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Robustness of Equilibrium Exchange Rate Calculations to Alternative Assumptions and Methodologies

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Abstract

This paper explores a number of methodological issues that arise in the calculation of equilibrium exchange rates, which are identified in this paper as those real effective exchange rates consistent with macroeconomic equilibrium, i.e., internal and external balance. A partial equilibrium, comparative static analysis is presented and the methodology is applied to the break-up of the Bretton Woods exchange rate system. Then the dynamic interaction between the current account and the stock of net foreign assets is examined. Finally, the analysis uses a more general equilibrium approach by relying on simulations using MULTIMOD, a multicountry econometric model. The paper demonstrates the extent to which the equilibrium exchange rate calculations depend upon alternative assumptions regarding factors that affect internal and external balance. In addition, results obtained using the comparative static and dynamic macroeconomic approaches are compared.

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1/ Economists, International Monetary Fund. The views expressed here are those of the authors and do not necessarily reflect those of the staff or the Board of the I.M.F. They gratefully acknowledge the helpful comments of Charles Adams, Jacques Artus, Leonardo Bartolini, Ulrich Baumgartner, Sterie Beza, Jack Boorman, Bankim Chadha, Hamid Faruqee, and Morris Goldstein, without in any way implicating them in any of the views expressed in this paper. This paper will appear in a volume on equilibrium exchange rates edited by John Williamson that will be published by the Institute for International Economics.

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Summary

This paper explores a number of methodological issues that arise in the calculation of equilibrium exchange rates. The approach taken here is to calculate such exchange rates as those consistent with macroeconomic equilibrium, i.e., internal and external balance. While we use the term "desired equilibrium exchange rate" (DEER), it is not that the exchange rate that is desired for its own sake, but rather is consistent with achieving "desired" positions of internal and external balance.

A partial equilibrium, comparative static analysis is presented and the methodology is applied to the break-up of the Bretton Woods exchange rate system. Given estimates of the full employment level of output and of the desired current account, the DEER is defined as the level of the real effective exchange rate consistent with achieving these objectives in the medium term. Alternative estimates of DEERs are obtained using different assumptions about underlying parameters and variables. The results indicate that changes in the underlying assumptions can have a significant impact on estimated DEERs, with the range between the highest and lowest estimates of the DEER in effective terms lying between 10 and 30 percent. This wide range underlines the need for caution in identifying any given set of exchange rates as "the" appropriate equilibrium values. Nevertheless, all of the calculations imply that the U.S. dollar was overvalued and the yen undervalued at their 1970 parities.

The dynamic interaction between current accounts and the net foreign assets is explored by taking account of certain hysteresis effects. Given that deviations of the actual exchange rate from the DEER generate changes in the current account and hence movements in the amount of equilibrium debt service, it is clear that the level of the real exchange rate consistent with medium-term external balance will be shifting as long as the actual real exchange rate is away from the DEER. Thus, the final DEER arrived at will not be independent of the path chosen towards it.

Finally, the analysis uses a more general equilibrium approach based on MULTIMOD simulations. As MULTIMOD is a fully-specified dynamic macroeconomic model, all major simultaneous effects are taken into account, including, for example, the hysteresis effects described above as well as the impact of changes in the external balance on the domestic economy. The aim is to see what difference it makes to the calculated change in the real effective exchange rate using a full model simulation, as well as to obtain an estimate of the likely domestic economic effects of the change in the external balance. As the exchange rate is determined endogenously in the model, it is necessary to use a "forcing" or exogenous variable to change the exchange rate in order to achieve the desired change in the external balance. The specific type of exogenous variable will have an effect on the entire macroeconomic system and will therefore influence the level of the real effective exchange rate that is consistent with desired positions of internal and external balance. In particular, the two types of shocks considered here (changes in currency preferences and fiscal policy) have very different implications for medium-term real output and interest rates and ultimately result in some differences in the estimated DEERs.

I. Introduction

The turmoil in foreign exchange markets in Europe in the fall of 1992 and the summer of 1993 focused attention on the causes of exchange market tensions and the extent to which exchange rates are in line with economic fundamentals. In these episodes tensions were concentrated in the currencies of the EMS, but the issue of appraising the level of exchange rates arises also in connection with currencies that are floating. In this connection, it is useful to look at trends over time in indicators of a country's external competitiveness and at developments in its balance of payments to see whether its real exchange rate is likely to be consistent with a sustainable external account. While an analysis based on differential movements in international competitiveness, i.e., a PPP type of approach, may be helpful in making such an appraisal, it is incomplete because it involves examining changes in relevant variables from some base period and therefore does not address the issue of whether the exchange rate was at an equilibrium level originally. Moreover, major changes in economic policies or structural changes, such as significant movements in a country's terms of trade, are not taken into account.

To overcome the deficiencies of an approach based mainly on indicators, it is necessary to relate the discussion and analysis of exchange rates more directly to the notion of a sustainable or equilibrium exchange rate. The concept of the equilibrium exchange rate is not unique, however. As noted by Frenkel and Goldstein (1986), there are at least three approaches to determining the equilibrium exchange rate: those based on structural exchange rate models such as the monetary model or the portfolio balance model of exchange rate determination, the purchasing power parity approach, and the "underlying balance" approach. 1/ According to this last approach, the equilibrium exchange rate is defined as the real effective exchange rate that is consistent with medium-term internal and external macroeconomic balance. This definition is discussed further below.

The underlying balance approach to the equilibrium exchange rate was developed by Fund staff during the 1970s (see Artus (1977) and International Monetary Fund (1984)). 2/ More recently, the equilibrium rate associated with underlying balance has been labeled the "fundamental equilibrium exchange rate" (FEER) by Williamson (1985). The concept of "fundamental" equilibrium would be more applicable, however, to a long-term situation where all underlying economic forces had worked themselves out, in particular, where actual asset stocks are at their desired levels. Moreover, we wish to stress that the concept of the equilibrium real exchange rate consistent with underlying macroeconomic balance is based upon a set of desired macroeconomic objectives. In this paper, therefore, we

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1/ See Taylor (1994) for a recent survey relating to the first two of these approaches. Frenkel and Goldstein (1986) discuss the relative merits of the three approaches.

2/ See also Nurske (1945) and International Monetary Fund (1970) for precursors of this approach.

shall use the term "desired equilibrium exchange rate" (DEER) to refer to this concept. It is not that the exchange rate is desired in and of itself, but rather it is consistent with, and necessary for, achieving "desired" positions of internal and external balance. Thus the DEER should not be viewed as an ultimate target itself, but rather as facilitating the achievement of macroeconomic objectives. The DEER has been used as an analytical device by a number of authors to assess exchange rate misalignment (Williamson (1985, 1990), Barrel and Wren-Lewis (1989) and Church (1992), as well as in the context of discussions of "blueprints" for international policy coordination (Williamson and Miller (1987)), Frenkel and Goldstein (1986), Currie and Wren-Lewis (1989)), and in discussions of the "appropriate level" at which to join a pegged exchange rate system such as the European Monetary System (Williamson (1991) and Wren-Lewis, et al. (1991)).

In this paper, we explore a number of methodological considerations that relate to DEER calculations. Our objective is not to obtain precise and up-to-date estimates of DEERs for individual countries, but rather to lay out a number of issues involved in the calculation of DEERs that need to be addressed prior to their application in the appraisal of exchange rates. We begin with a comparative static analysis. We then examine the dynamic interaction between the current account and the stock of net foreign assets by taking account of certain hysteresis effects on the DEER. Finally, we present some illustrative general equilibrium calculations of DEERs using MULTIMOD, the international macroeconometric model developed by the International Monetary Fund. The objective of the analysis is to show the extent to which calculated DEERs depend not only on alternative assumptions regarding positions of internal and external balance, for example, but also on whether a comparative static or a dynamic macroeconomic analysis is employed to generate the estimate.

As noted by Wren-Lewis (1992), the DEER is often treated as a comparative static calculation. Given values of the full employment level of output and of the current account, the DEER is defined as the level of the real effective exchange rate consistent with achieving these goals in the medium term. There are three elasticities needed to make this comparative static, partial equilibrium approach operational: the sensitivity of the current account to domestic activity, to foreign activity, and to the real exchange rate, all of which can be derived from estimated trade equations. We use the elasticities from MULTIMOD as our base case. In Section II, calculations using this approach have been made for the seven largest industrial countries based on an actual historical episode, namely, the break-up of the Bretton Woods exchange rate system in the early 1970s. Alternative estimates of DEERs are obtained using different assumptions about underlying elasticities, the historical period used for the base period, the level of potential output, and the desired external balance position. Attention is focused on the sensitivity of the DEERs to these and other alternative values of key parameters and variables; it is shown that plausible estimates of DEERs vary over quite a wide range.

In this paper we generally refer to a sustainable level of a real effective exchange rate. However, as long as inflation rates differ among countries, the sustainable level of a country's nominal exchange rate will vary over time. Moreover, to the extent that the underlying economic conditions affecting a country's DEER are themselves changing, the calculated DEER will not be a fixed number but will also vary over time. It is only for purposes of simplification that the concept and calculation of the DEER is discussed in terms of a level rather than a path.

Section III discusses the interaction between the path to equilibrium and the DEER itself in more detail. While not entirely overlooked in the literature (Wren-Lewis (1992)), the issue of how the DEER shifts for any given path towards it has received relatively little attention. Given that deviations from the DEER involve movements in the current account and hence movements in the amount of equilibrium debt service, it is clear that the level of the real exchange rate consistent with medium-term external balance will be shifting as long as the actual real exchange rate is away from the DEER. Moreover, movements in the DEER from this source will tend to increase the degree of misalignment since, for example, an overvaluation of a currency will entail a devaluation of its DEER value. Thus, the final DEER arrived at will not be independent of the path chosen towards it. The notion that different equilibrium values may not be independent of the dynamic adjustment paths toward them is generally termed "hysteresis." We derive the dynamic solution for the exchange rate and assess the importance of hysteresis effects for a given path of adjustment and set of initial conditions.

In Section IV of the paper we use MULTIMOD to provide illustrative calculations of the DEER. As MULTIMOD is a fully-specified dynamic macroeconomic model, all major simultaneous effects are taken into account, including, for example, the hysteresis effects described above as well as the impact of changes in the external balance on the domestic economy. It is important to realize that as the exchange rate is determined endogenously in the model, it is necessary to use a "forcing" or exogenous variable to change the exchange rate by the amount needed to achieve the desired change in the external balance. Moreover, the particular manner in which the exchange rate change is achieved will have an effect on the entire macroeconomic system and will therefore influence the level of the real effective exchange rate that is consistent with desired positions of internal and external balance. First, we assume that currency preferences shift in such a way as to generate the same trade balance positions as in the base case in Section II. Second, we examine the effect on the DEERs of changes in fiscal policy that would be needed to achieve these same positions. We then calculate estimates of DEERs for the major industrial countries in the early 1970s on the assumption that they were at full employment levels of output and attained the same external balance positions. Finally, we examine what difference it makes if the external balance objective is specified in terms of the current account rather than the trade balance. The results of these illustrative calculations show that the desired current account position is consistent in some cases with rather different changes in macroeconomic variables. For example, in those

countries where an improved external position is targeted, the effect on output is negative if the required real depreciation is brought about by a shift in currency preferences, but positive if the depreciation is achieved by a cut in government spending.

