First draft, July 1, 1993; revised 2/22/94 and 12/8/94

Sterilization of Money Inflows: Difficult (Calvo) or Easy (Reisen)?

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<u>Abstract</u>

Some countries undergoing exchange-rate-based stabilization and financial liberalization in Latin America and elsewhere have faced large capital inflows since 1991. Many have tried to sterilize the reserve inflows. Calvo and co-authors argue essentially that sterilization is more difficult than generally realized, due to the interest costs on sterilization bonds. Reisen argues essentially that sterilization is <u>easier</u> than generally believed. This paper reviews the issues in the simplest textbook model. The conclusions are that local interest rates are not likely to rise if the source of the disturbance is an exogenous capital inflow, but will rise if the disturbance is an increase in money demand or an increase in exports. In every case, sterilized intervention will leave interest rates higher than they would be if the inflow took place unsterilized. The case where the domestic money supply and the rest of the economy are insulated from foreign disturbances despite perfect capital mobility and a fixed exchange rate, which Reisen attributes to Southeast Asia, is seen to be the case where domestic agents are unresponsive to interest rates.

key words: sterilization, capital flows, reserve flows, monetary approach to the balance of payments, Colombia

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After seven years of sharply reduced lending to developing countries in Latin America and elsewhere, capital inflows have once again surged in 1990-93. These inflows have partly gone to finance renewed trade deficits in some countries, but also show up as renewed surpluses on the overall balance of payments. The increase in foreign demand for domestic assets could have been reflected as appreciations of the local currencies, if the central banks so chose. But to a large degree the monetary authorities have chosen to intervene to keep the exchange rate relatively stable1/, buying dollars to add to their reserve holdings and selling local currencies. In many countries, fears that increases in the money supply would be inflationary have prompted the central banks to attempt to sterilize the reserve inflows. The Latin American case is well-documented by Calvo, Leiderman and Reinhart (1993). Some countries in East Asia and the Mideast have also faced large inflows recently, and attempted to one degree or another to sterilize them.

A number of reasons have been given to explain these recent capital flows. Some factors are external to the countries. Calvo, Leiderman and Reinhart (1993a) argue convincingly that the external factors, particularly a decline in the rate of return to capital in the United States, play a dominant role. An important piece of evidence is the pattern whereby capital seems to be flowing, not just into a few Latin American or East Asian countries such as Chile or Mexico, which have undertaken serious policy reforms, but into a wider set of countries, including Brazil [and Egypt].

1/ The recent increased reliance in Latin America on a stable exchange rate as a nominal anchor for monetary policy has been examined by Edwards (1992b).

Other relevant factors are internal to the countries, particularly market-oriented policy reforms. These reforms include trade liberalization, monetary stabilization, domestic financial liberalization, and international financial liberalization. This last policy reform, the removal of controls on the international flow of capital, is especially relevant to the question whether these countries should or can successfully sterilize the reserve inflows. The sterilization issue has arisen in developing countries before, for example, the commodity booms in the early 1970s for countries producing oil, coffee, or other agricultural and mineral products, attempts at monetary stabilization in the Southern Cone of South America in the late 1970s, and manufacturing booms in the 1980s in Korea and Taiwan. But the recent introduction of a higher degree of capital mobility in many countries alters the problem.2/

The conventional view of these matters is fairly clear. It is that (1) sterilization of a reserve inflow is impossible under the idealized conditions of perfect capital mobility and a fixed exchange rate, but that (2) sterilization is possible in the short run if capital is less than perfectly mobile, and that it might even be desirable if inflation-fighting is considered sufficiently important. Indeed, if the goal is either to supply a nominal anchor to the monetary system or to prevent exporters from losing price competitiveness on world markets, then there would not be much point in pegging the exchange rate,

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2/ As Kenen (1993) points out, the removal of capital controls has two distinguishable implications. First, as one step in the direction of a more market-oriented economy, the liberalization makes domestic assets more attractive to foreign investors (shifting downward the BP schedule in the familiar textbook model that is presented below). Here the removal of controls on outflow, e.g., repatriation of earnings, is at least as important as the removal of controls on inflow. Second, the removal of controls on inflow by definition allows foreign residents to satisfy their demand for domestic assets more easily (flattening the BP schedule in the textbook model).

only to let the money supply and price level increase. These goals would require

both that the exchange rate be pegged and that the consequent reserve inflow

be sterilized.

