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11 Economic Adjustment and the Real Exchange Rate

Arnold C. Harberger

11.1 Introduction and Summary

At the time of this writing (July 1985) it is hardly necessary to try to motivate a study seeking to clarify the concept of the real exchange rate and to improve our understanding of the reasons for its movements. Among the major currencies, the Deutschmark has moved from a high of around .55 U.S. dollars in 1979 to a low of around $.30 in 1984–85. Over roughly the same period the British pound has fluctuated from more than two dollars down to barely over one. These movements far exceed the differential rates of inflation of the countries concerned. Real rates in both cases have exhibited swings spanning a factor of 1.5 or more.

Even though those variations in the dollar/Deutschmark and the dollar/pound exchange rates were greeted with widespread surprise and comment, they look minor when compared with the movements experienced by many less developed countries. For these countries, even after double deflation to correct for movements in their general price levels and in that of the United States, the observed range of variation of real exchange rates is nothing short of dramatic. For example, Mexico's real exchange rate vis-à-vis the U.S. dollar increased by around 80 percent between the fourth quarter of 1981 and the third quarter of 1982; Brazil's took a similar swing between the first quarter of 1982 and the third quarter of 1984; Uruguay's about doubled from the third quarter of 1982 to the first quarter of 1984; Chile's did the same from

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the first quarter of 1982 to the first quarter of 1985. And Argentina broke recent records with a more than quadrupling of its real exchange rate from the first quarter of 1981 to the third quarter of 1982. Even after substantial adjustment Argentina's real rate remained (at the end of 1983 and the beginning of 1984) at around three times its level of three years earlier.

The exploration of issues regarding the real exchange rate has surely been made more vital and pressing by this recent history, but at the same time it has been made more difficult to expound because of the enrichment our theoretical arsenal has experienced in the past few decades. Whereas the so-called elasticities approach was once king, its hegemony has more recently been challenged by the absorption (income-expenditures approach) and by the monetary approach to the balance of payments. And whereas a supply-demand framework based on flows once ruled supreme, more modern analyses deal with stocks as well as flows. In addition, they treat phenomena such as substitution between and among currencies that were not contemplated in the earlier traditions of international economics. Thus, although real exchange rate analysis may appear quite straightforward and natural in terms of the earlier traditions, it seems less self-evident to those who have worked predominantly within the spheres defined by more recent research currents and trends.

11.1.1 A Model of Real Exchange Rates

To begin, then, I shall try to place the phenomenon of real exchange rates, and the approach to be followed in this paper, in a setting that reveals its full compatibility with both the older and the newer strands of economic thinking.[1] A convenient springboard is provided by the following "generalized" demand equation:

$$(1) \qquad Q_i^d = a_0 + a_{1i}(P_i/\bar{P}_d) + a_{2i}\, y + a_{3i}\, \Delta D + a_{4i}(M^s - M^d).$$

[elasticities approach] [absorption approach] [monetary approach]

Here Q_i^d is the quantity of the ith good demanded; $(P_i/\bar{P}_d)$ is its relative price (in relation to a general price index $\bar{P}_d$ faced by local demanders); y is a measure of the real income of the demanders; ΔD is the net increment (measured in the same metric as y) to their borrowings from abroad; M^s is the actual money supply in their possession; and M^d is the amount they would demand in a full comparative static equilibrium if all key determining variables were to remain at their present levels.

The exposition presented in this paper is in terms of the flow supply of and demand for foreign exchange. The demand for imports of good

i is equal to the excess of the demand for purchases of good i (Q_i^d in the above equation) over the domestic supply of (Q_i^s) of the same. Since Q_i^s can also be expressed as a function of the relative price $p_i/\bar{p}_d$, we can, for given levels of y, ΔD, and $(M^s - M^d)$, together with other variables influencing Q_i^s, determine the demand for imports of i ($Q_i^d - Q_i^s$) as a function of $p_i/\bar{p}_d$. In a similar way, the supply of exports of good j ($Q_j^s - Q_j^d$ can be derived as a function of $P_j/\bar{P}_d$. The demand functions for individual import goods then provide the basis for the (flow) demand curve for foreign currency; likewise, the (flow) supply curve of foreign currency is built up from the supply functions for the individual export items. The equilibrium exchange rate (in the absence of capital movements) is the price that equilibrates the supply and demand for foreign currency thus derived, with appropriate adjustment for capital movements.

In the framework described by equation (1), the absorption approach is represented in part by the term $a_{3i}\Delta D$. This term reflects how additional indebtedness contracted abroad will influence the demand for good i; it is kept separate from the income term because the coefficients a_{2i} and a_{3i} are likely to be different from each other. When foreign borrowing occurs, it is often for a quite specific purpose (such as an investment project) with its own requirements for goods and services. The pattern of these requirements (reflected in a_{3i}) will only by accident be similar to the pattern (reflected in a_{2i}) in which incremental income is typically spent.

In part, too, the absorption approach is reflected in the term a_{4i} $(M^s - M^d)$. If "excessive" domestic credit creation occurs, not backed by loans from abroad, it will lead to "excessive" (in the sense of additional) demand for goods and services. In the process "excess" money balances will be created, which over some span of time will be worked off. To the extent, then, that the excess of expenditures over income, dealt with in the absorption approach, is a disequilibrium phenomenon financed by domestic credit expansion, it appears in the fourth term of equation (1).

The term a_{4i} $(M^s - M^d)$ also captures essential elements of the monetary approach to the balance of payments and of the idea of currency substitution. When the central bank engages in creating money (for simplicity, say, under a fixed exchange rate regime), the excess of the new money supply over the amount desired by economic agents will tend to be spent. Over time, this excess will tend to be reflected in a loss of reserves, which in turn will normally have the effect of inducing the monetary authorities to put on the brakes. If they do not, a devaluation crisis may be in the making.

Summing the demand functions for imports (derived as indicated above) over all the relevant goods and services yields the main com-

ponent of the flow demand (F^d) for foreign currency. Doing the same for export goods and services yields the main component of the corresponding flow supply (F^s). Thus, we may write:

$$\text{(2a)} \quad F^d = b_0 + \sum_i a_{1i}(P_i/\bar{P}_d) + b_2 y + b_3 \Delta D + b_4(M^s - M^d) + \ldots$$

[the demand for foreign currency arising from imports]

$$\text{(2b)} \quad F^s = c_0 - \sum_j a_{1j}(P_j/\bar{P}_d) - c_2 y - c_3 \Delta D - c_4(M^s - M^d) + \ldots$$

[the supply of foreign currency arising from exports].

Here b_2 would be equal to $\Sigma_i\, a_{2i}$, b_3 to $\Sigma_i\, a_{3i}$, and b_4 to $\Sigma_i\, a_{4i}$, where the summation runs over the set i of import goods and services; c_2, c_3, and c_4 would have similar connections to the a_{2i}, a_{3i}, and a_{4i}, the summation here being over the set of goods and services j that end up as exports.

Equations (2a) and (2b) do not tell the complete story of the flow demand for and supply of foreign currency. We must recognize that the net new indebtedness of a country (ΔD) is itself a component of the supply of available funds. Thus, when the net increment to debt within a period is fully spent on tradable goods, the increment of debt by itself causes the flow supply of foreign exchange to increase by ΔD. But the spending of the borrowed funds causes the flow supply to contract by $c_3 \Delta D$ (because of increased spending on exportables), while the increased spending on importables causes the flow demand for foreign exchange to expand by $b_3 \Delta D$. Thus, if $b_3 + c_3 = 1$, as it must if the new indebtedness is indeed fully spent on tradables, there is no cause for the equilibrium price of foreign currency to change. The added demand for foreign exchange associated with spending the borrowed funds is just matched by the added supply (as represented by the new debt itself).

In this context ΔD should be defined broadly. An increment in a country's dollar indebtedness, if used to acquire Miami real estate or equities on the New York Stock Exchange, would entail a zero ΔD. The same increment to dollar debt, used for the purchases of imports or of goods and services in the country's domestic market, would entail a positive ΔD, whereas the straight purchase of assets in Miami or New York (without borrowing the dollars) would generate a negative ΔD. In short, we want ΔD to reflect net foreign investment in the standard national accounting sense.

One possible cause of a negative ΔD (in this sense) is a wave of currency substitution. Rather than acquiring capital assets located within the United States, a country's residents might simply buy dollar bills

to hold as a store of value or as a medium of exchange. Such an act would be treated, for the purposes of the present analysis, as if it were a capital movement from the country in question to the United States (that is, a negative ΔD). If this movement were fully matched by increases in the supply of exports or reductions in import demand (that is, if for this particular "capital movement" $b_3 + c_3$ were equal to one), the whole operation would entail no pressure on the exchange rate. But if the increment in demand for foreign currency came at the expense of nontradables or simply as a shift of money holdings from local currency to U.S. dollars, the negative ΔD would not be offset and the country's currency would experience a tendency to depreciation.

In the framework of this paper, the exchange rate is the variable that equilibrates the flow demand for and the flow supply of foreign exchange, that is, that brings about:

$$F^d = F^s + \Delta D. \tag{3}$$

In terms of its time dimension or assumed degree of adjustment, one can probably say that the analysis concentrates on the middle to long run rather than on an extremely short one. Changes in a country's commercial policy, reasonably lasting shifts in the size or direction of capital flows, or both, and changes in the relative prices of particular products in world markets—these are the types of disturbances that will be analyzed here.

In conducting the analysis, the focus will accordingly be on those variables that bring about a new "equilibrium" of the economy under the changed circumstances. I therefore will pass over such elements as currency substitution, speculative waves, transitory disequilibria between M^d and M^s, and undesired changes in the levels of a country's international reserves. But this does not at all mean that the analysis presented here is somehow incompatible with these elements. They are left to one side only because I concentrate on the comparison of one equilibrium and another, in each of which the flow supply of and demand for foreign exchange come from exports and imports of goods and services that can be expected to be maintained at a relatively steady pace for some time, and the difference between flow supply and flow demand is compensated by voluntary capital movements that (within either the beginning or the ending equilibrium) likewise are not expected to be dramatically altered in the near term.

11.1.2 An Overview of the Analysis

The purpose of this paper is to take the reader on something of a guided tour of exchange rate analysis. Starting from the most elementary building blocks of international trade theory, I will deal first, in section 11.2, with the determination of the nominal exchange rate under

idealized circumstances: a flexible exchange rate system supported by a monetary policy that keeps the general level of prices stable. I will then move on to an equally familiar set of problems: examining the international adjustment mechanism for a small country with a fixed exchange rate. In each of these cases we shall examine the economic adjustments required by six different types of disturbances: (a) the imposition of import restrictions; (b) the imposition of export restrictions; (c) an inflow of capital spent exclusively on tradable goods; (d) an inflow of capital spent exclusively on nontradable goods; (e) a rise in the world price of an export product; and (f) a rise in the world price of an import product.

I will show that the equilibrium nominal exchange rate (the domestic currency price of foreign money) falls as a result of (a), rises as a consequence of (b), remains unchanged under (c), and falls under (d) and (e). The adjustment to disturbances of type (f) is ambiguous; its direction depends critically on the elasticity of the demand for imports of the affected product(s).

Our first meeting with the concept of the *real* exchange rate will come in section 11.3. When the nominal exchange rate is held constant, the same adjustments dealt with in section 11.2 take place through movements of the general price level. Whereas under a flexible exchange rate (with stable monetary policy) the disturbances (a) through (f) result in movements in the nominal exchange rate, E, the same disturbances give rise to movements in the general price level, $\bar{p}_d$, when a fixed exchange rate policy is pursued. When the exchange rate variable to be studied is defined as $(E/\bar{p}_d)$, the identical analysis is capable of answering the problems posed in both sections 11.2 and 11.3.

Section 11.4 explores in some detail the concept of the "dollar's worth" as the unit of measurement of the quantities of imports and exports. This concept implies that the exchange rate depends on the world prices of tradable goods in a fashion analogous to the way in which it depends on import and export restrictions, and on capital flows spent on tradable and nontradable goods. In particular, the exchange rate depends on the world prices of a country's export goods in one way, and on the world prices of that country's import goods in another, quite different way.

This concept argues powerfully against thinking of the real exchange rate as the price index of tradable goods relative to that of nontradables. In the simple analysis of sections 11.2 and 11.3 the nominal exchange rate is always the peso price of the dollar. The real exchange rate in these simple exercises is the peso price of the dollar relative to the general price index (or some other chosen numeraire).

Section 11.5 addresses the problem of following a country's real exchange rate over time. It is argued there that in so doing one should

try to replicate insofar as possible the analysis of sections 11.2 and 11.3. The problem is one of dealing with changes in the value of the dollar (or other relevant foreign currency unit) over time. We know that for simple cases like those in sections 11.2 and 11.3 we want to measure imports and exports in units of the "dollar's worth"; we also know that the number (quantity) of such units should change with alterations in the dollar prices of one or more import or export goods. But these conclusions were reached by doing exercises that were "timeless" in the sense that all comparative static theory is timeless. When we postulate changes in the dollar prices of some imports and exports, we are implicitly holding other dollar prices constant. This assumption is not made when we follow a real-world economy over time. In addition to the movements of the dollar prices of each particular country's tradables, there is a general movement of world prices, measured in terms of dollars or any other relevant foreign currency. We would like to be able to correct for general world price movements when we work with data spanning extended periods of time, yet at the same time we want to allow for changes in the relative prices of some or all of a country's imports and of some or all of its exports.

This last objective is accomplished by the choice of some general dollar (or world) price level, $\bar{p}^*$, as the yardstick for measuring over time the "real dollar's worth." Thus, the nominal demand for foreign exchange arising out of imports is Mp_m^*, where M is the quantity and p_m^* the dollar price of imports; the nominal supply of foreign exchange arising out of exports is Xp_x^*, with X being the quantity and p_x^* dollar price. The real quantity of foreign exchange demanded (for imports) is then measured over time t by $M_t p_{mt}^*/\bar{p}_t^*$, and the real quantity supplied (for exports) by $X_t p_{xt}^*/\bar{p}_t^*$. The corresponding real price of foreign exchange is $E_t p_t^*/\bar{p}_{dt}$, where p_t^* is the general dollar price index and $\bar{p}_{dt}$ is the general price index of the country in question, all at time t. The product of the real price times multiplied by the quantity would be, for imports, $(M_t p_{mt}^*/\bar{p}_t^*)\ (E_t \bar{p}_t^*/\bar{p}_{dt}) = M_t p_{mt}^* E/\bar{p}_{dt}$, and for exports, $(X_t p_{dt}^*/\bar{p}_t^*)(E_t \bar{p}_t^*/\bar{p}_{dt}) = X_t p_{xt}^* E/\bar{p}_{dt}$. That is, the real price times the real quantity of foreign exchange in either category is equal to its nominal domestic currency value at the border divided by the general index of domestic prices. This is as it should be. The real *value* of the foreign exchange demanded or supplied, as distinct from its real quantity or its real price, is independent of the index chosen to correct for changes in world prices over time. It depends, as it should, only on the current nominal market values of the foreign exchange transacted, and on the current value of the domestic price index used to convert nominal domestic currency values into real values.

