

## **ECONOMIC POLICY AND THE REAL EXCHANGE RATE**

A policy report submitted under

Contract No. EEM-C-00-06-00008-00

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TO: U.S. Agency for International Development

PPC/CDIE/DI -- Attn. ACQUISITIONS

Strategic Objective or Activity: 905-101/Economic Growth

Cognizant Technical Office: EGAT/EG

RRB, Room 2.11.123

1300 Pennsylvania Avenue NW, Washington, DC 20523

## ECONOMIC POLICY AND THE REAL EXCHANGE RATE

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December 2006

### 1. Introduction

The real exchange rate has been a key variable in discussions of economic policy for something like three decades. Present-day “real exchange rate economics” has had its main development only since about 1970. It had earlier reflections too, in somewhat inchoate form, but under different labels.

The most direct path to an understanding of this complex area of economics is to recognize the real exchange rate as one of a very few key macroeconomic variables -- being in many cases absolutely essential for diagnosing and understanding the economic situation of a country. One could really call it an essential variable in all cases; but like many others it can be peaceful and quiescent for long periods of time, tending in such periods to be “off the diagnostician’s radar screen.” That changes dramatically however, in more turbulent times. Particularly acute are situations of large swings in the rate of capital flow into and out of a country, wide movements in the prices of a country’s principal export product or products, and, of course, situations of genuine crisis of confidence, with their attendant massive capital flight.

Today there is renewed interest in real exchange rate issues because of the recent upsurge of the prices of petroleum, copper and other primary products. Accordingly, I will frame this

exposition mainly around that theme. However, this should not lead readers to overlook the many other sources of real-exchange-rate movements. Really, any and all forces that influence the demand and supply of foreign currency will impact the real exchange rate. And in some formal sense they all have the same potential power -- in the sense that it is the size and direction of an upward or downward shift of the demand or supply of foreign currency that matters -- not the specific source of that shift.

Here is a brief listing of the principal sources of variation in the demand and supply of foreign currency:

- a. international capital movements
- b. changes in import restrictions
- c. changes in export taxes and subsidies
- d. changes in productivity in the tradable-goods sector of the economy
- e. changes in productivity in the non-tradable sector of the economy
- f. changes in the world prices of a country's principal export products
- g. major expansions of tradables supplies due, for example, to new mineral discoveries.

All of these forces impact either the demand or supply of foreign exchange in a country, and it is the real exchange rate that in the end, by incorporating all of them, determines their net effect.

I know of no better description of the role of the real exchange rate on a nation's economy than this: "The real exchange rate is the principal equilibrating variable of a country's trade and payments; and as a result is also main operational determiner of a country's comparative advantage." To see how this works, think of a peso country with a flexible exchange rate with the dollar. A capital inflow that is to be spent in the nontradable sector of the country's economy will directly add to the supply of foreign currency (dollars) without directly

adding to the demand, causing the peso price of the dollar to fall. A trade liberalization reducing import restrictions will add to the demand for foreign currency and cause the peso price of the dollar to rise. Conversely, however, the reduction of an export tax will increase the supply of exports, leading to a fall in the price of the dollar.

As the price of the dollar moves up and down, it obviously impacts the profitability of all activities engaged in producing export (or exportable) goods, as well as those involved in the production of import substitutes. In the process, and without any particular fanfare, it ends up drawing a line between those tradables (export and import competing) activities that will be viable, and those that will not.

Large capital inflows and big export price surges have often led to a situation in which only a very few export products ended up being profitable -- all the rest had their profitability squeezed out by the declining price of foreign currency. This is the phenomenon called "Dutch Disease," a consequence of the suffering of the Netherlands' traditional export activities in the wake of the drastic drop in the real price of foreign currency (the real exchange rate) that resulted when that country's newly-discovered reserves of North Sea oil and gas were developed and massively exported.

The economics of Dutch Disease is simple and straightforward. The economic function of export industries is to produce foreign exchange; the economic function of import substitute activities is to save foreign exchange. When foreign exchange is scarce, the economic reward for producing and saving dollars is typically (and should be) pretty high. This gives a strong positive incentive to export and import substituting activities. However, when big capital inflows or oil and gas discoveries make foreign exchange super-abundant, it is quite natural that it should then be cheap in real terms. This means a low reward for the (other) export and import

substituting activities -- simply put, the dollars that the exporters produce and that the import substitutors save are no longer worth nearly as much as before. Activities that were once highly valuable to the economy now turn out to be of much lower priority, or even superfluous (in the cases of those activities that turn out to be non-viable at the new, lower real price of the dollar).

## 2. What Can Be Done About Dutch Disease?

In the first place, let us recognize that the things that cause Dutch Disease -- big inflows of capital, great mineral discoveries, export price booms -- are all bringers of and signals of prosperity for an economy. They, surely, are not properly considered as diseases. The disease part of the story is the unintended consequence of economic abundance -- abundance that in this case takes the form of a big inflow of foreign exchange. It is the consequent reduction in the price of this newly-abundant foreign exchange that causes trouble for producers of tradable goods and services, and sometimes for the labor and other factors of production engaged therein. But even here one must note that the losses that are borne by these producers and factors are basically matched by the benefits that accrue to the demanders of tradable goods.<sup>1</sup>

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<sup>1</sup>The gain to demanders of tradables is measured by  $-T_0^d \Delta E$  and the loss to producers and factors engaged in their production is measured by  $T_0^s \Delta E$ . Here  $E$  is the local-currency price of foreign currency (e.g., the peso price of the dollar),  $T_0^d$  is the initial, before-the-shock demand for tradables, measured in foreign currency (dollars in this case),  $T_0^s$  is the supply of tradables, measured in the same units.  $\Delta E$  (a negative number in this case) is the change in the price of foreign currency that comes as a result of the initial, underlying disturbance that we are analyzing (the capital inflow, or increment of export proceeds that started in motion the machinery that resulted in Dutch Disease). It is obvious, then, that if we start from an initial position where  $T_0^s = T_0^d$ , the negative consequences of the disturbance on the initial suppliers of tradables ( $T_0^s \Delta E$ ) will be exactly canceled by the positive consequences accruing to the initial demanders of tradables. If we start with a situation of a deficit in the balance of trade --  $T_0^d > T_0^s$  -- the benefits to demanders outweigh the costs to suppliers of tradables. [Recall the basic national accounting identity  $(T^d - T^s) \equiv (M - X)$ , where  $M$  and  $X$  are the values of imports and exports, respectively.] Only when the country starts out -- before the big foreign currency inflow -- with exports greater than imports, will the real-exchange-rate repercussions of the initial disturbance entail a net economic cost (which in turn would have to be weighed against the benefits of the disturbance itself -- e.g., a big oil-price rise, or mineral discovery, or capital inflow).

