of excess money growth across countries. On the other hand, in the short run exchange rate movements may be dominated by changes in financial asset markets transmitted via changing interest rate differentials. This does not imply that the

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[3] In this statement it is implicitly assumed that risk is being held constant.

[4] To be technically correct, capital flows are determined by expected future exchange rates as well as interest rate differentials. In particular, foreign investors calculate their rates of return in their own currencies, not the foreign currencies in which their financial assets are denominated. When a German, for example, purchases a dollar-denominated security, he is guaranteed a return in dollars (when the security matures), not in deutschemarks. Consequently, the return to a German buying a dollar-denominated security depends not only on the U.S. interest rate but also on the dollar/deutschemark exchange rate when the security matures. In fact, changes in the dollar/deutschemark exchange rate may eliminate any interest rate advantage that the United States may have had. To avoid this possibility, the foreign investor will typically sell the foreign currency proceeds of his investment forward (see footnote 6 below). In this manner the forward exchange rate (which reflects the expected future exchange rate) also influences the direction of international capital flows. For a more detailed treatment of this topic, see Douglas R. Mudd, "Do Rising Interest Rates Imply a Stronger Dollar?" this *Review* (June 1979), pp. 12-13.

[5] This change in the relative rates of inflationary expectations is a ramification, in financial markets, of a change in the relative rates of excess money growth across countries.

[6] The forward foreign exchange market is used primarily by international traders and investors who have contracted to make or receive payment in a foreign currency at a future date. These individuals are concerned that if the spot exchange rate changes before they make or receive their payment, they must make a greater than expected payment (or receive less than expected) in their own currency. By agreeing on a price today for a sale or a purchase of foreign currency in the future, the risk of exchange rate changes is eliminated.

causes of short-run and long-run movements of exchange rates are mutually exclusive. Certainly, interest rate differentials reflect relative changes in inflationary expectations that result from relative changes in the rates of excess money growth across countries. However, there are forces other than inflationary expectations that influence the determination of interest rates within financial markets. Also, since these markets adapt to changes (both real and monetary) much more rapidly than commodity markets do, changes in factors that influence the relative attractiveness of various financial assets have a greater impact on exchange rate movements in the short run.

SHORT-RUN MOVEMENTS OF THE FOREIGN EXCHANGE VALUE OF THE DOLLAR

In general, the dollar appreciated (on a trade-weighted basis) relative to other major currencies in 1980, beginning the year at 85.15 and ending at 89.99.[7] The movement of the trade-weighted value of the dollar during 1980 can be segregated into three distinct periods. In the first quarter of 1980 the dollar was extremely strong, appreciating by 11 percent to its high for the year of 94.64 on April 7. During the next three months this movement was reversed as the value of the dollar declined to 84.04, its low for the year. Since then the dollar has steadily appreciated (except for a short period in late August), closing the year at 89.99, 10 percent above its low and 5.7 percent above its value at the beginning of the year.

Changes in short-term interest rate differentials have motivated these short-run changes. Chart 1 shows that, since the fourth quarter of 1979, the trade-weighted value of the dollar has moved directly with a weighted average of three-month nominal interest rate differentials. This suggests that short-run changes in the value of the dollar during this period have been motivated primarily by changes in real interest rate differentials, a positive relationship that contrasts sharply with the negative one that existed from 1978 to the third quarter of 1979. In fact, since the present system of floating exchange rates began in 1973, a negative relationship has been the rule, not the exception.[8] Consequently, it appears that relative changes in inflationary expectations have greatly influenced the short-run movement of the value of the dollar during this period.

One explanation for this reversal involves the change in monetary control procedures that the Federal Reserve initiated in October 1979. Before then, the Federal Reserve used the federal funds rate as an intermediate target in its attempt to control the money supply. This procedure resulted in frequently missed monetary growth targets, primarily because the Federal Reserve was unwilling to change the federal funds rate target as often and by as much as necessary to achieve the targeted monetary growth. In other words, the Fed tolerated money growth volatility in order to limit short-run variations in nominal interest rates.

