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Fiscal Policy, the Dollar, and International Trade: A Synthesis of Two Views

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In most macroeconometric models, a larger budget deficit leads to an appreciation of a nation's currency and a rise in its trade deficit only to the extent that it drives up the differential between interest rates at home and abroad. In contrast, Mundell's pioneering work suggests that a rise in the budget deficit does these things without any change in the interest rate differential because market expectations adjust instantaneously to the effects of the larger budget deficit. The FRBSF macroeconometric model synthesizes these two approaches by making the expected real value of the dollar a function of current fiscal policies both at home and abroad. The result is that budget deficits have a significantly larger influence on the exchange rate, and a smaller impact on interest rates, than in most macro models. Consequently, expansionary fiscal policy tends to crowd out net exports more than interest-sensitive expenditures.

There are two distinct views in the literature on the causal nexus between fiscal policy and the real value of the dollar. The view that has gained ascendancy in recent years is that expansionary U.S. fiscal policy appreciates the real value of the dollar only to the extent it puts upward pressure on U.S. real interest rates and increases the differential between U.S. and foreign real interest rates. According to this view, the long-run equilibrium value of the dollar does not change, and the real value of the dollar is bid up in the short-run to the point where the real interest rate differential compensates for the dollar's expected depreciation in the future. Because it causes interest rates and the dollar to rise, expansionary fiscal policy crowds out both interest-sensitive expenditures and net exports. Most multicountry econometric models incorporate this view. However, recent simulations of these models suggest that this view can explain only about one-half of the dollar's rise after 1980.[1]

An alternative view consistent with the pioneering work of Robert Mundell (1963) stresses that because of an adjustment in expectations, capital inflows can be attracted to finance a U.S. budget deficit even with no increase in the real interest rate differential. Assuming the market regards the U.S. budget deficit as lasting more than temporarily, the market's longer-run expectation of the real value of the dollar will rise. This change in expectations, in turn, produces an appreciation in the real value of the dollar. The higher dollar, then, creates a "twin deficit" in the trade balance, which allows actual capital inflows to take place without there being any increase in the differential between U.S. and foreign real interest rates. Except to the extent that the fiscal expansion also raises the world level of interest rates, only net exports would be crowded out according to this view.[2]

A synthesis of these two views is possible. By embedding a rational expectations model of the dollar's longer-run equilibrium into the short-run dynamics of asset equilibrium, these two distinct linkages among fiscal policy, the dollar, and trade imbalances can be captured. Such a synthesis is modeled empirically in the international sector of the FRBSF macroeconometric model, which is used for forecasting and policy simulations at the

Federal Reserve Bank of San Francisco.[3] This paper describes the international sector of the FRBSF model and assesses the relative quantitative importance of each of these two linkages.

The paper is organized as follows. Section I reviews the conventional approach to modeling the effects of fiscal policy on the dollar and the trade balance. Section II discusses the unique features of the international sector of the FRBSF macroeconometric model and the determinants of the real value of the U.S. dollar during the 1980s in this model. Section III contrasts the simulated effects of a sustained shift in fiscal policy on the dollar and the trade balance obtained from the FRBSF model with those obtained from a conventional model. Finally, Section IV provides a summary and conclusions.

I. Conventional Model of Fiscal Policy in an Open Economy

Most macroeconometric models, including the FRBSF model, are disaggregated, dynamic versions of the basic IS-LM model on the demand side, with gradual wage and price adjustments on the supply side. In addition, most models assume the degree of international capital mobility is relatively high, so that interest rates have a direct and significant effect on the exchange rate. The most direct approach assumes perfect capital mobility and perfect asset substitutability between domestic and foreign bonds, so that *expected* yields—including the portion due to expected changes in exchange rates—are equalized at any moment in time. The available evidence suggests that this is a reasonably good approximation to reality for major industrialized countries.[4] Although not all macroeconometric models assume perfect asset substitutability, the interest rate differential and expected rate of appreciation or depreciation in the exchange rate are among the important explanatory variables determining the level of the exchange rate in most of them.[5]

Perfect capital mobility and the trade account's slow adjustment to changes in exchange rates, in turn, imply that exchange rates are determined in the short run by equilibrium in the market for financial assets, rather than by equilibrium between current international flows of goods and capital.[6] Assuming securities at home and abroad are perfect substitutes for one another, the asset theory of the exchange rate requires that the difference between the nominal returns on securities of a given maturity at home and abroad is equal to the expected percentage change in the nominal exchange rate over that period. This is called the "open interest parity condition." If, for example, the rate differential exceeded the expected depreciation in the exchange rate, market arbitrage would bid the value of the exchange rate up until its expected depreciation over the relevant time horizon equaled the rate differential. It is easily shown that this arbitrage condition also holds in real, or price-adjusted terms.[7] Thus,

$$lnEXCH - lnEXCH^e = n[(i-\dot{p}^e) - (i^* - \dot{p}^{e*})] \qquad (1)$$

where:

- $EXCH$ = current real value of the dollar, defined as units of foreign currency per unit of domestic currency deflated by the ratio of foreign prices to domestic prices
- $EXCH^e$ = real value of the dollar expected n years in future
- i = U.S. nominal interest rate on security maturing in n years
- i^* = foreign interest rate on security maturing in n years
- $\dot{p}^e$ = expected U.S. (annualized) inflation rate over n years
- $\dot{p}^{e*}$ = expected foreign (annualized) inflation rate over n years

The difference between the current real exchange rate and its expected future value—that is, the expected change in the real value of the currency—is thus proportional to the real interest rate differential. A central aspect of this theory is the importance of term structure effects. For example, assuming n is 10, a one-percentage point rise in the one-year U.S. real interest rate relative to the foreign one-year rate would cause the 10-year rate in the U.S. to increase by 0.1 percentage points (assuming future one year interest rates are not expected to change as well), and the real value of the dollar to go up only one percentage point. In contrast, a one percentage-point increase in the U.S. one-year rate that is expected to last for ten years would cause the 10-year U.S. bond rate to rise by one percentage point and the real exchange value of the dollar to rise by 10 percentage points. So the same movement in the one year rate generates different movements in the exchange rate depending on the change in the 10 year rate. Thus, if movements in long- and short-term interest rates are not perfectly correlated, the movement in the long-term real interest rate differential controls movements in the real exchange rate. In the short run, the expected real long-run equilibrium value of the dollar does not change, and the current exchange rate moves in proportion to the long-term interest rate differential. In the longer run, however, the expected real exchange rate tends to be consistent with the long-run equilibrium value of the exchange rate, so that with perfect asset substitutability, real interest rates at home and abroad tend to be equalized.

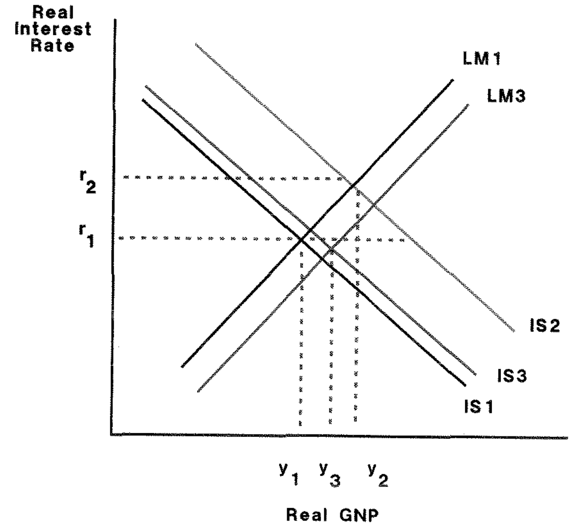
The implications of using the open interest parity condition to determine the exchange rate in the short run can be illustrated in the basic IS-LM framework. For this short-run analysis, fixed wage rates are assumed, but changes in the real value of the dollar are allowed to have an impact on the price level. For the moment, the foreign real interest rate is assumed to be fixed. The conventional approach assumes that the expected real value of the dollar in the long run is a constant, determined by the condition of purchasing power parity. This implies that the current real value of the dollar can be expressed as a simple function of the U.S. long-term real interest rate. The result is that the absolute value of the slope of the IS schedule (locus of equilibrium in the goods market) is less than it would be in a closed economy on account of the indirect response of net exports to the real interest rate occurring through the real exchange rate.