The objective of this paper is to examine methodological issues arising in connection with the calculation of exchange rates consistent with internal and external balance. There is a whole set of analytical and policy issues related to the question of the appropriate course of action in the event that actual exchange rates are out of line with calculated DEERs. These issues are important and relevant, and are in fact the logical next step in the analysis. However, as they deserve a full, systematic treatment, they are beyond the scope of this paper.

Section V provides some concluding comments and observations.

II. DEER Calculations Using a Comparative Static, Partial Equilibrium Approach

1. The DEER concept

The DEER is defined as the real effective exchange rate at which an economy is in both internal and external macroeconomic balance in the medium term. 1/ As explained above, external equilibrium is defined in terms of a sustainable value of the current account balance. Internal balance is usually defined as potential full-employment output; in most computations (e.g., those of Williamson, 1985, 1990) this is computed independently and thus not dependent on the real exchange rate itself, a tradition that we will follow in this section dealing with comparative static analysis. On this assumption, the DEER associated with internal and external balance is illustrated in Figure 1, where full employment income, Y*, is drawn as a vertical line in real exchange rate (R) and real income (Y) space. The current account (CA) schedule is drawn for a given level of the current account balance and slopes down from left to right for well-known (net import propensity) reasons; as real income increases, (net) imports tend to rise, requiring a devaluation of the real exchange rate to maintain an unchanged current account position. The solutions for R* and Y* give the DEER and the internal balance position. As income (GNP) is generally close to output (GDP), the full employment level of income, Y*, will be approximately the same as the full employment level of output.

One important issue, which will not be dealt with in detail in this paper, is how to define the sustainable level of the current account. One approach, used in Williamson (1990), is to calculate it from the difference between desired levels of saving and investment. Williamson notes that as

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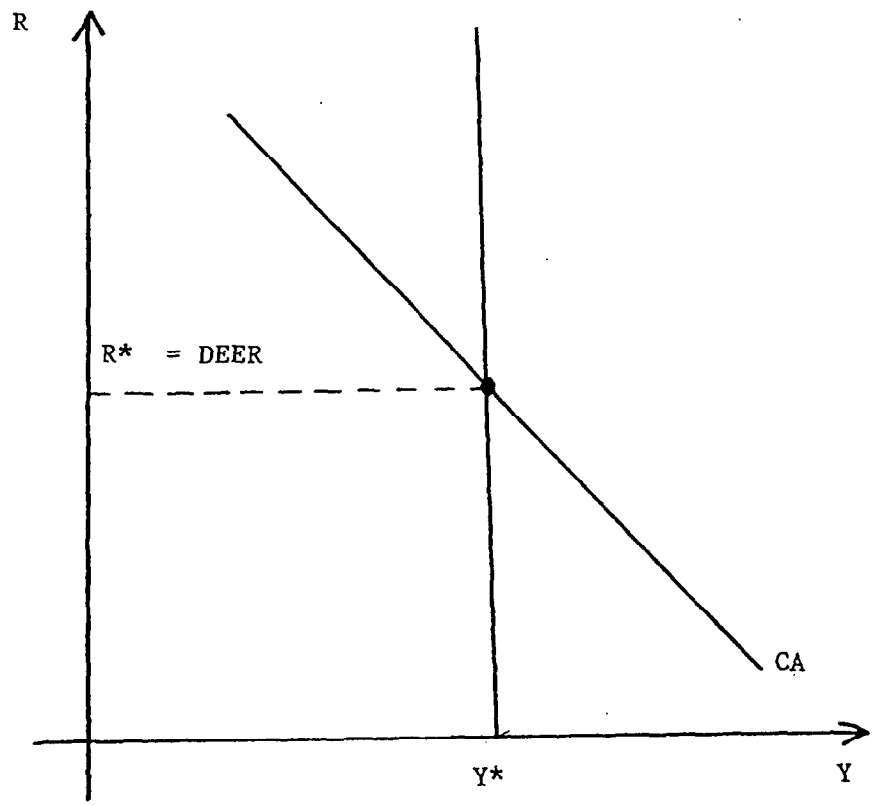
1/ The medium term in this context means the period needed for output to return to potential and for changes in competitiveness to be reflected in trade volumes, which would appear to be in the range of four to six years.

Figure 1: Internal and External Balance



the current account is a flow variable, representing the rate of international lending or borrowing of an economy, one needs to examine whether a given current account position is likely to lead to an unsustainable debt build-up in the medium term. This suggests that the desired level of the current account could be approached by considering the underlying stock equilibrium for international assets. Once this equilibrium has been identified, the desired path for the current account would depend upon both the underlying equilibrium level of net foreign assets for the economy in question and upon the adjustment path towards this equilibrium. This desired path for the current account could then be used to identify the appropriate DEER trajectory.

Although Williamson has generally used large macroeconomic models to calculate DEERs, it is basically a comparative static, partial equilibrium calculation, as noted by Wren-Lewis (1992). Given values of the desired levels of output and the current account, the DEER is the level of the real effective exchange rate consistent with achieving these goals in the medium term. Denoting by a star the levels of domestic income (Y), foreign income (FY), and the current account (CA) that correspond to internal and external balance, the DEER is R*, the value of the real exchange rate (R) derived from equation (1):

$$CA^* = CA(Y^*, FY^*, R^*). \qquad (1)$$

The easiest method of calculating the DEER is to start from the values of Y, FY, CA, and R in the current, i.e., the base period, and then compute the change in R implied in moving Y to Y*, FY to FY*, and CA to CA* using the function:

$$CA = CA(Y, FY, R). \qquad (1')$$

Although there appear to be three targets and only one instrument, it is assumed that Y and FY move to Y* and FY*, respectively, through the natural operation of economic forces, so that there is in effect one instrument, R, to achieve CA*. It should be noted that this static calculation assumes that the current account has fully adjusted to past movements in income and the real exchange rate in the base period.

The three elasticities required to make (1) operational are the sensitivity of the current account to domestic activity, foreign activity, and the real exchange rate, which can be derived from estimated trade equations. In the calculations below the elasticities from the MULTIMOD

equations for nonfactor trade are used. 1/ These are given in Table 1, together with other inputs used in the calculations described in this section. As estimated elasticities are subject to a degree of uncertainty, we explore below the sensitivity of calculated DEERs to a range of estimates.

One feature of the exercise outlined above is that fiscal policy has no explicit role in the *calculation*. While this may appear surprising at first sight, there can be reasons for taking the view that fiscal policy has little *independent* effect on the DEER for given levels of Y*, YF*, and CA*. Of course, fiscal policy affects the current account in the short run through two main channels: changes in the exchange rate and movements in output relative to potential, and both of these channels are taken into account in the calculation of the DEER. But this is not to say that fiscal policy cannot have an independent impact on the DEER. Fiscal policy can have a direct impact on the current account (and hence the DEER) over and above its indirect effects through aggregate demand. For example, if government consumption has a different import multiplier from other domestic spending, or if changes in fiscal policy affect the level of potential output, then it would be appropriate to include a separate effect of fiscal policy on the DEER. Another reason that fiscal policy can be important in determining the DEER is if the desired current account position varies with the fiscal balance. In this case, fiscal policy has a direct effect on the DEER through its effect on CA*. 2/

The comparative static, partial equilibrium approach has certain advantages and disadvantages. On the positive side, the calculations are simple and transparent, which also makes it easy to test the sensitivity of the calculations to alternative assumptions. On the other hand, certain dynamic factors are inevitably ignored. As noted above, this approach assumes that the current account in the base period has fully adjusted to past changes in output and the real exchange rate. In addition, it ignores the impact on the DEER of the path to equilibrium. For example, continuing current account imbalances may imply a significant change in the level of net external assets which in turn feeds back onto the net flows of interest, dividends and profits. Moreover, policies which affect the level of investment will change the level of potential output and hence the medium-term level of activity. This can be seen very clearly in Section IV where the choice of the policy or "forcing" variable that is altered to achieve a current account target can have very different effects on real interest

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1/ For a description of the MULTIMOD macroeconomic model, see Masson, Symansky, and Meredith (1990). Long-run exchange rate elasticities were used, since the focus of the analysis is on medium-term adjustment. For output, short-run absorption elasticities were used since these are more appropriate for cyclical disturbances.

2/ Fiscal policy also provides a potential policy tool for moving the current exchange rate to its equilibrium level, rather than as a major independent factor in the DEER calculation. This use of fiscal policy in this manner is described in Section IV below.

Table 1. Data and Assumptions

A. Output Elasticities

	Absorption Elasticities		Implied Output Elasticities (taking into account the effect on net exports)	
	Exports	Imports	Exports	Imports
United States	2.00	1.51	2.28	1.65
Japan	2.00	1.66	2.21	1.86
Canada	2.00	2.05	2.81	3.25
Germany	2.00	1.44	2.93	2.01
France	2.00	2.21	2.76	3.34
Italy	2.00	2.27	2.62	3.26
United Kingdom	2.00	1.38	3.09	1.85

B. Real exchange rate elasticities

	Real Exchange Rate Elasticities		Adjustment Due to Effect on Absorption		Total Effect
	Exports	Imports	Exports	Imports	
United States	0.71	1.10	0.04	0.07	1.91
Japan	0.71	0.77	0.05	0.04	1.55
Canada	0.71	0.45	0.13	0.06	1.35
Germany	0.71	0.90	0.14	0.14	1.89
France	0.71	0.72	0.11	0.10	1.63
Italy	0.71	0.40	0.10	0.05	1.25
United Kingdom	0.71	0.37	0.13	0.07	1.27

C. Base Case Ratios to GDP

	Current Account		Trade Balance		Output Gap	
	1971	1972	1971	1972	1971	1972
United States	-0.13	-0.48	-0.21	-0.53	-1.80	0.53
Japan	2.51	2.17	3.38	2.94	-0.72	0.79
Canada	0.38	-0.26	2.54	1.80	-1.42	-0.96
Germany	0.45	0.47	3.12	3.29	1.29	2.09
France	0.08	-0.18	0.54	0.54	4.22	2.77
Italy	1.72	1.49	0.49	--	0.04	-1.50
United Kingdom	1.89	0.30	0.33	-1.15	-1.66	-0.71

rates, potential output, and the real exchange rate. Finally, this approach abstracts from considerations relating to asset market equilibrium and thus implicitly assumes that over the medium term, interest rates (nominal and real) have settled down at their equilibrium levels. These dynamic and asset market effects are taken into account and analyzed in the sections below.

One dynamic factor which can be easily incorporated into the comparative static method are differences in inflation across countries. It is clear that the DEER calculations refer to real exchange rates. Consequently, projected changes in relative price levels feed through into the nominal DEER on a one-to-one basis.