The conventional view has recently been attacked from two opposite

directions. The first attack comes in several important and influential papers

by Guillermo Calvo and co-authors. I will characterize the critique as

"sterilization is more difficult than the conventional view has it." Specifically,

they have argued in the recent Latin American context that sterilization has

driven up interest rates and led to excessively high budgetary costs. Calvo

(1992, 1991) writes:

Capital inflows often accompany the first stages of stabilization programs based
    on exchange rates. This is, in principle, a welcome development, since these
    inflows contribute to the accumulation of reserves at the central bank....
    However, it will be argued in this note that if the [sterilization of inflows]
    is carried out by expanding the stock of nominal debt, forces may be set
    in motion that could also jeopardize the credibility -- and, hence, the
    sustainability -- of the anti-inflationary effort.

Calvo, Leiderman and Reinhart (1993a, p.110) write that sterilization of capital

inflows is "a step that tends to perpetuate a high domestic-foreign interest

rate differential and that gives rise to increased fiscal burden."

At the same time, Helmut Reisen (1993a,b) has, in provocative and appealing

terms, argued essentially that sterilization is _easier_ than the conventional

view has it. Specifically, he has argued in the recent East Asian context that

some countries have had great success in attaining all three points on the trinity

which conventional textbook theory says are mutually incompatible: the trinity

of open financial markets, fixed exchange rates, and monetary independence.

In the classic case of perfect capital mobility and fixed exchange rates, the
    central bank is often said to lose all power to influence domestic demand.
     The coexistence of stable exchange rates, free capital flows and monetary
    autonomy has thus been labelled the "Impossible Trinity." Yet, some Asian
    countries have achieved precisely that.

Reisen (1993c) has also suggested that countries in Latin America should emulate the East Asian approach to sterilization.

Some readers have expressed confusion with respect to these issues. Regarding Reisen: The logic of the impossible trinity seems so airtight; where could the conventional view have gone wrong, as he says it has? Did not the European exchange rate crisis of September 1992 reaffirm the impossibility of the trinity? Regarding Calvo: If the origin of the reserve inflow is an exogenous increase in foreign investors' demand for local assets, how could an increase in the local interest rate possibly be an equilibrium response? Is this not like saying that an apple-producer who responds to an increase in demand for apples by increasing supply runs the danger of a fall in price?

One might suppose that the explanation for any confusion must lie in the over-simplicity of the conventional textbook model, and that Reisen and Calvo each have complications in their models that render their respective conclusions correct under their respective assumptions. In that case, it would then be a matter of identifying the different assumptions, and trying to decide empirically which model is more realistic.

I will argue that the differences in outcomes do not arise primarily from any complications in model structure that the standard textbook model fails to capture. Rather there is some confusion in readers' minds regarding what is being compared to what, regarding the disturbances in which reserve inflows are implicitly assumed to originate, and perhaps regarding the slopes of the curves in the textbook model.

I should note from the outset the definition of sterilization of inflows that I have in mind: offsetting policy actions by the central bank to leave the aggregate money supply unchanged. A narrow technical definition of sterilization would restrict the policy actions to open market operations or other measures to leave the <u>monetary base</u> unchanged. Outside of the United States, and especially in industrializing countries, open market operations are not as frequently used, sometimes because government securities markets are not as well-developed. The monetary authorities instead sometimes raise reserve requirements on commercial banks or take other steps to prevent broader monetary aggregates like M1 or M2 from increasing, even if the monetary base does increase. The sort of policy that Reisen (1993a, p.48) identifies with Southeast Asian monetary authorities falls into this category:

> They often swap government excess savings (originating, say, in social security funds or public enterprises) held with banks into (or out of) government bonds. This practice can be considered as a generalized form of sterilised intervention.

2. The textbook model

We begin with the textbook model. It is simpler than simple. But if it is possible that any confusion can be cleared up in a simple textbook model and that a more sophisticated one is not necessary for this purpose, it is probably best to do so. We will note some possible complications below.

The overall balance of payments is the sum of the current account and the capital account: BP = TB + KA.

The capital account is given by:

$$KA(i-i^*; \ \Delta s^e 1, \ ...)$$

where i is the domestic interest rate, i* is the foreign interest rate, assumed exogenous, and $\Delta s^e 2$ is expected depreciation of the domestic currency. The three dots are meant to indicate that there are other variables that might enter the capital account function. They include uncertainty regarding the exchange rate, default risk, and the stocks of domestic and foreign assets already held.