A further aspect of the open interest parity condition is the effect on the slope of the LM schedule (locus of equilibrium in the money market). An appreciation in the real value of the dollar reduces prices both directly through the lower relative price level of foreign goods and indirectly through the competitive pressures placed on domestic producers of tradable goods. Therefore, as the real interest rate and real value of the dollar rise, the price level falls and the *real* stock of money rises. This effect tends to reinforce the reduction in the quantity of money demanded at the higher rate of interest, resulting in a less steeply sloped LM schedule than in a closed economy.

The effect of a fiscal expansion in this conventional framework is illustrated in Figure 1. Assume that U.S. and foreign real interest rates are initially at r_1, with the equilibrium U.S. real GNP at y_1. A fiscal expansion, due to either an increase in government spending or a cut in taxes, would shift the IS schedule from IS_1 to IS_2, raising the U.S. real interest rate to r_2 and U.S. real GNP to y_2. Real GNP would rise through an increase in the velocity of money produced by higher interest rates. However, the rise in interest rates would offset a portion of the initial effects of fiscal expansion by contracting domestic investment, and possibly also consumption, and also by contracting net exports through the associated appreciation in the real value of the dollar.

The conventional exchange rate analysis, based on interest differentials alone, implicitly assumes that any

Figure 1
Effects of Fiscal Expansion



change in fiscal policy is not expected to last, so that the expected long-run real value of the dollar is not affected. Thus, fiscal policy affects the real value of the dollar *only* through its influence on the current differential between U.S. and foreign real interest rates. A U.S. fiscal expansion opens up a positive interest rate differential which appreciates the exchange value of the dollar so as to equate expected yields. Moreover, fiscal crowding out in these models *always* falls partly on interest-sensitive domestic expenditures since a positive interest rate differential would not be sustained if the dollar were to rise by enough to place all the crowding out on net exports.

One problem with this approach is that changes in fiscal policy generally are fairly long lasting. As a consequence, expectations that the exchange rate will return to its original level will continually be disappointed. Specifically, the actual real exchange value of the dollar will exceed the expected value as long as the fiscal expansion lasts. That is, as long as the fiscal expansion lasts, the expected depreciation will not occur. Thus, it seems logical that the market eventually would begin to revise its expectation of the long-run exchange rate upward. In doing so, the current real value also would rise and the positive real interest differential in favor of the U.S. would fall until the longer-run equilibrium of no differential between U.S. and foreign real interest rates eventually would be reached.

This process is depicted in Figure 1. The rise in the expected real value of the dollar has the effect of shifting the IS schedule downward (through a reduction in net exports at any given interest rate), and the LM schedule downward also (through the increase in the real stock of money caused by an appreciating dollar). As long as the U.S. real interest rate exceeds the foreign real interest rate, the current exchange rate will continue to exceed the expected exchange rate, and the IS and LM schedules will continue to shift down through an adaptive adjustment of expectations until a full equilibrium at r_1, and y_3 is reached at the intersection of LM_3 and IS_3.[8]

II. International Sector of the FRBSF Macroeconometric Model

A key feature of the FRBSF macroeconometric model is that it treats the expected real value of the dollar in the long run ($EXCH^e$) as an endogenous variable determined by expectations of future fiscal policy. As a result, current fiscal policy influences the dollar through another channel besides the current level of interest rates. By altering expectations of future fiscal policy, it also influences the real value of the dollar through its effect on the expected real value of the dollar. The magnitude of the effect operating through this additional channel depends upon: 1) the size of the effect of changes in current fiscal policy on expectations of future fiscal policy, and 2) the size and direction of the effect of expected future fiscal policy on the expected real value of the dollar.

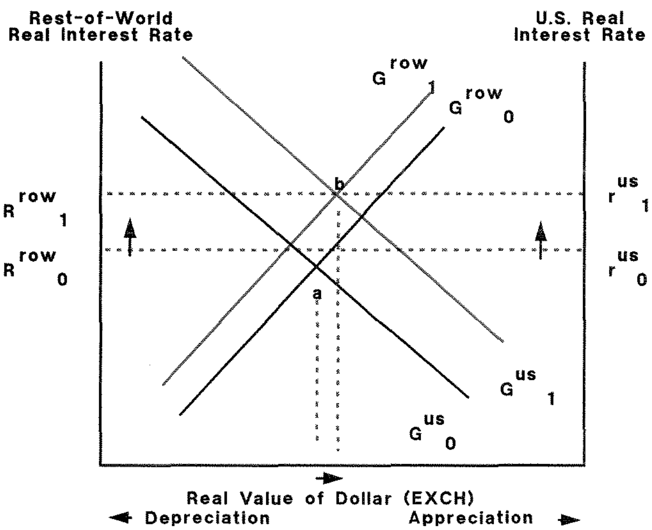
The effect of future fiscal policy on the real value of the dollar can be modelled in a two-country (the U.S. and the rest of the world), long run, or full employment, equilibrium framework. Dornbusch (1983) and Dornbusch and Blanchard (1984) have suggested a useful diagrammatic approach, shown in Figure 2. The locus of full employment equilibrium in the United States is given by G_0^{US}. This schedule slopes downward because at full employment an increase in the real value of the dollar reduces net exports, and so must be offset by the higher U.S. spending brought about by a lower U.S. real interest rate. Similarly, the locus of full employment equilibrium for the rest of the world slopes upward. A rise in the dollar expands net exports abroad and so must be offset by a higher real interest rate abroad to produce an offsetting change in aggregate demand. Assuming perfect capital mobility and perfect asset substitutability, real interest rates will equalize in the long run, and full employment equilibrium will occur at the intersection of these two schedules, at point *a*. At this intersection, real interest rates in the two countries are equal, and the real exchange rate produces trade balances that are consistent with full employment. Equilibrium capital flows, in turn, are mirror images of the trade balances.

A U.S. fiscal expansion increases domestic demand for U.S. goods and services. This shifts the U.S. schedule to the right from G_0^{US} to G_1^{US} because, for any given real exchange rate, higher U.S. real interest rates are needed to offset the rise in domestic spending and restore equilibrium. Since some of the increase in U.S. domestic demand is spent on imports, the U.S. fiscal expansion also shifts up the locus of full employment equilibrium for the rest of the world, G^{row}, through the increased demand for rest-of-the-world net exports. But most of the rise in world aggregate demand falls on U.S. output, so G^{US} shifts up by more than G^{row}. The larger increase in demand in the U.S. appreciates the real value of the dollar, which in turn diverts private demand away from U.S.-produced goods towards foreign-produced goods. A general equilibrium is restored at point *b*, where the higher level of world interest rates dampens the excess world aggregate demand created by the U.S. fiscal stimulus, and the dollar *appreciation* dampens the relative excess demand for U.S.-produced goods.[9]

However, it is possible for the dollar to *depreciate* if investors come to think that at some point, foreigners will demand a higher return on U.S. assets to absorb an increasingly large share of U.S. debt in foreign portfolios. Thus, in explaining current movements in the dollar, a fundamental issue is whether the market believes U.S. and foreign assets are, and will continue to be, close to perfect

Figure 2

Effects of U.S. Fiscal Expansion When U.S. and Foreign Assets Are Perfect Substitutes

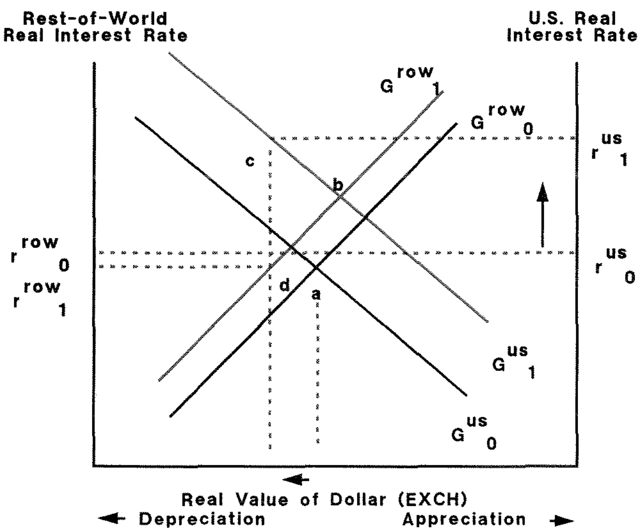


substitutes. If markets come to expect imperfect substitution between U.S. and foreign assets, a risk premium for holding U.S. assets (that is, a real yield differential) would have to be included in equation (1) and also in Figure 2.

