Interest rates and exchange rates under the Fed's new operating procedure: the uneasy marriage

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Movements in the trade-weighted value of the dollar have exhibited a greatly increased sensitivity to movements in U.S. short-term interest rates since the adoption of the Federal Reserve's new monetary policy operating procedure on October 6, 1979 (see chart). On that date, the Federal Reserve (Fed) changed its procedure to a system of so-called "reserve targeting" whereby it attempts to hit a target level of bank reserves estimated to be consistent with the desired level of the money stock.[1] Previous to that date the Fed had attempted to keep the federal funds rate within a targeted range believed consistent with the money stock's desired level.[2]

The relationship between interest rates and the dollar has been much more systematic since the change in operating procedure. Moreover, the relationship has been decidedly positive in the short run as well as over longer periods, which was not always the case in the past. This article will argue that there are strong reasons for believing that the Fed's shift to its new operating procedure can partially explain the more consistently positive relationship between domestic interest rates and the U.S. currency.

What are these reasons, and more generally, how does the observed relationship between interest rates and exchange rates mesh with various theories of exchange rate determination? It will be argued below that movements in the exchange value of the dollar respond to differences in real interest rates (that is, interest rates adjusted for expected inflation) and that these real interest rates are affected both by market perceptions of the Fed's operating stance and by the particular monetary policy operating target chosen by the Fed. This interpretation explains the relationship between nominal interest rates and the exchange rate over the past five years, as well as the shift in that relationship that seems to have occurred since the Fed implemented its new operating procedure in the fall of 1979. Moreover, it will be argued that this view is consistent both with the modern asset markets approach to exchange rate determination and with the more traditional theories of exchange rate movements.

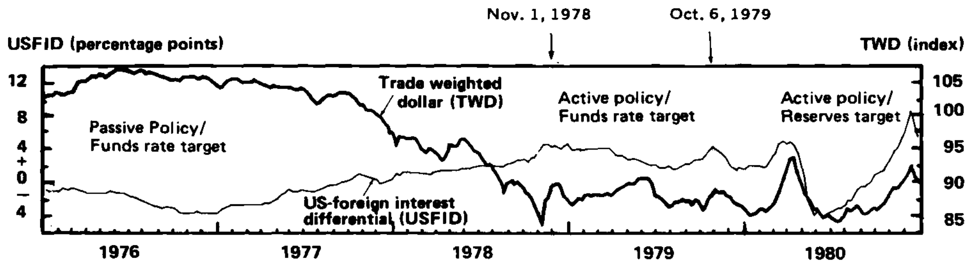
Interest rates and exchange rates—the theoretical relationship

The relationship between interest rates and exchange rates is a complex one which incorporates numerous behavioral parame-

[1]It will be helpful to remember that the new operating procedure adopted on October 6 is not a reserves operating procedure in the sense in which that term has generally been used—i.e., a total reserves targeting procedure. Because of lagged reserve accounting, under which the banks' current required reserves depend on their deposits two weeks ago, total reserves cannot be controlled closely in the current week. What the Fed can control is nonborrowed reserves, forcing banks to borrow any difference between required reserves and nonborrowed reserves at the Fed's discount window and thereby influencing the cost of reserves at the margin.

[2]Because the federal funds rate is the cost to a bank (at the margin) of obtaining funds to support loans to its customers, it influences interest rates on all other assets in the financial system. When the Fed operates on a federal funds rate target, it does so by supplying reserves to the banking system when the rate starts to rise above the target, and draining reserves from the banking system when the rate starts to fall below the target. Although under lagged reserve accounting there is a two-week delay in the transmission of disturbances from the federal funds market to conditions in the credit markets (and vice-versa), we will assume throughout this article that no such lag exists. Furthermore, we will speak of "the" interest rate as if such a representative rate existed. A technically more accurate analysis would examine the entire term structure of both interest rates and spot and forward exchange rates.