So when we think of “doing something” about Dutch Disease (DD), we should bear in mind that the whole “package” of which DD is a part is generally a big plus for the economy in question. Above all, policymakers should beware, in responding to DD, of killing the goose that laid the golden egg.

### **3. Transitory Versus Permanent Shocks**

One can think of Dutch Disease coming in response, say, to the discovery of a major oil field -- one whose productive possibilities stretch out for decades ahead. On the other hand, a country may face a big price rise for its main export (which could be oil), arising from a serious interruption of supply in some other part of the world. Here we have one clear-cut example of a disturbance that we can think of as “permanent” and another of a disturbance that is highly likely to be transitory in nature.

To most of us, it seems quite reasonable that different policy responses might be appropriate in these two cases. It makes more sense to allow an economy to make a full adjustment to a permanent disturbance than it does in the case of a disturbance that looks to be only transitory. The reason is simple: economic adjustments typically carry with them a bundle of “adjustment costs”. In the case of a permanent shock, these are simply a price that has to be paid to get an important benefit -- like the tuition and other costs of getting a college education. But in the case of a transitory shock, the economy faces two adjustment costs -- one to accommodate the shock when it comes, the other to adjust back to “normal” once the transitory shock disappears. That is to say, the transitory shock carries two sets of adjustment costs, yet has a much shorter-lasting benefit than what I have called a permanent shock.

Hence it is quite natural for policymakers to think about ways of reducing or mitigating the adjustment costs involved in a transitory shock. One easy way to do this is to grant subsidies or other benefits in some or all of the activities that are negatively affected (i.e., those afflicted with Dutch Disease). This, however, is a path fraught with perils -- the main risk being that such legislative benefits tend to come more easily than they go. If the disturbance is transitory, and the mitigating response is permanent or much longer-lived than the original disturbance, one gets a very unwholesome tradeoff -- a “permanent” distortion added to the list of ill-suited economic policies, in exchange for a bit of soothing salve to ease a transitory pain. And please do not forget -- subsidies and similar benefits to producers and/or factors of production in the nontradables sector are a benefit to them, but not to the economy as a whole. Just as with the change in the real exchange rate itself, there are demanders of tradables (or, more likely in this case, taxpayers) on the other side of the equation, bearing a cost.

I am quite ready to concede with respect to a subsidy that would offset a fraction of the fall in the price of foreign currency, for a period of time that would coincide with the period of Dutch Disease -- that such a subsidy, if sensibly designed, would actually palliate the effects of the disease without bringing permanent harm to the economy (so long as it really only lasted the indicated time). But then we come to the issue of sensible design. What are the chances that, once the possibilities of subsidy were opened, that all affected parties would be dealt with equally and neutrally? Much more likely is a grand melee of political forces and counterforces, with the luckiest or most powerful claimants coming out with subsidies that maybe even more than fully offset the change in the real exchange rate, and with the unlucky ones maybe getting nothing at all. Here we would be dealing with a disturbing battery of distortions even during an

allegedly short-run solution to a short-run problem. It would be even worse if the distortions persisted beyond the transitory scope of the problem.

#### **4. A Recommended Solution -- Offsetting the Inflow**

Compared with the type of distortive, ad hoc measure we have just discussed, the solution of offsetting the inflow has great appeal. It operates in the exchange market itself, introducing a new demand for foreign currency as an offset to a transitory increase in supply. Needless to say, the effect on the real exchange rate of an inflow of 10% of GDP, with an offset equal to half of that amount, will typically be only half as great as the effect of that same inflow without any countervailing offset.

Just as the inflows themselves can come either on the capital account (portfolio capital, direct investments foreign aid, emigrant remittances) or on the current account (world prices of exports rise, new export fields are developed); so the offsetting operations can take place under either of these two rubrics. On the capital account side, we obviously have the repayment of outstanding foreign indebtedness, which the country generally has the option to pay back ahead of schedule. Even if this option doesn't exist, a country's government can always build up investments abroad that yield an acceptable income stream. If the rate of yield of such investments matches the interest rate payable on the country's outstanding debt, it is a matter of virtual indifference whether to accumulate offsetting assets in this way, or to pay down the debt directly. Some might even argue that it is somewhat better to take the asset-accumulation route, as that leaves the country with a wider range of future options.

A second important capital-account area is the accumulation of assets in commodity "stabilization funds". A number of oil producing countries now have "oil funds" that aim at

accumulating foreign assets when oil prices are high, and drawing them down in periods when oil prices are low. Chile has had reasonable success over many years now with its copper fund, that works the same way in response to ups and downs in the world price of copper. The use of such funds is made easier in cases where the government has special taxes on the proceeds of exports of the commodity in question, still easier if the rate of such a tax is calibrated to variations in the world price of the commodity in question, and, of course easiest to the degree that the revenue from exports of copper, oil, or other leading export commodities accrue directly to the government through a public enterprise such as Pemex in Mexico or Codelco in Chile.

In cases where the proceeds of export sales of the commodity in question accrue exclusively or predominantly to private-sector companies, or where there is no special export tax, government would have to find ways of raising the local currency funds to buy the dollars to accumulate foreign assets in times of high export prices. In all cases, when export prices are low, the government would have to find ways of adding to its spending (hopefully in ways that are insulated from the tendency for spending items to be self-perpetrating).

Closely related to such capital-account operations is the accumulation of additional international reserves by the Central Bank. This route will be considered in more detail in the next section. Suffice it to say here that: a) such accumulations can indeed be, but are not automatically an offset, and b) the rate of yield on such assets held abroad can be an important determinant of how beneficial the accumulation of reserves is, as a matter of national policy.

The use of the current account of the balance of payments to generate offsets to the ups and downs of the world prices of major exports is something that has not been widely discussed, but deserves the attention of policymakers. The trick here is that a dollar increment in the demand for imports augments the demand for foreign currency in exactly the same way as an

increase of a dollar in the demand for additional foreign balances. Thus, it is a pleasant truth, that times of high commodity-export prices are typically times of general prosperity in a country (in spite of Dutch Disease). They tend also to be times when more funds are available for local investment purposes. How fortunate, then, might be the opportunity to use some of those funds to buy dollars to import road-building machinery and other construction equipment, to meet accumulated demands for hospital equipment and supplies, and maybe even to augment the annual quotas of students sent abroad for graduate and other specialized training.<sup>2</sup>

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<sup>2</sup>Obviously, one should be thinking of the benefits and costs of such expenditures as well as their function in helping to offset a big inflow of dollars. If we think of the “benefit function” in the same way as we think of a demand curve (recall that demand price is in any event the basic measure of benefits in applied welfare economics), then we can say that for the purposes of offsetting inflows of foreign exchange, we are looking for items whose benefit functions are quite elastic.