Figure 3 shows the long-run effect of a fiscal expansion in this case. Assume there is no risk premium initially because portfolios are balanced, with the initial equilibrium at point *a* in Figure 3. The U.S. fiscal expansion shifts the G^{US} and G^{row} schedules upward as in Figure 2. But as the risk premium, or yield differential, grows with the accumulation of U.S. debt by foreigners, it drives a wedge (equal to *cd*) between real interest rates in the U.S. and abroad. The new equilibrium is no longer at point *b*, but rather at a lower value for the dollar. Indeed, a stable long-run equilibrium in this case requires an increase in the risk premium by enough to *depreciate* the real value of the dollar. If the risk premium grew by only enough to leave the real exchange rate unchanged, this still would not be a stable equilibrium because capital inflows would be needed to service the interest on the accumulation of U.S. external debt, resulting in a further increase in the risk premium. Thus, servicing the accumulated debt without capital inflows (as required for a stable equilibrium in this case) requires that the risk premium rise enough to cause the real value of the dollar to depreciate, thereby generating an increase in U.S. net exports to balance the current account. This is illustrated in Figure 3.[10]

Figure 3

Effects of U.S. Fiscal Expansion When U.S. and Foreign Assets Are Imperfect Substitutes



Exchange Rate Equation in the FRBSF Model

In summary, then, movements in the exchange rate depend, in part, on the market's expectation of the real value of the dollar in long-run equilibrium, or the long-run "anchor" for the dollar in equation (1). The market's expectation of the dollar's long-run anchor, in turn, is shaped by expectations of the impact of future domestic and foreign fiscal policies.[11] To the extent investors alter their expectations of future fiscal policy in response to current changes in fiscal policy, the dollar's anchor will be affected and the current value of the exchange rate will change. Under the assumption of perfect asset substitutability, or at least a constant risk premium, expectations of a sustained U.S. fiscal expansion will cause the long-run anchor for the dollar to rise and the dollar to appreciate. However, if investors expect that within their investment horizon the fiscal expansion will significantly increase the risk premium between foreign and domestic assets, the long-run anchor for the dollar could fall and the current value of the dollar could tend to depreciate.

The exchange rate equation in the FRBSF macroeconometric model enables us empirically to examine these important expectational effects. High employment, or structural, budget balances as a percent of high-employment GNP are used as an approximate measure of the overall impact of fiscal policy. Structural budget balances are preferable to actual (non-cyclically-adjusted) balances because they isolate better the goods market pressures associated with fiscal policy shifts.[12]

How *expectations* of these budget balances are formed is an open question. The conventional approach assumes that future budget balances are independent of current budget balances, so that the expected real value of the dollar is a constant determined by a condition of purchasing power parity, possibly modified by a time trend.[13] In contrast, the approach taken here allows for the possibility that a rational expectation of budget balances at home and abroad over the relevant investment horizon should depend, at least in part, on current budget balances. Specifically, the effects of anticipated budget surpluses or deficits are modeled as a function of a four-quarter moving average of current budget balances.[14]

The logarithm of the expected real value of the dollar in the long run is thus assumed to vary with the current U.S. budget balance (B), and a weighted average of current foreign budget balances (B*).[15] The signs of the coefficients on the budget balances depend upon the length of the market's investment horizon and whether the market regards U.S. and foreign assets as perfect or imperfect substitutes within that investment horizon. The magnitudes of the coefficients on the budget balances depend, in part, upon the size of the response of expected budget balances to changes in current budget balances.

$$lnEXCH^e = a_0 + a_1B + a_2B^* \qquad (2)$$

Substituting, equation (2) into equation (1) yields the exchange rate equation to be estimated as:

$$lnEXCH = a_0 + n[(i - \dot{p}^e) - (i^* - \dot{p}^{e*})] + a_1B + a_2B^* \qquad (3)$$

As pointed out earlier, the differential on long-term real interest rates has a more stable impact on movements in the real exchange rate. This real bond rate differential can be decomposed into the nominal bond rate differential and an expected inflation differential. The nominal bond rate differential is modeled as a distributed lag on current and past differentials in nominal short-term interest rates, following the standard expectations model of the term structure of interest rates. The expected inflation differential is similarly modeled as a distributed lag on current and past values of the differential in quarterly inflation rates, but with separately estimated weights to allow for the possibility that the process of expectation formation may differ for nominal interest rates and inflation. The sum of the weights on the inflation differential is constrained to be the same as the sum of the weights on the nominal interest rate differential, but with an opposite sign. Both foreign interest rates and foreign inflation are measured on a trade-weighted basis.

The Board of Governors' index of the trade-weighted value of the dollar is used, and the foreign interest rates and budget balances are for the ten countries in this index.[16] The resulting equation for the real value of the dollar, estimated over the entire floating rate period, is:

$$lnEXCH = 3.44 + \sum_{i=0}^{18} a_i(i_s - i_s^*) + \sum_{i=0}^{18} b_i(\dot{p} - \dot{p}^*) - .0574B + .0773B^* + 1.02e_{-1} - .373e_{-2} \qquad (4)$$

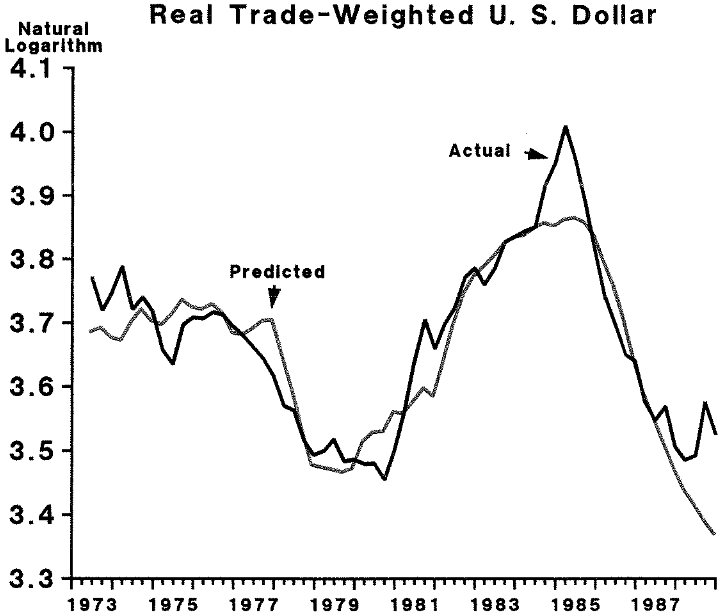
where: $\sum_{i=0}^{18} a_i = .104 \qquad \sum_{i=0}^{18} b_i = -.104$

Individual coefficients, *t* statistics, summary statistics, and exact estimation periods for this and other estimated equations are shown in the Appendix. The real interest rate differential is found to have a highly significant influence upon the real exchange rate, in accordance with the conventional view of exchange markets. A *sustained* one-percentage point change in the real short-term interest rate differential is estimated to produce a 10 percent change in the real trade-weighted value of the dollar in the same direction. The magnitude of this effect is consistent with an average horizon for investors in the foreign exchange market of 10 years.[17]

Signs of the estimated coefficients on U.S. and foreign budget deficits indicate that market participants view U.S. and foreign assets as *close substitutes*. Their magnitudes suggest that they view changes in structural budget deficits

Chart 1

Real Trade-Weighted U. S. Dollar



as being relatively *permanent*. Thus, a one-percentage point reduction in the current U.S. structural budget surplus as a percent of high-employment GNP is estimated to produce a six percent *appreciation* in the expected real trade-weighted value of the dollar, while a similar reduction in the weighted average of foreign budget surpluses *depreciates* the dollar by nearly eight percent. The difference in these coefficients is not surprising, given that the combined GNP of the foreign countries exceeds that of the United States. Moreover, these expectational effects are relatively large. In the FRBSF model, it would take about a nine percent appreciation in the real value of the dollar to reduce the trade balance sufficiently to fully offset the effect on aggregate demand from a one-percentage point reduction in the U.S. budget surplus, or in other words, to result in a full crowding out through the trade balance. The six percent appreciation generated by the expectational effects of a U.S. budget surplus is fully two-thirds of this.