2. Some illustrative DEER calculations

To illustrate the DEER approach, this section reports some calculations based on an actual historical episode, namely the break-up of the Bretton Woods exchange rate system. Bretton Woods was a fixed exchange rate system set up immediately after the Second World War. The system worked as a dollar standard backed by gold, with the U.S. dollar having a fixed parity against gold and the other members of the system having fixed parities against the dollar. 1/ The heyday of the system, involving full convertibility of all major currencies, lasted from 1959-68. In 1968 financial market tensions forced the separation of the private and official markets for gold, effectively ending the private convertibility of the dollar into gold at a fixed price.

The system continued as a dollar standard with fixed parities until 1971. In May of that year the deutsche mark and Dutch guilder were floated, and in August the United States suspended the gold convertibility of the dollar even for official borrowers. At that point, most major currencies began to float against the dollar while negotiations on a new set of exchange rate parities were initiated with the objective of returning to a fixed exchange rate system. New parities were agreed at a ministerial conference of the Group of Ten at the Smithsonian Institution in Washington on December 18 and 19. These involved a devaluation of the dollar in terms of gold from $35 per ounce to $38, a general revaluation of other Group of Ten currencies against the dollar that resulted in an effective devaluation of the dollar of 9.1 percent, and widening of the intervention limits from ±1 percent to ±2 1/4 percent. With the exception of the pound sterling, these parities held until February 1973 when the dollar was devalued a further 10 percent just prior to the general collapse of the system in March 1993. 2/

1/ See McKinnon (1993) for a fuller description of this system.

2/ There are a number of descriptions of the collapse of the Bretton Woods by academics (Williamson, 1977 and Garber, 1993), institutional historians (de Vries, 1976), and policy makers (Solomon, 1982, and Volcker and Gyohten, 1992).

This section illustrates how the DEER approach can be used to analyze the collapse of the Bretton Woods exchange rate system. There are many issues involved in its collapse, including divergent monetary policies, the asymmetrical position of the dollar, the level of liquidity in the system, and the ability to adjust parities. This section will abstract from these issues and focus on the appropriateness of the underlying parities. Two issues are examined. First, to what degree were the exchange rate parities of 1970, just prior to the initial collapse of the system, out of line with estimated DEERs. Second, to what extent did the Smithsonian parity adjustments move exchange rates between the major industrial countries towards their estimated DEERs.

Tables 2 and 3 below show a number of alternative calculations for the major industrial countries that illustrate the comparative static, partial equilibrium approach to estimating DEERs and highlight the importance of different assumptions in these calculations. Conceptually, the DEER calculations can be thought of as being carried out in three steps, although in practice these steps are performed simultaneously. First, the impact of moving output to potential in all countries is calculated by taking the implied movements in (trade-weighted) foreign output and in domestic output for each country and multiplying these changes by the short-run elasticity of exports and imports with respect to real output, respectively, and by the ratio of exports and imports to GDP. 1/ Next, the change in real multilateral exchange rate required to move this adjusted current account to its desired level is calculated for each country. These use the aggregate real exchange rate elasticities reported in the last column of Table 1, panel B. 2/ Finally, trade weights are used to derive the changes in the

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1/ The elasticities are shown in Table 1, panel A. The first two columns show the estimated absorption elasticities used in MULTIMOD (MULTIMOD uses absorption as the activity variable in the export and import equations). The output elasticities shown in the next two columns, which are the numbers actually used in the calculation, take account of the multiplier interaction between changes in real net exports and absorption given a fixed level of output. These elasticities are estimated using data from the post-1972 floating exchange rate period. No account was taken of the possibility that trade elasticities may have varied between the Bretton Woods era and the subsequent floating exchange rate regime.

2/ The aggregate effect is made up of the real exchange rate elasticities for exports and for imports plus an adjustment for the multiplier effects of these movements in exports and imports on absorption. These adjustments tend to increase the overall real exchange rate elasticity. For example, an appreciation in the real exchange rate lowers exports and raises imports. This in turn lowers net exports which, for a given level of domestic output, raises domestic absorption and hence raises the demand for imports.

Table 2. 1970 Parities, Base Case DEERS and Smithsonian Parities

	Bilateral Rates 1/			Effective Exchange Rates		
	1970 Parities	Base Case DEER	Smithsonian Parities (1970 Exchange Rates)	1970 Parities	Base Case DEER	Smithsonian Parities (1970 Exchange Rates)
United States				100	87.7	90.9
Japan	360	277	305	100	125.1	113.3
Canada	1.044 2/	1.037	1.089 2/	100	94.7	90.7
Germany	3.66	3.22	3.13	100	99.6	105.8
France	5.55	4.64	4.95	100	106.0	99.6
Italy	625	515	564	100	107.6	98.3
United Kingdom	0.417	0.365	0.358	100	101.7	105.2

1/ Local currency per U.S. dollar.
2/ Actual market rates.

Table 3. Alternative Calculations of DEERS

(1970 Parities = 100)

	Base Case	No Adjustment for Cyclical Factors	Trade Balance Equal to 1 Percent of GDP	1972 Data	Export Price Elasticities = 1	Import Price Elasticities = 0.75
United States	87.7	89.0	87.0	91.0	90.8	79.5
Japan	125.0	124.6	138.9	127.5	116.2	125.8
Canada	94.7	94.3	114.0	87.0	97.3	97.3
Germany	99.6	98.6	108.0	101.9	99.8	99.4
France	106.0	95.3	108.5	103.2	104.0	105.7
Italy	107.8	110.9	87.9	101.0	102.9	102.5
United Kingdom	101.7	108.6	86.0	92.5	100.5	100.4

real bilateral rates against the U.S. dollar from the change in the real effective exchange rate. 1/

Panel C of Table 1 shows the ratios of the current account, trade balance and gap between output and potential output to GDP for 1971 and 1972. The United States had the weakest current account of all of the major industrial countries in both years, followed by France and Canada. At the other end of the spectrum, Japan had the largest surplus, followed by Italy. The United Kingdom is notable for the size of the deterioration in its external position between 1971 and 1972. Trade balances show a similar picture for the United States and Japan, but in this case it is Germany and Canada who exhibit strong balances and the United Kingdom and Italy who have weak ones. The estimated output gaps indicate that in 1971 the United States, United Kingdom, Canada and, to a lesser extent Japan, were below potential output. All three show some recovery in 1972, the largest change being in the United States. In continental Europe, France and, to a lesser extent, Germany, were significantly above potential in 1971, while both France and Italy showed a significant deterioration in their output gaps between 1971 and 1972. By and large, these changes in output gaps are reflected in opposite movements in the current account; however, significant perverse responses are found for the United Kingdom, Canada, and Italy.

"Base case" values for the DEERs of the major industrial countries in 1970 are reported in Table 2. 2/ They were generated on the assumption that the targeted current account surplus for each country was equal to 1 percent of GDP in 1971. This has been adopted as a relatively neutral assumption that is useful for illustrating how the DEER approach can be used. A 1 percent surplus was chosen both because it is close to the actual surplus of the major industrial countries as a group in 1971 and because it was the approximate stated objective of the U.S. Administration during the

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1/ The methodology used here is similar in some respects to that described in Artus and Rhomberg (1973). Their approach, which is also comparative static, involves the use of a highly disaggregated model of traded and nontraded goods. There are supply and demand equations for a number of traded goods and demand equations for nontraded goods. Where this approach differs from that used in this section in that the response of trade flows reflects both supply and demand responses to exchange rate changes. Both approaches are partial equilibrium in that they do not include induced effects on domestic output arising from exchange rate changes and the interaction between trade flows, net foreign assets, and net interest payments. These macroeconomic effects are taken into account in the MULTIMOD simulation results reported in Section IV.

2/ No attempt is made to reproduce the calculations of appropriate exchange rates made at the time of the Smithsonian Agreement by the IMF and OECD, which used a set of desired adjustments in the current account which were different from the uniform 1 percent surplus assumed here. Rather, as noted above, the objective here is to illustrate the potential use of DEER calculations.

Smithsonian discussions. 1/ The reason for using 1971 current accounts with 1970 exchange rates is that exchange rates affect the current account with a lag. Although there is some uncertainty as to the length of these lags, one year appears to be a reasonable estimate. Results from using a two-year lag (i.e., using 1972 current account positions with 1970 exchange rates) are also reported as one of the variations on the "base case."

Table 2 shows the DEERs implied by these assumptions for the major industrial countries, measured both on a real bilateral basis against the dollar (using 1970 prices) and as real effective rates (1970 parities = 100). Compared to the 1970 Bretton Woods parities, the DEER calculations imply that a significant real appreciation against the dollar was necessary for the five major currencies which were participating in the Bretton Woods fixed exchange rate system, reflecting the weakness of the balance of payments in the United States. The magnitude of the implied changes in bilateral rates is relatively large, between 13 and 22 percent for the four European currencies and 30 percent for the yen. The one currency which was floating over this period, the Canadian dollar, was almost exactly at its calculated bilateral DEER against the U.S. dollar. Given the relatively stylized nature of these calculations, these calculated values should not be viewed as precise estimates of the actual underlying equilibrium exchange rate values. As will be shown below, they are sensitive to many of the underlying assumptions in the model. Rather, they illustrate how one could use the DEER approach to calculate such exchange rate values.

The real effective exchange rate DEER calculations highlight some interesting implications from the real bilateral rates. For the U.S. dollar, achieving a current account surplus equal to one percent of GDP is estimated to require a devaluation in real effective terms on the order of 12 percent. 2/ Despite their large calculated bilateral misalignments against the dollar, the deutsche mark and sterling were relatively close to their calculated DEERs on a real effective exchange rate basis, while in case of the French franc and lira an effective real appreciation of only 6-8 percent is needed. This reflects both the fact that intra-European real bilateral exchange rates were quite close to their estimated DEERs and the importance of these intra-European exchange rates for the real effective exchange rate calculations. By contrast, the importance of the United States in Japanese trade can be seen in the 25 percent real effective appreciation required to move the yen to its calculated DEER. In effective

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1/ In 1971 the United States ran a current account deficit of just over 0.1 percent of GDP. The goal of the United States was a turnaround of some $13 billion (about 1.2 percent of GDP) in the current account, which implies a target surplus of about 1 percent of GDP. It should be noted that the IMF staff does not regularly compute the type of desired current account positions that are referred to in this paper; the current account positions here are used for illustrative purposes only.

2/ The importance of Canada in U.S. trade can be seen from the fact that the bilateral misalignments against all currencies except the Canadian dollar were over 17 percent.

terms, therefore, these DEER calculations suggest that the misalignments in 1970 mainly involved the United States and Japan. These contrasts between the bilateral and multilateral measures of real exchange rates illustrate the potential importance of third-country effects in the exchange rate calculations, and underlines the importance of making the computations on a multilateral basis.