Inelastic demand items are therefore very poor candidates for this offsetting role. Take petroleum imports (in a country which is not itself an oil producer). We know that the demand for petroleum is quite inelastic; otherwise total receipts from petroleum sales would go down when its world price went up due to a shortfall of supply). Hence, to use “free foreign exchange” to add to oil imports to be dumped on the current market would make little sense. Each 10% increase in imports would imply a much more than 10% drop in the incremental benefit. Of course, the curve would turn flat at the point where an incentive was created for storing the oil, but the net benefit would be very low (given the costs of creating those facilities).

Now consider investing in equipment with, say, a 20 year life. Here what one is buying is the present value of the future stream of benefits that an asset will produce. If we buy an asset a year ahead of time, and do nothing at all with it the first year, we still have 19 years of benefits in common with what we would get by making the investment next year. We lose a little by making the investment “too early”, and it is that tiny amount that has to be matched by the extra benefit of offsetting the inflow of funds. Obviously, the longer lived is the capital equipment involved, the easier it is to justify varying its volume of imports as part of a policy of modulating swings in the real exchange rate. And, of course, the first-year benefits will not in fact be zero.

Something similar can be said about foreign training programs. Such programs typically deal with the most outstanding students in a field (in the country in question) -- perhaps the top 1 or 2 percent, or the top 5 or 10 percent based on grades, test scores and other criteria. As a long-time practitioner in the training of such people, I can attest with some fervor that the benefits of training do not fall off perceptibly as one moves from one percentile to the next, according to standard criteria. There is a predictably big difference in subsequent performance as one moves from the top decile to, say, the middle deciles. There is virtually no perceptible, predictable difference in subsequent performance as one moves from one percentile to the next, and not a great difference as one moves from the top decile to the one immediately below it. This means that a country can feel quite easy about using its programs of foreign training as a sort of shock-absorber, expanding the list of entrants in times of abundant foreign exchange, and contracting it when dollars are scarce. Also, it can grant extensions of study times with relative ease in the case of abundant dollars.

## 5. Two “Baseline Scenarios” of Dutch Disease

Central Bank policies being matters of some degree of technical precision, it is wise for us to set the stage by defining two precise baseline cases. They will both be flexible-exchange-rate cases, in which the Central Bank does not intervene in any way to influence the market for foreign exchange. The two cases will differ with respect to the nature of the disturbance we are analyzing. The first case will be called a “pulse”; it will entail a big inflow of foreign exchange, lasting no more than a year or two, with the economy then reverting to the status quo ante. The second case will be called a “flow”, it will entail an increase in the rate of inflow of foreign exchange, lasting long enough to call for the economy to reshape itself, so as to accommodate the new flow on a continuing basis.

In the “pulse” case, the natural reaction of a flexible-exchange-rate system, with no Central Bank intervention, would be for the nominal exchange rate to fall temporarily, over the period of the “pulse”, and then revert back to its old level, once the “pulse” subsided. I want to make clear to readers that this will typically entail a sort of “acute” case of Dutch Disease for the economy in question. In order for the exchange market to clear, in the presence of a big new inflow of dollars, the price of the dollar will have to go down, but by how much? Actually, by enough so that, in the case of an oil-price boom, non-oil exports are squeezed and total imports are stimulated, by an amount equal to the size of the “pulse” itself. Thus if a country’s oil revenues rose from \$1 billion to \$2 billion due to a spike in the world price of oil, one adaptation would be for non-oil exports to fall by \$300 million and the country’s total imports to rise by \$700 million. The precise amounts represented by the fall in non-oil exports and the rise in total imports would vary depending on supply and demand conditions (elasticities, etc.) in the

country. But the sum of the two would have to be \$1 billion, so as to equilibrate supply and demand in the market for foreign exchange.

The above assumes no change in capital flows into or out of the country in response to the oil-price shock. In a system with fully developed, sophisticated markets for both capital and foreign exchange, people would likely perceive that the “pulse” of added-foreign exchange would be only temporary, and would therefore predict that the price of the dollar would, say, by two years from now, have risen back to its old level. People would thus enter the market, engaging in operations -- call them arbitrage, call them speculation, as you will, at the point where they could expect to make money (in pesos) on the expected future rise in the price of the dollar. In the perfect market scenarios of economic theory, such a process would mean that the peso price of the dollar would drop precipitously at the institution of the “pulse”, but only to the point where buying dollars looked like a good investment. From there on, the holding of dollars would just yield a “normal” rate of return in the country, until at some point (say two years in the future) the exchange rate gets back to its initial “normal” level. In this “perfect” theoretical scenario, there would still be a degree of Dutch Disease involved, but the price of the dollar would not fall nearly so far as in the case where capital flows did not respond at all to the “pulse” of foreign exchange. In the numerical example given above, maybe in the first year the extra \$1 billion of foreign exchange would be reflected in a fall of only \$150 million in non-oil exports and a rise of only \$350 million in total imports, with \$500 million of the inflow of foreign exchange being bought by arbitrage-speculators and presumably deposited, say, in New York. Then the second year, non-oil exports would have risen by \$75 million from the year before, being now only \$75 million short of “normal”; and imports would have risen by \$175 million from the year before, being now just \$175 million short of normal. To make the story complete,

the arbitrageur-speculators would have to buy \$750 million of the pulse-generated petrodollars in order to absorb the full \$1 billion of them. By the third year, we are assuming that oil prices are back to normal, the “pulse” of \$1 billion is gone, and both non-oil exports and total imports have regained their “natural” (pre-pulse) levels.

The above scenario might well describe the nature of the reactions of an advanced, modern economy, but I do not think it is a good description of how a typical developing country’s economy would react. Here I believe the first scenario given -- with no response of capital flows to the pulse -- is the best starting point. It gives the correct intuition concerning the nature of the reaction. This intuition should then be modified by the recognition that there will probably be some offsetting reaction of arbitrageur-speculators, but not nearly enough for the exchange rate story to be dominated by them.

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The second case is that which I have called a “flow”. Oil prices rise to a new level and stay there for a long time. In this case the country’s oil exports rise from \$1 billion to \$2 billion, and just stay there. With a flexible exchange rate, the simplest trajectory would be for the price of the dollar to fall so as to fully “absorb” the extra \$1 billion -- say with non-oil exports falling by \$300 million and total imports rising by \$700 million, and just stay there. If the exchange rate started at 10 pesos to the dollar, maybe this would mean that it would fall to 8 pesos, and just stay there.