The trade-weighted dollar versus the U.S.-foreign interest differential, 1976-80



ters. Considered in isolation, a rise in interest rates in a given country would be expected to cause a rise in the value of that country's currency, simply because higher interest rates should attract capital from investors in other countries. However, when investors purchase the currency of a foreign country to take advantage of higher interest rates abroad, they must also consider any losses or gains they might incur due to fluctuations in the value of the foreign currency prior to maturity of their investment. Generally they cover against such potential losses by contracting for the future sale or purchase of a foreign currency in the forward market for foreign exchange so as to lock in a certain exchange rate on repatriation of their principal and interest.

Their actions in trying to profit from interest rate differentials between countries lead, in equilibrium, to the condition of so-called interest parity, in which any exchange rate gains or losses incurred by engaging in a simultaneous purchase and sale in the spot (immediate delivery) and forward (future delivery) markets are just offset by the interest differential on similar assets. Under these conditions, there is no incentive for capital to move in either direction, since the effective returns on foreign and domestic assets have been equalized (see box).

Interest parity can be upset by a sudden rise in domestic interest rates creating an opportunity for a shrewd and swiftly reacting investor to make a profit at little or no risk by borrowing money where it is cheap (the foreign market) and lending it where it is dear (the domestic market). This practice is known as interest arbitrage and it is engaged in frequently by the foreign exchange traders of large multinational banks and corporations.

In order to engage successfully in interest arbitrage, however, an arbitrager must accomplish four things before other traders have had time to react to the higher domestic interest rates and reestablish equilibrium. First, he must borrow at a lower foreign interest rate. Second, he must purchase domestic money with his newly borrowed foreign money in the (spot) foreign exchange market. Third, he must invest the domestic money at the higher domestic interest rate. Fourth, and finally, he must contract in the forward market for a future sale of his domestic currency for foreign currency at maturity of his investment in order to repay his loan.

As many investors simultaneously attempt to take advantage of the opportunity for profit occasioned by the rise in domestic interest rates, the interest and exchange markets typically react in the following manner: foreign interest rates rise as arbitragers attempt to borrow foreign currency; the domestic exchange rate rises as arbitragers attempt to convert foreign into domestic currency in the spot market; the domestic interest rate falls (although not back to its original level) as arbitragers invest their funds in the domestic credit market; and the forward price of the domestic currency falls as arbitragers attempt to sell the domestic currency in the forward market in order to pay off the foreign loans and retain the difference as profit. These actions will all work to reestab-

The interest parity condition

The interest parity condition simply relates interest rates and spot and forward exchange rates so there is no advantage to investing in one currency as opposed to another. It can be developed very simply by comparing the returns an investor would earn at home and abroad. Let E equal the spot exchange rate in deutsche marks (DM)/dollar. Also let R_f and R_h equal the German (foreign) and U.S. (home) interest rates on 12-month certificates of deposit (CDs) both expressed as a fraction (i.e., .06 instead of 6 percent), and assume that a U.S. investor has $1.00 to invest that he could put in either German or U.S. CDs.

If he places his dollar in the U.S. CD, he will have $1 + R_h$ at the end of 12 months.

If he places his money in the German CD, he must first convert his one dollar in the spot foreign exchange market. This will give him E DM. He must then invest the E DM in a German CD, which will give him $E(1 + R_f)$ DM at the end of 12 months. However, if he wants to be certain of his return in dollars, he must contract for exchange of his DM for dollars in the forward market. This will give him $E(1 + R_h)(1/F)$ dollars at maturity.

If there is to be no incentive for the investment in Germany, his dollar return on the investment there must be the same as his dollar return on the investment in the United States. Thus, for "parity,"

$$1 + R_h = E(1 + R_f)(1/F), \text{ or}$$

$$F/E = \frac{1 + R_f}{1 + R_h}.$$

This can be simplified further by subtracting one from both sides of the equation

$$1 = E/E = \frac{1 + R_h}{1 + R_h},$$

so that

$$F/E - E/E = \frac{1 + R_f}{1 + R_h} - \frac{1 + R_h}{1 + R_h} \text{ or}$$

$$\frac{F - E}{E} = \frac{R_f - R_h}{1 + R_h}.$$

Since $1 + R_h$ is not very different from one, we can approximate this condition as follows:

$$\frac{F - E}{E} \cong R_f - R_h.$$

In addition, we would expect that the forward rate (F) should be a reflection of the market's expectations about the spot exchange rate one year from now. If this were not the case, speculators would move the rate until it did reflect accurately their expectations of the future. For example, if an investor thought that the 12-month forward rate on DM were below what he was fairly sure would be the actual spot exchange rate 12 months from now, he could earn a profit by contracting in the forward market for purchase of DM. Then, after 12 months, he could exercise his contract by purchasing DM at the previously agreed upon forward rate, and immediately sell them at the current (higher) spot rate for a profit. If many speculators were attempting similar actions, this would drive up the forward rate until it accurately reflected market expectations. To the extent that the forward rate is a reflection of market expectations, the interest parity condition may be written as follows:

$$\frac{\text{Expected (E)} - E}{E} \cong R_f - R_h \text{ or}$$

$$\text{expected } \%\Delta E \cong R_f - R_h.$$

This is also known as the condition for uncovered interest parity since an investor would expect the same earnings even if he did not contract for sale in the forward market at maturity of his investment which should be the case in equilibrium.

lish interest parity and eliminate the opportunity for profit. Because exchange and money markets are connected by sophisticated telephone, telex, and computer hook-ups, the reestablishment of interest parity takes only a matter of minutes.

When the arbitraging has been completed, the ultimate results of the initial rise in domestic interest rates will be: higher domestic and foreign interest rates, a higher domestic exchange rate, and a *lower* foreign exchange rate.[3] In other words, even though increases in the home country's interest rate are associated with appreciation in its currency, increases in the foreign country's interest rate may be simultaneously associated with a depreciation in its currency.

Although this result may seem paradoxical at first, it is a necessary consequence of the nature of world capital markets today. The so-called Eurocurrency markets, where much of such arbitrage takes place, ensure that all of the world's money markets are highly integrated. With free movements of international capital, pressures are generated for fairly synchronous movements in interest rates. Under these circumstances a positive relationship between domestic interest rates and the price of the domestic currency necessarily implies an inverse relationship between the foreign country's interest rate and the price of its currency. Thus, if the deutsche mark/dollar exchange rate is appreciating with rising U.S. interest rates, the dollar/deutsche mark exchange rate is depreciating by definition, even though German interest rates are rising as they are pulled up to some degree by U.S. rates.

On the other hand, the relationship between the interest *differential* and exchange rates should be consistent. That is, if the interest differential favoring the United States (the U.S. rate minus the foreign rate on similar assets) is increasing, we should expect an appreciation of the dollar and a depreciation of the foreign currency.[4]

However, movements of interest rate differentials and exchange rates have not always displayed such consistency (see chart). As can be seen, the trade-weighted value of the dollar declined from mid-1976 to late 1978 even though the interest differential[5] favoring the United States rose continuously throughout this period. Then, in 1979, after the change in Federal Reserve operating procedures, this relationship reversed and the interest differential and the trade-weighted dollar rose and fell together.

A theory of the determination of nominal interest rates and exchange rates capable of resolving this seeming anomaly must include two essential elements. The first is a description of the mechanism by which expectations, especially of future inflation rates, influence the determination of nominal interest rates and exchange rates. The second is an explanation of the role of the Fed's operating target in the formation of these expectations. To understand these two keys to the process by which interest rates and exchange rates are determined, it is useful to begin by examining the leading alternative theories of exchange rate determination.

Theories of exchange rate determination

In addition to the simple interest parity theory, it is possible to identify four other

[3]Whether this scenario is played exactly according to script depends critically on the various elasticities of supply and demand in the spot and forward exchange markets and in the national money markets. Elasticities in the exchange market will depend largely upon the demand of exporters and importers for forward cover, the availability of funds for speculative purposes, and the certainty with which expectations are held, as expressed by the variance of market participants' subjective probability distributions.

[4]This analysis assumes that movements in U.S. rates determine the movement of the U.S.-foreign interest differential. There are two primary reasons why this is a plausible assumption. First, the large size of the U.S. capital market makes it more impervious to forces from outside. Second, the prevalence of the dollar in international trade and in the Eurocurrency markets makes U.S. monetary conditions the prime force internationally.