A by-product of this procedure was that the Fed smoothed short-run variations in real interest rates by typically supplying sufficient reserves to accommodate changes in the banking system's liquidity demands.[9] The changes in nominal interest rates that did occur were inadequate to keep money growth on target and were outweighed by variations in inflationary expectations. As a result, nominal dollar interest rates were negatively correlated with real dollar interest rates during this period.[10]

Since October 1979 the Fed has more directly controlled the money supply by focusing more on controlling the growth of reserves in the banking system and less on smoothing interest rates. Thus far, both

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[7]The trade-weighted average exchange rate is a geometric mean of the value of the dollar against 10 other currencies weighted by average trade shares. The countries included are Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland and the United Kingdom. For a more detailed explanation, see "Index of the Weighted-Average Exchange Value of the U.S. Dollar: Revision," *Federal Reserve Bulletin* (August 1978), p. 700.

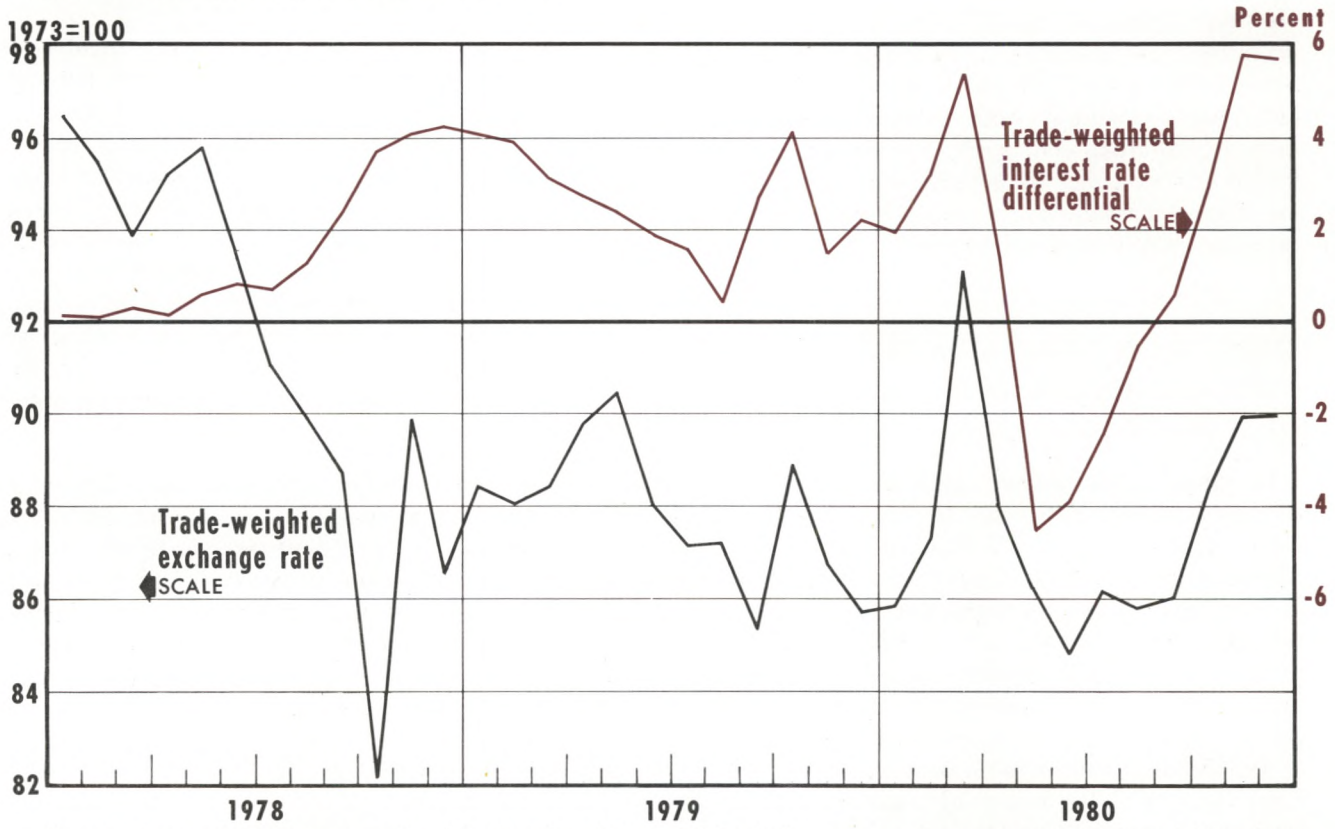
[8]See Mudd, "Do Rising Interest Rates Imply a Stronger Dollar?" pp. 9-13 and Michael Keran and Charles Pigott, "Interest Rates and Exchange Rates: The Relationship," Federal Reserve Bank of San Francisco *Weekly Letter* (September 12, 1980).