That simple scenario is a good starting point, but it leaves an important part of the story untold. Economic processes typically take time to work themselves out, and that is certainly true when it comes to the responses of non-oil exports and of total imports to changes in the real

exchange rate. Thus we should expect greater responsiveness, the longer the time allowed for the adaptation to take place.

I will here give a hypothetical trajectory as to how this development might evolve. Into it I will build the assumption that the supply of non-oil exports is more elastic than the demand for total imports. This means that as time goes on, a greater fraction of the adjustment (to the \$1 billion per year extra flow of foreign exchange) will be accounted for by the drop in non-oil exports. The story, then, might go as follows:

**TABLE 1**

Response to a Rise in Oil Export Prices  
(Flexible Exchange Rate with General Price Level Constant)

Year	Foreign Exchange From Oil	Non-Oil Exports	Total Imports	Price of the Dollar
(In millions of Dollars)				
0	2000	3000	5000	10.00
1	3000	2700	5700	8.00
2	3000	2500	5500	8.50
3	3000	2300	5300	9.00
4	3000	2300	5300	9.00
5	3000	2300	5300	9.00

In the above scenario, a full adjustment is achieved in three periods, with non-oil exports accounting for an increasing fraction of the adjustment as one moves from period 1 to 2 to 3.<sup>3</sup>

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<sup>3</sup>Note that I did not employ time-varying shares of response in presenting the case of a two-year “pulse”. The distinction was deliberate. The ideas of increasing responsiveness (elasticity) through time and of differential responsiveness (elasticity) between imports and non-oil exports depend importantly on perceptions and expectations. It is when a disturbance is perceived as long-lasting, and is expected to stay around for a long time, that economic

As one moves from period 1 to period 2 to period 3, the exchange rate rises, meaning that it takes less of a drop (from the initial level of 10 pesos per dollar) to elicit reactions (of non-oil exports and total imports) summing up to \$1 billion per year.

Note that what we have here is what economists call an “overshooting” of the exchange rate. The original equilibrium exchange rate was 10 pesos per dollar; the new equilibrium, with a steady flow of \$3 billion per year from oil exports (instead of \$2 billion), is 9 pesos per dollar. But in the adjustment process, the price of the dollar falls to 8 pesos, and then gradually works its way up to the new equilibrium level of 9 pesos. This sort of overshooting is a natural part of many adjustment processes. Mitigating it can be one of the objectives of Central Bank intervention in such cases.

## **6. Central Bank Policy with Flexible Exchange Rates**

It is easy to treat Central Bank policy in response to a “pulse” in foreign exchange -- the limiting case is quite naturally that of fully offsetting the pulse. In our example, it would mean the Central Bank’s buying \$1 billion of foreign exchange in each of the two years that the pulse lasted. That is not the end of the story, however, for the Central Bank can do this in two ways -- without or with sterilization. We will deal with these two cases in turn.

When the Central Bank operates by entering the foreign exchange market, but without sterilization, it simply enters to buy \$1 billion per year of foreign exchange, initially at the previously prevailing exchange rate of 10 pesos to the dollar. It thus augments the supply of base money ( $M_0$ ) by 10 billion pesos. Suppose the initial  $M_0$  was 50 billion pesos, and the initial broad money supply ( $M_2$ ) was 100 billion. The first year’s expansion of base money

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agents respond over time with progressive adaptations to it. Otherwise, they pretty much stay on their short-run response functions.

would end up (with a money multiplier of 2) causing an expansion of  $M_2$  to 120 billion. This extra money would represent (let us assume, only slightly oversimplifying a more complex reality) “undesired” real monetary balances ( $M_2 / \bar{p}_D$ ) on the part of the people, ( $\bar{p}_D$  is the general price level of the country).

The general mechanism of monetary adjustment is that when there is a gap between actual monetary balances  $M_2^S$  and desired monetary balances  $M_2^D$ , people will adjust over time so as to bring the gap ( $M_2^S - M_2^D$ ) back to zero. The speed and the path by which they do so may not be easily quantified and predicted, but the fact that they will respond by trying to get rid of excess monetary balance is extremely well established. That is, in fact, the mechanism that brings about the familiar connection (in inflationary situations) between the price level and the quantity of money.

How does all this play out in our example? Simply by causing the equilibrium price level to rise from index 100 to index 120 -- say, by the end of the first period. In the process, a flexible exchange rate should also go up to 12 pesos to the dollar. Now, in the second period, the Central Bank again intervenes to stave off any change in the real exchange rate. It again buys \$1 billion, this time paying 12 billion pesos. Now the supply of high-powered money goes up from 60 to 72 billion and that of  $M_2$  from 120 to 144 billion. Again the increment starts out being undesired cash balances ( $M_2^S = 144$  billion while  $M_2^D = 120$  billion). But as people spend the excess they drive the price level up from index 120 to index 144, so real monetary balances are brought back to their initial equilibrium level.

In the end, without sterilization, the new equilibrium after the “pulse” is the same as it was before in real terms. All that has happened is that prices, including the nominal exchange

rate) have risen by 44%, as have monetary magnitudes like  $M_0$ ,  $M_1$  and  $M_2$ . Also, in our scenario, the Central Bank's reserves of foreign exchange have risen by \$2 billion. That, in fact, is, in this scenario, the final use to which the foreign exchange generated by the oil-price rise has been put.

We now turn to the case of a "pulse" with sterilization. The scenario starts the same as before, but as the Central Bank buys the foreign exchange to add to its reserves, it sells peso bonds, so that it can acquire the new petrodollars without expanding the monetary base. In this way it avoids creating an excess of  $M^S$  over  $M^D$ , hence avoids stimulating the sort of price level rise that we saw in the no-sterilization case.

This "sterilization" case works out perfectly in a theoretical exercise. But it is not all unalloyed bliss in a real-world context. Here we must realize that the purchasers of the bonds issued by the Central Bank will be spending less on other things, which may or may not be matched by the extra spending of those who receive the extra oil income. In an alternative form of sterilization, the Central Bank would not sell bonds, but would bring about a reduction in the total volume of bank credit to the private sector so that  $M_2$  would not expand, in spite of the increment in the banking system's net foreign assets (through the Central Bank's purchase of the new petrodollars). In this case the potential for the sterilization policy to induce a reduction in economic activity is perhaps clearer than in the bond-sale case. In any event, that possibility may well eventuate. In such a case the Central Bank might choose to sterilize less than the full amount of the inflow of petrodollars, thus "buying" a greater stability in the real economy at the cost of a certain ultimate rise in the price level. ( $M_2$ , of course, will tend in the end to go up, on the basis of any unsterilized portion of the Central Bank's purchases of petrodollars).