In section 11.6 I discuss the issues surrounding the choice of an appropriate index to correct for foreign inflation. Having previously

established that the real exchange rate should fall when the dollar prices of exportables rise and should also be influenced by changes in the dollar prices of importables, I rule out the use of these specific prices, separately or in combination (that is, the dollar price level of the country's tradables), as the relevant deflating index. Ruling out a country-specific deflating index automatically suggests that a single dollar-price index be used for determining the real volume of foreign currency demand and supply and for defining the basket of goods whose relative price in each country is that country's real exchange rate. The questions that arise in this context are (a) whether the index should refer to dollar prices or to prices expressed in other currencies as well and (b) whether the index should reflect mainly or wholly the prices of tradables (even though it is not separately calculated for each country's tradables) or instead attempt to achieve a broader coverage of goods and services.

The answers given to these questions are admittedly judgmental rather than deterministic, suggesting useful and convenient conventions rather than solutions that are dictated in some absolute sense by the underlying theory. The answer suggested for (a) is that so long as the relevant trade statistics are presented in terms of U.S. dollars, the deflating index should be a deflator of dollar prices, but this does not prevent it from being an average of U.S. prices along with German prices converted at the dollar price of the Deutschmark, British prices converted at the dollar price of the pound, Japanese prices converted at the dollar price of the yen, and so on.

With respect to question (b), the concept is suggested of a basket of tradable goods somewhere on the high seas. The grounds for using wholesale price indexes are that they are composed predominantly of tradables and that they are available on a monthly basis and in general quite promptly. Simplest would be the use of the U.S. wholesale price index to deflate dollar values of imports and exports and to define over time the "real dollar" for which the real exchange rate of any country's currency is the relative price. More complicated but probably preferable would be a weighted average of the dollar prices of the wholesale price baskets of the major trading nations.

The notion that what is being priced is a bundle of tradables floating on the ocean rules out consumer price baskets and gross domestic (national) product (GDP) baskets. But one could conceive of a weighted average of the tradable components of these baskets. To the extent that separable GDP price deflators are already calculated for the manufacturing and the agricultural sectors, the possibility exists of building national price indexes for tradables on the basis of these components.

11.2 The Equilibrium Exchange Rate Under a Flexible Rate System

The six types of disturbances listed in the previous section are here analyzed for a flexible exchange rate system, under the assumption that monetary policy is managed in such a way as to keep constant the general price level ($\bar{p}_d$) of the country in question. Unless otherwise specified, prices in the rest of the world (expressed in the relevant foreign currency units—in this case dollars) are also assumed to be constant. Thus, the movements in the nominal exchange rate as derived in this section will also be movements in the real exchange rate as defined in the preceding section.

The demand curves for imports and the supply curves for exports presented in figure 11.1 are calibrated so that the quantity axis refers to units that cost one dollar at world market prices. Thus, if the world price of coal is 50 dollars a ton (2,000 pounds), coal will be measured in units of 40 (= 2000/50) pounds. If aluminum has a world price of 80 cents a pound, it will be measured in units of 1.25 pounds. In this way the foreign currency demand curves created by many different import goods can be amalgamated with a single demand curve for foreign currency to pay for imports; and the foreign currency supply curves created by many different export commodities can be aggregated into a single foreign currency supply curve created by exports. The two aggregate curves thus constructed are the demand curve for imports and the supply curve for exports, as these terms are commonly used in the literature of international economics.

When tariffs on imports exist, the demand for foreign currency created by any import good is derived by taking the demand price net of tariff for each successive dollar's worth of the import. This is done in figure 11.1a for the case of a general tariff (T_m) on all imports. The tariff is assumed to be a fixed percentage of the local currency price of the product; this assumption generates a net-of-tariff demand curve that spins out from the same quantity-axis intercept as the gross-of-tariff curve. One can easily see how the equilibrium exchange rate is reduced by the imposition of the tariff: both imports and exports fall (balanced trade is assumed here unless otherwise specified).

In figure 11.1b the case of a uniform export tax is examined. In this case the equilibrium market exchange rate must be sufficient to pay both the fundamental supply price of exports (given by the height, at any quantity, of the solid supply curve of exports) and the tax that is taken by the government. When there is no tax the equilibrium is at $M_0 = X_0$, and the market exchange rate E_0 goes only to pay the suppliers of exports; when there is a tax the equilibrium shifts to $M_1 = X_1$, where the market exchange rate produces enough to pay both what

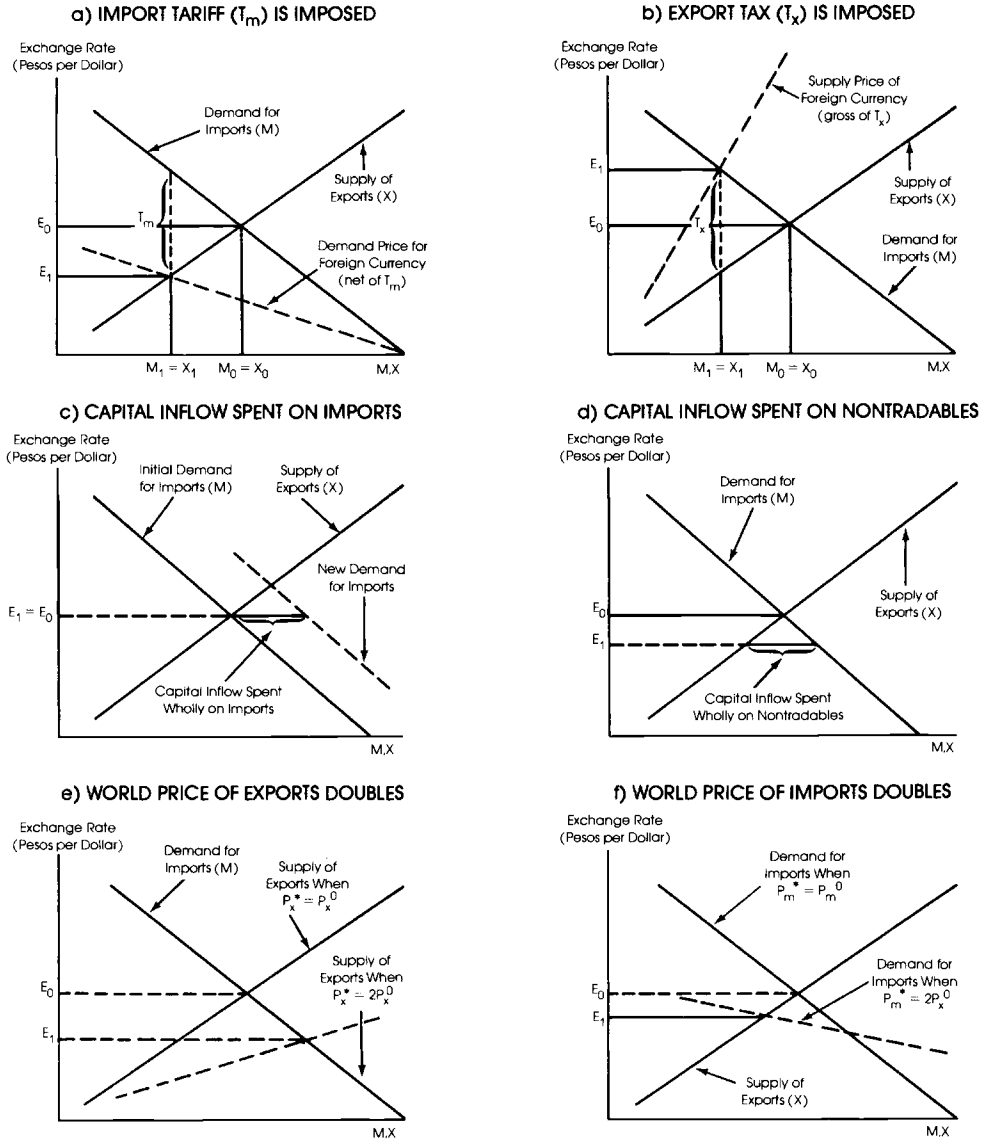


Fig. 11.1 Adjustment to disturbances under a flexible rate system. (The general price level P_d is held constant by monetary policy and imports (M) and exports (X) are measured in units worth one dollar at the world market price)

the suppliers of exports require to provide the quantity X_1 and what the government demands in the form of export taxes.

A comparison of figures 11.1a and 11.1b confirms the familiar proposition that under conditions of balanced trade the identical equilibrium can be produced either by a uniform import tariff (1a) or a uniform export tax (1b). It is worth nothing that although such an equilibrium is identical in terms of the quantities of exports and imports (at $M_1 = X_1$), and in terms of the gross price paid by the demanders of imports and the net price received by the suppliers of exports, it is *not* identical with respect to the exchange rate. In the specific case examined here, the nominal exchange rate falls as the result of an import tariff and rises as a consequence of an (otherwise equivalent) export tax. More generally, we will find that the equilibrium real exchange rate likewise has opposite directions of movement in response to import tariffs, on the one hand, and export taxes, on the other.

Figures 11.1c and 11.1d trace the consequences of inflows of capital. The first case is that in which the proceeds of the borrowing are spent on imports. This means that the demand curve for imports shifts to the right by the amount of the borrowing. Since the equilibrium of the balance of payments will require imports to exceed exports by the amount of foreign borrowing, there is no cause for the exchange rate to change in this case. It would be the same if the proceeds of the borrowing were spent fully on exportables (in which case the supply curve of exports would shift to the left by the amount of the borrowing, while the demand curve for imports would stay put) or if these proceeds were divided, with one part being spent on exportables and the remainder on importables. In the latter case the supply curve of exports would shift to the left by the amount of borrowing spent on exportables, and the demand curve for imports would shift to the right by the amount of the borrowing spent on importables. The combination of these two shifts would create, at the old exchange rate E_0, an excess of import demand over export supply equal to exactly the amount of the borrowing. Hence, when foreign borrowings are spent on tradables, they do not affect the equilibrium exchange rate.

The story is different when foreign borrowings are spent on nontradables. Here an economic adjustment must be made (the so-called transfer problem must be solved) in order to validate in real terms what would otherwise be simply a transfer of monetary purchasing power. The receiving country effectively *uses* a net capital inflow only to the extent that it imports more than it exports. When the capital flow is directly spent on tradables, the required excess of imports over exports is automatically created (see above). But when the capital flow is spent on nontradable goods and services (such as for roads, housing construction, and irrigation projects), the money borrowed from abroad

(dollars) must be sold to obtain the domestic currency (pesos) needed to pay wages and cover other domestic costs. In the process, the exchange rate will fall, as depicted in figure 11.1d, so long as monetary stability is maintained.

Of course, any actual capital inflow from abroad is unlikely to be spent exclusively on either tradables or nontradables. It should be clear from figures 11.1c and 11.1d that in such a case the exchange rate will still fall, since the part of the capital flow spent on tradables has no effect while the part spent on nontradables introduces downward pressure on the rate.

Figure 11.1e depicts the by now familiar phenomenon of "Dutch disease." A substantial increase in the world prices of exports—in real-world cases, a rise in the price of an important export product (natural gas, for example, in the case of Holland)—generates a large increase in the amount of foreign currency available in the market, which in turn leads to a reduction in the exchange rate (the price of foreign currency). The rise in the world price of exports causes a shift in the supply curve of foreign currency, even though the supply curve of the export good in terms of its own peso price remains constant. A single point on the peso supply curve, showing 20 million pounds of sugar at a price of one peso per pound, will be reflected in a supply of foreign currency of two million dollars against an exchange rate of 10 pesos per dollar if the world price is ten cents a pound; a supply of foreign currency of four million dollars against an exchange rate of five pesos per dollar if the world price is 20 cents a pound; and a supply of foreign currency of one million dollars against an exchange rate of 20 pesos per dollar if the world price is five cents a pound. Thus, an unchanged supply curve of sugar in terms of its domestic relative price will be translated into different supply curves of foreign exchange,[2] depending on the dollar price of sugar in the world market. Accordingly, as shown in figure 11.1e, the market exchange rate will fall (from E_0 to E_1) under a flexible rate regime in conditions of monetary stability.

Figure 11.1f shows that the foreign exchange demand curve created by imports also undergoes a shift with a changing world market price of the import goods in question. Though the nature of the shift is identical to that applying to the supply curve of exports, the shift in figure 11.1f looks different from that in figure 11.1e. This is only because the demand curve for imports slopes downward, while the supply curve of exports slopes up. The nature of the economic adjustment to a rise in the world price of imports is clear. The initial response is simply a rise in the internal (peso) price of the good(s) in question. This response will be reflected in unchanged peso expenditures if the elasticity of demand for imports of the good is one; in increased peso expenditures if the elasticity is less than one; and in reduced peso outlays if the elasticity of demand for imports of the good is greater than one. From

this we can deduce that there will be a range in which the demand for dollars (at a given exchange rate) will be reduced and another range in which that demand will be increased as a consequence of a rise in the world price of imports. In the case depicted, the initial equilibrium (at exchange rate E_0) was in the range in which the demand for imports had an elasticity greater than one; hence, the consequence of the price rise is a reduction in total peso outlays on dollars. Had the initial equilibrium been in a different range, peso outlays might have gone up rather than down, in which case the equilibrium exchange rate would have risen rather than fallen.[3]

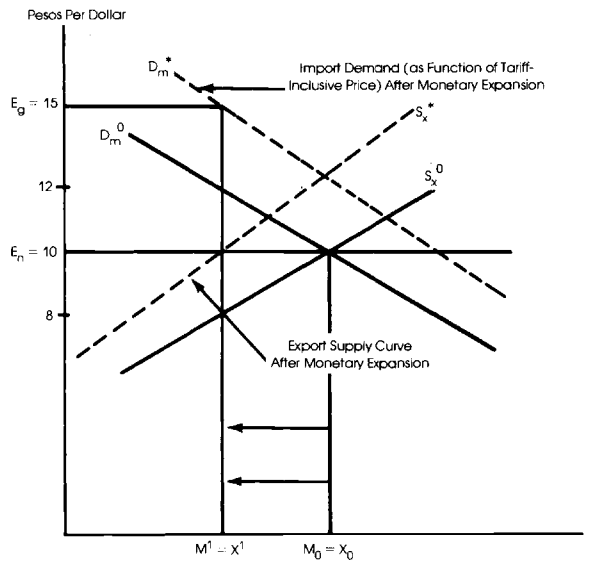
11.3 Economic Adjustment Under Fixed Exchange Rates

Figure 11.2 shows how the adjustment process works under a fixed exchange rate system. The key element that distinguishes this system from that of the flexible rate is that now the money supply and the general price level, $\bar{p}_d$, play an active role. Figure 11.2a considers the imposition of a 50 percent uniform import tariff. Since the world prices of importables and exportables are given, the tariff will cause the price of imports to rise, while that of exports (at the fixed exchange rate) stays constant. The reduction in imports resulting from the price increase causes a surplus to emerge in the balance of trade (which initially was in equilibrium). This, in turn, leads to expansion of the money supply as the central bank buys the extra dollars. As the money supply expands, upward pressure is placed on the general level of prices and costs, $\bar{p}_d$. Since the demand for imports and the supply of exports are functions of the relative prices ($p_m/\bar{p}_d$ and $p_x/\bar{p}_d$, respectively) of imports and exports, the upward pressure on $\bar{p}_d$ causes these curves to shift upward.