If the responsiveness of KA to the interest differential is finite, it is because we are examining a country where the removal of barriers to the international flow of capital is not complete. We can imagine that the capital flow equation is derived from a stock adjustment model, where the stocks of foreign vs. domestic assets demanded in long-run equilibrium depend on the level of rates of return, but where capital controls and transactions costs prevent instantaneous adjustment of the stocks.

The strongest textbook result is easily illustrated. Assume first that the spot exchange rate is pegged: $S = \overline{S} 3$, where S is the exchange rate in pesos per dollar. If the peg is considered sufficiently permanent that there are no fears of changes in the exchange rate, then $\Delta s^e 4$ is zero, and furthermore investors may treat domestic and foreign assets as perfect substitutes due to the absence of exchange risk. Assume second that capital is perfectly mobile, so that KA is infinitely sensitive to rates of return. It follows that arbitrage insures the simple interest rate parity condition:3/ i-i* = 0.

3/ There are many tests of interest rate parity. Two studies that distinguish the role of country factors (e.g., capital controls) in the interest differential from currency factors (expected depreciation and the risk premium) are Frankel (1991), which includes several developing countries in the sample, and Chinn and Frankel (1993), which applies to Pacific countries. A lack of forward rate data makes it difficult to test covered interest parity in the case of Latin America. It is also difficult to test uncovered interest parity, as explained in an Appendix.

The assumptions imply that the interest rate is tied down to the exogenous foreign interest rate. In some respects, the rest of the model does not matter. There is no scope for an independent monetary policy, as measured by the interest rate. If the central bank expands domestic credit to push down the interest rate, a potentially infinite rate of capital outflow will instantly deplete the central bank's foreign exchange reserves, on a one-for-one basis, until all reserves are exhausted and the central bank is forced to give up. As long as the definitions of perfect capital mobility and a fixed exchange rate are accepted, there is no way around this logic, no way of setting the domestic interest rate independently. What, then, can Reisen be talking about?

Success at influencing the interest rate is not the only, or the most proper, way of defining sterilization or an independent monetary policy. The most proper way of defining sterilization is central bank success at determining the money supply. The best way of defining an independent monetary policy is central bank success at influencing domestic demand and therefore influencing the level of output (in the short run, when prices are sticky) and influencing the level of prices (especially in the longer run). To consider these criteria of sterilization -- independent determination of the money supply and of economic activity -- we now proceed to introduce the rest of the textbook model.

Demand for output Y comes from both domestic aggregate demand, A, and net foreign demand for domestic goods, TB:

$$Y = A(i, Y; ...) + TB(S/P, Y; ...). \qquad (IS)$$

Other variables that might enter the aggregate demand function include government spending and wealth. Other variables that might enter the trade balance function include trade policy, and (particularly if we are to interpret TB as the total

current account) the interest rate and the perceived degree of permanence of fluctuations in income.

If the variables that are explicitly indicated in the equation are indeed the only ones to enter, then we see that the impossible trinity remains impossible. If S and i are tied down, then monetary policy cannot work to increase aggregate demand.

The demand for money is given by

$$L(i, Y; ...)P = M, \hspace{4cm} (LM)$$

where i is the interest rate, Y the level of real output, and P the price level. Other variables on which the demand for money may be thought to depend include expected depreciation of the domestic currency, which will matter if there is currency-substitution.[4]/ Another is the stock of bonds or other assets, which will matter in any portfolio-balance model. Another is the expected inflation rate.

According to the money market equilibrium condition as written, if the monetary authorities are unable to influence the interest rate, they are unable to determine the money supply. Sterilization is not possible. The money stock is determined endogenously by money demand.

3. Four disturbances with perfect capital mobility

These familiar textbook results are best illustrated with the familiar textbook graphs of the IS, LM and BP curves, corresponding to our three equations. Income Y is shown on the horizontal axis, under the assumption that the price level is pre-determined in the short run. But a movement to the right should be thought of as creating inflationary pressure. If one wished to consider a

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[4]/ Calvo and Vegh (1992).

frictionless full-employment economy, one could put the price level P on the horizontal axis instead of income. The right panels in each figure illustrate the special case where perfect capital mobility is assumed to tie i to i*: the BP line is horizontal.