[9]See Michael Keran and Charles Pigott, "Interest Rates and Exchange Rates: Policy Implications," Federal Reserve Bank of San Francisco *Weekly Letter* (September 19, 1980).

[10]Using a simple autoregressive model of past rates of inflation to predict expected rates of inflation, the real interest rate and expected inflation premium components of a nominal interest rate can be estimated (see chart 2). During the I/1978 to III/1979 period the standard deviation of the three-month commercial paper rate (a nominal interest rate) in the United States is 1.57; the standard deviation of the projected inflation rate is 2.03; the standard deviation of the difference between the two (an estimate of the real interest rate) is 1.17. For the III/1979 to IV/1980 period the standard deviation of the three-month commercial paper rate in the United States is 3.07; the standard deviation of the projected inflation rate is 2.30; the standard deviation of the estimated real interest rate is 3.46. Clearly, the variability of nominal interest rates in the first period was dominated by changing inflationary expectations while in the second period it was dominated by changes in the real interest rate.

Chart 1

Foreign Exchange Value of the Dollar and Interest Rate Differential



Sources: International Monetary Fund, International Financial Statistics; Morgan Guaranty, World Financial Markets
Latest data plotted: December

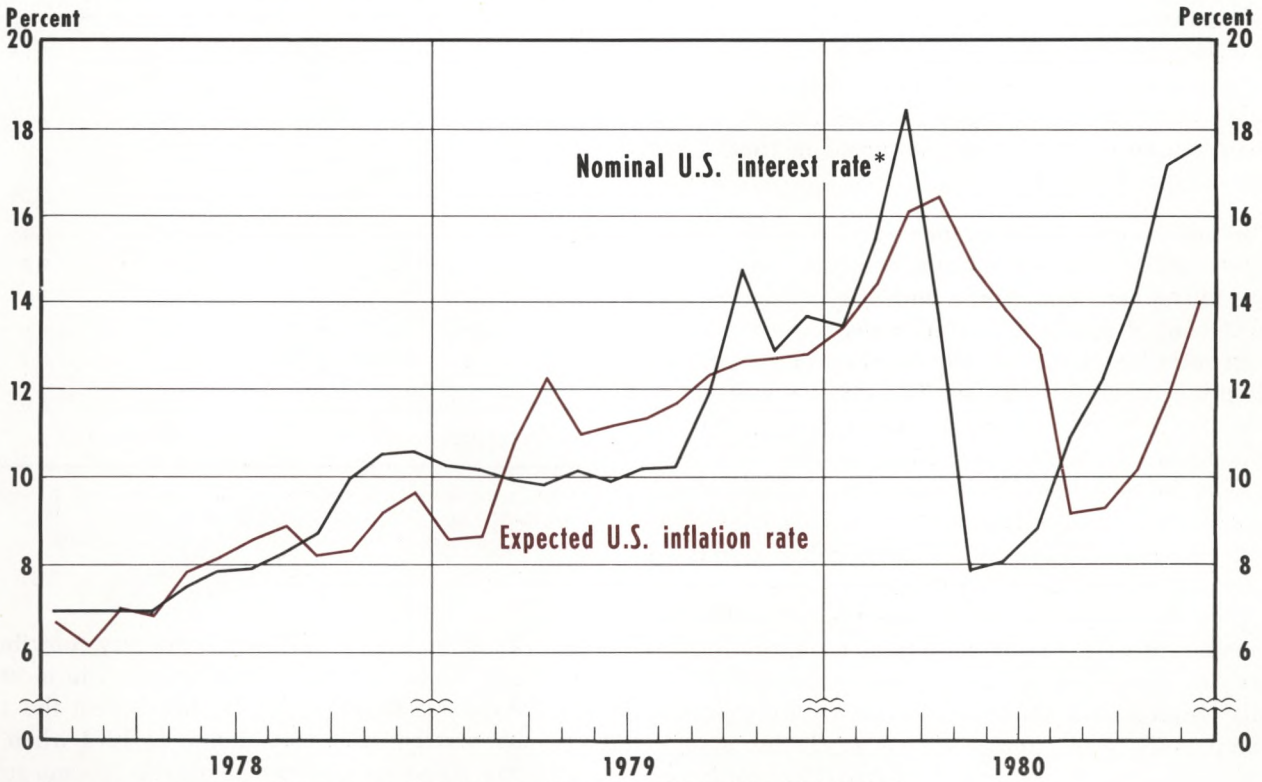
money growth and short-term interest rates have become increasingly volatile. Nonetheless, the Fed apparently has not accommodated the banking system's demand for reserves to the extent that it did when it targeted solely on the federal funds rate. Consequently, real interest rates have fluctuated relatively more and have been positively correlated with nominal interest rates since October 1979. This can be seen in chart 2 where the real interest rate is approximately the difference between the nominal interest rate and the expected rate of inflation.