These base case calculations can be compared with parities agreed at the Smithsonian meeting in December 1971 and maintained through February 1973 (except for the pound sterling, which was floated in mid-1972), which are also reported in Table 2. 1/ In order to convert these 1972 nominal bilateral parities into their real 1970 equivalents, the parities reported in Table 2 have been adjusted for differences in inflation between 1970 and 1972. 2/ 3/

Compared to the 1970 parities, the Smithsonian parities generally moved the bilateral real exchange rates against the dollar towards their estimated bilateral DEERs. Between half and two-thirds of the gap between the 1970 parities and calculated bilateral exchange rates was closed in the case of the franc, lira and yen. For the deutsche mark and pound sterling the new parities actually overshot the estimated real bilateral DEERs. The Canadian dollar, which was floating, moved away from its estimated real bilateral DEER over the period. The implied adjustments in effective exchange rates are also shown. In effective exchange rate terms, both the U.S. dollar and the yen moved between half and three-quarters of the way towards their estimated 1970 DEERs. By contrast, the appreciation of the deutsche mark and pound sterling resulting from the Smithsonian Agreement moved their real effective rates significantly further from their estimated DEERs, while there were more modest deviations for the French franc and lira. Hence, on these calculations, the overall impact of the Smithsonian parities was to move the U.S. dollar and the yen toward their estimated DEERs, but in Europe to move currencies away from their calculated DEERs.

Thus far, the analysis has focused upon the set of assumptions in the base case. Table 3 shows the DEERs resulting from using alternative assumptions about the targeted external balance position, trade elasticities, and deviations from potential output in order to get a sense for the range of plausible results involved in such calculations. The first

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1/ Since the Canadian dollar was floating throughout this period, the average market rate was used as the "parity" in both 1970 and 1972.

2/ The nominal parities against the dollar agreed at the Smithsonian meeting were 308 yen, 3.22 DM, 5.12 French francs, 582 lira, and 0.384 pounds sterling.

3/ Inflation was higher in Europe and Japan than in the United States over this period, hence the reported bilateral exchange rates for the yen and European currencies are lower than the actual Smithsonian parities (the opposite is true for the Canadian dollar). The largest adjustment is for the United Kingdom, whose GDP deflator rose by 7 percent more than that in the United States over the period.

set of alternative results show the impact of the economic cycle on the calculations; it reports the estimated DEERs when no account is taken of deviations of output from potential. The impact on the estimated DEERs is generally modest. However, when no adjustment is made for the cyclical position in the case of the French franc, the calculated DEER is roughly 11 percent lower than the DEER in the base case (a 5 percent depreciation instead of a 6 percent appreciation), while that for the pound sterling rises by over 7 percent relative to the base case. These examples illustrate that a country's cyclical position can have a substantial impact on its calculated DEER.

The next set of results show the impact of targeting a surplus of 1 percent for the trade balance, rather than the current account. Unlike the current account, the trade balance excludes earnings on services, income from factors of production and transfers. While some of these external receipts and payments may reflect underlying trends, others include the impact of transient factors; for example, interest payments reflect not only the real return to capital but also expectations about future inflation. Moreover, net interest payments reflect the international investment position of a country and are not immediately affected by its real exchange rate. Hence, the trade balance can be seen as a useful alternative gauge of the underlying external position.

The DEERs calculated using the trade balance as the targeted external position differ significantly in several cases from those using the current account. 1/ On an effective exchange rate basis the estimated DEER rises by 11 percent for the yen, 20 percent for the Canadian dollar, and 8 percent for the deutsche mark relative to the base case, while falling by over 15 percent for the lira and pound sterling, reflecting the large trade surpluses in Japan, Germany and Canada, and the relatively weak trade positions of Italy and the United Kingdom. These results also change the interpretation of the Smithsonian parities somewhat, particularly as regards the European countries. On these calculations the Smithsonian parities implied a large overvaluation of the pound sterling and lira compared to their DEERs, while putting the deutsche mark about in line with its estimated DEER.

The next column shows the impact of changing the lag between the exchange rate and the current account from 1 year to 2 years; this involves calculating the DEERs implied by using 1972 current accounts and deviations from potential output, rather than 1971 values. 2/ The DEERs using the 1972 data are generally similar to those in the base case, the largest

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1/ It should be noted that these calculations were made in the same way as in the base case, the only difference being the magnitude of the external balance objective.

2/ The aggregate external position of the major industrial countries deteriorated by around half a percent of GDP between 1971 and 1972. Accordingly, the current account target was lowered from 1 percent of GDP to 1/2 percent for each country in the calculations.

change being depreciations of over 8 percent for the DEER of the pound sterling and Canadian dollar, which reflects a deterioration in the current account of the United Kingdom and Canada from 1971 to 1972. More modest depreciations in the estimated DEERs occur for the lira and French franc, counterbalanced by appreciations of the U.S. dollar, yen, and deutsche mark compared with the base case.

The next two columns illustrate the impact on the estimated DEERs from changing the assumed values of the price elasticities for imports and exports. Raising the export price elasticities from 0.71 to unity (these elasticities are constrained to be equal across all countries in MULTIMOD) produces an across-the-board reduction in the size of the implied exchange rates required to reach the assumed current account positions. This reflects the fact that increasing the real exchange rate elasticities in the import equations makes the current account more sensitive to changes in the exchange rate, and hence smaller exchange rate changes are required to achieve a specific current account value. These results are somewhat closer to those implied by the Smithsonian parities, particularly for the U.S. dollar and the yen. Hence, one possible interpretation of the Smithsonian parities is that they reflected a relatively optimistic set of assumptions about the underlying price elasticities of trade.

The second experiment involves making all of the import price elasticities (whose estimated values vary across countries in MULTIMOD) equal to 0.75, the approximate mean of the estimated values. This significantly increases the exchange rate adjustment required to move to the DEER for the U.S. dollar, where the estimated import price elasticity is relatively large, and lowers the adjustment in Italy, the United Kingdom and Canada, where the import elasticities are relatively small. Clearly, the estimated trade elasticities have a significant impact on the estimated DEERs.

The results from Table 3 indicate that changes in the underlying assumptions can have a significant impact on estimated DEERs, with the range between the highest and lowest estimates of the DEER in effective terms lying between 10 and 30 percent. This wide range underlines the need for caution in identifying any given set of exchange rates as "the" appropriate set of values. Nevertheless, all of the calculations imply that the U.S. dollar was overvalued and the yen undervalued at their 1970 parities, with the effective exchange rate for the dollar implied by the Smithsonian parities within the estimated range of DEERs, while that for the yen lies slightly below the lowest estimate of the DEER. The calculations also generally indicate that the effective appreciation of the deutsche mark and pound sterling implied by the Smithsonian parities moved these currencies away from their DEERs. However, this reflects the underlying assumption in these calculations that an appropriate objective for all the major industrial countries would be to run the same current account (or trade balance) as a ratio to GDP.

III. A Dynamic DEER: Taking Account of the Path Toward Equilibrium 1/

1. Hysteresis in the DEER

As discussed in the previous section, the comparative static approach does not incorporate adjustments in the DEER that may be needed to take account of changes in the stock of international debt, and therefore in debt service, as long as the current account is not at the desired level. To take this dynamic behavior into account, the DEER needs to be computed as a trajectory, as the equilibrium exchange rate will not be independent of the path of the exchange rate towards its ultimate sustainable value. 2/

It is easy to see from Figure 1 how hysteresis in the DEER can arise. Suppose that the actual exchange rate happens to correspond initially to its DEER value and that internal balance is at the desired level--in other words, that there is no problem of the starting point or transition period. In terms of the figure, we are at (Y*, R*). Now suppose that in the next period there is a misalignment, i.e., the actual real exchange rate departs from its DEER value--specifically that it appreciates--while output remains at Y*. The appreciation causes the current account to deteriorate relative to the initial equilibrium position, which in this section is assumed to be zero, and as a consequence the DEER calculation must be performed afresh because net foreign indebtedness rises as a result of the deficit and creates an obligation to service the higher debt. Even disregarding any desire to eliminate the increase in indebtedness, the obligation to service more debt causes the CA schedule to move to the left; the real exchange rate which would have been consistent with the current account target in the absence of the increased debt service will now produce a deficit due to the increased debt-service obligation. More precisely, the trade account target has changed to provide a surplus sufficient to cover the increased debt service obligation. The current account target remains the same as it includes debt service, but its composition has changed, forcing CA to shift down and to the left.

The departure of the actual exchange rate from its DEER value (trajectory) thus forces a revision of the DEER. A "hysteresis loop" (Cross, 1992) would ensue if the previous DEER were to be re-established. The exchange rate would need to "overdepreciate" in order to reinstate the previous schedule. As shown in Figure 2, a displacement of the actual real rate of exchange from its DEER value--say, to point A--involves a real appreciation and a current account deficit relative to the current account balance underlying CA. This requires a shift of the CA schedule to CA', and a devaluation of the DEER from R* to R*'. Alternatively, if it were desired to reduce the stock of debt to the original level and for the DEER to be re-

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1/ This section draws on a more extensive treatment of this issue given in Artis and Taylor (1993).

2/ The need to take account of the path of the exchange rate towards its equilibrium value has been emphasized by Wren-Lewis (1992). See also Branson (1979).

established at R*, an overdepreciation would be needed, resulting in the "hysteresis loop" shown.

How large a revision of the DEER is required as a result of a misalignment? To derive an answer to this question, imagine again that starting from a position where the current real exchange rate is at its DEER value and internal balance is realized, the current exchange rate departs from its DEER value by, say, x percent. For concreteness, suppose this is an appreciation. Then a deficit in the current account will appear of $x(\mu+\tau)X$ where μ and τ are, the import and export elasticities, respectively, and X is the volume of exports (and imports--we suppose the two to be approximately equal). If this is a one-off deviation of "one-year" duration, then the DEER will have to be devalued to the extent necessary to service the additional debt incurred. It is convenient to assume that the DEER adjustment depends on the same elasticities. 1/ While the adjustment needs only to be large enough to service the interest cost of the extra debt incurred, it is easy to see that, if the interest rate is r, the adjustment required is $\delta = rx$. (The DEER devaluation, δ, must yield $rx(\mu+\tau)X$ to cover the debt service, or $\delta(\mu+\tau)X = rx(\mu+\tau)X$.) If the deviation is sustained for two "years," the total adjustment required will be twice as large. Thus, each initial x percent deviation of the actual from the desired equilibrium exchange rate will require a DEER adjustment of rx percent in the opposite direction if DEERs are adjusted annually.