The new equilibrium consistent with a 50 percent uniform tariff is shown at $M_1 = X_1$ in figure 11.2a. The price paid by demanders of imports is 15 pesos per dollar's worth. Of this, five pesos goes to the government, and ten pesos goes to buy the necessary foreign exchange at the fixed rate of ten pesos per dollar. The amount of foreign exchange demanded is M_1; this is equal to X_1, the amount supplied. The supply of foreign exchange has been reduced in the adjustment process as the pressure of increasing costs shifted the supply curve upward from S_x^0 to S_x^*.

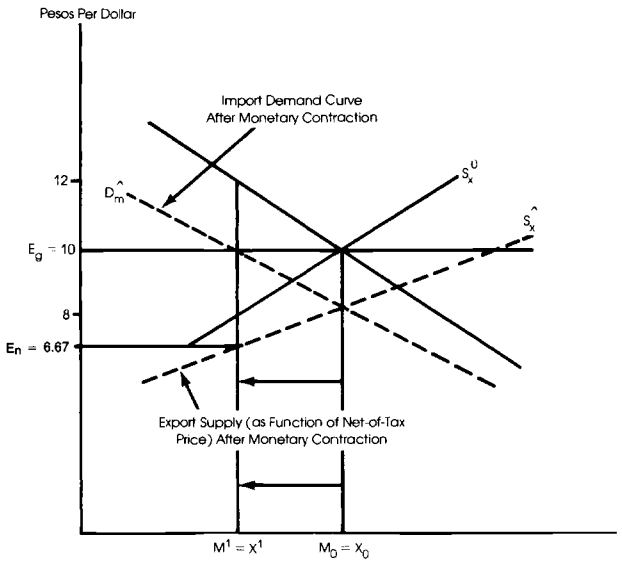
Figure 11.2b shows how the adjustment process works when a uniform export tax of 33 ⅓ percent is imposed. In this case the effect is to reduce the supply of exports relative to the demand for imports. A deficit in the balance of trade emerges, which has as its consequence a loss of international reserves and a reduction in the money supply. There is a downward pressure on $\bar{p}_d$, the general level of prices and

A 50% Uniform Tariff on Imports Causes
Monetary Expansion; New Equilibrium has
$E_g = 15$, $E_n = 10$



a) IMPORTS (M) & EXPORTS (X)
(Dollars' Worth)

A 50% Uniform Export Tax Causes
Monetary Contration; New Equilibrium has
$E_g = 10$, $E_n = 6.67$



b) IMPORTS (M) & EXPORTS (X)
(Dollars' Worth)

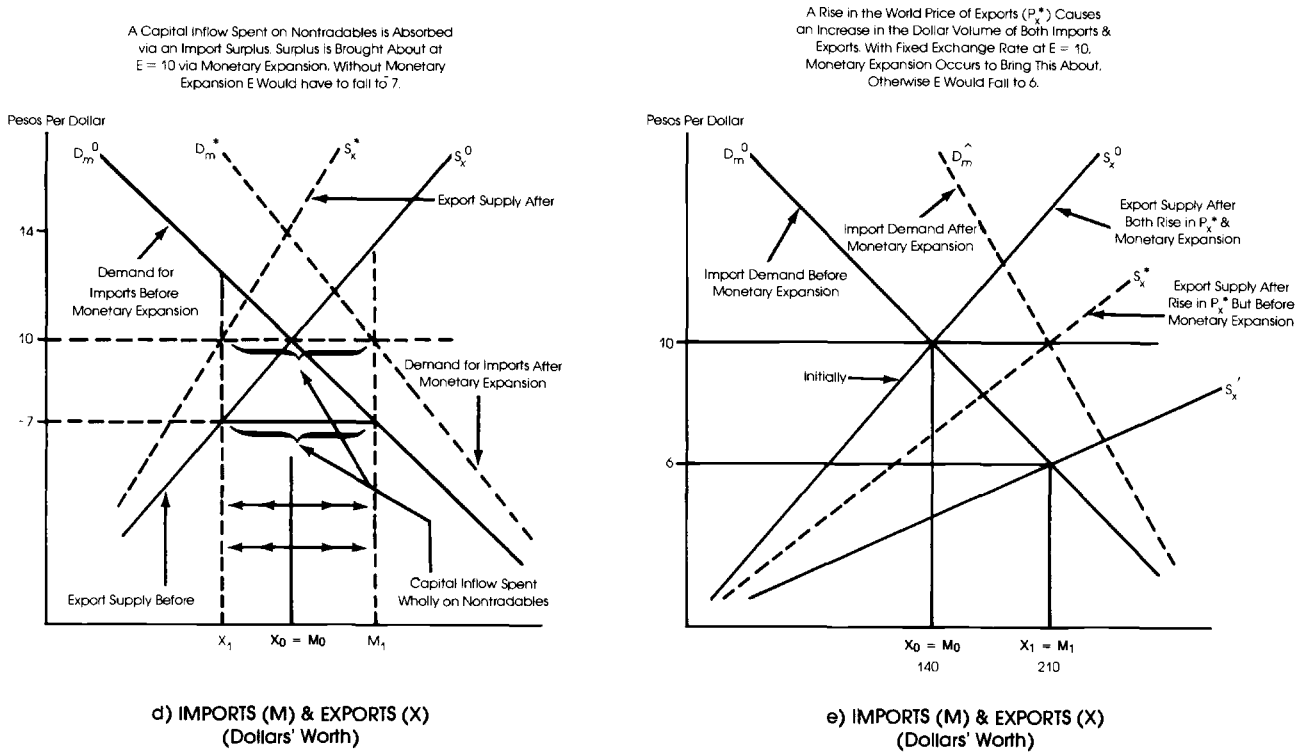


Fig. 11.2 Adjustment to disturbances under fixed exchange rates, with uniform import tariffs and export taxes. (A fixed exchange rate of ten pesos per dollar is assumed)

costs. Equilibrium is reached in a situation like that represented by the broken-line curves $\hat{D}_m$ and $\hat{S}_x$. The quantity of imports demanded (at a price equal to ten pesos per dollar's worth) has fallen from M_0 to M_1 because the general price level ($\bar{p}_d$) has fallen while import prices remained the same. The quantity of exports has fallen because in the presence of the tax, exporters are receiving only 6.67 pesos per dollar's worth. Costs have fallen, and this has caused a shift of the supply curve of exports from S_x^0 to $\hat{S}_x$, but the incentives are still for a reduction in supply from the initial equilibrium at $M_0 = X_0$. This is because the prices received by exporters have fallen more than the general price level, causing a movement back along $\hat{S}_x$ from X_0 to X_1.

This is the appropriate time to compare the results of figures 11.2a and 11.2b with those of 11.1a and 11.1b. The new equilibrium in the latter two cases can be replicated in figure 11.2 by following the solid curves D_m^0 and S_x^0 to the new equilibrium. If the general price level remains constant while the exchange rate falls, the equilibrium in figure 11.2a would be at an exchange rate of eight pesos per dollar; buyers of imports would pay 12 pesos per dollar's worth, because of the 50 percent import tariff.

The adjustment mechanism under fixed exchange rates produces (figure 11.2a) an equilibrium in which demanders pay 15 pesos per dollar's worth of imports, and suppliers receive ten pesos per dollar's worth of exports when the exchange rate is ten pesos per dollar and a 50 percent import tariff is in effect. With the same exchange rate, a 33 ⅓ percent export tax would generate (figure 11.2b) an equilibrium in which demanders would pay ten pesos, and suppliers would receive 6.67 pesos per dollar's worth. But in real terms all of these equilibria are the same. In all of them the price paid by demanders for a dollar's worth of imports ends up 50 percent higher than the price received by suppliers for a dollar's worth of exports. The differences in the levels of import and export prices simply mirror what happens to the general price level in each of the three cases. In the flexible exchange rate case (solid-line curves) the general price level, $\bar{p}_d$, remains constant. In the fixed exchange rate case with a 50 percent import tariff the monetary expansion produced by the adjustment causes the general price level to move up from index 100 to index 125. Under a 33 ⅓ percent export tax, the deflationary process entailed by the adjustment causes the general price level to fall from index 100 to index 83 ⅓. Thus, in each of the final equilibria the price of imports has risen 20 percent and the price of exports has fallen 20 percent, *relative to the general price level.*

Figure 11.2d is comparable to figure 11.1d. A capital inflow equal in amount to $(M_1 - X_1)$ dollars and spent wholly on nontradables would, if the general price level $\bar{p}_d$ were held stable by monetary policy, cause the nominal exchange rate E to fall from ten to about seven pesos per

dollar. This is shown by the gap $(M_1 - X_1)$ between the solid-line curves D_m^0 and S_x^0. Obviously, this cannot happen if the country is maintaining a fixed exchange rate. In such a case the initial impact of the capital inflow will come through the sale of the borrowed foreign exchange (dollars) to the central bank so as to obtain the domestic currency (pesos) needed for buying nontradable goods and services in the domestic market. This causes an expansion of the peso money supply—an expansion that continues until the gap between imports and exports becomes equal to the size of the capital inflow (here assumed to be a continuing flow over time, not a one-shot injection of funds). In the case depicted in figure 11.2d equilibrium is reached when the monetary expansion has caused a 40 percent upward shift in the demand curve for imports and in the supply curve for exports. This is consonant with a rise of 40 percent in the general price level, $\bar{p}_d$. Comparability between the fixed rate and the flexible rate cases is maintained. In the fixed rate case the general price level rises from 100 to 140, while the exchange rate stays constant at ten pesos per dollar. In the flexible rate case the general price level is assumed to remain constant; under that assumption the equilibrium exchange rate must fall to $10 \times (1/1.4) = 7.14$, shown on the graph as approximately equal to seven.

Figure 11.2e shows the response of the economy to a rise in the world price of exports when a fixed exchange rate is assumed. The rise in price itself shifts the supply curve of foreign currency to the right (as also occurred in figure 11.1e, and as is explained in greater detail in the discussion of figure 11.3b below). This *would*, with a flexible exchange rate and a stable general price level $\bar{p}_d$, cause the nominal exchange rate to fall from ten to six pesos per dollar. Instead, with a fixed exchange rate of ten pesos, monetary expansion occurs as a result of the inflow of foreign exchange, driving up the general level of prices $\bar{p}_d$. Its new equilibrium level is 166 ⅔ rather than 100. The new equilibrium real exchange rate, $E/\bar{p}_d$, is therefore the same under a fixed exchange rate system as it would be under a flexible one.

11.4 The Concept of the "Dollar's Worth"

It is hardly a new idea that when dealing with problems of international trade for a small country, one should treat world prices as given and should use the concept of composite commodities based on the given world prices when working with aggregates such as the demand for tradables, the supply of tradables, the demand for imports, and the supply of exports. Indeed, far from being new, the idea has become commonplace to the point that a shorthand notation has been developed for it. When a writer wants to key his readers into this well-established line of thinking, he usually begins by saying something like "the fol-

lowing analysis will be based on a small-country hypothesis" and then proceeds to his task.

It is my contention that we have probably become too complacent, too cavalier in working with the small-country hypothesis. Under its convenient shorthand, I believe, we have in effect buried at least two important issues. First, by correctly assuming that nothing a small country can do will change the world prices it faces, we have somehow fallen into the trap of neglecting changes in the world prices of individual commodities as an important class of disturbances to be analyzed. Second, and in part as a consequence of the first, we have been far too uncritical in accepting as a definition of the real exchange rate the ratio of the "price of tradables" to the "price of nontradables."

On the first point, let us recognize that one uses the small-country hypothesis in building the demand curve for imports, the supply curve for exports, and their counterparts for importables, exportables, and tradables generally. Each of these is typically a composite good; in constructing the demand or supply curve of that composite, we assume the individual prices of its separate component items move up and down together, that is, in the same proportion. Many of the problems that are dealt with in this context, particularly at the textbook or the very general analytical level, can be handled using composite goods thus defined.

Let the relative price of each member of the composite be defined as $p_j^* E(1 + t_j)/\bar{p}_d$, where p_j^* is the world price; E, the nominal exchange rate translating the world price from dollars into pesos; and t_j, the distortion (tariff in the case of imports, export subsidy in the case of exports) causing the internal price to be above the world price converted at the market exchange rate. The relative price of all tradables, thus defined, will move up and down if the exchange rate moves up and down, as would naturally happen, other things equal, with a change in the rate of capital inflow under a flexible exchange rate system. The relative price of all tradables would react similarly to capital flows under a fixed exchange rate system, but in this case the common fluctuations in each relative price derive from changes in $\bar{p}_d$ rather than in E.

In dealing with uniform tariffs—standard fare for textbook treatments of this type of material—one must distinguish between importables and exportables. But once that distinction is made one can see how, under the small-country hypothesis, a uniform tariff will cause the relative prices of all importables to move up by an equal amount, and those of all exportables to move down by a given amount. An export tax has a similar effect. A uniform export subsidy works on the relative prices of all exportables in the same way as a uniform import tariff works on the relative prices of all importables.

From the above we can derive such familiar results as the equivalence (under balanced trade) of uniform export taxes, on the one hand, and

uniform import duties, on the other, and the fact that (again under balanced trade) a uniform import tariff combined with a uniform export subsidy at the same rate has no ultimate real effect at all, producing instead only a countervailing movement, from one equilibrium to another, in the ratio $E/\bar{p}_d$.

The same framework has also been widely used in discussions of purchasing power parity. It shows, for example, how, when all p_j^* terms (for imports and exports alike) change by a given percentage, equilibrium can be restored under a fixed exchange rate by an equal percentage movement in $\bar{p}_d$. More generally, the necessary adjustment can be achieved through an offsetting movement in the ratio $E/\bar{p}_d$. When the predominant forces at work are monetary ones and they cause all the p_j^* terms to move by a certain percentage while $\bar{p}_d$ moves by a different percentage, the relative price of each tradable $(p_j^* E[1 + t_j]/\bar{p}_d)$ can nonetheless be kept constant by an offsetting movement in E. Such a move is stimulated when a country sets a new nominal exchange rate level by applying a purchasing power parity formula.

The above examples show how much can be done while still maintaining the assumption that the prices of all tradables (or exportables, importables, exports, or imports, as the case may be) move together. But obviously there are many problems that cannot be dealt with under that assumption. It is my impression that on the whole those problems have been dealt with by using more of a partial-equilibrium framework. Examples are the analysis of the effects of a tariff or an export tax on a single commodity; the calculation of rates of effective protection; and the finding of second-best optima, such as the Ramsey problem of choosing tariff rates for a subset of commodities so as to minimize the efficiency costs of raising a given amount of revenue therefrom.

In at least one case—the so-called Dutch disease problem of a dramatic rise in the world price of a country's principal export good—the nature of the problem demanded a macroeconomic framework and precluded the assumption of a composite export commodity. Here, in my opinion, the analysis has on the whole been correct and to the point, but the relationship of this case to the other general-equilibrium problems discussed above was not, in general, made clear.

In my view, we should try wherever possible to imbed our "partial" analysis in a general-equilibrium setting. In the matter at hand this means we should couch our analysis of a tariff on a single commodity in such a way that when imports are viewed as being subjected one after another to a given tariff rate, until finally all are covered, we get the correct answer for a uniform tariff. Similar reasoning applies for export taxes and subsidies and for the various combinations discussed above, of uniform taxes and subsidies on all exports and on all imports.

This means, of course, that we should recognize that each import tariff on each single good produces a downward shift in the demand curve for foreign exchange and a corresponding downward effect on the real exchange rate. Likewise, each export tax on a single good causes a leftward shift in the supply curve for foreign exchange and a corresponding upward effect on the real exchange rate.