[5]The interest differential is the difference between the U.S. rate on 90-day certificates of deposit and a weighted average of foreign interest rates on similar 90-day money market instruments. The countries entering into the weighted average are the same as those used in computing the trade-weighted value of the dollar (the Group of 10 countries plus Switzerland).

major theories of exchange rate determination: (1) the purchasing power parity theory, (2) the balance of payments theory, (3) the monetary approach to exchange rate determination, and (4) the asset markets or portfolio balance approach. Although, when considered in isolation, each may project a different course for exchange rates, each sheds some light on the relationship between interest rates and exchange rates and provides some insights into the formation of market expectations.

Purchasing power parity

The theory of purchasing power parity in its simplest form says that the exchange rate must change so as to equate the prices of goods in both countries in terms of a single currency. Thus, if the prices of German goods rose relative to the prices of U.S. goods, the German mark should depreciate (cost fewer dollars) to keep the dollar prices of goods in Germany the same as the dollar prices of identical goods in the United States. Otherwise, arbitragers would have an incentive to purchase goods in the United States and sell them in Germany until these prices were again equalized.

There are some obvious weaknesses of the purchasing power parity doctrine. First, it assumes that goods are identical across countries and are easily transported for arbitrage purposes. This is obviously not the case, for some goods such as houses are not traded at all. In addition, in order to compare the prices of dissimilar goods we have to rely on price indices, and it then becomes a question of which index is most reflective of goods traded between the two countries. However, the main implication of the purchasing power parity theory is quite useful, and remains at least approximately valid over the long run: If a country's domestic rate of inflation remains higher than that of its trading partners for a long period of time, that country's currency will tend to depreciate so that it does not price itself out of export markets. The purchasing power parity doctrine is not, however, a good predictor of short-run exchange rate movements.

The balance of payments approach

The balance of payments approach to exchange rate determination is quite straightforward. It says that if country A is buying more goods and services from country B than it is selling to country B, then residents of A will be attempting to obtain more of B's currency than residents of B are attempting to obtain of A's currency. This will cause an excess supply of A's currency relative to B's and a decline in its relative price. Thus, the balance of payments theory would predict exchange rate depreciation for countries with deficits in their international transactions and appreciation for those with surpluses.

The major problem with the balance of payments theory is that it is difficult to define unambiguously what constitutes balance in a country's international payments. Consequently, countries have resorted to classifications of their international transactions into the trade account (which encompasses trade in goods only), the current account (which includes goods and services and interest payments), and various arbitrary breakdowns of the capital account (which encompasses trade in financial assets).[6] None of these accounts by itself can explain movements in the exchange rate, but it is generally accepted that the current account balance will influence the exchange rate directly over the long run, and through its impact on expectations in the short run.

The monetary approach

The monetary approach emphasizes the role of the demand for and supply of money

[6]The controversy over balance of payments accounting seems to stem more from the inability to define money than from the inability to define the balance of payments. If international transactions could be defined on an actual "payments" basis, the balance of payments approach becomes simply the flow counterpart of the monetary approach which focuses on the stock of a particular asset, i.e., money.

in determining the exchange rate. The exchange rate is considered to be the relative price of national monies, and movements in exchange rates will be such as to make the stocks of national monies willingly held. Thus, if there is an excess supply of money in country A, part of that excess supply will be forced upon the exchange markets as individuals in country A collectively attempt to rid themselves of their unwanted money holdings. This will cause a depreciation in country A's currency. Consequently, an excessive rate of growth of a country's money supply relative to growth in its demand for money (which is based in part on its growth in real output) should manifest itself in currency depreciation.

In practice, the demand for money is an unobservable quantity which is strongly influenced by expectations. Thus, even though we may know what is happening to the money supply, unless we are equally sure of what is happening to money demand, it is difficult to predict accurately the direction of exchange rate changes.

The asset markets approach

The final approach, the asset markets or portfolio balance approach, emphasizes the fact that national currencies are one among an entire spectrum of real and financial assets that economic agents may desire to hold. Each asset, including national currencies, offers a combination of risk and expected return that is based partly upon anticipations about the future as well as on current economic conditions. Shifts in these perceived risks and returns induce financial agents to reallocate their portfolios between assets denominated in different currencies and, thus, bring about changes in the exchange rate.