This adjustment makes no allowance for the need to reverse the increment in debt acquired through the initial assumed appreciation of the current exchange rate over its DEER value. The reason for this is that the DEER external balance criterion is typically in terms of a flow equilibrium involving a change in net foreign assets rather than a particular stock of net foreign assets scaled, for example, by GDP. However, from a longer-term wealth accumulation perspective, the stock of net foreign assets may well be the appropriate target in terms of private sector behavior. In this case, a shock that causes a departure from the initial desired stock equilibrium condition might be expected to lead to a response calculated to offset it. In this case every x percent appreciation of the actual rate over its DEER value would require a subsequent reduction in the exchange rate large enough to pay back the debt over a defined period of time. The size of hysteresis effects will clearly be potentially much larger if the DEER adjustment needs to be of sufficient magnitude to repay the debt incurred, rather than simply to service the additional interest obligation. In what follows, however, we calculate DEER adjustments sufficient to cover only the cost of the additional interest payments arising from misalignment. This case is clearly the more conservative one to take and sets a natural "lower bound" to the size of the hysteresis problem. This simplifies the analysis and we thereby avoid having to specify--quite arbitrarily--the speed with which debt repayments were to occur. Finally, as in Section II, this is a partial

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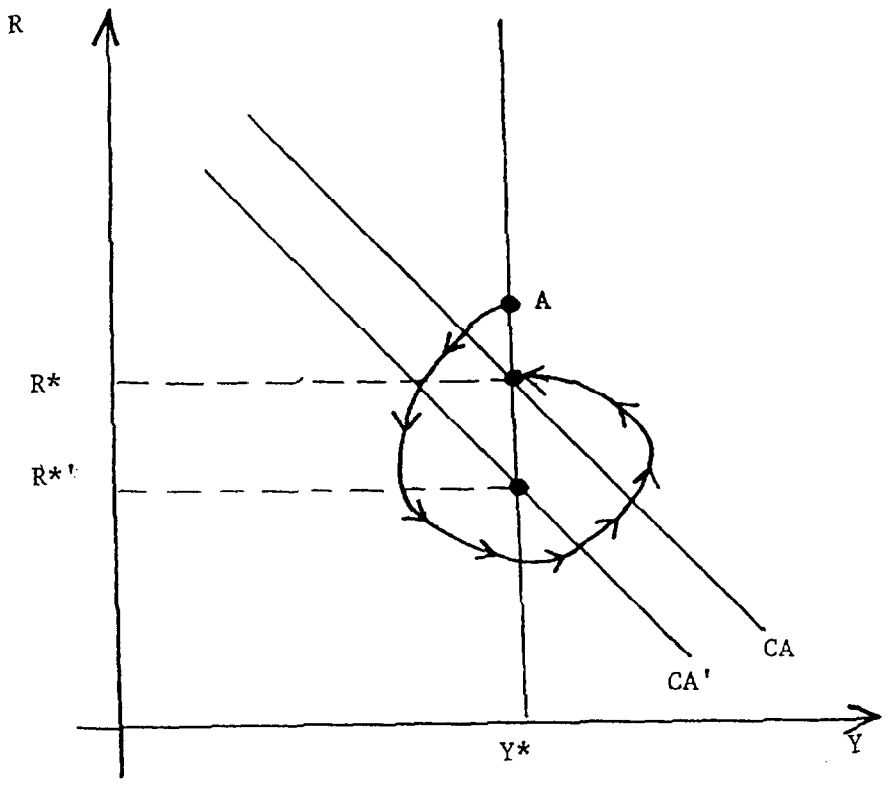
1/ It might be objected that the short-run elasticities differ from the medium-run elasticities used in constructing the DEER. A further adjustment could be made for any such differences.

Figure 2: Hysteresis Effects



equilibrium analysis and abstracts from the issue of the source of the exchange rate change. Therefore, real output and interest rates are assumed to be independent of the exchange rate change. However, as shown in Section IV, the source of the exchange rate change can influence these variables and might alter the hysteresis calculations.

We now proceed to derive a formula for the DEER adjustment process that expresses formally the hysteresis effect--the dependence of the DEER on the path of the actual exchange rate. Suppose that initially, in year 0, the actual real exchange rate is at its DEER value, which has a flat (stationary) trajectory at that point in time. Internal balance is assumed to be maintained at its given level throughout. Then any deviation of the actual rate from the DEER value implies a deviation from current account balance and requires a recomputation of the DEER on the lines indicated above.

Approximately, then:

$$R_n^* = R_{n-1}^* - r(R_{n-1} - R_{n-1}^*) \tag{3}$$

or

$$R_n^* = (1 + r)R_{n-1}^* - rR_{n-1} \tag{4}$$

where R_n^* is the logarithmic value of the DEER in year n, R_n is the logarithm of the actual real exchange rate in year n, and r is the rate of interest.

Equation (4) implies that

$$R_{n-1}^* = (1 + r)R_{n-2}^* - rR_{n-2} \tag{5}$$

$$R_{n-2}^* = (1 + r)R_{n-3}^* - rR_{n-3} \tag{6}$$

Recursive substitution (of (6) and (5) into (4) etc.,) yields

$$R_n^* = (1+r)^n R_0^* - r\sum_{i=1}^{n} (1 + r)^{i-1} R_{n-i} \tag{7}$$

Equation (7) shows how the initial stationary trajectory for R*, R_0^*, will require updating in the light of the evolution of the actual real

exchange rate. Thus, the DEER is not independent of the history of exchange rate movements. In particular, if the authorities wished to move the current exchange rate to the DEER at the end of n periods, they would need to choose a path for the real exchange rate (R_1, R_2... R_n) such that $R_n = R_n^*$, with R_n^* as defined in (7). Thus, given a deviation of the actual rate from the DEER and a desire ultimately to equate the two, the DEER arrived at when the actual rate again coincides with it will not be independent of the path taken by the exchange rate towards this goal. Indeed, as equation (3) makes clear, if R deviates from R*, R* will actually move away from R at speed r per period. Intuitively, therefore, we should expect that the eventual convergence of R* and R would require a movement of R towards R* at a speed greater than r in the following period. As demonstrated formally in Artis and Taylor (1993), this intuition turns out to be correct.

2. Converging on the DEER: rules of thumb

In light of the hysteresis effects involved in calculating the DEER, the following question naturally arises: given an initial misalignment of the exchange rate and a desire to correct the misalignment over a certain finite period, by how much does the required movement in the exchange rate differ from the initial misalignment? For example, suppose that the exchange rate is undervalued according to its value relative to the DEER, and that it is desired to correct this over a period of, say, five years. Assuming that the desired adjustment is uniform (e.g., a constant percentage annual appreciation), then, by our arguments, the DEER at the end of the fifth year, when the misalignment is zero, will be higher than the initial calculated DEER. Thus, the total required movement in the exchange rate will be greater than the initial difference between the exchange rate and the DEER. The additional movement in the exchange rate over the five-year period (over the initial misalignment measure) is thus, in some sense, a measure of the importance of hysteresis effects arising during misalignment.

If the rate of capacity utilization is held constant at 100 percent, then the overall movement in the DEER will be equal to the cumulative misalignment each period multiplied by the interest rate. Table 4 gives some illustrative examples of movements in the DEER, assuming an interest rate of 5 percent, initial undervaluation or overvaluation of 10 or 20 percent, and a constant annual percentage change in the exchange rate over a five-year convergence period. These trajectories are essentially found by fine-tuning the annual percentage change in the exchange rate to find $R_5 = R_5^*$ with R_n^* as given in (7), for given R_0^* and R_0. 1/

The results of this exercise are reported in Table 4. These show that the effect of a changing net asset stock due to misalignment is to increase the total amount of the required exchange rate adjustment by some

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1/ In fact, the precise calculations were slightly different because we used percentage differences rather than logarithmic differences. A spread sheet program was used to perform the calculations.

Table 4. Movements in the DEER: Five-Year Convergence 1/

a. Initial 10 percent overevaluation

Year	0	1	2	3	4	5
Exchange Rate	100.00	97.61	95.27	92.99	90.70	88.60
DEER	90.00	89.55	89.18	88.90	88.70	88.60
Misalignment (Percent)	+10.00	+8.26	+6.40	+4.41	+2.28	+0.00

Annual exchange rate movement = -2.39 percent
Overall movement in the DEER = -1.56 percent
Overall movement in the exchange rate = -11.40 percent
Difference between initial misalignment and overall exchange rate movement = 1.4 percentage points

b. Initial 10 percent undervaluation

Year	0	1	2	3	4	5
Exchange Rate	100.00	102.24	104.52	106.86	109.25	111.70
DEER	110.00	110.55	111.00	111.34	11.58	111.70
Misalignment (Percent)	-10.00	-8.13	-6.20	-4.19	-2.13	0.00

Annual exchange rate movement = +2.24 percent
Overall movement in the DEER = +1.54 percent
Overall movement in the exchange rate = +11.70 percent
Difference between initial misalignment and overall exchange rate movement = 1.7 percentage points

c. Initial 20 percent overvaluation

Year	0	1	2	3	4	5
Exchange Rate	100.00	95.03	90.30	85.81	81.55	77.49
DEER	80.00	79.20	78.54	78.03	77.67	77.49
Misalignment (Percent)	+20.00	+16.66	+13.03	+9.07	+4.75	0.00

Annual exchange rate movement = -4.97 percent
Overall movement in the DEER = -3.14 percent
Overall movement in the exchange rate = -22.51 percent
Difference between initial misalignment and overall exchange rate movement = 2.51 percentage points

d. Initial 20 percent undervaluation

Year	0	1	2	3	4	5
Exchange Rate	100.00	104.34	108.87	113.60	118.54	123.68
DEER	120.00	121.20	122.18	122.93	123.43	123.68
Misalignment (Percent)	-20.00	-16.16	-12.22	-8.21	-4.13	0.00

Annual exchange rate movement = +4.34 percent
Overall movement in the DEER = +3.07 percent
Overall movement in the exchange rate = +23.68 percent
Difference between initial misalignment and overall exchange rate movement = 3.68 percentage points

1/ We assume a constant, 100 percent rate of capacity utilization, and an interest rate of 5 percent per annum.

1.5 percentage points for an initial 10 percent misalignment, and by 3 percentage points for an initial 20 percent misalignment. Note that the revision due to debt accumulation or decumulation is greater in the case of undervaluation, since the initial exchange rate on which the percentage is calculated is at a depressed level.

As a very rough rule of thumb, therefore, for economies operating near full capacity utilization, the results of this section suggest that the initial measure of misalignment should be increased by about 1.5 percentage points for each 10 percent of misalignment if the desired period of convergence is five years. Thus, an initial misalignment of 10 percent would suggest a required exchange rate movement of about 11 1/2 percent over five years.

IV. Dynamic Macroeconomic Calculations of DEERs using MULTIMOD

In this section of the paper we use MULTIMOD to calculate the change in the real effective exchange rate needed to achieve the desired change in the external position of the major industrial countries. The first objective is to obtain results that are as closely comparable as possible to those derived in Section II above that uses a simple comparative static approach. The aim is to see what difference it makes to the calculated change in the real effective exchange rate using a full model simulation, as well as to obtain an estimate of the likely domestic economic effects of the change in the external balance. It is demonstrated that the manner in which the exchange rate is changed affects the whole macroeconomic system, including real output and the real exchange rate. In particular, the two types of shocks considered here (changes in currency preferences and fiscal policy) have different implications for medium-term real output and interest rates and ultimately the DEER. The same "base case" regarding the external position is used as in Section II; namely, it is assumed that the desired level of the current account is 1 percent of GDP in all countries. However, to make the results from the two methods as comparable as possible, no allowance is made initially for moving the economies to potential output in the MULTIMOD simulations. Thus, the comparable calculation of the DEER in Table 3 is that identified as "No Adjustment for Cyclical Factors."

It should be pointed out that the simulations using MULTIMOD involved shocking the model away from its baseline values in order to achieve the change in the real effective exchange rate consistent with attaining the desired current account position. As the historical baseline values of GDP used in the MULTIMOD simulations do not involve a return of real output to its potential level, the deviation of the variables from the baseline reported below do not capture the effects of the movement of actual output to potential. To estimate these effects on the DEER, it is necessary to undertake a specific simulation in which potential output is raised relative to actual output in those countries where there is an output gap. The results of this simulation are reported at the end of this section.