These facts cause no apparent difficulties until we realize that p_j^* and $(1 + t_j)$ enter in a similar way in the expression for the relative price $(p_j^* E[1 + t_j]/\bar{p}_d)$ of imports of j. Just as we do not want to confine ourselves to analyzing only uniform tariffs or export taxes, so too do we not want to confine ourselves to cases in which all the p_j^* terms for all tradables move together. We should strive for an analysis that can deal with changes in the price of individual export or import goods, or both, and one that can do so in such a way that the sum total of the individual effects on all such goods is equal to the already well-recognized general-equilibrium result.

Figures 11.3a, 11.3b, and 11.3c illustrate how the demand and supply curves of foreign exchange (created by imports or exports of particular commodities) are altered when the world price of the relevant good changes. In figure 11.3a, the effect of doubling of the price of imports of good j is explored; in figure 11.3b, a doubling of the price of exports of good k is assumed. In each case what is shown is the demand curve for (or supply curve of) foreign exchange created by the market for the good in question.

Each demand and supply curve is built on the assumption that the world price of the commodity in question is given. The units in which the horizontal axis is measured are units of a "dollar's worth"—the amount of the commodity in question which at the given world price sells for a dollar. The units of price are the demand or supply price (relative to the general level of prices, $\bar{p}_d$) corresponding to each separate quantity unit.

Consider the case of a commodity, wheat (w), selling in the world market for \$4 a bushel. Its ordinary demand curve will measure bushels on the horizontal axis and the relative price of the bushel $(p_w^* E[1 + t_w]/\bar{p}_d)$ on the vertical axis. To express this demand curve in units of dollar's worth, stretch the quantity axis by multiplying by p_w^* (\$4 in this case); the quantity units are now in dollar's worth. Since the price of a dollar's worth is $(1/p_w^*)$ times the price of a bushel, the new price axis is measured in units of $E(1 + t_w)/\bar{p}_d$. This expresses what demanders actually pay per dollar's worth and includes the tariff or other tax received by the government. To produce a demand curve in which the demand price represents the actual price for foreign currency, we must shift the ordinate of each point downward, dividing by $(1 + t_w)$. The resulting

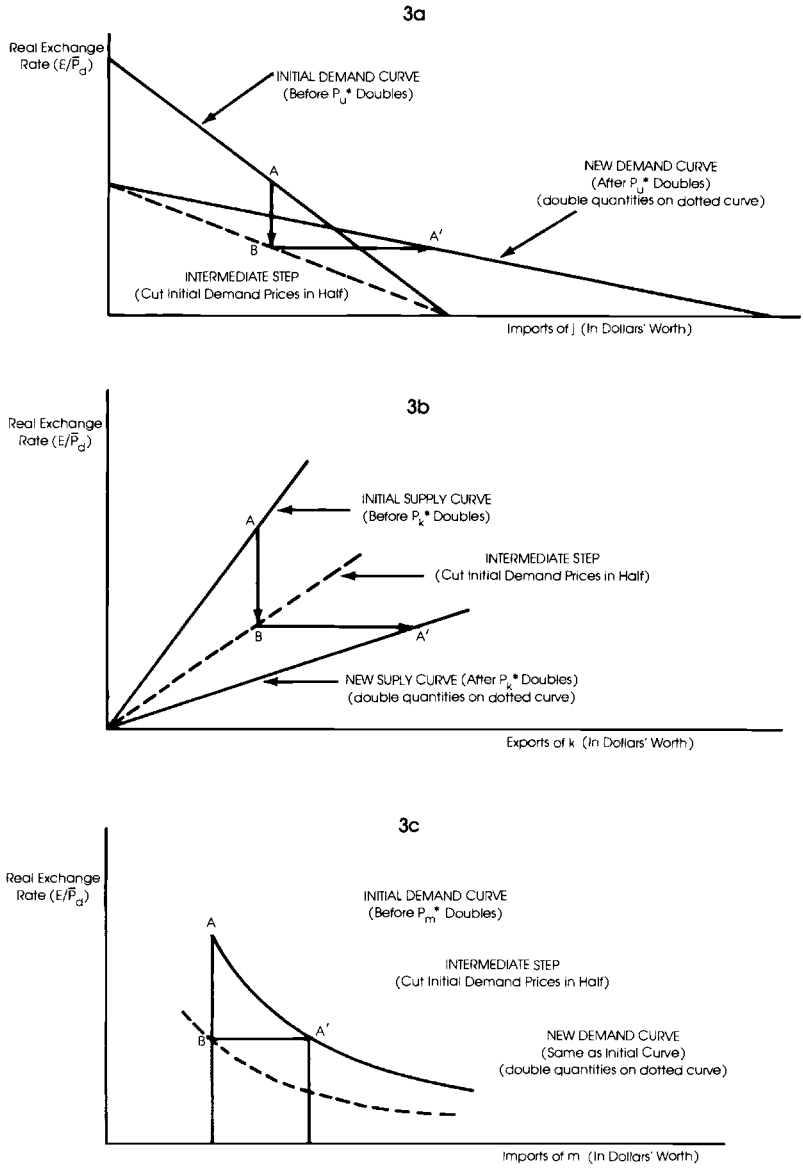


Fig 11.3 Demand and supply curves for foreign exchange.

demand curve has dollars' worth on one axis and $E/\bar{p}_d$, the relative price of a dollar's worth, on the other.

Now when the world price of wheat p_w^* changes, this same transformation must be performed again. Each ordinate of the curve must be multiplied by the old p_w^* ($4) and divided by the new one (say, $8); similarly, the quantity of foreign exchange demanded at each price must be divided by the old p_w^* and multiplied by the new one. This is what is done in figure 11.3, for a postulated doubling of the world price of the good in question. Figure 11.3a deals with a linear demand curve. In effect, it shifts from measuring demand in units of a quarter-bushel to measuring it in units of an eighth-bushel. Here as an initial step the vertical intercept is cut in half; this operation produces the broken-line curve. Then the abscissa of each point must be doubled (reflecting the doubled quantity of dollars that each physical quantity unit, for example, each bushel, now produces). This second step produces the new foreign currency demand curve created by imports of j.

Figure 11.3b does the same thing for an export supply curve. To obtain the (intermediate step) broken-line curve, the height of each point on the old supply curve is cut in half; to obtain the new foreign currency supply curve created by exports of good k, the abscissa of each point on the broken-line curve is then doubled.

Figure 11.3c shows how these transformations map a unit-elastic demand curve onto itself. Starting at point A we cut the height in half to get point B; then we double the quantity to get point A'—a different point on the same unit-elastic demand curve with which we began.

From figure 11.3c it is also easy to visualize how, starting from a demand curve of a constant elasticity less than one, a rise in the world price of the commodity will result in a new demand curve (for foreign currency) that lies everywhere to the right of the original one. Likewise, if we start from a demand curve of a constant elasticity greater than one, a rise in the world price will map that curve into a new demand curve for foreign currency that lies everywhere to the left of the original one.

Thus, the Dutch disease phenomenon is not in any way limited to changes in the world price of the principal export(s) of a country. Even the least important export goods give rise to the same type of disease, only in very small doses. All import goods (except those with a fortuitously unit-elastic demand curve) also generate, when their world prices change, effects on the real exchange rate. In cases in which there is domestic production of the imported good or of close substitutes, the demand is likely to be of greater than unit elasticity, and a rise in world prices will cause a decline in the demand for foreign currency and in the real exchange rate. For imports of essential goods that are not produced domestically (most particularly, raw materials), the de-

mand is likely to be inelastic,[4] with a rise in world price producing an increase in the real exchange rate.

All of this suggests a complex set of connections between the world prices of tradable goods and the real exchange rate. If one were trying to explain variations in the real exchange rate as resulting from changes in the world price of tradables, one would probably want to distinguish at least three separate explanatory variables: the world price level of the country's exports, the world price level of its competitive imports, and the world price level of its noncompetitive imports. But even here the strength of the causal connection would differ from commodity to commodity within each category, depending on its individual elasticity of import demand and export supply. Hence, one has no particular reason to expect to find a particularly good (or "tight") empirical relationship between variations in the real exchange rate and changes in the separate price levels of exports and of the two classes of imports. Even less would one expect to find a good "fit" for equations depicting movements in the real exchange rate on the basis of changes in the terms of trade (the ratio of the world price level of exports to the world price level of all imports) or changes in the world price level of a country's tradable goods (typically a weighted average of the price levels of its exports and all of its imports).

This leads to the second main point of this section: how tricky or precarious it may be to think of the real exchange rate as the ratio of the price level of tradables to that of nontradables. This definition works without any problem when the disturbance in question is a capital movement spent on nontradables, for in this case it follows from the nature of the disturbance that all tradables prices will move together (or remain constant while $\bar{p}_d$ undergoes changes stemming from movements in nontradables prices). But in just about every other interesting case—a world oil boom, looked at either from the standpoint of an oil-exporting or an oil-importing country; a reduction in the real costs of producing a particular tradable good, either locally (as a backward country adopts a technology already known but new to it) or worldwide (as in the "green" revolution or the arrival of the computer age); the introduction or relaxation of trade restrictions, either selectively or across the board—differential movements of tradables prices or different forces influencing production separate one or more tradables from the rest. In none of these cases is the ratio of tradables prices to that of nontradables prices particularly illuminating or useful as an analytical concept or tool. For example, knowing precisely what happens to this ratio does not tell us how the listed disturbances will influence the nominal exchange rate *(E)* in the event that the general level of prices ($\bar{p}_d$) is held constant, or what will happen to $\bar{p}_d$ in the event E is held fixed.

More broadly, we should realize that just as we must use the unit of the dollar's worth to measure the demand for imports and the supply of exports in determining the real exchange rate ($E/\bar{p}_d$) as defined here, so too must we use that unit when talking about the demand for and supply of importables and exportables. After all, the demand for imports (under the small-country hypothesis) is nothing more nor less than the excess-demand curve obtained from juxtaposing the demand and the supply curves for importables; and the supply of exports is nothing but the excess-supply curve obtained when doing the same thing for exportables. Finally, of course, the dollar's worth has to be the unit for measuring the supply and demand for tradables—at least if we want to maintain the magnificently useful identity between the balance of trade and the excess supply of tradables.

Thus, if this line of argument is correct, we should not put p_t/p_n (the price of tradables divided by the price of nontradables) on the vertical axis when we model demand and supply in the market for tradable goods. Rather, the vertical axis (in a timeless, comparative static analysis) should be labeled $E/\bar{p}_d$, just as it is when we directly analyze adjustment in the market for foreign exchange.

Finally, we should also remember that the demand and supply curves of tradables themselves undergo shifts when world prices of particular import and export goods change, as well as when tariffs, domestic excise taxes, export taxes and subsidies, and other types of distortions and restrictions are imposed. I come away from this entire exercise with a new respect for the old way of thinking about exchange rate determination as taking place in the market for foreign exchange. This way of thinking is not just a guide to the day-to-day setting of the nominal exchange rate. It is also a sound guide to help us understand the forces determining the equilibrium real exchange rate $E/\bar{p}_d$.

11.5 The Domestic Deflator, $\bar{p}_d$

The matters treated in this and the next section are more practical than conceptual, having more to do with the actual indexes used in empirical work than with the underlying theory of the subject. At the purely theoretical level, we know that the real side of economics deals with real (as against nominal) quantities and with relative prices. At some point, therefore, one typically has to choose a *numeraire* commodity—one in terms of whose price the remaining prices are expressed. The analysis to date has taken us part of the way down the road, in the sense that we have specifically singled out the world and internal prices of export(able) and import(able) goods, and we have recognized the possibility that the internal demand and supply prices might differ because of excise taxes or subsidies. The problem then is:

Relative to which price or price level do we wish to express these various supply and demand prices of the different tradable goods?

Although one could in theory pick any arbitrary good to serve as a numeraire,[5] this would miss the point; the numeraire would then have no particular economic content or meaning. Our concern is to give specific content and meaning to what we have already identified as $\bar{p}_d$. As far as I can see, there are only two reasonable candidates: (a) a general price index covering, in principle, all goods and services, including the tradables; and (b) a general index (p_n) of nontradable goods. If I had to make the choice only at the theoretical level, I would be inclined to opt for (b), on the grounds that it is cleaner to work with p_m/p_n and p_x/p_n than with $(p_m/[\alpha_1 p_m + \alpha_2 p_x + \alpha_3 p_n])$ and $(p_x/[\alpha_1 p_m + \alpha_2 p_x + \alpha_3 p_n])$, even though any given values of the former pair will imply specified values for the latter pair.

But if I intend to use actual data—even of estimated (or guesstimated) elasticities of demand and supply—my inclination tilts strongly toward option (a). In the first place, well-established indices of nontradable goods, especially ones that are reliable and readily (and speedily) available, are typically not at hand. In the second place, nearly all of the elasticity estimates in the literature express relative prices as ratios of individual goods prices to a general index like the consumer price index or the GDP deflator. Not only are the numerical estimates derived in this way, but our intuitive sense as to the likely orders of magnitude is based, in the final analysis, on such estimates. In the third place, when working through the theory of the international adjustment mechanism under flexible exchange rates, it is much more reasonable to assume a monetary policy that is designed to stabilize (or otherwise take as its target) the general price index than to assume that it is some nontradables price index that is being stabilized (or targeted). Similarly, it is much more natural to think of the adjustment mechanism under fixed exchange rates as taking place through movements of the money supply and the general price level, rather than through movements of money and of the price level of nontradables alone, since it is the general price level that presumably governs people's behavior with respect to their holdings of money and other assets denominated in money terms. This is true even in cases in which, theoretically, only movements in nontradables prices can cause the general price level to change. These are, as it were, the pure textbook cases; there are other textbook cases in which tradables prices would change (either exogenously or as a result of policy changes); and, of course, in the real world the prices of some tradables or others are always changing. The general index of prices $\bar{p}_d$ is under these circumstances the deflating index that one can most rely on in dealing with both theoretical and empirical problems.

Having opted, therefore, for the general index $\bar{p}_d$ rather than an index covering nontradables only, I will deal only briefly with the question of which index to use for $\bar{p}_d$. To my mind, wholesale price indexes are everywhere very heavily weighted with tradables—the mere fact that they are typically based on the prices of tangible and transportable goods practically guarantees that. Obviously, even though the deflating index is not a pure nontradables index, it should at least give them their due weight. Two widely used indexes that do this are the consumer price index (CPI) and the GDP (or GNP) deflator. Of these the latter is the more comprehensive, but the former is (so long as it is formulated following accepted professional standards) conceptually sound, acceptably general, and above all readily and quickly available (in nearly all countries), on a monthly as well as a quarterly and an annual basis. Thus, for most purposes I would choose the CPI as a deflator, probably reserving the GDP deflator mainly for historical time-series work where yearly data are all that is needed.