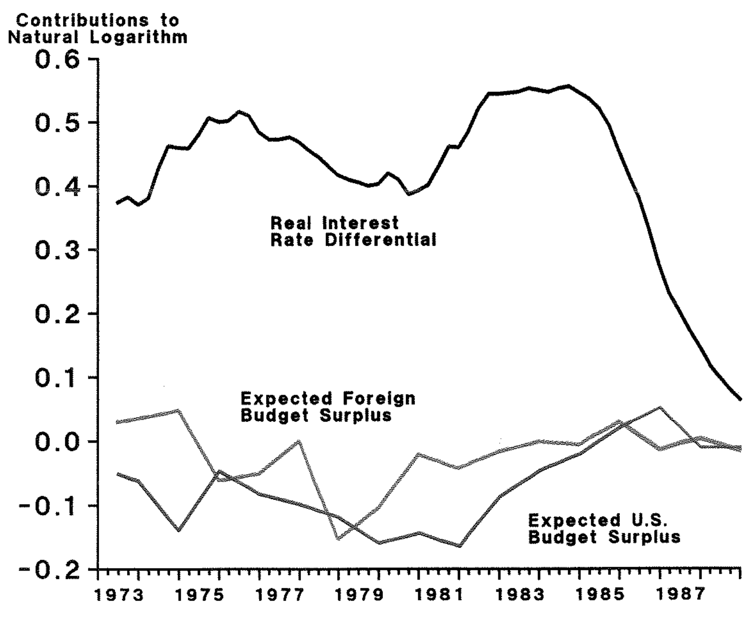
A plot of actual and predicted values from this equation for the whole period of floating exchange rates since 1973 (excluding serial correlation terms in predicted values) is shown in Chart 1. The overall fit is quite good. Although the variables in the equation do not explain the strength of the dollar in 1985 very well, this was a period when short-term speculative factors appear to have been particularly important. It is of particular interest that the equation tracks the major movements in the dollar quite well even though it ignores the potential effects of central bank interventions in the exchange market, except insofar as the latter influence interest rates. This result is consistent with the exchange rate model's basic premise of highly substitutable private capital.

Chart 2 decomposes the predicted real value of the dollar into its various components. From 1973 to 1980, the real value of the dollar dropped by 25 percent. The effects on expectations of the shift in the U.S. government budget toward surplus and the shifts in foreign government budgets toward deficits account for practically all of this depreciation.[18] The differential between U.S. and foreign real long-term interest rates rose until 1975, tending to push the real value of the dollar up during this period, but by 1980, the differential had returned to its 1973 level, reinforcing the tendency for the dollar to fall.

Between 1980 and 1985, the real value of the dollar appreciated sharply by 55 percent. The effect of the U.S. budget deficit on market expectations was the largest contributor to this appreciation. The change in expectations arising from the growing budget deficit accounts for about 40 percent of the total increase in the real value of the dollar in this period. Foreign budgets generally were moving from deficit into surplus, with the associated expectational effects contributing about 20 percent of the increase in the dollar's value. Finally, a rising real interest differential accounts for about 20 percent of the dollar's appreciation, with the remaining appreciation apparently due to speculative factors.

Chart 2

Contributions of Various Factors to Real Trade-Weighted U. S. Dollar



During the period from 1985 to 1988 when the dollar depreciated sharply, the combined effect of changes in the U.S. and foreign budget deficits on the long-run expectation of the dollar contributed only 10 percent of the total depreciation in the real value of the dollar. In contrast to the preceding period, the declining real long-term interest rate differential accounted for nearly 75 percent of the total decline in the real value of the dollar. The declining real interest rate differential, in turn, was primarily due to both the decline in the U.S. real bond rate that followed monetary disinflation in the United States and a rising trade-weighted foreign real bond rate. Foreign central banks raised their interest rates in response to the effects of the persistently strong dollar. These movements in real interest rates were conducive to a better domestic macroeconomic equilibrium and were consistent with the Plaza Agreement of September 1985, in which the Group of Five agreed to cooperate in reducing the value of the dollar.

Other Aspects of the International Sector of the FRBSF Model

The remainder of this section briefly discusses the response of the trade balance and inflation to changes in the exchange rate, as modelled in the FRBSF macroeconometric model. These equations are similar to those in most large-scale econometric models, although this model is relatively small in size.[19] Since the model is fully documented elsewhere (Throop [1989]), only the most pertinent aspects of the international sector are described here.

Reactions of Foreign Central Banks

In modelling the exchange rate and the trade balance, one needs to take into account the reactions of foreign central banks to changes in U.S. interest rates. Floating exchange rates have diminished the short-run monetary linkages among national real interest rates. Nonetheless, foreign central banks continue to pursue macroeconomic stabilization and so, continue to respond to changes in U.S. interest rates, though to a lesser extent than before. For example, foreign central banks tend to allow foreign interest rates to rise in response to a rise in U.S. rates, to prevent capital outflows and a depreciation of their currencies that would result in an increase in aggregate demand and higher output and inflation. However, matching the rise in U.S. interest rates exactly would have a deflationary impact on foreign economies. As a result, foreign central banks have tended to match some, but not all, of the changes in U.S. real interest rates in an effort to stabilize aggregate demand.

The estimated response function of the trade-weighted foreign real short-term interest rate to changes in the U.S. real short-term interest rate in the FRBSF model is:

$$\Delta(i_s^* - \dot{p}_s^{e*}) = .235\Delta(i_s - \dot{p}_s^e) + .143\Delta(i_s - \dot{p}_s^e)_{-1} + .160\Delta(i_s - \dot{p}_s^e)_{-2} + .009\Delta(i_s - \dot{p}_s^e)_{-3} + .222e_{-1} \quad (5)$$

The short-term inflationary expectations that enter into short-term real interest rates at home and abroad are modeled by a four-quarter moving average of the inflation rate. Summing the coefficients on the lagged real interest rates suggests that foreign central banks have matched about 55 percent of the change in U.S. real short-term interest rates after three quarters on average.

Exports and Imports

Real exports (GEX82) are modeled as a function of real GNP in the U.S.' ten major industrial trading partners (ROWGNP82) and the real trade-weighted value of the dollar (EXCH). The equation for exports is:

$$lnGEX82 = -.811 + \sum_{i=0}^{2} a_{-i}\, lnROWGNP82_{-i} + \sum_{i=2}^{9} b_{-i}\, lnEXCH_{-i} + .774e_{-1} \quad (6)$$

$$\text{where: } \sum_{i=0}^{2} a_{-i} = 1.75 \qquad \sum_{i=2}^{9} b_{-i} = -.523$$

Real nonpetroleum imports (NPM82) are related in a similar fashion to U.S. GNP and the real trade-weighted value of the dollar.[20] Real imports of petroleum (PM82) historically have been subject to a number of special factors, including for a time, a complex system of controls on U.S. production. But after 1974, the ratio of petroleum imports to GNP has been significantly and negatively related to the real price of oil (POIL), as theory would suggest under stable domestic supply conditions. Oil imports have not been significantly related to the real exchange rate in the expected direction, however, partly because imports are priced in dollars, and so are not immediately affected by changes in the value of the dollar. Moreover, in the longer run, the response of foreign oil suppliers to the movement in the real value of the dollar has been quite erratic. The two import functions are:

$$lnNPM82 = -20.1 + \sum_{i=0}^{2} a_{-i}\, lnGNP82_{-i} + \sum_{i=0}^{9} b_{-i}\, lnEXCH_{-i} + .797e_{-1} \quad (7)$$

$$\text{where: } \sum_{i=0}^{2} a_{-i} = 3.01 \qquad \sum_{i=0}^{9} b_{-i} = +.384$$

$$ln(PM82/GNP82) = -.291 + .897\,ln(PM82/GNP82)_{-1} - .137 lnPOIL - .251e_{-1} \quad (8)$$