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We now turn to the case of a steady “flow” of net petrodollars rather than just a pulse. Here one pretty much has to accept that in the ultimate new equilibrium, the country will be permanently accepting and making use of the new petrodollars -- as indicated in Table 1 -- and that the real exchange rate (the real price of foreign currency) will have fallen as a consequence of the increased flow of foreign exchange available to the country.

One policy question that the country’s Central Bank might face is whether or not to try to offset all or part of the real exchange rate “overshoot” that tends to occur when an economy adapts to a more-or-less permanent external shock. This would entail allowing the nominal exchange rate to go from 10 pesos to 9 pesos to the dollar, in the example of the table, with the Central Bank, when intervening to buy dollars at 9 pesos, then sterilizing the operation by reabsorbing the emission of base money which that process entailed. This would amount to smoothing the adjustment process and sparing the economy a bulge in the trajectory of the real exchange rate -- a bulge that would in any case tend to be self-correcting, but over a longer period.

Another policy question is whether to accept a scenario in which the absolute price level of non-oil tradables has to fall. I am here assuming that the dollar prices of non-oil tradables remain constant through the adjustment period, so that a fall in the nominal price of the dollar would mean a fall in the absolute price (in pesos) of these goods and services. Whether this creates a problem or not depends somewhat on the nature of these non-oil tradables. If they are primary products whose price structures embody a lot of economic rents to mineral deposits and land, then I see little problem in allowing their internal price to fall. However, if their price structure is heavily weighted with wages and salaries, one has to wrestle with a different sort of problem

That problem derives from the so-called downward-rigidity of wages and salaries. It is a plain fact of history that real wages have fallen many times, and in lots of countries. But in the great bulk of these cases, most or all of the fall has come with prices rising and wages rising by less than prices, not by prices staying constant or falling, while wages fall by more than prices. The bottom line is that the path from an equilibrium real wage of 100 to one of 90 is achieved with less friction when the nominal wage stays the same while the price level rises, than if the price level stays the same and wages fall.

So the downward pressure on nominal wages in the tradable sector of the economy could be mitigated by having the same real appreciation of the currency occur through rising prices of nontradables rather than through falling prices of tradables. In the example of Table 1 the final equilibrium could be at an exchange rate of 10 pesos per dollar and a general price level index of 111, rather than, as in the table, at an exchange rate of 9 pesos per dollar, and a general price level index of 100. Relative prices are the same in both these cases; the real exchange rate is also the same, but the adjustment process in getting to the new equilibrium can easily be less fraught with frictions, particularly with frictional unemployment.

## **7. Central Bank Policy with Fixed Exchange Rates -- Response to a Transitory Shock**

This is a good point to introduce a formal definition of the real exchange rate. In my opinion, the best technical definition of the real exchange rate is  $E\bar{p}^*/\bar{p}_D$ , where  $E$  is the nominal price of the dollar (or other foreign currency)  $\bar{p}^*$  is a price index that attempts to capture the world price level of tradable goods (expressed in that same foreign currency), and  $\bar{p}_D$  is a local general price index -- usually either the GDP deflator or the consumer price index

of the country in question.<sup>4</sup>

The key difference between economic adjustment with fixed exchange rates and that with flexible rates is that under fixed rates all the variation in the real exchange rate comes via movements in  $\bar{p}_d$ , while under flexible rates both  $\bar{p}^*$  and  $\bar{p}_d$  can (and do) move.

Economists often assume, as we did in Table 1, that under a flexible rate the monetary authorities so manage things as to keep  $\bar{p}_d$  constant, but that is a rare event in the real world, and in no way necessary for the proper functioning of a flexible exchange rate system.

Table 2 is the mirror image of Table 1, with the movement of the real exchange rate now taking place exclusively through  $\bar{p}_d$ . It is easy to see from comparing Table 2 with Table 1 that the whole story is exactly the same in real terms. The two tables differ only in how a given real exchange rate movement is reflected -- it is reflected exclusively on movements in  $E$  in Table 1, and exclusively in movements on  $\bar{p}_d$  in Table 2.

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<sup>4</sup>Many practitioners use a weighted average of the wholesale price indexes of several countries for  $\bar{p}^*$ . This practice derives from the fact that wholesale (or producer) price indexes are typically heavily weighted with tradable goods prices. The weighted average index is then taken as a proxy for the relevant world price of the tradables,  $\bar{p}^*$ , and placed in the numerator of the formula  $E\bar{p}^*/\bar{p}_d$ . Anyone who tries to do this should realize that the separate price indexes of, say, the UK, and Japan, have to be converted to a dollar base (by multiplying the "pound" and "yen" indexes by an index of the exchange rate of these countries with the dollar -- i.e., by multiplying the British wholesale price index by an index of a \$/£ exchange rate, and the Japanese wholesale price index by a \$/¥ exchange rate, all the exchange rates and price indexes in the  $E\bar{p}^*/\bar{p}_d$  formula having been previously adjusted to a common base year. Readers should also be warned that no measure of the real exchange rate that uses the same type of index for  $\bar{p}^*$  and  $\bar{p}_d$  has a sound basis in the economics of real exchange rates. Ideally, the  $\bar{p}^*$  index should contain no nontradables prices at all. Sound theory can be used to justify either a general price index including both tradables and nontradables with appropriate weights, or an index that contains only nontradables prices. The latter, however, is only a theorists dream. Huge hurdles must be surmounted to develop a nontradables index in practice. Hence, as indicated, real-world calculations of real exchange rates can best rely on either the country's GDP deflator (a general price index with production weights) as its consumer price index (a general price index with consumption weights) to function as  $\bar{p}_d$ .

**TABLE 2**

Hypothetical Response to a Rise in Oil Export Prices  
(Fixed Exchange Rate Case)

Year	Foreign Exchange From Oil	Non-Oil Exports	Total Imports	E	$\bar{p}^*$	$\bar{p}_d$	$\frac{E\bar{p}^*}{\bar{p}_d}$
(in millions of dollars)							
0	2000	3000	5000	10	100	100	10.00
1	3000	2700	5700	10	100	125	8.00
2	3000	2500	5500	10	100	118	8.50
3	3000	2300	5300	10	100	111	9.00
4	3000	2300	5300	10	100	111	9.00
5	3000	2300	5300	10	100	111	9.00

I deliberately introduced the word “hypothetical” in the title of Table 2 in order to emphasize that it was a very special kind of example. Table 2 was set up to show how it was theoretically possible to have exactly the same adjustment process (in real terms), under either fixed or flexible exchange rates. In reality, however, these processes are quite different, with adjustment typically being much faster under flexible than under fixed exchange rates. But the underlying real equilibrium that represents “full adjustment” is still the same. The economy tends to get there by a different path in the two cases -- faster with flexible, slower with fixed rates, but the final destination is the same. I try to reflect this difference in speed by referring in Table 2 to “periods”, which I think of as longer than a year, while referring to “years” in Table 1.