11.6 The Dollar-Price or World-Price Deflator, $\bar{p}^*$

It is well to recall at the outset of this section that one does not need a dollar-price or world-price deflator for most analytical purposes. The nominal price of an import good at the country's border is $p_m^* E$; its relative price at the border is $p_m^* E/\bar{p}_d$; and the relative price of a dollar's worth of it at the border is simply $E/\bar{p}_d$. This is true of each and every import good, at all times. The same can be said for export goods: their relative price at the border is $p_x^* E/\bar{p}_d$, and the relative price of a dollar's worth is always $E/\bar{p}_d$. With this definition of the real exchange rate we can analyze tariffs, quantitative import restrictions, export taxes and subsidies, domestic taxes, domestic production subsidies, agricultural price supply programs, and changes in the world prices, p_m^* or p_x^*, of particular imports or exports, or of groups of them, or of all of them, recognizing, of course, that some of these introduce distortions by which the relative prices paid for a dollar's worth by domestic demanders, or received by domestic suppliers, or both, are different from the corresponding relative prices at the border.

But when we thus argue the power of $E/\bar{p}_d$ as a measure of the real exchange rate, we should recognize that we are talking in the world of theory. Our analyses of things like tariffs and excise taxes are carried out in the timeless world of comparative statics. We analyze policies or other disturbances one at a time (or in packages of our own choosing), with other potentially complicating factors held constant. Through it all, as explained earlier in this paper, we measure our quantities of tradable goods in units of the dollar's worth.

But what if the value of the dollar changes over time? This question can be answered in three ways. First, there are many problems for

which the fact of the dollar changing over time is of no particular moment. Thus, if a 50 percent uniform tariff causes $E/\bar{p}_d$ to be 20 percent lower than it otherwise would be, this disincentive to export activity will presumably be present when the dollar-price level is 100, when it is 200, and when it is 500 as the dollar suffers the throes of inflation. The presence of inflation does not by itself alter or modify the disincentive.

Second, our precise purpose may be to analyze the effects of an inflationary process in the world (dollar) economy. This can be done (analytically) by assuming that all dollar prices of goods and services move up together. Obviously, once this assumption is made any dollar-price numeraire can be used to convert the "dollar's worth" of different time periods into units of constant purchasing power. All will give the same answer. In particular, it does not matter whether we use an index $(\beta_1 p_m^* + \beta_2 p_x^*)$ of the dollar prices p_m^* and p_x^* of the specific imports and exports of the country in question, or whether we use instead a more general dollar-price index $\bar{p}^*$; nor, if we use $\bar{p}^*$, does it matter what its composition is.

Third, we may be concerned with the empirical analysis of real-world data characterized by ample fluctuations in the relative prices of individual goods (and groups of goods) as well as irregular movements in the general dollar price level (however defined). Here we want to find a deflating index that defines a meaningful concept of the real dollar's worth. At this stage I would suggest ruling out goods in the nontradable category. For example, technological advance in the tradables category in the United States and other advanced countries can cause a rise in the dollar prices of nontradable goods and services while the general dollar price level of tradables stays relatively constant. One would not expect such a change to cause an adjustment of the real exchange rate (properly defined) of a developing country. A simple way to ensure that this attribute also applies to our *measure* of the real exchange rate is to keep nontradable goods and services out of the index used to convert nominal dollars' worth into real dollars' worth.

At this point I have limited our search for the relevant deflator to the subset of goods that I call tradable. I believe the most interesting question here is whether (a) we should use one index (based on the country's own exports and imports) of the value of the dollar when we are talking of the real exchange rate of Spain, another when we are dealing with the real exchange rate of India, a third for Colombia, and so on or (b) we should seek a common measure of the value of the dollar to be used in all cases.

The choice between (a) and (b) is not clear-cut or obvious, but my own inclination is strongly toward (b). In the first place, a country by its own trade policy can alter the composition of its tradables: it can drive goods out of the import category by prohibitions or very high

tariffs, and it can drive goods out of the export category simply through a policy of generally heavy protectionism (leading to such a strong appreciation of the real exchange rate that many exports are rendered unprofitable). On the whole, it does not seem appropriate for such policy-induced changes in the mix of a country's traded goods to dictate changes in the index used to convert inflated dollars into dollars whose purchasing power is constant over time.

Second, we definitely want to be able to distinguish situations in which the disturbance is a change in the relative dollar price of one or more key commodities from one in which a general world inflation prevails. An extreme example would be a country whose sole export was natural gas and whose principal imports were petroleum products. An energy price boom could then cause the dollar prices of both its exports (p_x^*) and its imports (p_m^*) to rise by the same percentage. Even though this might have the same effect on the particular country as a general world inflation would, that similarity would be picked up in the analysis by working with the relative prices ($p_x^*/\bar{p}^*$) and ($p_m^*/\bar{p}^*$) and using $\bar{p}^*$ as the general dollar-price deflator. This procedure seems to me better than ignoring $\bar{p}^*$ and using a country-specific term ($\beta_1 p_m^* + \beta_2 p_x^*$) as the general dollar deflator.

A third consideration is the fact that a fair amount of empirical work in international economics deals with cross-sections of countries. Here a definition of the real dollar's worth that remains invariant as one moves from country to country (at any given time) has obvious appeal.

Fourth, and in a similar vein, there are occasions a commodity-price rise has an impact on the economies of the countries producing or using that commodity. It would seem reasonable in such circumstances to deal with a rise in the relative dollar price of, say, oil that is the same for all countries. This, of course, would not be the case if the general deflating index differed across countries, weighting the different commodity prices by their relative importance in each country's own trade. Particularly for a commodity like oil, which is practically the sole export in some producing countries and has a more moderate weight in others, differing weights for the commodity in an index of the form ($\beta_1 p_m^* + \beta_2 p_x^*$) might cause a doubling of oil prices to be reflected as changes of very different percentages in the relative world-market price of oil in different countries. But this does not seem sensible to me. The price of oil, translated into local currency and expressed relative to the domestic general price level $\bar{p}_d$, will very likely differ from country to country, and in ways that reflect how the relative importance of oil in total output, exports, consumption, and so on differs among countries. But here I am not talking of the relative price of oil ($p_j^* E[1 + t_j]/\bar{p}_d$) within Nigeria, Indonesia, or Venezuela. Instead I am talking about its relative price ($p_j^*/\bar{p}^*$) in the world market. The former relative price does in reality differ among countries; and our analysis must capture

and explain this. I see no reason, however, why the relative price of oil in the world or dollar economy should differ from country to country.

I therefore propose that the index $\bar{p}^*$ for converting nominal dollars' worth into real dollars' worth be an index of the dollar prices of tradable goods and that the weights used for the different goods in this index should not vary as we move from one developing country to another. I allow for the possibility that in a particular developing country the relative prices of both its importables and its exportables could rise (or fall) during a given period; the analysis then would capture the total effect of such a change as being similar, for the country concerned, to that of a general world inflation.

The single index $\bar{p}^*$ can be thought of as an index of the prices of tradable goods "somewhere on the high seas." The analogy is apt because it clearly connotes that there is no principle dictating that it should be an index of U.S. prices, or German prices, or U.K. prices.

Throughout this paper I have talked of the dollar's worth as the unit of measurement of tradables. This is clearly the result of the dominance of the U.S. dollar as the key currency during the past few decades and of its likely continued importance into the next few. As a consequence of this role of the dollar, many international trade statistics are measured in terms of dollars; this creates a pragmatic necessity for a deflator to convert these nominal dollar data into real terms.

The most natural, readily available index for doing this job is the U.S. wholesale price index. But it is not difficult to convert the German, British, or Japanese wholesale price indexes into dollar terms by multiplying by the dollar price of the mark, the pound, or the yen. On this basis we could then create a dollar wholesale price index based, say, on the relative weights of the different major currencies in the SDR (that is, Special Drawings Rights, the unit, a basket of major currencies, in which credit from the International Monetary Fund is measured). The index would then be not a U.S.–price index but a *dollar*-price index, one that could appropriately be used to deflate trade statistics expressed in dollars and to trace over time the real exchange rates reflecting the price of the dollar in different countries' domestic currencies.

One alternative to the use of wholesale price indexes is to work with those components of GDP deflators that are most readily identifiable as relating to tradables. These are clearly those for the manufacturing, agricultural (including forestry and cattle raising), and mining sectors. With these components it would be easy to construct for any country a national index of tradables prices.

Once again one could here think of using the U.S. "tradables GDP deflator" as the relevant index, or alternatively a weighted average of several countries' "tradables GDP deflators," each converted into dollar terms by the relevant dollar exchange rate of the respective country's currency. The appeal of this index is its conceptual clarity, with

respect to both the definition of tradable goods (here, manufactures plus agricultural and mineral products) and the weights with which their prices are combined in each country (that is, the relative weights they have in the corresponding GDP). The disadvantages of this index are that it is never available on a monthly basis (and not always even quarterly) and that it often appears with a long lag and in relatively obscure sources.

My vote for work to be done in the near future would be to use the U.S. wholesale price index as the deflator for the dollar values of trade. If consensus regarding the conceptual framework is approached, one can hope that the International Monetary Fund might begin to publish (in *International Financial Statistics*) monthly indexes of the wholesale prices in a number of major countries (say, those whose currencies compose the SDR), converted into dollars by the relevant exchange rate and also, if possible, averaged together (presumably with SDR weights). Once such an index was regularly calculated and readily available, I believe it could claim superiority over the U.S. wholesale price index for the purpose at hand.

It is also my belief that indexes based on components of the GDP deflator, either of the United States alone or of a combination of countries, will be useful in the future, but for rather more restricted purposes than those based on wholesale price series. Nonetheless, I believe the time is ripe for researchers to make imaginative use of price indexes of tradables baskets that are built up from corresponding components of GDP deflators.

11.7 Reflections and Conclusions

The writing of this paper has been much more difficult than I had initially anticipated. The process has been sobering, too; among other things I have come to appreciate how a concept of the real exchange rate that is simple and obvious in one context can lead one seriously astray in others.

Among the contending concepts are (a) the price level of a country's tradables deflated by that of its nontradables, (b) the nominal exchange rate deflated by a general price index, (c) the nominal exchange rate (for example, the peso price of the dollar) double deflated by a peso-price index and a dollar-price index of a similar concept, and (d) the nominal exchange rate deflated by an index of nominal wages and salaries.

Of these, concept (a) is very naturally suitable in examining problems of international capital movements and the transfer problem generally; concept (b) is quite appropriate for dealing with internal inflation in the country in question, as well as for handling other policies, such as tariffs, taxes, and subsidies; (c) has been sanctified for the better part

of a century in the literature on purchasing power parity, and it is appropriate when monetary movements take place at different rates in the country in question and in the rest of the world; and (d) is powerful medicine, forcefully bringing home the fact that a required devaluation of the real exchange rate often necessarily entails a fall in real wages and salaries.

Being a firm believer that language (and communication in general) must always be understood in the context in which it is imbedded, I am not too uncomfortable with the thought that these and other competing notions of the real exchange rate will probably swirl through economic discourse for years to come. But I am quite a bit more uncomfortable with that idea now than I was before I undertook writing this paper. The trouble is that, unlike such issues as whether demand elasticities are defined as positive or negative and whether an exchange rate is taken to be the dollar price of the peso or the peso price of the dollar—which are simple ones—the issues raised by the different usages of the real exchange rate are complex. Moreover, the problems involved are not widely appreciated, so that people who are thinking in terms of one concept may well find unintelligible or downright stupid the things that are said by others who have a different concept in mind. So complex and intertwined are the issues that I am supremely confident of only one thing: Despite the best efforts of myself and others, much confusion will surround the concept of the real exchange rate for a long time to come.

I have been chastened, also, in writing this paper by the fact that all too recently I myself used the above concepts more or less interchangeably, at times explicitly listing concepts (a), (c), and (d) as three guises in which the real exchange rate appears. How fateful that I should now come forward as a defender of concept (b) and as an advocate of yet another concept, (e), double deflation using an index of the world prices of tradables as the foreign deflator and a general index like the CPI as the domestic deflator! But so it is.

The first task (or test) that I would require of a concept of the real exchange rate is that it correctly replicate simple textbook cases of exchange rate determination. This is done admirably by the concept $(E/\bar{p}_d)$, so long as the general price level in the rest of the world is taken as given.

In figure 11.1 I dealt with six disturbances, assuming a flexible exchange rate and a monetary policy that held the general internal price level $\bar{p}_d$ constant. They were the imposition of a general tariff, the imposition of a general export tax, an inflow of capital spent on tradable goods, an inflow of capital spent on nontradable goods, a rise in the world price of a country's exports, and a rise in the world price of a country's imports.

These cases gave the familiar and expected answers, but in the process it was underscored that (for the flexible rate case, at least) the exchange rate is a price that is set *in the market for foreign exchange.* The units that are demanded and supplied are dollars of foreign exchange. To link this fact to the demand for imports and the supply of exports, we must measure the quantity of each individual import and export good in units that have a given value (say, one dollar) in the world market. Based on this assumption we can construct demand and supply curves for foreign exchange and determine the equilibrium exchange rate. One key result was that the demand and supply curves for foreign exchange shift when the world prices of import and export commodities change, causing changes in the nominal exchange rate for a given $\bar{p}_d$.

Figure 11.2 presented my first explicit introduction to the real exchange rate. I there explored the process of adjustment to disturbances like those in figure 11.1, only now under the assumption that the nominal exchange rate was fixed. Here, as is well known, the adjustment process works through monetary expansion and contraction; identical results to those of the first figure are obtained, however, when the price of foreign currency is expressed as $E/\bar{p}_d$. In figure 11.1 the adjustment is in the numerator of this expression; in figure 11.2 it is in the denominator.

The concept $E/\bar{p}_d$ is exceedingly robust. Using it one can handle essentially all types of disturbances originating in the domestic economy and basically any relevant disturbance originating abroad (since the only channels through which foreign disturbances would enter the picture are movements of capital and changes in the world prices of tradable goods and services). The only flaw I find in using $E/\bar{p}_d$ as the general and definitive concept of the real exchange rate is the fact that its equilibrium value falls (signifying an appreciation of the peso or other local currency) when there is a general world (or dollar) inflation. Where world (or dollar) inflation is not an intrinsic part of the picture (for example, in any and all theoretical analyses of the consequences of domestic policies and other domestic disturbances), $E/\bar{p}_d$ is, I believe, the correct concept to use.

Where world inflation is the problem (or an integral part of the problem), the concept of the real exchange rate can be made more nearly symmetrical by introducing a world-price deflator $\bar{p}^*$ along with the domestic price deflator $\bar{p}_d$. The real exchange rate concept then becomes $\bar{p}^*E/\bar{p}_d$. This is a natural extension of the original concept; when the real value of the dollar is not changing, we can treat the basic demand and supply as being for the dollar's worth of foreign exchange. When the real value of the dollar is changing, basic demand and supply will be for the *real* dollar's worth of foreign exchange.

But note that if we fail to introduce $\bar{p}^*$ into the expression for the real exchange rate, the consequences are not cataclysmic; we simply obtain an expression that could be denominated "the real peso price of the dollar, uncorrected for dollar inflation." This type of index has in fact been widely and quite successfully used in cases of countries experiencing very rapid inflation.