One reason, then, why the value of the dollar has moved in the same direction as nominal interest rate differentials during 1980 is that, since the new monetary control procedure promoted higher real interest rate variability, changes in nominal interest rate differentials have been dominated by changes in real interest rate differentials. Consequently, the dollar and nominal interest rate differentials have moved in the same direction since October 1979. On the other hand, real interest rates were relatively stable compared to inflationary expectations during the previous period. Increasing money growth during this period led to a faster growth of inflationary expectations in the United States than abroad. The resulting relative increase in nominal interest rates reflected this relative increase in inflationary expectations, and the dollar fell even though nominal interest rate differentials rose.

This explanation can be verified by comparing the movement of the forward value of the dollar with nominal interest rate differentials. If the movement of U.S. nominal interest rates (and nominal interest rate differentials) during the I/1978 to III/1979 period was outweighed by relative changes in inflationary expectations, then nominal interest rate differentials and the forward dollar exchange rate should move in opposite directions (that is, they should be negatively correlated). On the other hand, if changes in real in-

Chart 2

Nominal U.S. Interest Rate and Expected Inflation



*Three-month commercial paper rate from Morgan Guaranty, World Financial Markets.
Latest data plotted: December

terest rate differentials have been the dominant component of changes in nominal interest rate differentials, then there should be no significant relationship (that is, the forward dollar exchange rate should not be correlated with changes in nominal interest rate differentials).

Since the relationship between the dollar and the deutschemark is closely followed in foreign exchange markets, U.S./German interest rate differentials and the forward dollar/deutschemark exchange rate are used to test these hypotheses.[11] In particular, changes in the difference between rates on three-month Eurodollar deposits and three-month Euromark deposits are compared with changes in the three-month forward deutschemark price of a dollar. The data show that neither hypothesis can be rejected; that is, during the period from January 1978 to September 1979 the Eurodollar/Euromark interest rate differential and the three-month forward deutschemark price of a dollar did move in opposite directions. However, no significant relationship between these two variables has been exhibited for the period from October 1979 to December 1980.[12]

CONFLICTING GOALS OF POLICYMAKERS

In attempting to prevent (or at least mitigate) short-run exchange rate movements, some policymakers have been faced with incompatible external and internal goals, especially the apparent conflict between exchange rate stability and money growth stability. For example, if a government does not want the foreign value of its currency to rise, it can enter the for-

[11]Also, Germany's weight is the largest in the calculation of the trade-weighted value of the dollar. Consequently, changes in the dollar/deutschemark exchange rate have the largest impact on the trade-weighted value of the dollar.