The exchange rate is seen as being jointly determined with other economic variables such as national output, the trade balance, and the price of other goods. Moreover, it is primarily through the medium of expectations that exchange rates are affected, and other variables such as the current account balance or the rate of monetary growth influence the exchange rate primarily to the extent that they affect expectations. Over the long run, these factors will affect the exchange rate directly, but the effect of expectations will usually dominate at any given time. The asset markets approach is consistent with the actual behavior of the financial markets and with the interest parity relationship discussed earlier. In fact, most economic models of exchange market behavior which follow this approach take the interest parity condition as their point of departure.

Real interest rates and expectations

The same factors that are adduced in the above theories of exchange rate determination also enter into the determination of domestic interest rates. That is, domestic rates of inflation, rates of monetary growth, international monetary flows (the balance of payments), risk, and real return all affect interest rates as well as the domestic exchange rate. There is a fundamental reason why this should be so. The interest rate is the price of money services over a certain period of time, or the price of credit. On the other hand, the exchange rate is the relative price of two national money *stocks* at a given point in time. In a free market, the relative prices of any two stocks of assets automatically include information on the implicit flows of services from those assets. For example, if the ratio of the prices of two automobiles is 2 to 1, this implies that the market has determined the present value of expected services from one automobile to be twice that from the other. If the interest rate is determined in a free market, we would expect it to incorporate all information relevant to the expected flow of services from a given national currency. If exchange rates are similarly freely determined, we would expect that same information to be incorporated in them.[7]

[7]If information were perfect and there were no intervention in either market, one could argue that the relationship between interest rates and exchange rates should be *exact*. Any explanation of deviations from this relationship must therefore be sought in either governmental policies or informational deficiencies.

The problem is that exchange rates and interest rates are not always market determined. However, when some outside interference prevents *nominal* interest rates from adjusting to all of the relevant risk/return information pertinent to the holding of a given asset, the adjustment to that new information is absorbed by an adjustment of the market's assessment of the *real* rate of return on that asset. This can be more clearly understood if we examine the components of the nominal interest rate.

Economists have long accepted the hypothesis that nominal interest rates include both a real rate of return and an inflation premium to compensate lenders for the expected loss of value of their principal. This can be expressed as:

$$R = r + I^e$$

where R is the nominal rate of interest, r is the real rate of interest, and I^e is the expected rate of inflation. Thus, a change in nominal interest rates may arise from either of two sources: a change in the real interest rate or a change in the expected rate of inflation.[8] Likewise, if the nominal rate is fixed, a change in inflationary expectations implies a change in the real return on the asset concerned.

The importance of these ideas for the determination of the exchange rate can be seen by examining the interest parity condition in more detail. The simple (uncovered) interest parity condition suggests that the rate of change of the exchange rate equals the nominal interest differential (see box for an explanation):

$$\text{expected } (\%\Delta E) = R_f - R_h$$

where E is the foreign currency price of the home currency, and the subscripts f and h denote foreign and home, respectively. Using the above relationship between nominal and real interest rates, interest parity may be rewritten:

$$\text{expected } (\%\Delta E) = (r_f + I_f^e) - (r_h + I_h^e) \text{ or,}$$

$$\text{expected } (\%\Delta E) = (r_f - r_h) + (I_f^e - I_h^e).$$

This says that changes in the exchange rate should be the sum of differences in the real rates of interest and differences in expected inflation rates. In long-run equilibrium, real rates of interest are equalized by international capital flows, $r_f - r_h = 0$, and we have simply that

$$\text{expected } (\%\Delta E) = I_f^e - I_h^e$$

which is nothing more than the purchasing power parity theory of exchange rates.