Of the alternative concepts of the real exchange rate mentioned at the outset of this section, the one I consider most vulnerable is p_t/p_n, the ratio of the price level of tradables to the price level of nontradables. Taken at face value, this index simply gives the wrong answer too much of the time. The right answers to questions concerning the real exchange rate are those represented in figure 11.1. Of the six disturbances there considered, the concept p_t/p_n does well for only two: a capital inflow spent on tradables (for which the supply of tradables would shift to the right by the amount of the capital inflow and the demand would shift likewise, leaving p_t/p_n unchanged); and a capital inflow spent on nontradables (adjustment to which would require that an excess demand for tradables be generated, causing a fall in the equilibrium level of p_t/p_n). An import tariff and an export tax would each have an ambiguous effect on the price level of tradables, since one component of it (the price level of importables) would rise under either of the two disturbances, while the other component (the price level of exportables) would fall. Whichever one of these two dominated, the effect on p_t/p_n would be the same under either a general import tariff or a general export tax that introduced the same gap between the price levels of importables and exportables, respectively. As the analyses of figures 11.1 and 11.2 show, however, the real exchange rate must unequivocally fall in the case of a general tariff and rise in the case of a general export tax. The concept p_t/p_n therefore *cannot* give the right answer in these cases.

A similar conclusion can be drawn with respect to changes in the world prices of specific tradable goods. A rise in the world price of exports (alone) must cause a fall in the equilibrium real exchange rate. Yet since exportables are an important component of tradables (they could be much more than half or much less than a half, even with balanced trade, because of the existence of domestic consumption of exportables and domestic production of importables), the effect of a rise in export prices might cause the index p_t/p_n to rise, or to fall, or to remain the same. Here again p_t/p_n does not lead us to the correct answer.

We have seen that the effect of a rise in import prices on the demand for foreign currency (and hence on the real exchange rate) will depend on the price elasticity of import demand, the effect being nil with unit elasticity, negative under elastic demand, and positive under inelastic

demand. The elasticity of import demand does not even come into play when one considers the ratio p_t/p_n; this ratio *must* rise if the world prices of imports rise while those of exports remain the same. Thus, p_t/p_n once again gives the wrong answer.

In my view, two correct answers out of six is not good enough. Even worse, an extension of the analysis to cover other types of domestically imposed distortions—such as quotas, price supports, and domestic taxes and subsidies—would reveal still further failures of the p_t/p_n concept to predict reliably what would happen to the nominal exchange rate under conditions of a stable general (or for that matter a stable nontradables) price level.

The use of the ratio p_t/p_n has yet another defect: it diverts attention from the necessity of measuring both the demand for and the supply of tradables in dollars' worth. (Actually, if this is done, and if p_t is explicitly defined as the internal price at the border [that is, without tariffs, taxes, or subsidies] of a dollar's worth of tradable goods, the p_t/p_n ratio can be rehabilitated.) The p_t/p_n concept focuses attention on tradables and nontradables as two bundles of goods and services competing for the interest of demanders and for the application of resources by suppliers. One's instinct is to treat those bundles symmetrically, when what is called for instead is an asymmetric treatment. One is also inclined to treat tradables as a single bundle, when familiar disturbances require the separation of importables from exportables and often the breaking down of these categories into individual commodities or groups.

In general the p_t/p_n concept can be amended to produce the right answers when it is employed. Two basic elements are involved here. First, exportables and importables must be expressed in units of "dollars' worth." When this is done, and for "properly defined" curves, the excess-demand curve for importables becomes the demand curve for imports, the excess-supply curve of exportables becomes the supply curve for exports, and we are back in a framework of the supply and demand for foreign exchange. But we must work hard to "define properly" the demand and supply curves of importables and exportables. In general we must make beforehand the necessary corrections so that the tradables price reflected on the curve is the border price of a dollar's worth of tradables. Thus, for a tariff the demand for and supply of exportables would remain untampered with, but the height of the supply and demand curves for importables could be reduced by the amount of the tariff. There would be an outward shift of the supply of importables and an inward shift of demand, with the result that the supply curve of tradables (importables plus exportables) would shift outward; and the demand curve inward, producing a fall in the equilibrium real exchange rate (p_t/p_n in this modified framework). For any disturbance being analyzed, it is possible to find the necessary shifts of the supply

of and demand for exportables or importables, or both, that will result in the correct final result. The underlying principle here is that the equilibrium p_t in the p_t/p_n ratio must always be the border price, net of import tariff, gross of export tax, gross of import subsidy, net of export subsidy, and so on. It must always be what an import buyer pays per dollar's worth of a (hypothetical if necessary) nondistorted import good, or what an exporter receives for selling a dollar's worth of a nondistorted export good. Once this is done, the p_t/p_n framework is rehabilitated. I doubt, however, that the result is worth the effort, since other means exist of reaching the same conclusions more directly and simply.

The other concepts of the real exchange rate are more easily employed. To use the nominal exchange rate divided by an index of wages and salaries is just like using $E/\bar{p}_d$, with the general internal price level being represented by the wages and salary level. (Actually, the corrected p_t/p_n ratio, just discussed, substitutes p_n for $\bar{p}_d$ in the same way.) None of the above are corrected for foreign inflation—which for solving many analytical problems is not necessary and which may not be necessary in dealing with particular practical ones.

If one is to correct for foreign inflation, I do not believe that deep theoretical considerations enter seriously into the choice of the index to be used. Foreign CPI indexes and foreign GDP deflators have been widely used, particularly in tandem with domestic price deflators ($\bar{p}_d$) based on the same concept. Since the nontradables of the rest of the world have little connection to a given developing country's economy, I prefer to use as a foreign price deflator $\bar{p}^*$, which explicitly concentrates on tradable goods. And I prefer a general dollar-price index to one that is based on a country's own tradables weights. For practical reasons I prefer a dollar-price index that is quickly and readily available. The U.S. wholesale price index meets this criterion, as does a weighted average of the wholesale price indexes of major trading nations, converted to a dollar basis using the exchange rates of their respective currencies vis-à-vis the dollar.

An alternative would be to use for $\bar{p}^*$ the tradable component of the U.S. GDP deflator or a weighted average of the corresponding components of the GDP deflators of the major trading nations (once again converted to a dollar basis using the prevailing exchange rates). Indexes based on GDP (or GNP, as the case may be) deflators probably have greater conceptual clarity, but they are not available monthly and are quite slow to appear. Of the options available for precisely defining the composition of $\bar{p}^*/\bar{p}_d$, I would at the one extreme opt for the U.S. wholesale price index as representing $\bar{p}^*$ and the country's own consumer price index as representing $\bar{p}_d$. This option is useful for work that requires readily available easy-to-use, and monthly data. At the

other extreme I would consider an index constructed from agricultural, mining, and manufacturing components of the U.S. GNP deflator for $\bar{p}^*$ and the individual country's own total GDP deflator for $\bar{p}_d$. This option is appropriate largely for time-series work that requires annual data. It should be clear that these are preferences, not choices determined by profound analytical dictates. In other words, there is much room for fruitful debate over and experimentation with different indexes.

A final note concerns the design of empirical work aimed at explaining movements over time in the real exchange rate. The analysis of this paper suggests a partial list of explanatory variables that might be useful; it also carries warnings that certain variables might not be useful at all, and still others only in restricted cases. An ideal list of explanatory variables would certainly include net capital inflow spent on tradable goods, net capital inflow spent on nontradable goods, the world price level of a country's exports, the world price level of its competitive imports, the world price level of its noncompetitive imports, the average strength of tariffs and other restrictions inhibiting import demand, and the average strength of export taxes (subsidies) and other policies inhibiting (or promoting) export supply.

The above list is only partial, as I have limited it to items explicitly discussed in this paper. Nonetheless, it clearly shows how difficult is the task of empirically explaining movements in the real exchange rate. We rarely have breakdowns as to the types of goods on which a country's foreign borrowings are spent, yet we know that only the part spent on nontradables should influence the real exchange rate. In examining small countries we usually can obtain world prices for a few principal exports, but import prices are difficult to come by, especially if we want to classify them into competitive or noncompetitive imports (or other categories that distinguish groups with different import demand elasticities). We usually have average receipts from import tariffs, but we have little clue as to the strength (and the variation over time) of nontariff barriers. The story is similar with the incentives (particularly the disguised ones) that countries often give to certain export activities.

The list is interesting for the variables it includes, and it is also sobering in light of how difficult it is (in many cases) to approximate the actual variables one has to use to the desired ones. But the woes of empirical workers are familiar, particularly those related to the failure of actual data series to measure what one really wants.

Let me therefore end on a more positive note. The above list intentionally excludes the terms-of-trade (the ratio of export to import prices) variable in favor of separating it into components. The lesson is to avoid trying to work with this variable as an explainer of real exchange rates changes. The list explicitly includes export taxes as variables causing the real exchange rate to rise; these have been extremely im-

portant (and variable over time) in a number of countries (among them Argentina and Uruguay), but to my knowledge they have not been used in real exchange rate regressions. Also useful are the concept of net foreign borrowing as a separate argument in the demand functions for different categories of goods and the concept of the fraction of foreign borrowing spent on tradables as being important in determining its ultimate effect on the real exchange rate. These observations, derived from analyzing the underlying concept and measurement of the real exchange rate, may ultimately be of use in empirical investigations that attempt to explain its variations.

Appendix: Impact of a Rise in P_j^* on the Real Exchange Rate

Analysis of Substitution Effects

This is not the place for an extended treatment introducing further complications to the above analysis. But I cannot avoid examining at least in passing the situation in which the demand for imports of the good whose world price changes is not independent, say, of other tradables prices. The issue at stake is standard in the demand for composite commodities, and it is much like the difference between long-run and short-run marginal cost curves. Assuming gross substitutability in all relevant respects, we will have, at any viable equilibrium position (i) a demand curve ($\bar{D}\bar{D}$ in figure 11.4) for imports of j that assumes all other tradables prices move together with that of j (that is, tradables prices move as the exchange rate moves) and (ii) a demand curve (D^*D^*) for imports of j that assumes only p_j^* moves, while other import prices remain constant at their previous level. Assuming that import j is a gross substitute for the rest of the tradables, we find that D^*D^* will be more elastic than $\bar{D}\bar{D}$.

Consider A′ in figure 11.4 to be a point like A' in figure 11.3a. Imagine having started from a point like A in figure 11.3a, with that equilibrium being disturbed by a rise in p_j^*. There would be a curve like D^*D^* and one like $\bar{D}\bar{D}$ through A; the two demand curves depicted in figure 11.4 are the "remappings" of these original curves as a consequence of the rise in p_j^*. Likewise, A' is simply the remapping of the original point A. Any adjustment involved must take off from this point. Since only p_j^* has changed, it would seem at first glance that the new equilibrium would be at C. But one must ask what is the meaning of the distance (CF) between D^*D^* and $\bar{D}\bar{D}$ at this point. Obviously, this distance

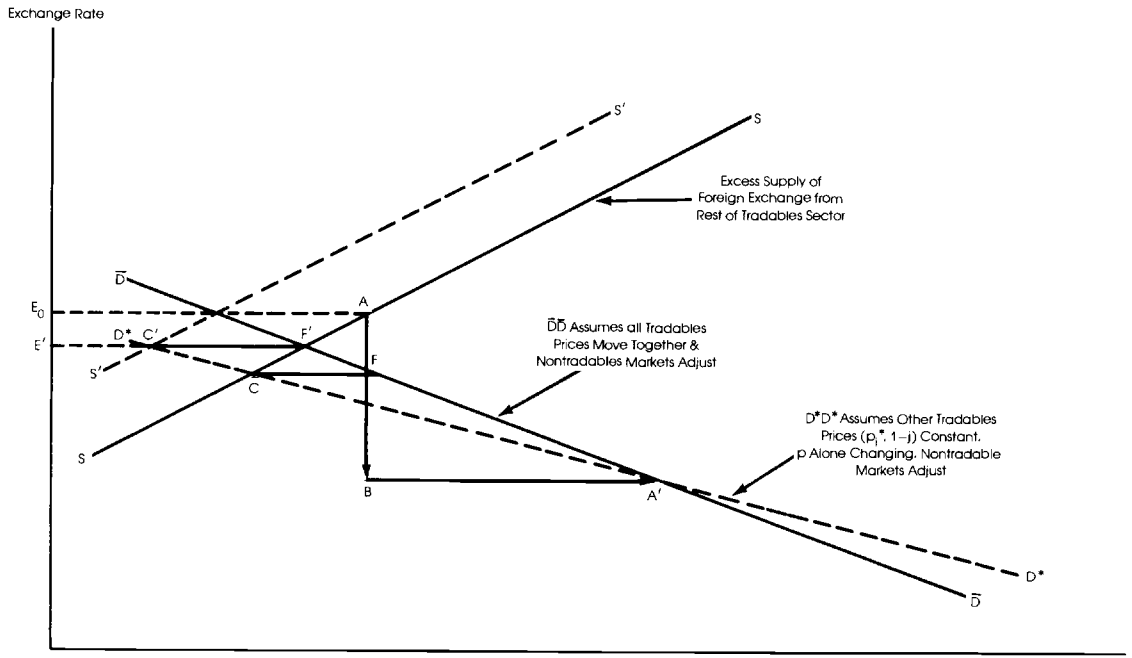


Fig. 11.4 Foreign exchange spent on imports of good *j*.

represents the additional substitution that takes place against good j, when other tradables prices are held constant rather than moving up from A′ pari passu with p_j^*. But if people are substituting away from j and toward other tradables, the excess supply curve of foreign exchange arising out of these other tradables markets will shift to the left. Thus, point C is not an equilibrium point, as it is on the old excess supply curve, but not on the shifted one.

Actually, the new equilibrium must be at C' (neglecting income effects). Remembering that the units of tradables are being measured in "dollars' worths"; the extra substitution (at a given price) away from good j and toward other tradables must cause the demand for those other tradables to expand by a like amount. This in turn causes the excess supply curve of other tradables to shift to the left by the same amount. The distance $C'F'$ is thus at one and the same time the leftward shift in the excess supply curve of other tradables *and* the extra substitution in demand of favor of these other tradables because only p_j^* (not all tradables prices) has risen. The end result of the whole process is that the equilibrium exchange rate falls from E_o to E'. It is thus exactly as if one had moved up on $\bar{D}\bar{D}$ from A' to F', neglecting entirely the fact that it was only p_j^* that changed and forgetting entirely about D^*D^* and $S'S'$.

Thus, we need be concerned with only one demand curve for imports of good j—that represented by $\bar{D}\bar{D}$. When p_j^* changes, this curve will be remapped, as shown in figure 11.3a, but no serious complexities are introduced by the changing of only one (or any subset) of the world prices of importable goods. Demand curves will be displaced, downward or upward depending on their elasticities of demand at the points in question, but we do not have to bring in new concepts of demand to take care of the case of nonindependence.

The same story holds for the supply of exports. One can visualize a supply curve of exports of good k, built on the assumption that all tradables prices move together, and another built on the assumption that the other prices are held constant, while only p_k^* moves. The difference between these two curves at an exchange rate like E' will be (for a rise in p_k^*) the substitution (in demand, for present purposes) against good k and in favor of other tradables—something that does not occur if all tradables prices move together. One of the two supply curves will be like D^*D^* in being based on the assumption that only the price of k rises, while the prices of other tradables remain fixed. Along this supply curve and the old excess demand curve for tradable goods other than k, there will be a point analogous to C. This will not be an equilibrium because it fails to take into account that any substitution away from k and toward other tradables will shift to the left, by a like amount, the excess demand for foreign currency generated in

that set of markets. Thus, the new equilibrium will be at a point like C' where the extra substitution away from good k is just offset by the rightward shift in the excess demand for foreign exchange. Again, in short, one can operate with the supply-side counterpart of the demand curve $\bar{D}\bar{D}$ without having to concern oneself with the counterpart of D^*D^*. Substitution effects among the tradables end up cancelling themselves out.