[12]The simple correlation coefficient between the Eurodollar/Euromark interest rate differential and the three-month forward deutschemark price of a dollar is –.548 for the first period and .292 for the second. Critical values for the two periods are –.369 and .476, respectively.

eign exchange market and purchase foreign currency, using its own currency as payment. In essence, the government is increasing the demand for foreign currency, thereby causing its value to fall (or at least preventing it from rising). This action, however, also increases the domestic money supply, which has an inflationary impact on the economy. Since inflation is undesirable, these policy goals are incompatible. The best example of this conflict occurred in the United States in the spring of 1980.

By mid-March 1980 economic activity in the United States (and consequently loan demand) was beginning to weaken. This, along with the imposition of a credit control program, caused a sharp decline in interest rates beginning in early April and a precipitous fall in the value of the dollar. The Fed instantly intervened in the foreign exchange market, buying $1,013.8 million from April 8 to April 23. Even with this intervention, the trade-weighted value of the dollar declined by 6 percent in this two-week period. At this time, those conducting domestic monetary policy attempted to thwart the fall in interest rates (and as a result support the dollar) by withdrawing $1,500 million of reserves out of the banking system from April 23 to May 14. These two efforts to prevent the fall of the dollar prompted a dramatic decline in the domestic money stock and greatly exacerbated the already weakening level of economic activity. The result was a decline in real output at a 9.9 percent annual rate in the second quarter of 1980.[13]

LONG-RUN MOVEMENTS OF THE FOREIGN EXCHANGE VALUE OF THE DOLLAR

Up to this point, the analysis has concentrated on short-run changes in the value of the dollar. In contrast to short-run movements of exchange rates, which are determined principally by events that occur within financial markets, long-run movements in exchange rates primarily reflect relative excesses in money growth above the amount demanded across countries. In this context, exchange rate movements depend on (1) policy changes that affect the rate of money growth and (2) real disturbances that affect money demand. Both have had a significant impact on the long-run movement of the dollar in the last two years. In particular, the 150 percent increase in oil prices since the beginning of 1979 was a primary contributor to the recessions (decline in real income) in most industrial nations during 1980. In this respect the 1980 economic scenario was very similar to 1974 when oil-importing countries adjusted to sizable income transfers to oil-exporting countries. However, the recessions of 1980 were not as long or as severe. In fact, most major countries appear to have already reached the troughs of their recessions; Italy, the United Kingdom and Germany are the only nations for which the Organization for Economic Co-Operation and Development (OECD) expects continuing declines in real gross national product in 1981.[14] A general, secular decline in the rate of money growth has also accompanied this oil-price shock, as policymakers have attempted to check the inflationary pressure associated with the rise in oil prices (see table 1).

Table 1

Annual Rates of Money Growth[1]

Country	IV/1975-IV/1978	IV/1978-IV/1979	IV/1979-IV/1980
Belgium	7.0%	2.5%	0.2%
Canada	7.9	4.9	8.8
France	10.3	10.6	9.0[2]
Germany	10.1	4.4	4.5
Italy	22.2	25.2	9.6[2]
Japan	10.9	5.6	–1.8
Netherlands	8.1	4.5	5.2
Switzerland	9.6	–0.4	–3.1
United Kingdom	16.1	9.0	3.6
United States	7.4	7.7	7.3

[1]The annual rate of growth of M1 is reported for each country except the United States for which the M1B growth rate is reported.

[2]IV/1979-III/1980

Since excessive money growth causes domestic prices to rise, the ramification of the oil shock and declining money growth on relative rates of excess money growth across countries can be ascertained by comparing relative rates of domestic inflation. Table 2 contains the difference between the 12-month rate of inflation in the United States and that of its major trading partners. Since the rate of inflation in the United States has improved relative to all countries except the United Kingdom in 1980, it appears that

[13]Rapid money growth followed this decline in real GNP. The foreign desk impeded the domestic desk's ability to slow money growth by purchasing $5,813.1 million equivalent of deutschemarks from July to the end of the year.