Now let us turn to a more explicit analysis of adjustment under fixed exchange rates. First, we examine the case of a short-period rise in oil prices, such as might happen with a transitory interruption of supply in an oil source outside of “our” oil-producing country. The price of oil rises in world markets, say for a couple of years. During this period our Central Bank receives (and under a fixed exchange rate system is committed to buy) an extra flow of dollars. In the process it prints and emits new pesos -- adding to the country’s supply of base money,  $M_0$ . On the basis of the addition to base money,  $\Delta M_0$ , the banking system increases the broad money supply (say,  $M_2$ ) by a multiplier  $\mu$  times  $\Delta M_0$ , as indicated in our earlier discussion of sterilization under flexible rates. People now hold more cash balances ( $M_2^S$ ) than they really want ( $M_2^d$ ), and over time they work off these excess money holdings ( $M_2^S - M_2^d$ ), until finally we get back to equilibrium, with  $M_2^S = M_2^d$ .

During this process of “spending down” their excess monetary balances, people spend some of the added outlays on tradables, some on nontradables. The spending on nontradables tends to produce a bulge in their internal price trajectory, tending to tilt demand away from them and toward tradables. But even without this tilt, an important part of the rundown of excess monetary balances will be directly spent on tradables. This leads to greater demand for imports and (via increased local spending on exportables) to a lower supply of exports. The consequence is an induced deficit in the country’s trade balance and a resulting loss of foreign exchange reserves. At each step of this reserve loss, what we see is the Central Bank selling dollars, and thus re-absorbing some of the extra pesos it emitted as new base money ( $\Delta M_0$ ) in response to the oil-price shock. So as this process goes on, the excess broad money supply ( $\mu\Delta M_0$ ) that was initially generated is going to be gradually drawn down. If all other basic determinants of the

economy remain the same, the ultimate equilibrium will be back at the starting point -- the same equilibrium that prevailed before the transitory oil shock. The economy's path thus is of an up-and-down nature.  $M_0$  goes up and down,  $M_2$  goes up and down, demand for nontradables goes up and down, and so do their prices, and the demand for tradables goes up and down. In the process, of course, the reserves of the Central Bank have gone up and down.

To avoid or mitigate this up-and-down movement, Central Banks often engage in sterilization operations. In this case, the Central Bank would buy the petro-dollars, but at the same time or shortly thereafter would sell bonds or some other asset, so as to re-absorb the  $\Delta M_0$  generated by the oil-price rise, before it had much of a chance to affect the broad money supply,  $M_2$ . These sterilizing operations typically have the effect of reducing the amount of bank credit available to the private sector.<sup>5</sup>

## 8. Central Bank Policy with Fixed Exchange Rates -- Response to a Long-Lasting Shock

We now turn to the case of a permanent (or long-term) rise in the price of oil. Here the economy, quite obviously, would not move back to an initial equilibrium, as in the case of a

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<sup>5</sup>The consolidated balance sheet of the banking system has broad money as its main liability. Its main assets are "net foreign assets" (principally the international reserves of the Central Bank); "bank credit to the government," including holdings of government bonds by the Central Bank; and "bank credit to the private sector", most of it issued by commercial bankers in the form of loans to businesses and consumers. In one kind of sterilizing operation, the Central Bank gains reserves but reduces its own holdings of government bonds, thus leaving  $M_0$  and  $M_2$  unaffected, and also having no direct effect on commercial bank operations. In a second approach, the Central Bank could print its own bonds or similar obligations, and sell them, rather than government bonds, in the open market. In yet a third kind of sterilizing operation (one that may happen when the Central Bank has no (or few) government bonds to sell, we see the Central Bank reducing its advances to the commercial banks, shrinking the reserves they hold against deposits and causing them to contract their credit to the private sector. In all three cases, the sterilization operation leaves the broad money supply unchanged. In cases one and two, the Central Bank ends up holding greater international reserves, which are reflected as an increase in "net foreign assets" of the consolidated monetary system. But in the first case we have "bank credit to the government" going down as the Central Bank's holdings of government bonds are depleted, while in the second case it is "bank credit to the private sector" that is squeezed as the Central Bank's international reserves go up. Real-world sterilizations typically have bank credit to both government and private sector declining. But in developing countries which do not have highly developed government bond markets, it is overwhelmingly credit to the private sector that takes the hit as the Central Bank tries to sterilize big purchases of foreign exchanges.

transitory oil-price shock. Instead, it must in the end adapt to a new equilibrium, with greater foreign exchange revenues from oil and fewer from other sources. Such an adaptation was sketched in Tables 1 and 2. They highlight the “overshooting” phenomenon -- in Table 2, the general price level shoots up to 125 before settling down at 111. This has its reflection in the real exchange rate falling from 10.00 to 8.00, before coming to its final resting place at 9.00 (a story also told in Table 1).

The underlying reason for the overshooting phenomenon is, as mentioned earlier, the fact that many economic adjustments -- particularly those on the supply side of the supply-demand picture, take place gradually over time. In the case of an oil-price rise, the needed adjustment (in an oil-producing country) is for some resources to move out of the non-oil tradable sector of the economy (producing exportable and import-competing products) and into the nontradable sector, where they will likely go to activities like construction and services.

Given the rise in oil prices, there is greater income in the hands of the public, which leads to increases in their demand for both tradable and nontradable items. At the same time the dollar (i.e., foreign currency in a peso country) becomes cheaper, tending to drive resources out of non-oil tradables and into nontradable activities. This resource movement, however, takes time. Thus, in the early stages, tradables supplies have not been cut by much, and nontradables supplies have not increased by much. Hence the effect of increased demand for nontradables takes place mainly in prices -- construction costs, house rents, and the general wage level rise in relation to the prices of tradable goods (which stay the same because of the fixed exchange rate). This is represented by period 1 of Table 2. Then, as the resources movement out of tradables and into nontradables continues, the greater supplies of nontradables help to satisfy their newly-expanded demand, thus mitigating the sharp price rise they experienced initially (as in line 1 in

Table 2). By period 3 in Table 2, the full adjustment has been accomplished. But over the whole adjustment process the general price level has shot up from 100 to 125, and then come back down to 111. This overshoot can have serious consequences in a real-world setting, owing once again to the downward rigidity of wages and some other prices. That is to say, some of the downward pressures in the later stages, instead of being worked out through falling prices of nontradables, would likely instead be reflected in reduced economic activity and increased unemployment.