Analysis of Income Effects

It remains to speak about income effects. These are dealt with explicitly in figures 11.5a and 11.5b. I have just shown that we can work with tradables demand and supply curves built on the assumption of a pari passu movement of all tradables prices, so far as substitution effects are concerned. The course of prudence is to thank God for this bit of largesse (in clarifying our thoughts and simplifying our tasks), and build our analysis of income effects around it. Once we realize this, a neat trick can be brought into play. Rather than work with excess demand and excess supply curves of the D^*D^* type, why not continue to work with $\bar{D}\bar{D}$ and its supply-side counterpart? We know that if p_j^* (for an import) rises, the induced change in real income (measured in dollars) is $-M_j dp_j^*$, where M_j denotes imports of good j and dp_j^* denotes the percentage change in the world price of j (recall that all tradables are expressed in units whose price is one dollar). This change in income will be spread among commodities in accordance with the respective marginal propensities μ_i of the society to spend on each of them. Since some of them are exportables and some importables, the consequence is that both the compensated excess demand curve and the compensated supply curve will be shifted by the income effect. This is a painful thought, especially since any given equilibrium real exchange rate can be the result of a number of different disturbances, each of which have different effects on the real income of the society.

Now for the trick. Instead of trying to incorporate the income effect of a given disturbance into the excess demand and supply relations we are dealing with, why not insert it as a wedge between the two compensated curves? In that case we need only break down the income effect into two fractions: μ_t spent on tradables, and μ_n spent on nontradables.

Figure 11.5a is built like figure 11.3a, except now we know that we can work with SS as it stands and with the remapped $(\bar{D}\bar{D})$ in seeking the new equilibrium. Some of the change in real income will result in reduced spending on tradables other than j. This will cause SS to shift to the right by an amount equal to $(\mu_t - \mu_j)M_j dp_j^*$. It will also lead to

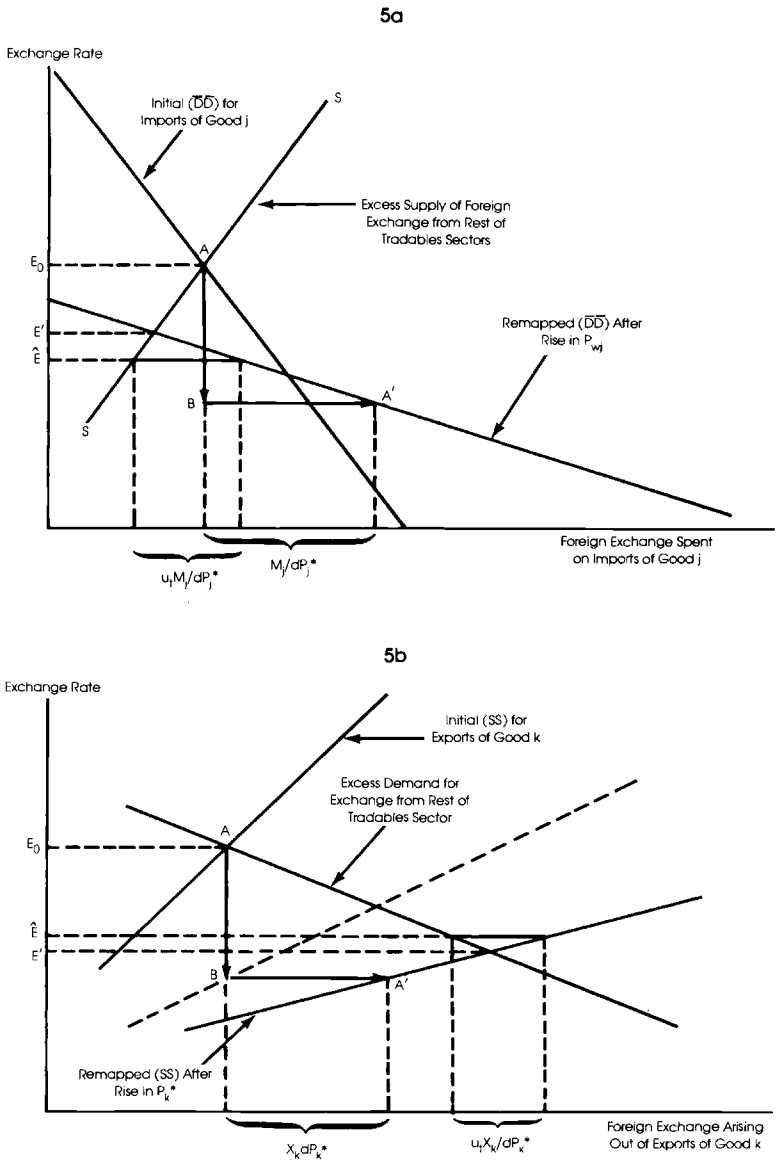


Fig. 11.5 Real exchange rate analysis including the income effects of changes in import or export prices.

less spending on good j itself. This will cause the import demand curve for j to shift to the left by the amount $\mu_j M_j dp_j^*$. The sum of these two shifts is always $\mu_t M_j dp_j^*$, whatever the import good we happen to call good j. Thus, if we know $\mu_t M_j dp_j^*$, we know the size of the wedge to insert between SS and $\bar{D}\bar{D}$ in figure 11.5a, and this is enough to tell us where the equilibrium exchange rate, $\hat{E}$, will be, after accounting for income effects. (Of course, we will need to know the separate value of μ_j in order to determine the equilibrium value of the abscissa, in cases in which that is required.)

Figure 11.5b shows the counterpart of this situation for a rise in the world price of export good k. The remapping of the excess (export) supply curve of good k is done just as in figure 11.3b. Recall that at A' exporters would be replicating the situation at A, providing the same quantity and receiving the same peso price. The point at which the excess demand curve for foreign exchange from the rest of the tradable sector crosses the remapped supply curve for exports of k would call for equilibrium at E'. But this will not hold in the presence of real income effects. Properly, the demand curve would shift to the right by $(\mu_t - \mu_k)X_k dp_k^*$, and the remapped ($SS$) would shift to the left by $\mu_k X_k dp_k^*$. But we can obtain the same equilibrium result by inserting a wedge equal to $\mu_t X_k dp_k^*$ between the excess demand curve and the remapped (SS). When this is done, the equilibrium exchange rate $\hat{E}$ results.

Notes

1. This paper is explicitly designed as an introduction; I have attempted to make it accessible to students and to other readers with limited formal training in economics, as well as to seasoned professionals in the field. Although the last group may find much of the expository material familiar, I believe that the analysis as a whole enables us to see more clearly than we have been able to from the literature to date some of the main issues surrounding the concept and the measurement of the real exchange rate. A more extended exposition of some of this material can be found in Harberger (1985).
2. This point will be treated in more detail in section 11.4.
3. Once again, for further elaboration of the relevant analysis, see section 11.4.
4. There are some interesting technical relationships among the elasticities of demand for imports and for tradables in general. These are briefly explored in the appendix.
5. This is what is done in mathematical treatments of most general-equilibrium problems. The other general-equilibrium tradition has its roots in international trade theory; it deals with a relatively small number of identifiable commodity groups, one of which perforce ends up being chosen as the numeraire. This choice is what we are concerned with here.

Selected Bibliography

Arriazu, R. H. 1983. Policy interdependence from a Latin American perspective. *International Monetary Fund Staff Papers* 30 (March): 113–63.

Calvo, G. and Rodriguez, C. 1979. A model of exchange rate determination under currency substitution and rational expectations. *Journal of Political Economy* 85 (June): 617–25.

Corden, W. M. 1981. The exchange rate, monetary policy and North Sea oil: The economic theory of the squeeze on tradeables. *Oxford Economic Papers*, Supplement (July): 23–46.

Dornbusch, R. 1974. Real and monetary aspects of the effects of exchange rate changes. In *National monetary policies and the international financial system*, ed. R. Z. Aliber. Chicago: University of Chicago Press.

———. 1976. Expectations and exchange rate dynamics. *Journal of Political Economy* 84 (December): 1161–76.

Edwards, S. 1984. The external sector in developing countries. *Princeton Essays in International Finance* no. 156 (December). Princeton: International Finance Section, Princeton University.

Frenkel, J. and Rodriguez, C. 1981. Exchange rate dynamics and the overshooting hypothesis. IMF Departmental Memo no. 81/88 (December). Washington, D.C. International Monetary Fund.

Harberger, A. C. 1982. The Chilean economy in the 1970's: Crisis, stabilization, liberalization reform. In *Economic policy in a world of change*, Carnegie-Rochester Conference Series on Public Policy, eds. K. Brunner and A. Meltzer. Amsterdam: North-Holland.

———. 1983. Dutch disease: How much sickness, how much boon? *Resources and Energy* 5 (no. 1): 1–20.

———. 1985. Elements of real exchange rate analysis. Washington, D.C.: Economic Development Institute, World Bank, April. Photocopy.

———. 1985. Lessons for debtor country managers and policymakers. In *International debt and the developing countries*. A World Bank Symposium, eds. J. Smith and J. Cuddington. Washington, D.C.: World Bank, March.

Harberger, A. C. and Edwards, S. 1982. Causes of inflation in developing countries: Some new evidence. Paper presented at the 95th Annual Meeting of the American Economic Association, New York, December.

McKinnon, R. I. 1973. *Money and capital in economic development*. Washington, D.C.: Brookings Institution.

———. 1982. The order of economic liberalization: Lessons from Chile and Argentina. In *Economic policy in a world of change*. Carnegie-Rochester Conference Series. Amsterdam: North-Holland.

Mussa, M. 1982. A model of exchange rate dynamics. *Journal of Political Economy* 90 (February): 74–104.
Nunes, L. 1984. Optimal capital accumulation and external indebtedness in a two sector small economy model. Ph.D. dissertation. Chicago: University of Chicago.
Obstfeld, M. 1980. Imperfect asset substitutability and monetary policy under fixed exchange rates. *Journal of International Economics* 10:177–200.
Penati, A. 1983. Expansionary fiscal policy and the exchange rates. *International Monetary Fund Staff Papers* 30 (September): 545–69.
Rodriguez, C. A. 1982. Gasto publico, deficit y tipo real de cambio: Un analisis de sus interrelaciones de largo plazo. *Cuadernos de Economia* 57 (Universidad Pontificia de Chile) (August): 203–16.
Sachs, J. 1982. The current account and the macroeconomic adjustment process. *Scandinavian Journal of Economics* 84 (no. 2): 147–59.
Salter, W. E. 1959. Internal and external balance: The role of price and expenditure effects. *Economic Record* 35 (August): 226–38.
Sjaastad, L. 1983. International debt quagmire: To whom do we owe it? *The World Economy* 6 (September): 305–24.
van Wijnbergen, S. 1984. The "Dutch disease": A disease after all? *Economic Journal* 94 (March): 41–55.

Comment

Carlos Díaz-Alejandro

An admiring connoisseur of smorgasbord is selective. Faced with Harberger's rich table, I will dwell on just two of his servings: the definition of the "world dollar price level" relevant for developing countries (LDCs), and exchange rate policy differences among LDCs and between LDCs and developed countries.

Defining the world dollar price level relevant for LDCs is far from an unimportant or easy matter. Debates over imported inflation, exchange rate policy, and the real cost of servicing the external debt have gained in acrimony in recent years, partly due to the use of different yet plausible statistics for that price level. In Argentina and Chile, for example, those who defended government policies during the years 1978–80 argued that the world price level relevant to those two countries was rising at an annual rate of 30 percent per annum (more than double the inflation in U.S. wholesale prices), so that persistent local inflation, a sluggish pace of domestic currency devaluation, and heavy borrowing abroad were easier to explain and justify.

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Since 1972 severe changes in relative prices in the world economy have indeed generated a rich menu of candidates for the world price level, depending on how different goods and services are weighted. For long-term trends this is, of course, less of a problem than for exercises involving two or three years. The already mentioned two-year period, 1978–80, during which some of the most adventurous Southern Cone policies were implemented, coincided with particularly turbulent and confusing fluctuations in international relative prices.

Table C11.1 collects a variety of indicators for dollar inflation during the period 1972–83. Over the whole 11-year period there is a clustering between 7 and 11 percent per annum, using the most plausible indicators. But international dollar prices for LDC imports, including oil, seem to have risen more than price indexes for the U.S. economy. A difference of a couple of percentage points per annum can, of course, cumulate to a very significant gap over 11 years. Export unit values for Argentina, Brazil, and Chile show an inflationary trend distinctly lower than that of the U.S. price indexes and, a fortiori, than that for their imports. Note that the simple averages for import and export price inflation in those three Latin American countries over the 11-year period are very close to the U.S. measures of inflation. For all nonoil LDCs, the simple average of export and import inflation works out only a shade higher than that for U.S. wholesale prices, a generalization that can be extended to the domestic inflation of two classic, *very* open, small Latin American economies, Haiti and Panama, which have maintained rigid pegs to the U.S. dollar for many years. Over the long term the U.S. wholesale price index does well as a measure of dollar inflation, even for international prices, supporting Harberger's suggestion.

In short periods of only two years, however, we are in trouble. Table C11.1 documents the turbulence and unevenness in dollar price behavior during the periods 1972–74 and 1978–80. Although the U.S. wholesale price index did show more sensitivity than U.S. consumer prices and the GNP deflator, it lagged behind most international dollar prices during those two-year periods. But apologists for Southern Cone policies grossly exaggerated that gap for 1978–80. Given the numbers in table C11.1, it would be difficult to argue that the international dollar inflation relevant for the Southern Cone during 1978–80 went beyond a range of 18 to 22 percent per annum. Interestingly, a higher number could be justified for international inflation (and its gap vis à vis that in U.S. wholesale prices) during 1972–74. Note that in Haiti and Panama annual inflation during 1978–80 remained in the 11 to 15 percent range, somewhat lower than during 1972–74.

Of all subperiods shown in the table, 1974–78 exhibits the most 1960s-type, placid behavior. Inflation measures cluster. Only the collapsing Argentine and Chilean dollar export prices deviated much from the 7 percent per annum norm.

Table C11.1 **Selected Indexes of Annual Rates of Dollar Inflation, 1972–83, in Percentages**

Index	1972–83	1972–74	1974–78	1978–80	1980–83
Nonoil LDCs' import unit values	11	34	7	20	−2
Argentine import unit values	10	32	9	11	−2
Brazilian import unit values	12	34	6	24	0
Chilean import unit values	11	27	10	22	−2
Industrial countries' *export* unit values	8	22	8	14	−4
Nonoil LDCs' export unit values	9	34	6	16	−5
Argentine export unit values	6	35	−3	20	−7
Brazilian export unit values	6	30	5	9	−7
Chilean export unit values	5	41	−5	21	−11
Western Hemisphere export unit values	10	37	7	15	−5
Industrial countries' *import* unit values	10	31	7	21	−4
U.S. wholesale prices	9	16	7	13	4
U.S. consumer prices	8	8	7	12	7
U.S. GNP implicit price deflator	7	7	7	9	6
Panamanian consumer prices	7	12	5	11	5
Panamanian wholesale prices	11	20	9	15	7
Haitian consumer prices	11	19	7	15	9

Sources: Data on Argentine, Brazilian, and Chilean import and export dollar unit values obtained from worksheets of the United Nations Economic Commission for Latin America, courtesy of Andres Bianchi. Data on the U.S. GNP implicit price deflator obtained from U.S. Council of Economic Advisers, *Economic Report of the President* (Washington, D.C.: GPO, 1984), table B-3, p. 224. All other data obtained from International Monetary Fund, *International Financial Statistics*, Yearbook 1984, and January 1985 (Washington, D.C.: IMF, 1984 and 1985). The Yearbook 1984 does not present a Western Hemisphere import unit value; such a series is presented in the January 1985 *International Financial Statistics*, starting in 1979. "Nonoil LDCs" refers to line 201 in the *International Financial Statistics;* "Western Hemisphere" refers to line 205; "Industrial countries" refers to line 110.