[14]Empirical support for these observations is included in OECD, *Economic Outlook* (December 1980), pp. 5-28.

Table 2

Inflation Rate Differentials Between the United States and Selected Foreign Countries[1]

1980	Belgium	Canada	France	Germany	Italy	Japan	Nether-lands	Sweden	Switzer-land	United Kingdom
January	8.2%	4.6%	1.2%	9.2%	–6.4%	7.6%	8.6%	1.6%	9.2%	–4.2%
February	7.6	4.6	0.8	8.5	–6.8	6.1	8.0	0.6	10.0	–5.0
March	8.2	5.3	1.1	9.0	–5.8	6.7	8.8	1.2	10.8	–5.1
April	8.2	5.5	0.9	8.9	–6.2	6.3	8.3	1.1	10.6	–7.1
May	7.9	5.0	0.8	8.4	–6.4	6.2	7.8	1.2	10.0	–7.5
June	8.2	4.1	0.9	8.3	–6.6	5.9	7.7	1.3	11.1	–6.7
July	6.6	3.1	–0.4	7.8	–8.9	5.5	6.1	0.0	9.9	–3.7
August	6.4	2.0	–0.7	7.4	–9.2	4.1	5.7	0.5	8.7	–3.5
September	5.9	1.9	–0.9	7.6	–8.6	3.8	5.7	–2.3	8.9	–3.1
October	5.6	1.6	–0.9	7.6	–8.6	4.8	5.9	–3.0	8.9	–2.8
November	5.0	1.4	–0.9	7.2	–9.4	4.2	5.9	–2.0	8.3	–2.6
December	4.3	1.2	–1.3	7.0	–8.9	5.3	5.7	–1.8	7.9	–2.7

[1]The measure of inflation employed is the rate of growth of each country's consumer price index over corresponding 12-month periods.

excess money growth is relatively slower in the United States than in these countries. Consequently, the value of the dollar in terms of the currencies of these countries (except the United Kingdom) should have risen during this period. The data contained in table 3 support this conclusion for all countries except Japan. That is, in all other cases, if the rate of inflation in the United States improved in relation to the other country, the dollar appreciated; if the rate of inflation in the United States worsened relative to the other country (as with the United Kingdom), the dollar depreciated.

Over the long run, the concept of purchasing power parity is a good indicator of the direction in which market fundamentals are pushing the exchange rate. Chart 3 contains the monthly deutschemark price of a dollar determined in the foreign exchange market and the deutschemark price of a dollar necessary to maintain purchasing power parity for 1979 and 1980.[15] Obviously, the two are not identical; this is due to the existence of trade barriers, transport costs and nontraded goods. Nonetheless, they are nearly equal, indicating that the longer-run movements in the dollar relative to the deutschemark have closely reflected relative changes in their rates of inflation. The move-

[15]Since purchasing power parity is a long-run concept, the data were smoothed by calculating 12-month moving averages.