The overall fit of the export and import equations is quite good, as shown in plots of actual and predicted values in Charts 3 and 4 (excluding serial correlation terms from the predicted values). The absolute value of the price elasticity of demand for exports exceeds that for nonpetroleum imports, consistent with other recent work.[21] The lags on the real exchange rate are much longer than on GNP in the case of both exports and imports. Also, the elasticity of U.S. nonpetroleum imports with respect to U.S. GNP is 3.01, substantially exceeding the 1.75 elasticity of U.S. exports with respect to foreign GNP. This difference may be due to pure income effects; or it may be capturing the effect of different rates of productivity growth in tradable goods at home and abroad.[22]

Inflation and the Dollar

In the FRBSF macroeconometric model, movements in the real value of the dollar have a significant impact on the price level. The inflation equation in the model may be characterized as an expectations-augmented Phillips curve that includes the effects of "supply shocks" from changes in the real price of oil and the real value of the dollar. The civilian unemployment rate (LHUR), adjusted for changes in the natural rate of unemployment due to demographics (U*), is used to measure excess demand, and the expected rate of inflation is measured by a distributed lag on past inflation. Changes in the real value of the dollar influence prices both directly through prices of imports, and indirectly through competitive effects on domestic prices of exports and import substitutes. The Phillips curve equation captures these relationships by including a distributed lag on current and past changes in the real trade-weighted value of the dollar. A second type of "supply shock" to the price level comes from the real price of oil. Changes in the real price of oil alter the mark-up of prices over unit labor costs by changing the price of an important non-labor input. A distributed lag on the percentage change in the real price of oil captures this effect. The estimated inflation equation is:

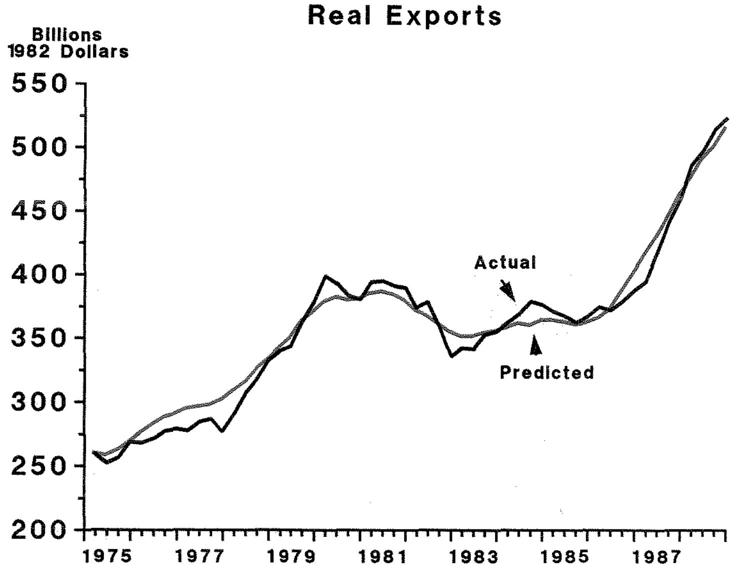
$$\dot{GDF} = .0847 - .600(LHUR - U^*) + \sum_{i=2}^{11} a_i \dot{GDF}_{-i} + \sum_{i=0}^{4} b_i \dot{POIL}_{-1} + \sum_{i=0}^{6} c_i \dot{EXCH} + .388e_{-1} \quad (9)$$

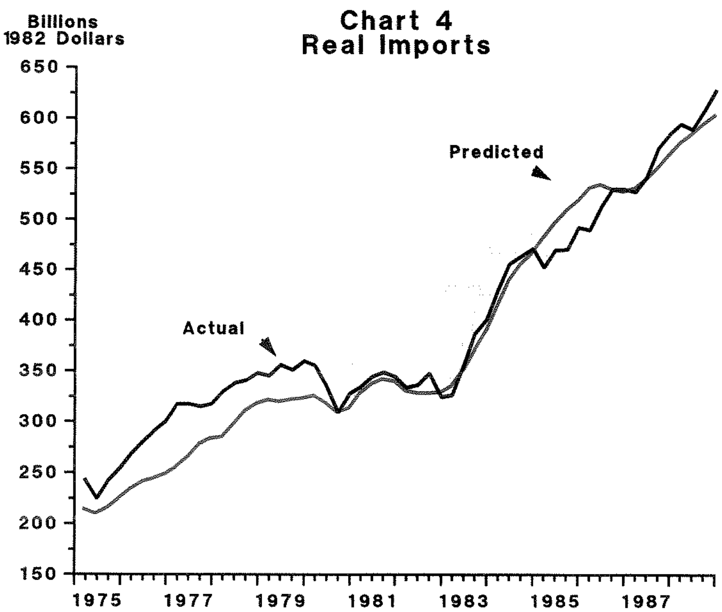
where: $\sum_{i=2}^{11} a_{-i} = 1.0 \quad \sum_{i=0}^{4} b_i = .0389 \quad \sum_{i=0}^{6} c_i = -.0794$

The sum of the estimated coefficients on past inflation is not significantly different from one, and so it is constrained to that value. The lag on past inflation extends about three years. These results imply a vertical long-run Phillips curve in which, absent supply shocks, the rate of inflation at full employment is equal to the rate of inflation inherited from the past. Equivalently, they reflect an accelerationist view that excess demand, or an unemployment rate below

Chart 3

Real Exports





full employment, leads to a continuing acceleration in the inflation rate.[23]

A 10 percent change in the real price of oil is estimated to change the U.S. price level by 0.4 percent in the same direction over five quarters; and a 10 percent change in the real trade-weighted value of the dollar moves the price level by 0.8 percent in the opposite direction over seven quarters. Because of the role of the dollar in the inflation equation, a fiscal expansion in the FRBSF model causes the real value of the dollar to appreciate, prices to drop, and the real stock of money to expand—relieving some of the pressure on interest rates and allowing real GNP to expand by more than it otherwise would.

III. Effects of a Fiscal Expansion

This section compares the estimated responses of interest rates, the dollar, and the trade balance to a fiscal expansion obtained from the FRBSF model with those obtained from the more conventional framework in which the market's expectation of the future real value of the dollar is unaffected by current fiscal policy. To represent the conventional framework, the coefficients on the budget balances in the FRBSF model's exchange rate equation are set equal to zero. I assume for a baseline the actual path of the economy from 1981 through 1988. Monetary policy is defined in terms of the actual path of nominal M2, which I initially assume is unaffected by the fiscal expansion. A simple fiscal change is examined, namely a permanent increase in government spending equal to one percent of high-employment GNP.

For simulating this fiscal expansion with the complete FRBSF model, only two exogenous variables are changed from their historical paths. These are the value of government spending itself and the ratio of the cyclically-adjusted budget balance to high-employment GNP that appears in the exchange rate equation. The results of this simulation are compared with those from the conventional framework which, effectively, changes only the first of these variables from its historical path.

Table 1 shows the results of these simulations as deviations from the historical baseline path. In all of the simulations, real government spending is increased by $32 billion in the first quarter, with this increment growing to $38.8 billion by the 32nd quarter. Simulation A shows the results from the conventional framework. After two quarters, real GNP rises to a maximum of $44.8 billion, but then turns down as the lagged effects of higher interest rates and an inventory adjustment produce a cyclical downturn. The U.S. real bond rate rises steadily because of persistent pressure from higher government spending on short-term interest rates. After 32 quarters, the U.S. real bond rate has risen 151 basis points, and the differential between U.S. and foreign real bond rates has increased by 64 basis points. As a consequence, the real trade-weighted value of the dollar has appreciated 6.9 percent above its baseline path. This produces a $16.3 billion decline in real net exports. At this point, interest rates have nearly peaked, and the impact of the fiscal expansion on the dollar and the trade balance is near its maximum. Even so, only 40 percent of the crowding out occasioned by increased government spending falls on net exports.