Taking this one step further, if one incorporates into the analysis a monetarist assumption about the determinants of inflation, the monetary approach to exchange rate determination also falls out of the interest parity condition. For example, if the rate of price increase is assumed to equal the excess of the rate of monetary growth over the rate of growth of money demand ($I^e = \%\Delta MS - \%\Delta MD$),[9] then the parity condition is

$$\text{expected } (\%\Delta E) = (\%\Delta MS_f - \%\Delta MD_f) - (\%\Delta MS_h - \%\Delta MD_h).$$

This relationship expresses the monetary approach to exchange rate determination in its most rudimentary form and illustrates the fact that both this theory and the theory of purchasing power parity are theories of long-

[8]Technically, the nominal interest rate should incorporate a risk premium as well so that $R = r + I^e + Z$, where Z is a composite risk premium (one could argue that the variance of I^e should also be included in Z). Thus, any change in perceptions of Z due to political events or other occurrences should also be reflected in changes in either R or r or both depending on the authorities' willingness to let R adjust to market forces.

[9]This is a simple monetarist proposition based on the quantity equation. If $MS \cdot V = PY$ where P is the price level and V is velocity, taking logarithms and differentiating both sides gives: $\dot{MS} + \dot{V} = \dot{P} + \dot{Y}$, where the dot signifies percentage rates of change. If $\dot{V} = 0$ (constant velocity) and the real income elasticity of demand for money were one ($\dot{MD} = \dot{Y}$), then $\dot{P} = \dot{MS} - \dot{MD}$.

run equilibrium (based on the assumption that $r_f = r_h$).

The balance of payments approach to exchange rate determination is based on the fact that excess demands for and supplies of foreign goods create demands for and supplies of foreign currencies. However, this approach has been criticized for focusing narrowly on international transactions in goods and services and overlooking the international transactions in financial assets included in the capital account. If the balance of payments were properly defined to reflect the actual monetary flows through the foreign exchange market, this approach would be very similar to the monetary approach, since a balance of payments surplus or deficit, conceptually, *is* a monetary flow. Any supply of a currency to the foreign exchange market which influences the exchange rate should also affect interest rates since that money is no longer available for domestic lending.

All of these ideas are synthesized in the asset markets approach to exchange rate determination. The asset approach incorporates relative rates of price increase (purchasing power parity), relative rates of monetary growth (the monetary approach), and balance of payments phenomena into the exchange rate determination process through their impact on anticipated risks and returns to various financial assets.

Moreover, by emphasizing the jointly determined nature of interest and exchange rates and the role of expectations in influencing both, the asset market approach focuses much more on the short run and reintroduces the role of real interest differentials, since these real returns are residuals that incorporate both relative risks and relative nominal returns (see footnote 8). If nominal interest differentials adjust to changes in the perceived real differentials, then changes in relative nominal rates should cause exchange rate movements consistent with the asset markets approach. Any inconsistencies in this relationship should result either from imperfect information or from government intervention into one or the other of the various markets. It is the latter which explains the changes in the nature of the nominal interest/exchange rate relationship since the Fed implemented its new operating procedure.

The role of the Fed in the formation of expectations

From the above discussion it should be clear that expectations about the future course of economic policy play a critical role in the determination of both interest rates and exchange rates. Through its ability to influence interest rates, the Fed plays a key role in the formation of these expectations, and the reactions of both the money and foreign exchange markets will be quite different depending on how the financial markets view the Fed's actions. For purposes of exposition, let us identify the two extreme types of Federal Reserve policy stances as perceived by the financial markets: an "active" policy of intervening in the money and/or foreign exchange markets to impose a prescribed growth path on the economy and a "passive" policy of accommodating demands emanating from the private sector. When the market perceives Fed policy as active, movements in the money supply figures or the current account balance may generate a totally different set of expectations than would result under perceptions of a passive policy.

Likewise, the extent to which interest rates themselves incorporate these expectations and thus reflect current information depends on the extent to which interest rates are market determined as opposed to government administered. This will in turn depend on the intermediate target of Federal Reserve policy.

Thus, when the operating target of monetary policy is the federal funds rate, any influence of expectations on nominal interest rates may be attenuated by actions of the Fed to keep the funds rate within a specified range. On the other hand, if the Fed were to set a level of bank reserves and let the funds rate find its market-determined level, changes in expectations should be fully reflected in movements of this key interest rate.[10]

In order to clarify these ideas, and isolate various effects on the financial markets, Fed policy is characterized in the accompanying table according to market perceptions both of its basic stance and of its actual operating target. If new information becomes available that suggests worsening inflation—e.g., an unexpected increase in the rate of monetary growth (% Δ MS)—the reactions should be as depicted. Although there are other possible positions in between the ones shown, focusing on extreme cases makes clearer the forces generated by policy shifts.