We consider several different possible sources of a reserve inflow. Figure 1 considers a deliberate reduction in domestic credit, an attempt at monetary contraction designed, presumably, to reduce inflation. In the right panel, the attempt to shift the LM curve to the left cannot succeed, if the fixed exchange rate is to be maintained. Rather the hypothetical point H is a point where a potentially infinite capital inflow is attracted by the high domestic interest rate. For every peso of domestic credit that is extinguished through sales of securities, another peso of money is created through purchases of foreign exchange to keep the domestic currency from appreciating. The central bank is forced to give up the attempt to reduce the money supply, and the economy returns to its starting point. This point is labelled M on the graph, to signify that this adjustment process is the essence of the famous Monetary Approach to the Balance of Payments. Monetary policy is powerless. Under these conditions -- perfect capital mobility and a fixed exchange rate -- the government had better have a well-developed fiscal policy instrument, if it wishes to exercise any discretionary macroeconomic control.

The alternative, of course, is that the central bank give up the attempt to peg the exchange rate and allow an appreciation. The loss of price competitiveness leads to a deterioration of the trade balance and a leftward shift of the IS curve. The economy moves to point A (for "Appreciation"). Under these assumptions -- perfect capital mobility and a floating exchange rate -- monetary independence reaches its peak, as measured by the magnitude of the effect

of money supply changes on the economy. Under either exchange rate regime, fixed or floating, the trinity remains impossible; it is merely a question whether the central bank chooses to give up monetary autonomy or exchange rate stability.

Figure 2 illustrates the case of an improvement in the capital account due to an exogenous increase in the worldwide availability of funds, as represented by an exogenous fall in the foreign interest rate i*: a downward shift in the BP curve. This case corresponds to Calvo, Leiderman and Reinhart's identification of the early-1990s capital flows to Latin America as originating in a fall in U.S. rates of return. Under perfect capital mobility, the domestic country has no choice but to accept a fall in i. If the exchange rate is kept fixed, money automatically flows in to bring the interest rate down and stimulate spending, attaining point *M*. If the central bank chooses instead to keep the money supply fixed and abandon the exchange rate peg, then the currency appreciates, the trade balance worsens, and the economy moves to point *A*.

Next we consider the case of an increase in the demand for domestic money, shifting LM to the left. This could be the result, for example, of perceptions that a high existing inflation rate has now been eliminated, in a model where expected inflation is an additional term entering the demand for money. Residents will increase their demand for money because they no longer expect it to lose value. This is the case considered in Calvo (1991). If the exchange rate is fixed, the desired money flows in automatically through the balance of payments, irrespective of any futile attempts undertaken to sterilize it. The LM curve returns immediately to where it was. The economy returns to *M* in Figure 1, which does double-duty here, because the experiment of an increase in money demand looks the same as a decrease in money supply. If the exchange rate is allowed to appreciate, we instead move to *A*.

Figure 3 illustrates an improvement in the trade balance. This could be an exogenous export boom (e.g., a Dutch Disease boom in coffee exports), or the response to a real devaluation. The IS curve shifts to the right, putting upward pressure on the interest rate and therefore on the capital account. If the exchange rate is fixed, money once again automatically flows in through the balance of payments, allowing full accommodation to the increase in demand for domestic output, at point *M*. If the central bank wishes to keep the money supply fixed and abandon the exchange rate peg, the currency appreciates far enough to return the trade balance, the IS curve, and Y to their starting points at *A*.5/

4. Possible areas of elaboration of the textbook model

The stripped-down model could be extended in many directions, either to make it more realistic or it to ground it more rigorously in economic theory.

(1) **Expectations of exchange rate changes**. Even when the government proclaims a fixed exchange rate, we could allow for the perceived possibility that the peg will have to be devalued in the future due, for example, to a reversal of the capital inflow. This is the Δs^e 5 term above. Certainly, when Latin American interest rates have been observed to rise above foreign interest rates, expected depreciation is usually part of the explanation. [This is difficult to verify in practice, because of the difficulty of measuring expectations. An appendix explains the problem.]

5/ This analysis would apply to an exogenous increase in domestic spending, regardless whether originating in the private or government sectors.