The response of the real exchange rate and net exports to a fiscal expansion in the complete FRBSF model, which includes the effects of changes in the expected long run real value of the dollar, is quite different. As shown in Column B of Table 1, after four quarters, the size of the increase in the real bond rate, and the differential between it and the foreign real bond rate, is about the same as in Column A. But the dollar appreciates significantly more in Simulation B—7.3 percent, versus 1.2 percent—because of the expectations effect. This stronger appreciation, in turn, produces larger reductions in net exports and actual declines in domestic prices in subsequent quarters. The larger increase in the real stock of money from lower prices combines with the larger decrease in net exports to pull the

Table 1

Sensitivities to a Change in Real Government Spending Equal to One Percent of High-Employment Real GNP

(Deviations from Historial Path of 1981-88)

A - M2 exogenous, and unchanged long-run expectation of real exchange rate
B - M2 exogenous, and changed long-run expectation of real exchange rate
C - M2 path to stabilize real GNP, and changed long-run expectation of real exchange rate

	Government Spending (Billions of 1982 Dollars)	Net Exports (Billions of 1982 Dollars)			Real Trade-Weighted Dollar (Percent)		
Quarter	A,B, and C	A	B	C	A	B	C
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	32.0	−4.8	−5.1	−5.1	0.2	1.6	1.7
2	32.2	−10.4	−11.0	−11.0	0.7	3.7	3.7
4	32.6	−11.3	−14.5	−14.4	1.2	7.3	7.5
8	33.4	−12.1	−21.5	−21.6	1.8	8.1	8.5
12	34.2	−14.3	−27.5	−27.7	2.2	7.7	8.4
16	35.1	−14.5	−29.1	−29.9	3.1	7.2	8.0
20	36.0	−14.1	−27.6	−28.5	3.5	6.4	7.4
24	36.9	−13.8	−26.7	−27.7	3.6	5.4	6.7
28	37.8	−15.2	−28.4	−27.2	4.8	5.4	6.8
32	38.3	−16.3	−30.0	−31.0	6.9	5.9	7.6

	U.S. Less Foreign Real Bond Rate (Basis Points)			U.S. Real Bond Rate (Basis Points)			Real GNP (Billions of 1982 Dollars)			GNP Price Index (Percent)		
Quarter	A	B	C	A	B	C	A	B	C	A	B	C
0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	2	3	7	7	11	30.2	30.0	29.9	0.0	0.0	0.0
2	7	7	8	30	31	36	44.8	44.0	43.6	0.1	0.1	0.1
4	12	13	15	46	51	58	35.2	30.7	29.4	0.2	0.1	0.1
8	18	19	23	41	27	35	33.3	21.4	19.2	0.5	−0.2	−0.2
12	21	16	22	31	12	21	27.3	15.4	12.3	1.0	−0.2	−0.3
16	29	11	19	65	25	39	17.6	12.7	8.8	1.6	−0.2	−0.4
20	33	4	14	71	23	42	10.0	12.2	6.9	2.2	0.0	−0.3
24	34	−4	7	61	3	25	4.4	13.8	6.6	2.8	0.3	−0.3
28	45	−5	8	102	−1	25	−2.2	14.9	5.8	3.4	0.6	−0.1
32	64	0	15	151	9	40	−16.4	10.5	0.0	3.9	1.1	−0.1

U.S. real bond rate back to the baseline path by 28 quarters. The real value of the dollar remains high, supported by expectational effects, even though the U.S. real bond rate and the differential between it and the foreign real bond rate return to their baseline levels.

Between four and 32 quarters in Simulation B, the real trade-weighted value of the dollar fluctuates between 8 percent and 5½ percent above its baseline path. As a result of the higher dollar, net exports fall rapidly, reaching close to their maximum amount of decline after only 16 quarters. Thus, in Simulation B, real net exports decline by $27.7 billion after 12 quarters and by $31.0 billion after 32 quarters, compared with $14.3 billion and $16.3 billion, respectively, in Simulation A. By incorporating the expectational effect in Simulation B, not only does the dollar appreciate much faster, but also after the first year there is much less pressure on real interest rates. This outcome puts a significantly higher proportion of the crowding out from a fiscal expansion on net exports. In the period from 12 to 32 quarters after the fiscal expansion, 80 percent of the crowding out associated with the increment to government spending falls on net exports in the FRBSF model, compared with only about 40 percent in the conventional framework.

After 32 quarters, real GNP in Simulation B is still $10.5 billion higher than the baseline path, due to both the interest elasticity of money demand and the increase in real M2 produced by the dollar's appreciation. In the long run, however, the economy will tend to return to full employment as domestic prices adjust, so that fiscal policy will affect only the composition of output. Simulation C approximates this longer-run solution in the context of the complete FRBSF model by raising the path of nominal interest rates about 11 basis points above that in Simulation B, so that after 32 quarters real GNP returns to its baseline path.

In this long-run solution, there is an extra 31 basis point increase in the U.S. real bond rate and an extra 1.7 percentage point appreciation in the real value of the dollar compared with Simulation B. But the incidence of crowding out does not change significantly. About 80 percent of the crowding out from higher government spending continues to fall on net exports, with the remainder falling on interest-sensitive consumption and investment. I estimate that the real value of the dollar would have to appreciate by nine percent to make crowding out fall entirely on net exports. It actually appreciates by 7½ percent in this longer-run simulation. Roughly six percentage points of the appreciation are due to the expectational effect of the fiscal expansion, while the remaining 1½ percentage points are caused by the rise in the real bond rate differential. Thus, in the longer run, expectational effects continue to be more important than interest rate effects in appreciating the dollar, and the stronger dollar continues to be more important than interest rates in determining which components of aggregate demand will bear the brunt of crowding out.

IV. Summary and Conclusions

This paper synthesizes two major strands in the literature on open-economy macroeconomics that deal with the linkages among fiscal policy, the dollar, and international trade. Assuming perfect capital mobility and perfect asset substitutability, as well as an instantaneous adjustment of expectations, Mundell (1963) showed that a fiscal expansion can attract net capital inflows without any increase in the differential between domestic and foreign real interest rates. Under the same assumptions with regard to capital mobility and asset substitutability, the conventional short-run dynamic analysis of asset equilibrium, expounded by Dornbusch (1976), Frankel (1979) and others, implies that a fiscal expansion will attract net capital inflows only insofar as it increases the differential between domestic and foreign real interest rates. My analysis suggests that both the interest rate differential and expectations matter. The international sector of the FRBSF macroeconometric model provides a synthesis by embedding a rational expectations model of the dollar's longer-run equilibrium into the short-run dynamics of asset equilibrium. This is done by including expected fiscal balances for the U.S. and other countries along with the interest rate differential in the exchange rate equation.

My econometric estimates suggest that expected budget balances are significant determinants of long-run expectations of the exchange rate. These estimates also indicate that market participants believe that an expansionary fiscal policy will appreciate, rather than depreciate, the real value of the dollar in the long run, suggesting that they do not expect risk premia to be significantly affected by the change in U.S. fiscal policy. Thus, the economy's adjustment to a fiscal expansion is similar to that originally proposed by Mundell. Interest rates rise by less, and the value of the dollar rises faster and farther than in conventional macroeconometric models, where the real value of the dollar is determined solely by the differential between U.S. and foreign real interest rates. As a result, a fiscal expansion rapidly crowds out a relatively large amount of net exports.