Possible responses to information on increased monetary growth (given R r I^e)

Operating target	Perceived policy stance: Active	Passive
Federal funds rate	ambiguous responses	I^e - increase R - no change r - decrease E - depreciate
Reserves	I^e - no change R - increase r - increase E - appreciate	ambiguous responses

In the extreme, market perceptions of a truly active policy imply no change in inflationary expectations (% Δ MS = > Δ I^e = 0) even when there is news of developments that otherwise would be inflationary. In other words, the news leads the public to anticipate strong Fed countermeasures rather than worsening inflation. In contrast, when the Fed is perceived as passive, new inflationary information becomes fully incorporated into inflationary expectations. (% Δ MS = > Δ $I^e \neq 0$)

Let us further consider two types of operating targets: a federal funds rate target and a reserves operating target. Under a federal funds rate target, the Fed modulates movements in the rate by adding reserves to or draining reserves from the banking system. The *polar case* of such an operating procedure would be to fix the federal funds rate at some constant, predetermined level (Δ R = 0).

Under a reserves operating target, the Fed tries to hold the growth of bank reserves to a prescribed growth path and allows the federal funds rate to fluctuate according to market demand for reserves. Under this procedure nominal interest rates would react to incorporate any new information relevant to determining future risks and returns (ΔR market determined).

One additional matter needs to be clarified. An active policy using a federal funds rate target is somewhat ambiguous. If the policy is truly active it will require moving the federal funds rate to a new (higher, in the example above) target when new information becomes available, thus raising the real return on assets and yielding results similar, if not identical, to those resulting from an active policy with a reserves target. On the other hand, if credit demands in the economy are stronger than expected, the Fed may fail to raise the rate sufficiently to prevent engendering more inflationary expectations. The movement in the real rate will depend on the magnitude of the policy action relative to changes in credit demands.

Thus, market perceptions of the Fed's policy stance, by influencing the response of inflationary expectations to new information, and the Fed's operating target, by influencing the immediate response of nominal interest rates to new information, should jointly influence real interest differentials and the exchange rate. Moreover, because these factors determine whether real and nominal interest rates vary directly or inversely with one another, they should also determine the relationship between nominal interest rates and the exchange rate.

Interest rates and exchange rates, 1976-80

What light does the above framework shed on movements in interest rates and exchange rates in recent years? First, two dis-

[10]Under the current system of "lagged reserve accounting" this is not actually the case, since demand in the market for federal funds is established by conditions two weeks in the past.

tinct shifts in Fed behavior conveniently divide the period since 1976 into three distinct subperiods. The first important shift in Fed behavior occurred on November 1, 1978, when the Carter administration adopted a policy of active dollar support. Because this was widely viewed by the money markets as a shift to a more active monetary policy, the Fed's perceived policy stance prior to that date can be characterized as "passive" and subsequent to that date as "active."

The second major behavioral shift occurred on October 6, 1979, when the Fed moved from a federal funds rate operating target to a nonborrowed reserves target. The three subperiods between January 1976 and December 1980 may thus be characterized as follows:

Period	Policy stance	Operating target
1/76 - 10/78	Passive	Federal funds rate
11/78 - 9/79	Active	Federal funds rate
10/79 - 12/80	Active	Nonborrowed reserves

The entire period has been one of almost continuously increasing monetary growth and inflationary expectations, marked by sharp movements in interest rates. Using the relationships in the table on page 11, the correlation between nominal and real interest rate differentials can be classified as follows:[11]

Period	Correlation between movements in real and nominal interest rate differentials
1/76 - 10/78	Negative
11/78 - 9/79	Ambiguous
10/79 - 12/80	Positive

In the first period, the trade-weighted dollar declined almost continuously. According to our theory, this should have been caused by a declining real interest differential. Moreover, based on our characterization of Fed policy during this period, we would expect an inverse relationship between real and nominal interest rates in the U.S., thus implying a rising nominal interest differential. This was in fact the case, and the trade-weighted dollar moved inversely with the nominal interest differential. Movements in the value of the dollar and in the nominal interest differential diverged because the Fed prevented nominal interest rates from incorporating fully the rising inflationary expectations, thereby lowering the market's evaluation of the real return on U.S. financial assets.