If rationally expected depreciation were the reason why the interest rate that the central bank must pay on its domestic sterilization bonds exceeds the interest rate it earns on its foreign exchange reserves, then the financing costs would be a wash. Arguments against sterilizing the inflow would have to make the ultimate devaluation endogenous, and probably to argue that monetization and inflation in the future would be worse than monetization and inflation in the present. If the source of the difficulty is some market failure that allows the magnitude of the indebtedness to become excessive under the sterilization strategy, one suspects that the solution will turn out to lie in direct measures to discourage borrowing, rather than in allowing an unsterilized inflow.

(2) **Risk**. Domestic and foreign bonds could be treated as imperfect substitutes. Uncertainty regarding changes in the exchange rate, and risk-aversion on the part of investors, is sufficient to create imperfect substitutability. Exchange risk [like default risk] could be the explanation for the finite sensitivity of BP to expected rates of return that we consider below. When the domestic-foreign interest differential is believed to be too large to be attributed to expected depreciation of the currency, the difference, $i - i^* - \Delta s^e$ [6], can be interpreted as an exchange risk premium that must be paid to investors to induce them to hold risky domestic assets. One can go a long way toward deriving investor behavior from first principles of expected utility maximization, if one so desires. Then the exchange risk premium can be seen to depend on such parameters as the variance of the exchange rate and the degree of risk-aversion. Much empirical work on the risk premium, if it is based in the theory of optimal portfolio diversification and rational expectations,

concludes that the risk premium must be rather small. Less orthodox approaches, however, can produce larger estimates of the risk premium.6/

An interest differential attributable to an exchange risk premium or default premium arising from exogenous variability, like an interest differential attributable to exogenous expected depreciation, could be interpreted as nothing more than the fair market price that the central bank should expect to pay to borrow domestically and invest abroad. But an appropriate analysis, again, would make the risk of a devaluation endogenous.

(3) **More assets**. The textbook model has a very simple asset menu. Domestic residents are assumed to hold only domestic money, domestic bonds and foreign bonds, with the demand for domestic money depending only on the domestic interest rate. Foreign residents, in the simplest set-up, are assumed not to hold domestic money, or even domestic-denominated bonds. Even a simple "small-country" portfolio-balance model would have domestic residents allocate shares of their portfolio among the three assets. In terms of equation *LM*, wealth would be another variable determining the demand for money, and the rates of return on all assets would enter all demand functions describing domestic residents. The view that sterilization is more difficult if the level of government debt is already high is captured by including the stock of bonds as a determinant, along with other components of wealth, of the demand for money. One would also want to take into account the government borrowing constraint, whereby the budget deficit must be financed by some combination of borrowing from foreign residents, borrowing from domestic residents, and money creation.

6/ The optimal-diversification approach to the exchange risk premium is pursued, for example, in Chapters 9, 10 and 11 of Frankel (1993). Estimates of the exchange risk premium that use survey data to measure investor expectations appear in Chapters 12-17, Dominguez and Frankel (1993), Frankel and Chinn (1993), and Chinn and Frankel (1993).

Then more assets could be introduced, to distinguish equities and direct investment from bonds, long-term bonds from short-term bonds, bank deposits from bonds, "monetary stabilization bonds" created by the central bank in sterilization operations from treasury bonds created by the rest of the government, and so on. In a currency substitution model, potentially relevant for most of Latin America, domestic residents also hold dollar money. Next, foreign investors would be viewed not just as passive agents willing to lend (or borrow) at the going foreign interest rate, but as portfolio investors willing to consider holding domestic bonds, equities, and other assets in their portfolios, when the return prospects and diversification opportunities are attractive.[7]

One particular version of this portfolio approach might help explain why the central bank finds it has trouble selling domestic bonds, unless it pays high interest rates, at the same time that foreign investors are eager to buy domestic assets. If the increase in foreign investor demand takes the specific form of an increase in demand for equities or direct investment, and if the bonds that the central bank sells are considered poor substitutes for equities or direct investment by all investors, then the capital inflow might drive up the interest rates on those bonds at the same time that it drives down the required rate of return on the other assets.[8] If the problem with the bonds is thought to be perceived risk of default, one possibility would be for the central bank to make them more attractive to investors by allocating its new foreign exchange reserves to a special fund for the designated purpose of servicing the debt. [The flip

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[7] Of course one could then derive the asset-holding preferences of both classes of investors from the principles of expected utility maximization.