Table 3 presents a scenario in which the overshooting is avoided. The “trick” here is once again “sterilization” -- in this case the sterilization of only a fraction of the extra foreign exchange revenues produced by the oil-price boom, a fraction that declines over time and becomes zero when the full-adjustment equilibrium has been reached. In order for readers to follow the steps represented in Table 3, the key element is that in periods 1 and 2, the Central Bank has limited the amount of foreign exchange going on the market whereas in Table 2, the Central Bank allowed 3000 of oil money to be absorbed by the market, (seen by the difference between non-oil exports and total imports, which has to be financed by the proceeds of oil exports). The scenario of Table 3 only has 2250 of oil money being active in the market. This is only 250 more than was being financed by oil exports in period 0, before the oil-price shock.

The bottom line is that the Central Bank has kept 750 of the oil proceeds as an increment to its international reserves, and has done so by selling, say, government bonds in an equivalent amount. (Think of the Central Bank as actually buying the full 3000 of foreign exchange revenues from oil, and issuing pesos in exchange, but then selling \$750 million worth of government bonds [or its own bonds] in order to absorb three quarters of the “extra” 10 billion pesos issued [1 billion dollars of extra oil revenues times the fixed exchange rate of 10 pesos per

dollar].) The end result is a first-period adjustment equal to just 1/4 of the adjustment depicted in Table 2. Hence, instead of non-oil exports moving from 3000 to 2700, they go only 1/4 of that distance, and end up at 2925. Likewise, total imports, which went from 5000 to 5700 between periods 0 and 1 in Table 2, now in Table 3 go only 1/4 of that distance to 5175. As a consequence, the effects on the general price level  $\bar{p}_d$  are also only one fourth as big as in the step from period 0 to period 1 in Table 2. Instead of going from 100 to 125,  $\bar{p}_d$  goes from 100 to 106.25. In consequence, the real exchange rate moves from 10 just to 9.41, instead of going all the way to 8.00

**TABLE 3**

“Cushioning” the Overshoot of the General Price Level  
In Response to a Rise in Oil Export Prices  
Fixed Exchange Rate Case

(The nominal exchange rate  $E$  remains constant at 10, and the world price level of non-oil tradables  $\bar{p}^*$  remains constant at 100, throughout the adjustment process.)

Year	Foreign Exchange From Oil	Non-Oil Exports	Total Imports	Increment of Central Bank Reserves	$\bar{p}_d$	$\frac{E}{\bar{p}_d}$
(In Millions of Dollars)						
0	2000	3000	5000	0	100	10.00
1	3000	2925	5175	750	106.25	9.41
2	3000	2750	5250	500	109	9.18
3	3000	2300	5300	0	111	9.00
4	3000	2300	5300	0	111	9.00
5	3000	2300	5300	0	111	9.00

The story is the same for the second step in the adjustment. The key here is to continue to think of the base, from which the adjustment is measured, as being period 0. (We are working along supply and demand functions reflecting responsiveness over two periods, rather than over one period. Non-oil exports fall by more than in period 1 because more resources are moving out of those activities into the production of nontradables. But fewer resources have moved out in the scenario of Table 3 than was the case in Table 2. So, instead of going from 3000 to 2500, between periods 0 and 2, non-oil exports now go from 3000 to 2750. In a similar vein, total imports, instead of going from 5000 to 5500 as in Table 2, now go from 5000 to 5250. Relative import prices now fall by less, and fewer resources have moved out of the production of import substitutes. The general price level  $\bar{p}_D$  moves from 100 to 109, instead of to 118, and the real exchange rate goes from 10.00 to 9.18 instead of to 8.50.<sup>6</sup>

The second period adjustment, then, has non-oil exports having fallen by 250, from their base period level, while total imports have risen by a like amount. These adjustments have thus reflected half of the total oil-price shock of 1000. To produce this effect the Central Bank would have to be buying and sterilizing the other 500, which in Table 3 we assume it to do by selling government bonds.

By the time the scenario of Table 3 has ended, we have arrived at exactly the same values (in periods 3, 4, and 5) as in Table 2. We have avoided the overshoot of exports, imports, the price level and the real exchange rate. The cost has been that the private sector has forgone consumption and/or investment to the tune of 12.5 billion pesos, for which they have received bonds, and the Central Bank has acquired additional foreign reserves of 1.25 billion dollars.

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<sup>6</sup>Readers should be aware that if a number changes by a certain percentage, its reciprocal cannot change by the same percentage -- e.g., as 10 goes to 12.5, a 25% change its reciprocal goes from 0.1 to 0.08, a 20% change. This explains why the same fractional changes are not preserved as we go to the last column of Table 3.

To consider the costs and benefits of this move, we have to look to the interest paid (by the government or the Central Bank) on the newly offered bonds, compared with the interest (presumably in dollars) that the Central Bank receives on the extra \$1.25 billion of international reserves that it has acquired. Typically, the real interest rate paid on domestic bonds will exceed the real interest rate received by the Central Bank on its extra reserves. If the Central Bank itself were the issuer of the bonds, it is easy to see that the difference would be reflected as a loss on the books of that institution. But it is just the same if the Central Bank performs the sterilizing operation by selling government bonds that it previously held in its portfolio. In that case, instead of having to pay out interest on its own bonds, it will be forgoing the interest that it would have received on the government bonds it sold in the sterilizing operation.

The main point is that the primary measure of the cost to a country's economy of its Central Bank's performing a so-called "sterilized intervention" is the difference in interest rates between: a) the domestic rate of interest paid (or forgone) by the Central Bank on the items in its portfolio which it sells (or otherwise allows to contract) as part of the sterilizing operation, and b) the international rate of interest (or return) received by that entity on the extra foreign financial assets that it acquires as the other part of the sterilization operation.

Against this cost one must weigh the benefits of the sterilizing operation, which typically take the form of avoiding abrupt "pulses" or "blips" in imports, exports and the real exchange rate (in cases where the shock is temporary) or avoiding unwanted "overshoots" in these same items as the economy adjusts to a more long-lasting or permanent shock. Clearly, sterilized intervention will be easier to justify if the real interest rate paid (or foregone) is 4% while that received on the foreign assets acquired is 3%; and harder to justify if the real rate paid is 7% while the rate received on newly-acquired foreign assets is only 1%.