As noted above, the base case involves achieving current account surpluses equal to 1 percent of GDP. However, the calculations using MULTIMOD involved changing the trade balance by the same magnitude as the current account in the base case considered in Section II. The reason for this modification is that in the simplified approach in Section II only changes in trade flows are taken into account as no allowance is made for the impact of changes in interest rates and in the net foreign asset position on net debt-service flows, and therefore what is reported in Section II as a change in the current account is in fact restricted to trade flows only. This modification has been implemented in the simulations using MULTIMOD by aiming at a change in the trade balance/GDP ratio equal to the difference between the current account/GDP ratio in 1971 (reported in Table 1 above) and 1 percent.

1. DEERs resulting from a change in currency preferences

The exchange rate changes required to achieve this particular set of trade balance objectives were first implemented by introducing changes in currency preferences in the equations determining exchange rates in MULTIMOD. Thus, for the countries that had a current account deficit or a surplus less than 1 percent of GDP in 1971, asset preferences are assumed to shift away from the currencies of these countries and in favor of the currencies of the countries which had a surplus larger than 1 percent. Such shifts in currency preference can be viewed as a market response to the external imbalances that have been identified as illustrative examples. These currency preference shifts are designed to correct the imbalances and are exogenously imposed on the model, i.e., they are not policy instruments. More specifically, these changes in currency preferences are implemented in the uncovered interest parity equations that are the proximate determinants of bilateral exchange rates in MULTIMOD. Such a modified equation in general form is given below.

$$E_i = E_{i,t+1} + r_i - r_{us} + CP_i - CP_{us} \qquad (8)$$

where:

E_i = U.S. dollars per currency i (nominal exchange rate)

r_i = short-term interest rate in currency i

r_{us} = U.S. short-term interest rate

CP_i = currency preference shift variable in favor of currency i

CP_{us} = currency preference shift variable in favor of the U.S. dollar.

In terms of equation (8), the exchange rate needed to realize a particular external balance objective is achieved by varying the currency preference shift variables. For example, in the case of Japan and the

United States, the reduction in the Japanese surplus and in U.S. deficit is achieved in part by adjusting the shift variables in favor of the Japanese yen and against the U.S. dollar by an amount sufficient to attain the needed changes in the bilateral exchange rate of the dollar against the yen. Comparable adjustments are made in the equations for the other bilateral dollar exchange rates for the other major industrial countries. In all these simulations, nominal monetary targets remain unchanged and all exchange rates are fully flexible. Given the considerable number of dynamic interactions in MULTIMOD, considerable experimentation is needed to find the set of currency preference shifts required to achieve bilateral and real effective exchange rate changes that will be consistent with the targeted or desired external balance positions. The currency shift parameters are introduced in 1971, and then varied somewhat over time to reach the desired change in the trade balance. The specific adjustment of currency preferences is somewhat arbitrary. In general, the average preference shift is 150 basis points for every 1 percent deviation in the trade balance as a percent of GDP from its desired target, and it cumulates over time as long as the deviation persists.

As noted above, a major difference between the comparative static approach and that described in this section is that here the domestic economic effects of exchange rate changes are taken into account in calculating the changes needed to attain any given external balance objective. Moreover, the lags in the effect of exchange rate changes on the external sector, and through this sector on the domestic economy, are incorporated in the MULTIMOD simulations. In order to allow for these lags, the results reported in Table 5 are for the values of the indicated variables in 1975. For most countries it takes roughly five years for the lags to work themselves out. This makes these results comparable to Section II where long-run elasticities were used. Moreover, a five-year adjustment period is consistent with the medium-term notion of a DEER. 1/ However, because the dynamic adjustment path is also of interest, the simulation results for one country--the United States--are also included for each year 1971-77. These are shown in Table 5A.

In looking at the results in Table 5, it is important first to take account of the domestic economic effects of the shifts in currency preferences that are assumed to bring about the exchange rate changes. In particular, equation (8) shows that shifts in currency preferences will have an impact not only on exchange rates but also on short-term interest rates in order for the uncovered interest parity condition to hold; thus, a depreciation is generally reflected in a rise in the real interest rate, and an appreciation a fall, as shown in line 6 of Table 5. Therefore for those countries in which a positive change in the trade balance is needed, the

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1/ Although the dynamics of trade equations indicate an adjustment period on the order of five years, it takes significantly longer for MULTIMOD to converge to a steady state. In some cases, the figures reported below represent an overshooting of the target, while for other countries the external balance targets have not yet been achieved after five years.

Table 5. Calculation of DEERs using MULTIMOD: Targeted Trade Balances with Changes in Currency Preferences 1/

	United States	Japan	Germany	United Kingdom	France	Italy	Canada
1. Trade balance/GDP	1.0	-1.7	0.6	-1.1	0.8	-1.1	0.5
2. Current account/GDP	1.4	-2.5	1.2	-1.6	1.0	-2.9	-0.3
3. GDP	-0.8	1.8	-0.4	0.5	-0.5	1.1	-0.3
4. Domestic absorption	-2.5	4.6	-1.3	2.8	-1.7	3.6	-0.7
5. Foreign absorption	0.2	-1.2	0.2	-0.4	0.3	-0.5	-1.7
6. Real long-term interest rate 2/	0.7	-1.7	0.5	-1.0	0.6	-0.6	0.5
7. PX/PFM 3/	-12.3	16.6	-1.3	6.9	-2.8	9.8	-3.9
8. PGDP/PM 4/	-13.5	28.0	-2.1	9.1	-4.3	14.5	-0.4
9. Nominal effective exchange rate	-17.5	36.0	-3.4	10.9	-6.1	17.4	-2.0

1/ Deviation from baseline in 1975 in percent, unless otherwise indicated.
2/ In percentage points.
3/ Export price/competitors' prices in foreign markets.
4/ GDP deflator/import deflator.

Table 5A. Calculation of U.S. DEER using MULTIMOD: Targeted Trade Balances with Changes in Currency Preferences 1/

	1971	1972	1973	1974	1975	1976	1977
1. Trade balance/GDP	0.0	0.7	1.0	1.1	1.0	1.0	1.0
2. Current account/GDP	0.0	0.8	1.2	1.4	1.4	1.4	1.4
3. GDP	0.1	0.0	-0.4	-0.8	-0.8	-0.8	-0.6
4. Domestic absorption	-0.6	-1.4	-2.0	-2.4	-2.5	-2.5	-2.5
5. Foreign absorption	0.0	0.2	0.4	0.5	0.2	0.3	0.2
6. Real long-term interest rate 2/	1.0	1.2	1.2	0.9	0.7	0.5	0.4
7. PX/PFM 3/	-11.7	-11.3	-11.5	-11.9	-12.3	-12.5	-12.4
8. PGDP/PM 4/	-13.2	-12.6	-12.6	-13.0	-13.5	-13.9	-13.8
9. Nominal effective exchange rate	-16.8	-16.6	-16.8	-17.2	-17.5	-17.5	-17.2

1/ Deviation from baseline in percent, unless otherwise indicated.
2/ In percentage points.
3/ Export price/competitors' prices in foreign markets.
4/ GDP deflator/import deflator.

real interest rate rises, whereas is those countries--Japan, Italy, and the United Kingdom--where a reduction in the trade balance is targeted, there is a decline in the real interest rate. The positive interest rate changes work in the same direction as changes in the real exchange rate since they reduce domestic absorption and thus improve the trade balance. Of course, this effect can be offset by similar changes in domestic absorption in the country's trading partners.

The simulated changes in the trade balance in 1975, expressed as a percent of baseline GDP in line 1 of Table 5, are not exactly the same in all cases as the targeted changes, which are equal to the difference between the actual current account/GDP ratio in 1971 (shown in Table 1) and 1 percent. 1/ The reason for these discrepancies is that given the lags in the trade and other variables in a macro model, it is difficult to hit simultaneously the targeted trade balances for all the industrial countries in any given year with a shift in currency preferences. For example, in Italy the trade balance as a percent of GDP in 1975 declines relative to baseline by 1.1 percent of GDP, compared to the targeted fall of 0.7 percent. This overshooting in the adjustment in the trade balance disappears in the long run, i.e., after 20 years when the fall in the trade balance settles is 0.7 percent. Again, the United States achieves a 1.0 percent increase in the trade balance instead of the targeted 1.1 percent in 1975. Table 5A shows that there is a considerable lag--four years--before the targeted change is achieved.

Turning now to the DEERs calculated using MULTIMOD, Table 5 reports two different measures of the real effective exchange rate: the price of a country's exports relative to the prices of competing goods in foreign markets (line 7), which is used in MULTIMOD's export behavioral equation, and the price of domestic output relative to the price of imports (line 8), which is used in the import behavioral equation. 2/ These figures can be compared with the DEERs reported in the relevant column in Table 3 ("No Adjustment for Cyclical Factors") where only one real exchange rate measure is used. In the case of Germany, France, and the United Kingdom, the differences are quite small. In the case of Japan, the two DEERs from MULTIMOD bracket those calculated using the comparative static analysis described in Section II. The same is true for Italy, but in this case it is

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1/ These targeted changes in the trade balances in percent of GDP are: United States (1.13), Japan (-1.49), Germany (0.55), United Kingdom (-0.89), France (0.92), Italy (-0.72), and Canada (0.62).

2/ In general, the change in the former in less than the change in the latter. This reflects the fact that the export prices for one country are influenced by the export prices of competing countries in the short-to-medium run, whereas import and GDP deflators are less closely connected. Thus in MULTIMOD Japanese export prices are estimated to be much more closely tied to competitor's prices than U.S. export prices, and therefore, the real effective exchange rate change rising relative export prices is much smaller than using PGDP/PM in Japan, as compared with the United States.

necessary to take account of the fact that the simulated change in the trade balance--a reduction equal to 1.1 percent of GDP--is considerably larger than the targeted change of -0.72 percent, which is the basis for the calculated DEER using the comparative static approach. If one were to make a crude adjustment for this difference by scaling down the calculated real effective exchange rate changes for Italy reported in Table 5, these changes (6.4 percent and 9.3 percent, respectively) are less than the 10.9 percent appreciation calculated in Section II. These lower figures appear to reflect the fact that the rise in GDP in Italy, which occurs in the MULTIMOD simulation but is absent from the comparative static estimate, means that a smaller exchange rate change is needed to achieve a given change in the trade balance. 1/

The case of the United States is interesting in that MULTIMOD DEERs are somewhat larger than the partial equilibrium estimate. One factor that could account for this difference is that much of U.S. trade is with developing countries, and the external financing constraint of developing countries that is a feature of MULTIMOD implies that there is little scope for their trade balance to change at the margin. Moreover, the high U.S. interest rate reduces inflows into these countries and raises their debt servicing costs, thereby reducing their imports. Therefore the United States needs a larger change in its real effective exchange rate against industrial countries to achieve a given trade balance objective.