The most recent subperiod, 1980–83, presents a remarkable picture: international deflation coexisted with mild U.S. inflation. Again the U.S. wholesale price index behaved closest to international prices, yet a significant gap remained, as during 1972–74 and 1978–80, but with a different sign. It is tempting to speak of U.S. inflation catching up with the higher international price inflation of 1972–80, or perhaps more accurately, of international deflation during 1980–83 wringing out some of the 1972–80 "excess" international inflation. What is more certain is that if one is calculating ex post real interest rates on the Latin American debt, a gloomier view emerges when using some weighted sum of international prices than the already dismal picture one would obtain using U.S. price indices. The real devaluations of Latin American currencies during 1980–83 would appear somewhat less dramatic if international dollar prices were used in the analysis (a point echoing

stylized facts of the early 1930s). On the other hand, the nonimported component of the domestic inflations in Latin America would loom larger for 1980–83.

Numerous puzzles remain. Even during short periods Haiti and Panama tend to follow U.S. price trends more than international price trends. This is particularly striking during 1980–83. Either their economies are not as open as they used to be, or the international price indexes have peculiar and unbalanced weights (note that Haiti and Panama have very different per capita incomes and, presumably, different consumption and production baskets, yet their price trends are similar). On balance, this evidence leads me to accept Harberger's recommendation for using the U.S. wholesale prices, even for short periods, although I do so with some misgivings and pleas for further research on the international dollar price level relevant for different types of LDCs.

Recent experiences in Latin America and elsewhere have reinforced the argument that exchange rate policy should differ between LDCs and most developed countries. Freely fluctuating exchange rates with substantial convertibility, an attractive option for most developed countries, remain out of reach for the majority of LDCs, except during short transitions or for the most advanced countries. Credible options for LDCs wishing to have a national currency seem limited to traditional fixed pegs to one currency or to a basket of major currencies, or to passive crawling pegs, for the larger LDCs.

Fuzzy but venerable optimum currency area considerations still carry weight for numerous very small LDCs, many with long traditions of price stability. Freely fluctuating rates among developed countries have complicated the choice of peg for these LDCs and have introduced some inevitable flexibility in their effective exchange rates. But *some* peg and *some* convertibility vis à vis at least one major currency remain the cornerstones of the credibility of national cash and coins, as well as of confidence in domestic banks. In these LDCs the relevant policy change may be either having a pegged nominal rate or having no national currency at all.

But what should keep larger LDCs with a long tradition of monetary autonomy, and often of monetary excess, from adopting freely fluctuating exchange rates with substantial convertibility? The simplest answer is that a majority of these countries are in a near-permanent state of policy experimentation, the success of which crucially depends on the real effective exchange rate and on the rate of devaluation. Those experiments typically include transitions toward less protectionist commercial policies, lower rates of inflation, and more efficient yet safe domestic financial systems. A truly flexible exchange rate regime would imply a substantial liberalization of capital movements.

This combination generates large changes in real effective exchange rates even in developed countries; in LDCs with thin future markets and shallow and shaky banking, financial, and political institutions, one would expect even greater exchange rate gyrations, which would threaten trade liberalization, inflation control, the stability and efficiency of the domestic financial system, as well as the reliability of signals emanating from the price system.

Because the real effective exchange rate is such a crucial variable for LDCs engaged in policy experiments, I feel uneasy about Harberger's pessimistic assessment of attempts to establish systematic empirical links between that variable and such at least partly exogenous variables as the terms of trade and capital movements, whose often violent fluctuations are a source of shocks to LDCs. Policy makers groping for a real effective exchange rate compatible with a more open and stable economy would gain much from knowing how that variable relates at least to the expected terms of trade and to "normal" capital movements.

The inability of preannounced nominal "active" crawling pegs to credibly deliver on a real effective exchange rate compatible with trade liberalization, stable capital flows, and the nimble adjustment of domestic relative prices to outside shocks has doomed "tablita" experiments. One can imagine a world in which the tablita would simultaneously reduce inflation, generate quickly the real exchange rate compatible with trade and financial liberalization, and coexist with orderly capital flows. Copper, corn, and coffee exporters, with long histories of domestic inflation and abrupt policy changes, are most unlikely ever to live in that world. Betting on the tablita is a very risky business for them.

Bailouts during the 1982–85 period have shown that one cannot expect the threat of losses and bankruptcies to be a major disciplining element keeping private capital inflows into LDCs near optimum levels. After this experience lenders will expect LDC governments explicitly to guarantee and therefore to control private as well as public borrowing abroad. In this sense, international lenders are imposing the use of exchange controls even on those LDCs disliking them; once inflows are regulated it appears inevitable to do so with capital outflows also. If exchange rates are roughly "correct" and if domestic inflations are below levels that make "currency substitution" too tempting, those controls may be accompanied by relatively few distortions and could provide some insurance against shocks and unwarranted panics. The danger, of course, is that they will be used as substitutes to desirable adjustments in the real exchange rate or to buttress extravagant levels in the inflation tax on domestic currency. One returns to the old truism that no exchange rate system can do well if fiscal and monetary policies

are out of control, while most exchange systems will do reasonably fine if fiscal and monetary policies are prudent and are expected to remain so.

Finally, it may be noted that multiple exchange rates have experienced a revival during 1982–85 in Latin America—not so much as a mechanism to tax exporters or to prevent further terms-of-trade deterioration, as during the 1930s, but as devices to bail out externally indebted private firms and public enterprises. Cheap dollars have been delivered and promised to those firms to keep them from bankruptcy and to keep their foreign creditors from blacklisting all domestic borrowers. The fiscal cost of these subsidies may be quite large.

Comment Mohsin S. Khan

Harberger's paper is certainly a wide-ranging and comprehensive piece. It would really not be too much of an exaggeration to say that it gives us just about "everything we ever wanted to know about real exchange rates," and perhaps more! In analyzing the various questions regarding real exchange rates, Harberger brings in his unique blend of economic intuition, technical skills, and a remarkable ability to synthesize and simplify some fairly complex arguments.

The first part of the paper comprising sections 11.2 and 11.3 goes through a very standard partial-equilibrium treatment of the determination of nominal and real exchange rates, respectively, and shows the effects on these of a variety of shocks. There is very little to take issue with in the almost textbook approach, as Harberger himself recognizes, adopted here; and its usefulness lies in the fact that it is all put together in one convenient place. What surprised me, and this will probably strike other readers as well, is that there is no mention whatsoever of any of the current work or thinking on the subject of exchange rates. Although we may not have learned very much in this area, the voluminous literature on the subject is certainly worth a few words. The one other reservation I have about the specific analysis in those two sections is that it leads Harberger to argue for a particular definition of the real exchange rate, and I believe such an inference cannot necessarily be made. I will pick up this point later in this comment.

The paper, despite its breathtaking scope, does exhibit some additional weaknesses. In certain instances Harberger skirts some difficult issues and ignores existing work on the subject, while in others he is

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too cavalier in pressing his point. A major omission I found is the absence of any discussion of *effective* exchange rates, whether nominal or real. The paper focuses exclusively on *bilateral* exchange rates, and it would have been preferable to round out the picture by some analysis of effective exchange rates. There are several important issues that need to be addressed here, such as the choice of the base period, the weights to be used, and the choice of price indices. Without any discussion of effective exchange rates, which are after all the relevant indicators of a country's international competitiveness, the paper does tend to lose some of its relevance for policy.

There are essentially three specific areas where I found myself particularly uncomfortable with Harberger's analysis: the definition, measurement, and, determination of the real exchange rate. I will deal with these in turn.

Definition of the Real Exchange Rate

Let me state at the outset that I agree with Harberger that there is a great deal of confusion in the literature regarding the appropriate definition of the real exchange rate. I would not, however, go along with him in his claim that since a particular definition ($\bar{E}/p_d$) is able to replicate the results of his model, it is therefore the correct one. Rejecting a definition that has become quite popular in recent years, namely, the ratio of the price of tradables to nontradables (p_t/p_n), because it yields ambiguous answers is, I believe, too hasty. The world may well be more complicated than Harberger's model would lead us to believe, and thus the fact that the response of the real exchange rate to a certain type of shock is not clear cut is hardly surprising. Indeed, if one considers a model with tradable (importable and exportable) and nontradable goods, one can still obtain the same, or at least similar, answers, provided certain conditions, such as gross substitutability in demand, are met. For example, the imposition of a uniform tariff on imports in a Dornbusch-type model would lead to an appreciation of the real exchange rate (a fall in the domestic currency price of foreign money).[1] There is no ambiguity here, although in the case of other types of shocks there may well be.

At any rate, this alteration in the model turns out not to matter much in the final analysis because of the way the real exchange rate that Harberger prefers is actually defined, $\bar{p}^*E/\bar{p}_d$. To use Harberger's own words, the foreign price index, p^*, is an index of the "dollar prices of tradable goods somewhere on the high seas." If the domestic price index, p_d, is highly correlated with the price index of nontradable goods in the home country, and if one truly has good reason to believe that it would be in

most economies, then $p^*E/p_d \approx p_t/p_n$. In essence, one has gone through a fairly convoluted exercise to get back to square one.

The Measurement of the Real Exchange Rate

Following Harberger's framework I will also divide my comments into the following: first, the appropriate domestic price deflator; and second, the world price deflator.

The Domestic Price Deflator

There is really no dispute on the relative merits of using the consumer price index (CPI) or the whole price index (WPI) to construct the real exchange rate. The CPI is often the only reliable price index available in developing countries, and the fact that it is a better measure than the WPI is certainly fortunate. To the reasons given in the paper on why the CPI is preferable, I would add that it is also a better indicator of overall labor costs in the economy. But the CPI is also not free of problems, particularly in developing countries. For example, it is a meaningful proxy only for short-run changes in relative costs; it does not directly reflect profitability of the primary producing sectors; and its coverage tends to be concentrated in the urban areas of the country. When using the CPI, one therefore has to weigh these negative features against the advantages when using the CPI.

The paper also appears to argue that the GDP deflator is in some sense an ideal index and that it would be the one to use were it not for the fact that it appears with a significant lag, and then only on an annual basis. It should be noted, however, that the GDP deflator also has problems. First of all, it is truly relevant mainly for long-run developments in profitability. Second, the way in which the GDP deflator is computed (as the ratio of current to constant-price value added) can cause major errors, since the imputation of value added at constant prices for certain types of goods and services may not be sufficiently reliable for most developing countries. Finally, the GDP deflator may exclude certain types of costs, such as the costs of nonmanufacturing intermediate inputs in the manufacturing sector.

All these points are, of course, well known, but they should be kept in mind when picking a domestic price index to deflate to a nominal exchange rate.

The Foreign Price Deflator

Fewer problems are posed by the choice of the foreign price deflator that one should use in defining the real exchange rate. I am less sanguine than Harberger regarding the use of the foreign price level in the cal-

culation of real exchange rates because most developing countries do not have such high rates of inflation that one can ignore foreign price changes. I suppose Harberger has in mind such countries as Argentina, Bolivia, and Brazil, rather than developing countries in general. But I believe one will almost always have to bring foreign prices into the picture.

I have three basic points to make regarding the foreign price deflator. First, I think that one ought to use a country-specific index rather than a general international price index, as suggested by Harberger. Consider his own example of a country that is an oil importer. A change in the price of petroleum products may have a small effect on the "world" price level, but as we saw in the 1970s, it can have a dramatic effect on an individual country's import price level. It is really not too difficult to calculate a weighted average of partner-country wholesale price indexes for individual developing countries, so why not do so?

Second, suppose one has followed Harberger and decided to work with a single index. Would it then matter a great deal whether one used the U.S. wholesale price index or some type of weighted average of the wholesale price indexes of countries that make up, say, the SDR basket? In fact, Harberger calls for the construction and publication of such an index using SDR weights. I am not sure how much mileage one would get from this, as these two price series are likely to be closely related, if only because the U.S. series would have a relatively large weight in any basket. To illustrate this point I ran a regression relating a weighted average of the consumer price indexes of all the industrialized countries (Pw) to the U.S. consumer price index (Pus).[2] Using quarterly data for the period 1976–84, I found:[3]

$$\log Pw_t = \underset{(1.41)}{-0.096} + \underset{(88.52)}{0.993} \log Pus_t$$

($\bar{R}^2 = 0.996$; Durbin-Watson = 2.49).

Though one would not want to take this regression too seriously, it does show the tight fit between the two series. I suspect the result for wholesale prices would be similar, and so I am not convinced that much would be gained by going the weighted-average route.

Finally, Harberger ignores the work that has been done on price indexes for tradable and nontradable goods. Such series have been constructed by Clements (1980) for the U.S. and by Goldstein and Officer (1979) for a number of industrialized countries. The methodology outlined in their papers is fairly straightforward and can be easily used to construct a series for the price of tradables, if indeed that is what one wishes to have.

The Determinants of the Real Exchange Rate

Harberger also tends to be much too pessimistic about the possibilities of modeling the real exchange rate for developing countries. Here I think he is influenced by studies on Latin America, and specifically those dealing with countries in the Southern Cone. Aghevli (1981), for example, has shown that one can specify and estimate such a model for a number of Asian countries. In general, there is ample evidence that relating the real exchange rate to variables such as money growth, inflation, and fiscal deficits produces fairly good fits in time-series analysis. Of course, shocks, whether real or nominal, also play an important role; one therefore should not assume that these models will necessarily be appropriate for prediction purposes. Rather than throwing up one's hands in despair, I would argue for more research on this topic. Perhaps no fundamental law will emerge, but identifying any empirical regularities in the behavior of real exchange rates would still represent an important step forward.

Notes

1. See Dornbusch (1974).
2. The data on these indexes are reported regularly in *International Financial Statistics* (Washington, D.C.: International Monetary Fund). The index for the industrialized countries is calculated using GDP weights.
3. The values in parentheses are t-ratios. The equation was corrected for second-order autocorrelation in the errors.

References

Aghevli, Bijan B. 1981. Experience of Asian countries with various exchange rate policies. In *Exchange rate rules: The theory, performance and prospects of the crawling peg*, ed. John Williamson, 298–318. New York: St. Martin's Press.

Clements, Kenneth W. 1980. A general equilibrium econometric model of an open economy. *International Economic Review* (June): 469–88.

Dornbusch, Rudiger. 1974. Tariffs and nontraded goods. *Journal of Political Economy* (August): 117–85.

Goldstein, Morris, and Officer, Lawrence H. 1979. New measures of prices and productivity for tradable and nontradable goods. *Review of Income and Wealth* (December): 413–27.

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