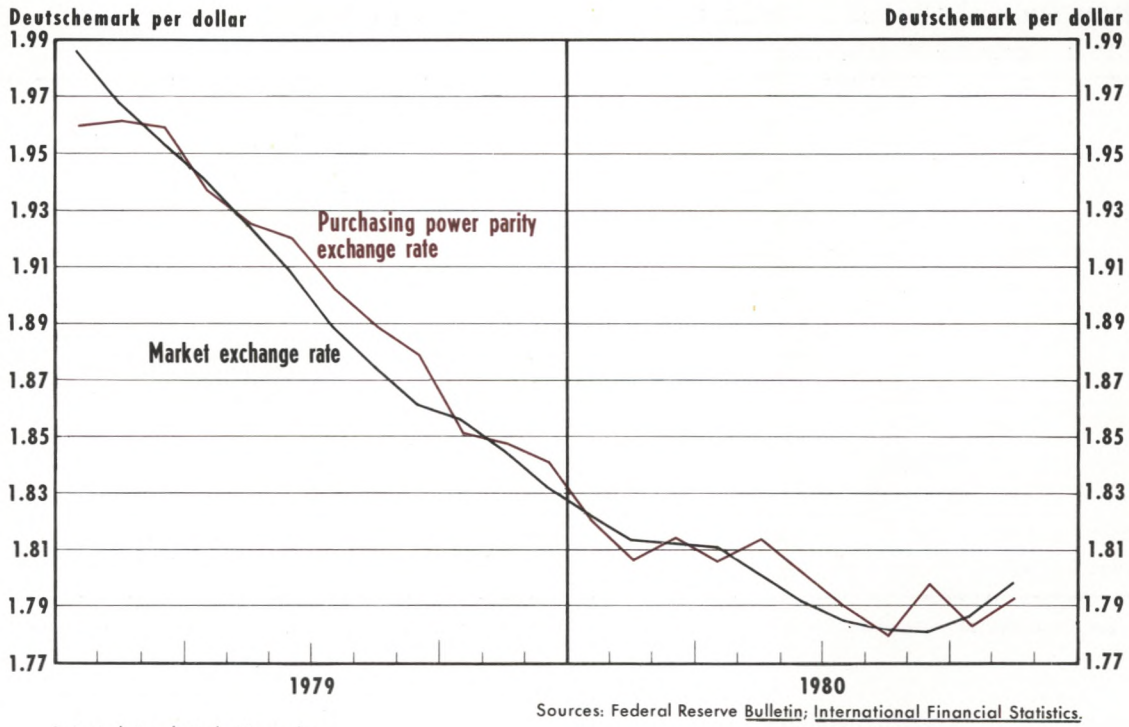
Table 3

Annualized Rates of Change in the Price of a Dollar[1]

Country	December 1979-December 1980
Belgium	12.4%
Canada	2.3
France	12.3
Germany	13.8
Italy	15.3
Japan	–12.8
Netherlands	11.7
Sweden	5.5
Switzerland	11.6
United Kingdom	–6.1

[1]A positive change indicates that the dollar has appreciated; a negative change indicates that the dollar has depreciated.

Chart 3
Purchasing Power Parity and Market Exchange Rate



Sources: Federal Reserve Bulletin; International Financial Statistics.

Latest data plotted: November

ment of the purchasing-power-parity exchange rate also provides a clear picture that excess money growth has been more rapid in the United States than in Germany during most of this period. Consequently, the dollar has been steadily depreciating relative to the deutschemark. However, at the end of 1980, both the market exchange rate and the purchasing-power-parity exchange rate began to rise. Although it is too early to discern a change in trend, it seems that the long-run value of the dollar is beginning to strengthen.

SUMMARY AND OUTLOOK

This article has attempted to clarify some of the ambiguities concerning changes in the value of the dollar in 1980. In particular, the dollar has moved with nominal interest rate differentials during the year primarily because these changes have reflected changes in real interest rate differentials. Changes in nominal interest rate differentials prior to the third quarter of 1979 were motivated largely by relative changes in inflationary expectations. Consequently, the dollar and nominal interest rate differentials moved in opposite directions. This change in the complexion of changes in nominal interest rate differentials may have been due largely to the new procedures for monetary control implemented by the Fed in October 1979.

A longer-run analysis of the dollar shows (1) that the current deutschemark price of a dollar is consistent with its long-run purchasing-power-parity value and (2) that excess money growth in the United States may be slowing relative to its trading partners and, consequently, the long-run value of the dollar may be strengthening.

What can one expect about the value of the dollar in 1981? First, changes in the value of the dollar should only be as volatile as changes in real interest rates. This does not mean, however, that a fall in U.S. nominal interest rates will necessarily signal a decline in the dollar as many economists have predicted. Only if this decline reflects a fall in real interest rates will the value of the dollar fall. However, if the U.S. monetary authorities are more successful than other central banks in controlling excess money growth (as the long-run analysis tentatively indicates), then a fall in nominal interest rates may indicate a deceleration of inflationary expectations in the United States relative to other countries, and the dollar should remain strong in 1981.