Movements in nominal U.S. interest rates and the trade-weighted dollar showed a somewhat different pattern in the period between November 1978 and October 6, 1979. In the first half of this period, both the nominal interest differential and the trade-weighted dollar remained relatively flat, and manifested a slight inverse relationship to one another. The two variables declined together from June to August 1979, and then, in August and September, the interest differential rose while the dollar fell slightly. These movements are also consistent with the interpretation given above. As was argued in the previous section, the active monetary policy with a federal funds rate target that characterized this period could result in either a positive or negative relationship between real and nominal rates depending on the appropriateness of the federal funds rate

[11]This relationship has been tested empirically for the presence of structural shifts. When estimated in first difference form with slope dummy variables, the estimated relations for the three periods are:

Period I: $\Delta TWD = -.703 \Delta USFID$ (−2.27)

Period II: $\Delta TWD = .261 \Delta USFID$ (2.04)

Period III: $\Delta TWD = .632 \Delta USFID$ (1.07)

$R^2 = .14$ DW = 1.75 F = 21.94

where Δ's signify first differences of the variables and TWD and USFID are the trade-weighted dollar and the U.S.-foreign interest differential, respectively. The numbers in parentheses are t-statistics. The t-statistics for periods II and III test the statistical significance of the point estimates of incremental slope changes in each of those periods. The low t-statistic for period III can be explained by the theoretical equivalence of periods II and III if the Fed were choosing the "right" funds rate. See William L. Wilby, "Federal Reserve Policy and the Interest-Exchange Rate Relationship: 1976-1980," unpublished manuscript, July 1981.

chosen by the Fed. The ambiguous relationship between movements in the interest differential and the dollar reflected this ambiguity, as exchange rates responded to differing market perceptions of both policy and the outlook for inflation.

Finally, in the period from October 1979 to December 1980, there was a decided shift in the nature of the relationship between U.S. and foreign nominal interest rates and the trade-weighted dollar. Movements in both became more volatile, and the relationship between them was distinctly positive. During this period Fed policy was essentially active, and the Fed's operating target shifted from the federal funds rate to nonborrowed reserves. Consequently, real interest differentials moved in the same direction as nominal interest differentials, and the latter moved in the same direction as the exchange rate. This positive relationship, in turn, resulted from the fact that nominal interest rates were allowed to reflect more efficiently market information with respect to both real rates of return and inflationary expectations, the most important variables affecting exchange rates.

Conclusion and outlook

The exchange rate normally moves in response to real interest differentials. The nature of the relationship between *nominal* interest differentials and the exchange rate depends on the correspondence between real and nominal interest rates. This correspondence depends critically on Fed policy.

Market perceptions of the Fed's monetary policy stance, in conjunction with its operating target, determine movements in real interest rates and, consequently, the relationship between nominal interest rates and the exchange rate. The active policy stance and nonborrowed reserves operating target in effect since October 6, 1979, have tightened considerably the relationship between the nominal interest differential and the exchange rate.

Do these observations shed any light on the future direction of the relationship between U.S. nominal interest rates and the exchange rate of the dollar? To the extent that the Fed modifies its targeted reserve path to cushion any decline in the federal funds rate, it will have implicitly retreated in the direction of a funds rate target. If this occurs, the positive relationship between the dollar and interest rates might be upset again depending on whether the actual rate is above or below the rate consistent with the Fed's monetary goals. Moreover, to the extent that other central banks modify their own interest rate policies in an attempt to move the real rates of return on their domestic assets, the positive relationship might be distorted, since the analysis above assumes that the actions of foreign central banks are dominated by the Fed. This seems to have occurred in early 1981 as the German Bundesbank intervened substantially in support of the mark.

Thus, whether the recent close correspondence between U.S. interest rates and the dollar proves to be a summer romance or an enduring marriage depends critically on the future actions of the world's central banks, and in particular the Fed.