APPENDIX
Selected FRBSF Econometric Model Equations

A. REAL EXCHANGE RATE

$$lnEXCH = \underset{(6.66)}{3.44} + \sum_{i=0}^{18} a_i (i_s - i_s^*)_{-i} + \sum_{i=0}^{18} b_i (\dot{p} - \dot{p}^*)_{-i}$$

$$- \underset{(-3.09)}{.0574B} + \underset{(2.06)}{.0773B^*} + \underset{(7.50)}{1.02e_{-i}} - \underset{(-2.75)}{.373e_{-2}}$$

LAG	a_i	b_i
0	.00849	−.00279
1	.00829	−.00756
2	.00806	−.00716
3	.00781	−.00780
4	.00754	−.00781
5	.00724	−.00775
6	.00692	−.00761
7	.00658	−.00741
8	.00621	−.00713
9	.00582	−.00678
10	.00541	−.00636
11	.00497	−.00587
12	.00450	−.00531
13	.00402	−.00467
14	.00351	−.00396
15	.00298	−.00318
16	.00242	−.00233
17	.00184	−.00141
18	.00123	−.00041
SUM	.104	−.104
	(5.74)	(−5.87)

R^2 = .943
R.E. = .0354
D.W. = 2.00

Sample Period: 1973.Q2 - 1988.Q4

EXCH = *real trade-weighted value of the dollar*
i = *U.S. short-term interest rate*
i^* = *foreign trade-weighted short-term interest rate*
$\dot{p}$ = *U.S. inflation rate*
$\dot{p}^*$ = *trade-weighted foreign inflation rate*
B = *4 quarter moving average of U.S. budget balance*
B^* = *4 quarter moving average of weighted foreign budget balance*

B. FOREIGN REAL SHORT-TERM INTEREST RATE

$$\Delta(i_s^* - \dot{p}_s^{e*}) = \underset{(3.32)}{.235}\,\Delta(i_s - \dot{p}_s^e) + \underset{(1.99)}{.143}(i_s - \dot{p}_s^e)_{-1}$$

$$+ \underset{(2.23)}{.160}\,\Delta(i_s - \dot{p}_s^e)_{-2} + \underset{(0.13)}{.009}\,\Delta(i_s - \dot{p}_s^e)_{-3} + \underset{(1.69)}{.222e_{-1}}$$

$\bar{R}^2$ = .263
S.E. = .754
D.W. = 1.90

Sample Period: 1973:Q2-1987:Q4

C. EXPORTS

$$lnGEX82 = \underset{(-1.28)}{-.811} + \sum_{i=0}^{2} a_{-i}\, lnROWGNP82_{-i}$$

$$+ \sum_{i=2}^{9} b_{-i}\, lnEXCH_{-i} + \underset{(8.28)}{-.774e_{-1}}$$

LAG	a_i	b_i
0	0.591	
1	1.071	
2	0.084	−.126
3		−.107
4		−.089
5		−.072
6		−.055
7		−.039
8		−.024
9		−.010
SUM	1.75	−.523
	(13.9)	(−5.75)

$\bar{R}^2$ = .988
S.E. = .0213
D.W. = 1.76

Sample Period: 1972:Q4 - 1987:Q4

GEX82 = *exports in billions of 1982 dollars*
ROWGNP82 = *GNP in 1982 dollars of 10 major industrial trading partners*
EXCH = *real trade-weighted value of dollar*

D. NONPETROLEUM IMPORTS

$$lnNPM82 = \underset{(-15.0)}{-20.1} + \sum_{i=0}^{2} a_{-i}\, lnGNP82_{-i} + \sum_{i=0}^{9} b_{-i}\, lnEXCH_{-i} + \underset{(8.85)}{-.797e_{-1}}$$

LAG	a_i	b_i
0	1.67	.054
1	1.16	.051
2	0.17	.047
3		.044
4		.040
5		.037
6		.033
7		.029
8		.026
9		.022
SUM	3.01	.384
	(16.2)	(2.61)

$\bar{R}^2$ = .994
S.E. = .0266
D.W. = 1.81

Sample Period: 1972.Q4 - 1987:Q4

NPM = *nonpetroleum imports in 1982 dollars*
GNP82 = *GNP in 1982 dollars*
EXCH = *real trade-weighted value of dollar*

E. PETROLEUM IMPORTS

$$ln(PM82/GNP82) = \underset{(-1.61)}{-.291} + \underset{(17.2)}{.897} ln(PM82/GNP82)_{-1} \underset{(-2.06)}{-.137} lnPOIL \underset{(-1.72)}{-.251e_{-1}}$$

$\bar{R}^2$ = .843
S.E. = .113
D.W. = 2.16

Sample Period: 1975.Q1 - 1987.Q4

PM82 = *petroleum imports in 1982 dollars*
GNP82 = *GNP in 1982 dollars*
POIL = *real price of crude petroleum*

F. INFLATION[a]

$$\dot{GDF} = \underset{(0.41)}{.0847} \underset{(-3.86)}{-.600} (LHUR - U^*) + \sum_{i=2}^{11} a_i\, \dot{GDF}_{-i} + \sum_{i=0}^{4} b_i\, POIL_{-i} + \sum_{i=0}^{6} c_i\, EXCH + \underset{(4.01)}{.388e_{-1}}$$

LAG	a_i	b_i	c_i
0		.00976	−.0057
1		.00733	−.0097
2	.061	.00634	−.0124
3	.155	.00679	−.0138
4	.148	.00867	−.0140
5	.138		−.0129
6	.126		−.0106
7	.112		
8	.095		
9	.077		
10	.056		
11	.032		
SUM	1.00	.0389	−.0794
		(2.60)	(−2.69)

$\bar{R}^2$ = .809
S.E. = 1.26
D.W. = 2.00

Sample Period: 1958:Q2 - 1987:Q4

GDF = *annualized percent change in GNP fixed-weighted price index*
LHUR = *civilian unemployment rate*
*U** = *measure of variation in the civilian unemployment rate due to demographics*
POIL = *annualized percent change in real price of crude oil*
EXCH = *annualized percent change in real trade-weighted value of dollar*

[a] *The personal consumption deflator is used to deflate the nominal stock of M2 in the FRBSF model. However, its rate of change is a function of the rate of inflation in the GNP fixed-weighted price index.*

NOTES

1. For an overview of these simulation results, see Helkie and Hooper (1988) and Bryant and Holtham (1988).

2. Mundell (1963) assumed static expectations with regard to the exchange rate in the sense that the exchange rate in the future is expected to be the same as today's exchange rate. As discussed below, however, a rational adjustment of the market's long run expectation of the dollar to changes in the current budget deficit has a similar effect on the incidence of the fiscal change. The most forceful recent proponents of this view have been Dornbusch (1983) and Blanchard and Dornbusch (1984). For an earlier comparison of these two alternative views, see Hutchison and Throop (1985). For recent surveys that put Mundell's contribution into historical perspective and further discuss some of the issues covered in this paper, see Frankel and Razin (1987) and Marston (1985).

3. The FRBSF macroeconometric model is fully described in Throop (1989).

4. In technical terms, previous research indicates that risk premia on internationally-traded assets are small, vary with time, and are difficult to associate systematically with structural variables. See Danker, *et. al.* (1984), Frankel (1982), and Hutchison and Throop (1985).

Although Mundell (1963) implicitly took perfect mobility to require perfect substitutability, current writers generally take perfect capital mobility to mean only an absence of substantial transaction costs, capital controls, or other impediments to the flow of capital between countries. This definition of perfect capital mobility implies that the exchange rate would adjust instantaneously to equilibrate the international demand for stocks of national assets, as opposed to the more traditional view of adjusting to equilibrate the international demand for flows of goods and capital. But it leaves open the question whether domestic and foreign assets are perfect or imperfect substitutes. See Dornbusch and Krugman (1976) and Frankel (1983).

5. For a survey of the most important multicountry econometric models, see Bryant, *et. al.* (1988), especially Chapters 3 and 5. Additional detail on these models may be found in Part I of the *Supplemental Volume.*

6. The asset theory of exchange markets was pioneered by Dornbusch (1976a) and Frankel (1979). See also Hooper and Morton (1982) and Hutchison (1982) for applications of the asset view. A useful general survey of modern exchange rate theory is Shafer and Loopesko (1983).

7. The open interest parity condition in nominal terms is:

$$\ln s - \ln s^e = n(i - i^*)$$

where s is the nominal value of the dollar, defined as units of foreign currency per unit of domestic currency, and s^e is the expected value of the nominal exchange rate. By definition

$$s = EXCH \frac{p^*}{p}$$

and

$$s^e = EXCH^e \frac{p^*(1 + \dot{p}^{e*})^n}{p(1 + \dot{p}^e)^n}$$

where EXCH is the real exchange rate and p and p^* are the U.S. and foreign price levels, respectively. Taking logarithms and substituting into the arbitrage equation in nominal terms gives equation (1) in the text.