This point -- the key role played by the interest rate differential -- is rarely mentioned in the financial press, or even in the economics literature on the subject. Yet even from the simplified analysis presented here, its critical role should be obvious.

## **9. Lessons from This Analysis**

1. The real exchange rate is a key economic variable. Its role is to generate equilibrium in the country's trade and payments vis-a-vis the rest of the world.

2. The basic forces that determine the real exchange rate will be operative under any particular arrangement concerning how the nominal exchange rate is determined. In particular, a country's full-equilibrium real exchange rate will be no different as between a flexible exchange rate or a fixed exchange rate system.

3. What does differ as between fixed and flexible exchange rate systems is the time path by which an economy moves to a new equilibrium in response to changes in the underlying conditions affecting its economy. In general, the adjustment will be faster with flexible exchange rates, slower with a fixed rate.

4. Dutch Disease is the term used to describe situations in which an abundance of foreign exchange leads to a lower price of foreign exchange in real terms. The source of abundant foreign exchange does not matter -- it can be a rise in the price of a country's major export (say, oil); it can be an inflow of private capital from abroad; it can arise from increased emigrant remittances or increase of flows of foreign aid. In all these cases the natural result is that the dollar (and other foreign currencies) will be cheaper in real terms. This brings benefit to consumers of imported goods, and of tradable goods generally. But it creates problems for local producers of exportable items and of import substitutes.

5. The natural adjustment called for, when foreign exchange becomes more abundant, is for resources to move out of the production of tradables and into that of nontradables. This is almost self-evident once it is realized that the “shock” giving rise to the greater availability of dollars typically reflects greater economic spending power for its residents. It is thus quite natural that some of this extra spending power should be reflected in a greater demand for nontradable goods and services.

6. When the extra availability of foreign exchange is (or is expected to be) quite transitory, it often makes sense for the authorities to mitigate the need for an adjustment, or to try to live with a smaller adjustment. This is because the adjustment in this case would be in two steps -- resources moving from tradables to nontradables production in the first step and then back from nontradables to tradables in the second step. The wisdom of intervening to cushion the economy’s response will depend on the ease with which the economy makes these adjustments. The more difficulties and frictions that the adjustments entail, the greater justification there is for intervening.

7. At the extreme, a full sterilization of the extra inflows of foreign exchange would leave the real exchange rate unaffected. What it would amount to is the full economic benefit of extra (but transitory) abundance of dollars being in the end reflected in increased international reserves of the Central Bank. If individual groups in the society (e.g. oil producers) achieved greater purchasing power as a result of the initial shock, then others (e.g. the buyers of Central Bank bonds) would end up with reduced purchasing power over current goods and services. In a broad sense, the economy as a whole would not perceive the shock, apart from the Central Bank’s accumulation of international reserves.

8. The purpose of sterilization is somewhat similar when the increased flow of foreign exchange is expected to be “permanent” (or long-lasting) rather than transitory. In this case, it would not be wise to attempt to prevent the full adjustment of the economy to the change, but it might well be prudent to try to smooth out the overshoot of the real exchange rate (and of the economic variables like imports, exports, and the production of nontradables that respond to its movement). To perform such a smoothing operation, the Central Bank would build up its international reserves, initially offsetting a significant fraction of the increased foreign exchange flow, but reducing the size of its interventions over time, stopping them entirely by the time a full adjustment has been reached.

9. The economic cost associated with a sterilizing intervention by the Central Bank is measured by the difference between: a) the interest rate that it pays on bonds that it issues or foregoes on bonds that it sells, and b) the interest rate (or rate of return) on the financial assets that it builds up abroad as it increases its international reserves as a consequence of intervening in the foreign exchange market. This difference can be very large in some cases (making sterilized interventions very costly) and quite small in others (rendering it quite inexpensive). Obviously, the wisdom of intervention will depend importantly on the size of this interest-rate differential.

10. The benefits of sterilized intervention consist of avoiding or reducing the costs associated with sharp movements of the real exchange rate that are expected soon to be reversed. Such movements call forth shifts of resources between the sectors of the economy producing tradable goods (exportable goods plus import substitutes) and those producing nontradable goods and services. Smoothing the trajectory of the real exchange rate (via sterilized intervention by the Central Bank) helps eliminate the sort of out-and-in, or back-and-forth movements of

resources that would tend to occur in response to sharp spikes or quick dips in the real exchange rate. Such movements are not particularly costly to the economy if markets are very fluid and flexible, but in markets as they actually function, particularly labor markets, sharp contractions tend to be reflected in significant increases in the rate of unemployment. Avoiding these is one of the principal benefits of real exchange rate smoothing, carried out by sterilized intervention.

11. A final note. Nothing in this paper should be interpreted as supporting attempts to maintain the real exchange rate permanently (or for long periods of time) above or below its longer-term equilibrium level. Intervening to keep the price of the dollar high would entail ever-growing international assets;<sup>7</sup> intervening in the opposite direction would entail a steady loss of international reserves of the Central Bank. Sound economic principles dictate that the real exchange rate of the economy should reflect major changes in any of its principal determining factors (export prices, import prices, long-term capital flows, and productivity changes in either the tradable or nontradable sector of the economy). Failure to permit the real exchange rate to do so would in effect, keep it from performing its fundamental economic function of equilibrating a country's trade and payments with the rest of the world.

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<sup>7</sup>Our examples have dealt with a simple situation in which economic growth does not enter the picture. All of the analysis and conclusions, however, can readily be translated to a growing economy. Readers can visualize the equilibrium of a "static" economy as a flat line on the time scale, while equilibrium in a growing economy would be a rising line through time for things like GDP, capital stock, imports, exports, productivity and real wages in most economic sectors, etc. Some relative prices would tend to fall over time, others to rise. The simplest way of characterizing equilibrium processes in a static economy is to think of a magnet attracting outlying particles to it. The counterpart for a growing economy is best visualized as a dog chasing a rabbit. The equilibrium point (the rabbit) is constantly changing, but the economy (the dog) is heading toward it just as certainly as the metal particles head for the magnet in the static case.

One point of qualification, however, can be made for the case of a growing economy. This is that it is totally normal, and economically justified, that the international reserves of the Central Bank should tend to grow over time as the economy in question experiences average growth in its GDP. Thus, the baseline of the moving equilibrium of a growing economy should typically entail exports being greater than imports, with the normal excess being used to acquire the additional reserves corresponding to that economy's ongoing economic growth. The counterpart of this would, of course, be an equilibrium trade deficit in the country or countries supplying the international reserves.