By contrast, it is somewhat puzzling that in the case of Canada the calculated changes in the DEER are smaller than the comparative static estimate of a real effective depreciation of 5.3 percent. As foreign absorption declines by 1.7 percent and thereby adversely affects Canada's exports, one would have expected that the MULTIMOD calculations would have yielded a larger estimate of the depreciation of the Canadian dollar needed to achieve a given improvement in the trade balance. Two technical measurement factors appear to account for this anomaly. First, MULTIMOD allows for the fact that the shares of imports and exports in GDP increase over the period 1971 to 1975, whereas the comparative static estimates are based on shares at the beginning of the period; as a consequence the necessary exchange rate change is lower in MULTIMOD. Second, the estimates in Section II do not distinguish between import and export price elasticities. By contrast, the MULTIMOD calculations take account of differences in these elasticities and differences in export and import shares, which again results in a lower required exchange rate change.

1/ It should be noted that while the analysis in Section II does take some account of the effect of changes in absorption on trade flows, it does not include any induced changes in real output.

2. DEERs resulting from a change in fiscal policy

Table 6 is comparable to Table 5 in that the trade balance target is the same, but is achieved by means of changes in an alternative exogenous variable--specifically, changes in government spending--rather than changes in currency preferences. 1/ However, there are some differences between line 1 in Tables 6 and 5 because of the difficulties in achieving exactly the same trade balance in the two different experiments for each country. Bilateral exchange rates are still assumed to be fully flexible and determined by equation (8), but now the currency preference shift variables are set equal to zero. The changes in real government spending by 1975 needed to achieve the trade balance targets range from a decline of 6.2 percentage points of GDP in the United States to an increase of 6.4 percentage points in the United Kingdom. The effect on the domestic economy is quite different than that arising from currency preference shifts. The cut in government spending in those countries assumed to aim at an improved trade balance position (United States, Germany, France, and Canada) results in lower real interest rates and releases the resources needed for the improvement in the external position. Moreover, part of these resources are used to raise investment spending. Consequently, in these countries output rises in Table 6, whereas in Table 5 output falls. Partly as a result of this higher output, domestic absorption either does not fall as much relative to baseline as in Table 5, or in the case of Canada, it actually increases. However, the rise in output occurs only in the medium term as the fiscal consolidation crowds in domestic investment. Table 6A shows that in the case of the United States, the decline in real government spending reduces output below its baseline path in 1971 and 1972; only by 1973 does it rise above baseline.

For these four countries the required real exchange rate change brought about by fiscal policy is somewhat higher than in the case considered above where currency preferences shifted. This would appear to reflect the fact that the increase in output induced by the fiscal policy change results in a smaller decline in domestic absorption than in Table 5 without any offset in foreign absorption, thereby necessitating a larger depreciation to achieve the same trade balance objective. The same argument applies, but in the opposite direction to those countries (Japan, the United Kingdom, and Italy) that are assumed to alter fiscal policy to reduce their trade surpluses. The assumed increase in government spending in these countries lowers output by 1975 relative to the simulation described in Table 5, thereby moderating

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1/ Although there are several other exogenous variables that could have been used to attain the current account targets, two likely candidates were infeasible. Monetary policy could not be used since it is neutral in MULTIMOD after several years. Surprisingly, productivity changes could not be used to attain a current account target. An increase in potential output raises real income and lowers prices, and these have opposite effects on the trade balance. The net effect, which depends on several underlying parameters, was very small and therefore productivity shocks could not be used to achieve a given level of the current account.

Table 6. Calculation of DEERs using MULTIMOD: Targeted Trade Balances with Changes in Fiscal Policy Instead of Currency Preferences 1/

	United States	Japan	Germany	United Kingdom	France	Italy	Canada
1. Trade balance/GDP	1.0	-1.4	0.5	-1.0	0.8	-0.6	0.6
2. Current account/GDP	0.8	-2.1	1.0	-2.6	0.8	-1.4	2.4
3. GDP	1.8	0.2	0.9	-1.2	1.5	0.8	1.8
4. Domestic absorption	-0.1	2.9	-0.1	2.4	-0.3	3.4	1.3
5. Foreign absorption	1.1	0.4	1.0	0.6	1.1	0.5	0.2
6. Real long-term interest rate 2/	-2.2	-1.4	-1.6	0.8	-2.1	-1.0	-2.4
7. PX/PFM 3/	-14.3	18.7	-2.5	15.0	-6.0	12.5	-5.2
8. PGDP/PM 4/	-14.9	32.4	-3.1	20.6	-8.6	19.5	-1.1
9. Nominal effective exchange rate	-15.3	31.2	-3.0	11.9	-7.2	17.6	-1.4

1/ Deviation from baseline in 1975 in percent, unless otherwise indicated.
2/ In percentage points.
3/ Export price/competitors' prices in foreign markets.
4/ GDP deflator/import deflator.

Table 6A. Calculation of U.S. DEER using MULTIMOD: Targeted Trade Balance with Changes in Fiscal Policy Instead of Currency Preferences 1/

	1971	1972	1973	1974	1975	1976	1977
1. Trade balance/GDP	0.2	0.8	1.0	1.1	1.0	1.0	1.0
2. Current account/GDP	0.2	0.7	0.9	0.9	0.8	0.8	0.9
3. GDP	-2.4	-0.9	0.6	1.4	1.8	1.6	1.5
4. Domestic absorption	-3.4	-2.6	-1.3	-0.5	-0.1	-0.3	-0.4
5. Foreign absorption	-0.5	0.2	0.9	1.2	1.1	1.1	1.0
6. Real long-term interest rate 2/	-1.2	-2.0	-2.3	-2.4	-2.2	-1.9	-1.6
7. PX/PFM 3/	-13.2	-14.3	-15.0	-15.0	-14.3	-13.3	-12.7
8. PGDP/PM 4/	-15.0	-15.7	-16.0	-15.7	-14.9	-14.2	-13.7
9. Nominal effective exchange rate	-17.0	-17.1	-16.8	-16.3	-15.3	-14.4	-13.9

1/ Deviation from baseline in percent, unless otherwise indicated.
2/ In percentage points.
3/ Export price/competitors' prices in foreign markets.
4/ GDP deflator/import deflator.

the rise in absorption and increasing the magnitude of the appreciation needed to reduce the trade balance by the amount shown in line 1. In comparing the results of Tables 5 and 6 it is also interesting to note that the impact on the current account is quite different in a number of cases depending on whether a country is a net creditor or net debtor. These difference arises in part because in the scenario in Table 6 interest rates on dollar-denominated instruments are considerably lower (roughly 3 percentage points) than in the results reported in Table 5. As a result, the United States--a net creditor--experiences a much smaller improvement in its current account, whereas Canada--a net debtor--experiences a substantially greater improvement in its current account in Table 6 compared to Table 5.

3. Calculated DEERs with moving to potential output

As noted at the beginning of this section, the calculations of DEERs using MULTIMOD described above do not take account of departures of actual output from potential in 1971. In all the major industrial countries output was estimated to be below potential except for Germany and France, where output was estimated to be above potential, and in Italy, where output was equal to potential. We now take account of this discrepancy between actual and potential output in the calculation of the DEERs. In order to calculate the effect of moving to potential, we exogenously shifted productivity beginning in 1971 to open the gap between actual and potential output that was estimated to exist in that year. 1/ Between 1971 and 1975 the natural economic forces operating in the model are sufficient to close this gap by the end of the five-year period. For example, for countries below potential there is downward pressure on prices, interest rates, and the exchange rate that induces a rise in total spending that brings output back to potential. These endogenous effects are incorporated in the simulation results reported in Table 7. In addition, currency preference shift variables are also introduced in the same manner as in Table 5 to achieve the same trade balance objectives in line 2 of that table. Thus, the figures in Table 7 reflect the effects of a compound experiment that involves (1) moving the major industrial countries to potential output by 1975; and (2) achieving trade surpluses equal to 1 percent of GDP in 1975.

The effect of moving to potential output can be seen by comparing the results in Table 7 with those in Table 5. For those countries that had a output gap in 1971--the United States, Japan, the United Kingdom, and Canada--the comparison shows that, as one would expect, the deviation of output and domestic absorption from baseline is either positive or less negative as a result of moving to potential output. As a consequence, a larger real effective depreciation is needed to achieve a given improvement

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1/ An alternative method for making the calculation would have been to lower the baseline level of output by the amount of the gap. As MULTIMOD is fairly linear in the neighborhood of potential output, this alternative calculation would have yielded results similar to those reported in the text.

Table 7. Calculation of DEERs using MULTIMOD: Targeted Trade Balances and Achieving Potential Output with Changes in Currency Preferences 1/

	United States	Japan	Germany	United Kingdom	France	Italy	Canada
1. Trade balance/GDP	1.0	-1.7	0.6	-1.2	0.6	-1.0	0.6
2. Current account/GDP	1.3	-2.5	1.3	1.9	0.8	-2.9	--
3. GDP	0.8	2.5	-1.5	2.2	-4.3	0.8	1.0
4. Domestic absorption	-1.1	5.2	-2.1	3.4	-4.1	3.2	0.5
5. Foreign absorption	0.6	-0.6	0.1	-0.5	0.3	-0.9	-0.6
6. Real long-term interest rate 2/	0.5	-1.7	0.6	-1.2	0.8	-0.6	0.3
7. PX/PFM 3/	-14.2	16.5	0.2	1.2	4.1	9.8	-4.3
8. PGDP/PM 4/	-15.1	28.3	-0.5	1.1	5.4	13.9	-0.3
9. Nominal effective exchange rate	-18.9	35.6	-3.0	4.6	0.7	16.7	-2.0

1/ Deviation from baseline in 1975 in percent, unless otherwise indicated.
2/ In percentage points.
3/ Export price/competitors' prices in foreign markets.
4/ GDP deflator/import deflator.

Table 7A. Calculation of U.S. DEER using MULTIMOD: Targeted Trade Balance and Achieving Potential Output with Changes in Currency Preferences 1/

	1971	1972	1973	1974	1975	1976	1977
1. Trade balance/GDP	-0.1	0.7	1.0	1.1	1.0	1.0	1.0
2. Current account/GDP	-0.1	0.8	1.1	1.4	1.3	1.3	1.4
3. GDP	0.5	0.9	0.9	0.8	0.8	0.9	1.0
4. Domestic absorption	-0.4	-0.6	-0.9	-1.0	-1.1	-1.1	-1.0
5. Foreign absorption	0.0	0.4	0.6	0.8	0.6	0.6	0.6
6. Real long-term interest rate 2/	0.8	0.8	0.8	0.6	0.5	0.4	0.4
7. PX/PFM 3/	-13.7	-13.6	-13.8	-14.0	-14.2	-14.2	-14.0
8. PGDP/PM 4/	-15.1	-14.7	-14.6	-14.9	-15.1	-15.3	-15.2
9. Nominal effective exchange rate	-19.4	-19.0	-18.9	-19.0	-18.9	-18.7	-18.3

1/ Deviation from baseline in percent, unless otherwise indicated.
2/ In percentage points.
3/ Export price/competitors' prices in foreign markets.
4/ GDP deflator/import deflator.

in the trade balance in the case of the United States. In the case of Canada, the improvement in the trade balance can be achieved with roughly the same real depreciation on account of the fact that when the United States moves to potential output, this significantly increases the demand for Canadian exports and offsets the effect of higher output in Canada on its demand for imports. The appreciation of the yen is the same in both cases as the higher output and absorption, which would tend to reduce the needed appreciation, is counterbalanced by a smaller reduction in foreign absorption that would tend to result in higher demand for Japanese exports. In the case of the United Kingdom, the higher output and domestic absorption, combined with little difference in the change in foreign absorption between the two scenarios, means that the appreciation required to reduce the trade surplus by a given magnitude is reduced.