In theory, the relevant interest rate differential should be after taxes. Although marginal tax rates on real interest income differ among industrial countries, no estimates of these rates are available. For a survey of and some background papers on what is known about how interest income and foreign exchange gains and losses are taxed in various countries, see Tanzi (1984).

8. The ultimate equilibrium at LM_3 and IS_3 is similar to that in Mundell's (1963) classic analysis, in which the dollar appreciates without any increase in the equilibrium real interest rate differential. Mundell assumed static expectations with respect to the exchange rate (meaning that the exchange rate expected in the future is the same as today's exchange rate), allowing this short-run equilibrium to be reached immediately. Also, he ignored the effect of the currency appreciation on the LM schedule, so that the IS schedule shifted all the way from IS_2 to IS_1, leading to a full crowding out of net exports by the fiscal expansion.

9. Because real interest rates equalize in the long run, the dollar appreciates without any increase in the equilibrium real interest rate differential, just as in Mundell's classic analysis of a small country with fixed prices. The difference in this two-country, full-employment case is that because the world interest rate rises, there is some crowding out of U.S. domestic investment, and possibly consumption, in addition to net exports. However, the smaller is the country with the fiscal expansion relative to the rest of the world, the greater is the crowding out of net exports. Crowding out from fiscal expansion in a country small enough to have no significant impact on world interest rates would fall entirely on net exports, just as in Mundell's small country case with fixed prices.

A further point is that the crowding out of world-wide capital formation by a U.S. fiscal expansion gradually shifts up the locus of full-employment equilibrium in both countries as capital becomes scarcer, thus raising real interest rates at full employment in both countries. Since this shifts up the schedules of both countries, there is no necessary impact on the real value of the dollar. However, if consumption spending is a function of net wealth, as is commonly believed, the increase in the relative wealth position of the foreign country would shift up its full-employment equilibrium relatively more, thus tending to *depreciate* the dollar. To the extent that investors expected the fiscal expansion to have such an impact within their investment horizon, the current value of the dollar could be affected. Whether this is in fact the case is an empirical matter.

10. Branson (forthcoming) and Sachs (1985) have constructed formal models in which the risk premium in an open-interest parity condition varies over time in proportion to relative debt positions. Krugman (1985, 1988) correctly points out, however, that risk premiums should also enter into the expected long-run value of the dollar, consistent with Figure 3. But he suggests in addition that the market has not correctly assessed the limit to absorption of dollar-denominated assets by the rest of the world. The implication that expectations in the foreign exchange market are irrational, is hard to accept.

Rather, it is more realistic to assume there is a relatively large potential world demand for dollar assets. The dollar is universally accepted as a means of international payment and serves as an international store of value to an extent unmatched by any other asset. Moreover, the breadth, depth, and resilience of U.S. financial markets provide a degree of liquidity not available in other assets. As a result, only a small increase in the U.S. real interest rate relative to the foreign real interest rate likely would be required to ensure continued external financing of the U.S. payments deficit. As a consequence, over relatively long time horizons, the expectation of a relatively permanent U.S. budget deficit is more likely to lead to an *increase* in the expected long-run equilibrium in the real value of the dollar than a decrease, consistent with the empirical results discussed below. For a further defense of this view, see Cheng (1988).

11. The analysis shown in Figures 2 and 3 makes it clear that the expected real value of the dollar also should depend on the expected rate of private saving at home and abroad. Although the U.S. private saving rate declined significantly in the 1980s, prior to that it had been stable over a long period of time. (See Denison [1958] and David and Scadding [1974].) The question whether expectations of long-run private saving rates have changed significantly is beyond the scope of this article.

12. They are only approximate because the marginal effects of government spending, transfer payments, and various taxes on aggregate demand are not exactly the same. The budgetary data are combined federal, state, and local balances compiled by the OECD. Sources of these data are Price and Muller (1984) and recent issues of the *OECD Economic Outlook.*

Both inflation-adjusted and unadjusted structural budget balances were tried. Unadjusted structural budget balances count the inflation premium in interest paid on government debt as an outlay, but do not count the corresponding erosion in the real value of this debt due to inflation as a receipt. The inflation-adjusted structural budget balance corrects this by including the erosion in the value of the debt as tax revenue. These two measures performed equally well in the exchange rate equation.

But evidence from the consumption function in the FRBSF econometric model, as well as empirical work by Eisner and Peiper (1984) and Price and Muller (1984) that shows real growth in the United States and Europe to be more closely related to movements in inflation-adjusted budget balances than to unadjusted ones, supports using the adjusted measure. The inflation-adjusted measure is consistent with households' behaving rationally and therefore saving (and reinvesting) inflation premiums in the interest on government debt.

Because of this behavior, the private saving rate as conventionally measured should tend to rise and fall with the inflation rate. This response of the private saving rate to inflation is particularly evident in European countries that have experienced sharp changes in inflation. However, it is obscured in the U.S. data by simultaneous movements in the ratio of real wealth to income, which also influence the saving rate in a life-cycle model of consumption. For further discussion of the inflation-adjusted measure, see Jump (1980), Siegel (1979), and Tanzi, Blejer, and Teijero (1987).

13. See, for example, Bryant, *et. al.* (1988), Bryant and Holtham (1988), and Helkie and Hooper (1988).

14. The alternative of budget balances over four quarters ahead did not perform as well. Neither did distributed lags on current and past budget balances.

15. Trade-weights clearly are appropriate for combining the rest of the world's real interest rates since that is the way the exchange rate is constructed. However, in the case of the structural budgets, the relative size of the country also is important. The larger the country, the smaller trade generally will be as a proportion of GNP, and the flatter will be its full employment locus in Figures 2 and 3. Therefore, the impact of a one-percentage point change in the country's structural budget on its real bilateral exchange rate with the U.S. would be greater the larger is the size of that country's economy. Thus, the weight for the foreign budget balances that I used is the trade-weight times the relative GNP-weight.

Since the relative effects of domestic and foreign budget balances on the real exchange rate depend upon the relative size of the U.S. and the rest of the world, there is no reason that the coefficients on the two budget balances should be constrained to be of equal absolute value, as is the case with U.S. and foreign interest rates.

16. Multilateral trade weights are used. See Board of Governors of the Federal Reserve System (1978). The nominal index is deflated by the ratio of trade-weighted foreign consumer prices to the U.S. GNP fixed-weight price index.

17. Hooper (1985, 1987) estimates a six percent change in the real exchange rate for a one-percentage point change in the real interest rate differential. He uses interest rates on securities with maturities that are usually 10 years, but sometimes less.

18. Although the standard measure of the U.S. federal fiscal deficit as a percent of high-employment GNP rose and the state and local government balance was about unchanged, there was a larger increase in the inflation "tax" on government debt. Hence, the U.S. inflation-adjusted structural budget balance rose. See footnote 12.

19. The FRBSF model has only 28 behavioral equations,

compared with 124 in the Federal Reserve-MIT-Penn model (Brayton and Mauskopf, 1987), for example.

20. Weighted averages of domestic spending and domestic output also were tried as scale variables, on the theory that imports depend upon spending as well as production, but they gave inferior results compared with real GNP.

21. See Feldman (1982) and Warner and Kreinin (1983).

22. The measured difference in income elasticities would imply a need for the real value of the dollar to decline secularly unless there is an offsetting difference in growth rates of income at home and abroad. A classic study on income elasticities in world trade, originally pointing out the need for a secular decline in the real value of the dollar, is Houthakker and Magee (1969). Subsequent literature on income elasticities is surveyed in Goldstein and Kahn (1985). A recent discussion of the effect of income elasticities and productivity growth on the trend in the real value of the dollar is provided in Krugman and Baldwin (1987). A negative time trend to account for the possible effect of the difference in elasticities initially was included in the equation for the exchange rate (equation (4)), but it proved to be statistically insignificant.

23. The full employment rate of unemployment, at which inflation tends neither to accelerate nor decelerate, is estimated at 5¾ percent in the U.S. economy at present.

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