Looking now at France and Germany--the two countries above potential in 1971--the effect of moving output down to potential (i.e., removing the cyclical excess demand) is to put upward pressure on the exchange rate. In the case of France this causes a switch in the sign of the exchange rate change from a depreciation to an appreciation. This comes about from the fact that the decline in output and absorption is so large that an appreciation is needed to offset what would otherwise be an excessively sharp drop in import demand. 1/ The case of Germany is similar but the magnitude of the shift is much less sharp.

The MULTIMOD simulations of the effects of moving to potential output reported in Table 7 can be compared to the results in the "Base Case" in Table 3 that were obtained using the comparative static approach. After scaling the exchange rate changes in Table 7 by the ratio of the targeted change in the trade balance/GDP ratio to the actual trade balance/GDP ratio shown in Table 7, the calculated exchange rate changes are quite close for four countries (Germany, France, Italy, and the United Kingdom). The MULTIMOD calculations show a somewhat larger depreciation in the case of the United States, and a smaller depreciation in the case of Canada; the reasons for these differences from the results in Section II would appear to be those already discussed above in connection with Table 5. In the case of Japan, the calculated appreciation of the yen is smaller in the MULTIMOD simulation on account of the large increase in GDP, which means that a smaller appreciation is needed to achieve a given change in the trade balance compared with the comparative static approach, where output is exogenous. It is also noteworthy that the estimated impact on the real exchange rate of moving to potential output is quite similar using the two different methods, which can be seen by comparing Tables 7 and 5 for MULTIMOD and the "Base Case" to "No Adjustment for Cyclical Factors" in Table 3 for the comparative static method.

1/ The estimated excess of actual output over potential output in 1971 in France may well be too high. Nonetheless, this simulation result illustrates the importance of taking account of cyclical developments in calculating DEERs.

4. Current account vs. trade balance targets

Up to this point the analysis has focused on achieving a given change in the trade balance relative to GDP. This was done for two reasons: first, to compare the results directly with the calculations in Section II, and second, to avoid complications from interactions between the trade account and net interest payments arising directly as well as indirectly from valuation effects due to exchange rate changes. However, it is important to take these interactions into account, as was emphasized in Section III. Consequently a MULTIMOD simulation was run in which the objective was to achieve a change in the current account/GDP ratio as close as possible to that achieved for the trade balance/GDP ratio in Table 5.

The results of this simulation are reported in Table 8, where again the required exchange rate movements were brought about by changes in currency preferences. Because the impact of changes in the net foreign asset position on the current account are taken into account, and the effects on net interest payments go in the same direction as the trade balance, the required change in the real effective exchange rate is typically smaller than if the trade balance is targeted. A comparison of the results for exchange rate changes in Table 8 with those in Table 5 show that this is indeed the case for all countries except Canada, which is discussed below. Moreover, a comparison of Tables 8A and 5A shows that the magnitude of the real effective exchange rate change in the U.S. dollar to achieve a given improvement in the U.S. current account declines over time (relative to the change needed for the same improvement in the trade balance) on account of the change in net foreign assets.

The interaction between the net foreign asset position and the current account has been discussed in detail in Section III above. However, the analysis in that section considered the case where the initial real effective exchange rate differed from the initial estimate of the DEER, leading to a final adjustment of the DEER larger than the initial misalignment. Thus, that analysis dealt with an adjustment to the DEER to account for an initial misalignment. By contrast, the comparison of Tables 8 and 5 does not involve a misalignment; rather, the required change in the real effective exchange rate needed to achieve a change in the current account is smaller than that required to realize a change in the trade balance of the same magnitude because of the effects on debt service which have an impact on the current account but not on the trade balance.

However, the simulation results for Canada are counter to this general tendency; the Canadian dollar depreciates by a larger amount even though the change in the current account is only 0.4 percent, which is less than the 0.5 percent change in the trade balance actually achieved in Table 5 and the target change of 0.6 percent. The reason for this is that because Canada is a large net debtor, there are two factors operating to counteract the positive effect of the trade balance on the current account. First interest rates on U.S. dollar-denominated claims rise, and as it is assumed that the net foreign assets of all major industrial countries are denominated in U.S. dollars, this increases Canadian net interest payments

Table 8. Calculation of DEERs using MULTIMOD: Targeted Current Account Balances with Changes in Currency Preferences 1/

	United States	Japan	Germany	United Kingdom	France	Italy	Canada
1. Trade balance/GDP	0.7	-1.4	0.3	-0.9	0.5	-0.5	1.0
2. Current account/GDP	1.0	-1.5	0.6	-0.9	0.7	-1.1	0.4
3. GDP	-0.6	1.6	-0.3	0.4	-0.3	0.6	-0.6
4. Domestic absorption	-1.8	3.6	-0.6	2.1	-1.1	1.7	-1.7
5. Foreign absorption	-0.1	-0.9	-0.1	0.1	0.1	-0.4	-1.2
6. Real long-term interest rate 2/	0.7	-1.8	0.5	-1.2	0.6	-0.5	1.6
7. PX/PFM 3/	-8.4	12.1	-0.3	4.9	-1.6	4.4	-4.4
8. PGDP/PM 4/	-9.1	19.5	-0.7	6.2	-2.4	6.3	-2.4
9. Nominal effective exchange rate	-12.1	26.3	-1.7	8.5	-3.8	8.0	-5.5

1/ Deviation from baseline in 1975 in percent, unless otherwise indicated.
2/ In percentage points.
3/ Export price/competitors' prices in foreign markets.
4/ GDP deflator/import deflator.

Table 8A. Calculation of U.S. DEER using MULTIMOD: Targeted Current Account Balance with Changes in Currency Preferences 1/

	1971	1972	1973	1974	1975	1976	1977
1. Trade balance/GDP	0.0	0.5	0.7	0.8	0.7	0.6	0.7
2. Current account/GDP	0.0	0.6	0.9	1.0	1.0	0.9	1.0
3. GDP	0.1	0.0	-0.3	-0.6	-0.6	-0.6	-0.5
4. Domestic absorption	-0.5	-1.1	-1.5	-1.8	-1.8	-1.8	-1.7
5. Foreign absorption	-0.1	0.0	0.1	0.1	-0.1	-0.1	-0.1
6. Real long-term interest rate 2/	0.8	1.0	1.0	0.9	0.7	0.6	0.5
7. PX/PFM 3/	-0.9	-8.8	-8.6	-8.5	-8.4	-8.2	-7.8
8. PGDP/PM 4/	-10.5	-9.8	-9.3	-9.2	-9.1	-9.1	-8.8
9. Nominal effective exchange rate	-13.4	-13.0	-12.5	-12.3	-12.1	-11.8	-11.3

1/ Deviation from baseline in percent, unless otherwise indicated.
2/ In percentage points.
3/ Export price/competitors' prices in foreign markets.
4/ GDP deflator/import deflator.

in U.S. dollars. Second, as the targeted current account is measured in local currency, and as the Canadian dollar depreciates slightly against the U.S. dollar, there is a negative valuation effect that also adversely affects the flow of net interest payments. As a result of these two factors, a larger exchange rate change is needed to achieve the fairly substantial change in the trade balance required for the assumed improvement in the current account.

V. Concluding Remarks

As noted at the beginning of this paper, the focus of the analysis has been on methods for calculating exchange rates consistent with a desired position of internal and external balance. The basic approach taken here is that making an assessment of a country's exchange rate involves not only looking at the recent developments in a country's international competitive position and external accounts, but also requires taking a broader perspective by examining the extent to which a country's real effective exchange rate is also consistent with sustainable positions of internal balance. This broader approach has aimed at estimating what have been referred to in the literature as "equilibrium" or "fundamental equilibrium" exchange rates in a multilateral context in which all major industrial countries are at their desired positions of macroeconomic balance.

Attention has concentrated on illustrating the use of two different methods to compute such rates: a comparative static, partial equilibrium approach based on elasticities and multipliers, and a dynamic macroeconomic approach using the Fund's MULTIMOD macroeconomic model. In addition, we demonstrated how dynamic complications may arise (hysteresis effects) while the actual real exchange rate is away from the desired equilibrium exchange rate (DEER). It should be realized, first of all, that the use of these approaches to derive estimates of DEERs is itself at a preliminary stage; the methods employed in each approach need to be developed further and refinements made in the analysis in order to develop confidence in the robustness of the results. Second, it should be clear from the application of both approaches that the estimated DEERS depend very much on the assumptions that are made regarding what are desirable positions for an economy both domestically and internationally. In particular, Section II pointed out that the calculated DEER is very sensitive to the assumption regarding external balance. Therefore it needs to be stressed that the objective of achieving trade and current account balances equal to one percent of GDP was assumed for illustrative purposes only, and is not meant to have any normative significance.

The differences in the results obtained using the two approaches have been discussed in detail above and need not be elaborated here. However, a number of observations are warranted. First, it is perhaps surprising that in many cases the estimates obtained are fairly similar. Where differences are significant, the reason often seems to lie in the fact that the general equilibrium approach takes account of the country's net international investment position and net investment income as well as the domestic and

foreign macroeconomic effects of the exchange rate. 1/ While the results for the exchange rate are often similar, the simulated effects on other macroeconomic variables, such as real interest rates and output, can be quite different, depending on the manner in which the exchange rate is achieved. For example, these results show that a country requiring a reduction in its external deficit will experience a significantly better economic performance if the exchange rate change is brought about through appropriate fiscal action rather than through changes in currency preferences. 2/ From this perspective, the general equilibrium approach would appear to have a clear advantage over the simpler comparative static method. However, the latter has the advantage of being easy to implement, and therefore the implications of alternative assumptions can be obtained quickly. Moreover, this method can easily be extended to other countries without the need to estimate an entire model. Thus, while MULTIMOD is a more appropriate vehicle for estimating DEERs because it takes account of macroeconomic interactions, the partial equilibrium approach has certain clear advantages that lend themselves to practical applications.

An important conclusion of the analysis in this paper is that a range of estimates of DEERs is obtained using alternative but plausible assumptions regarding underlying parameters and variables, with the range between the highest and lowest estimates of the DEER lying between 10 and 30 percent in the illustrative calculations presented in Section II. This wide range underlines the need for caution in identifying any given set of exchange rates as "the" appropriate equilibrium values. Nevertheless, the analysis presented here provides a useful framework that can be used to generate a plausible set of estimates of the DEER as a benchmark for judging whether exchange rates are in line with economic fundamentals.

1/ In some cases, however, the MULTIMOD results appear to reflect specific assumptions, such as the assumption that all foreign assets are denominated in U.S. dollars.

2/ In this connection it should be noted that the I.M.F. staff in its work on exchange rates tries to encourage countries to pursue appropriate underlying economic policies and would be sensitive to the implications of the different adjustment paths described here.

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