[8] Fischer and Reisen (1992) and Kenen (1993, p.245) point out the potential problem of a mis-match in desired assets. But Reisen (1993c) suggests that if the capital inflow is in the form of equities or direct investment, as opposed to "hot money" flows, it is more likely to be permanent, with less need to intervene to prevent an appreciation in the first place.

side, however, is that when the monetary stabilization bonds issued by the central bank look different from regular treasury bonds, it may be hard for the central bank in the future to explain to the government the need to spend resources servicing the bonds.]

(4) **Heterogenous expectations**. It is still relatively uncommon for economists to consider the possibility that different actors have different expectations. But if the central bank is having difficulty selling domestic assets to domestic residents at the same time that foreign investors are beating the doors down to buy domestic assets, it may be that their asset preferences differ. The possibility that domestic residents are more pessimistic about domestic assets must be taken seriously: a widely-held interpretation of the massive capital flight from Latin America that took place in 1982 and the years immediately preceding it is that residents of these countries correctly perceived dangers ahead, at a time when foreign banks were foolish enough to be still lending eagerly.

So far in the present episode, repatriation of past-flown capital by domestic residents seems to be as important a part of the inflows as new investments by foreign residents. Nevertheless, anyone who is concerned about a possible replay of 1982 -- as are Calvo, Leiderman and Reinhart -- wants to be vigilant to any future signs that the locals are again losing confidence. Unfortunately, capital flight can only be estimated with a lag of a quarter or two (and, even then, very imperfectly).

Another place where it might be useful to look, though few have done so, are the prices of country-funds that invest in the stock markets of a number of Latin American and Asian countries. Fluctuations in the premium of the U.S. price of the fund over the net asset value could be a measure of fluctuations

in the difference in expectations of U.S. versus local investors. For most of these funds this premium has been higher (or the discount has been lower) during the period 1990-1992 than during the preceding three years, suggesting bullish sentiment on the part of foreign investors. Hardouvelis, La Porta and Wizman (1993) argue persuasively that the existence and behavior of these premiums and discounts are inconsistent with an Efficient Markets Hypothesis, and reflect "U.S. investor sentiment" in imperfectly integrated markets. They note a dramatic switch in 1990 across most of the country funds, an improvement in U.S. investor sentiment compared to the preceding three years, which they attribute to the fall of the Berlin Wall and German unification. From our viewpoint, however, the 1990 switch in the relative enthusiasm of American investors to invest in Latin America and elsewhere, which is observable in the data on long-term capital flows, could be due to the decline in expected U.S. returns identified by Calvo, Leiderman and Reinhart.

The charts at the end of the paper show the weekly discount or premium of the country funds in recent years for nine countries, three in Latin America and six in East Asia. Unfortunately, only two of the country funds in each region have been in existence long enough to allow a pre-1990 and post-1990 comparison. [Also presented is the common component of the nine oldest funds, as estimated by Hardouvelis, La Porta and Wizman (1993).] Mexico and Brazil show a clearly higher level of relative U.S. investor confidence in the three years from 1990, consistent with the trend for the Germany Fund and the common component of country funds. Taiwan and Thailand show a clearly <u>lower</u> level of U.S. investor confidence, again as compared to the end of the 1980s. If our interpretation of the data is correct, that they represent the confidence of U.S. investors relative to local investors, these four graphs suggest a possible replay of the period leading

up to 1982, when Latin American residents turned pessimistic regarding their own countries while U.S. banks were still bullish.

Heterogeneous expectations can also enter when the private sector is skeptical that the stabilization will be sustained, but the government believes that it has better information and that the commitment to the exchange rate is genuine. If the government's view is in fact correct, then the interest rates that it has to pay on sterilization bonds, even after allowing for the "true" probability of devaluation, will indeed be "too high".

5. Reisen, Calvo, and the model with imperfect capital mobility

In the experiments considered in Section 3, a central bank that gives up the freedom to vary the exchange rate clearly also gives up an independent monetary policy, whether measured by the interest rate, the money supply, or output. If East Asian countries have retained some degree of monetary autonomy, in reality some of it must be because their exchange rates are not literally fixed nor their capital markets completely open. Recent findings that the United States and Germany have been able to affect the mark/dollar exchange rate through sterilized intervention clearly depend on investor awareness that the exchange rate is variable to get the effect (whether through a portfolio-balance/risk-premium channel or through an expectations channel).9/

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9/   Dominguez and Frankel (1993) and Catte, Galli and Rebecchini (1993). (Many others, such as Obstfeld, 1990, find what they consider evidence of the contrary: that sterilized intervention cannot affect exchange rates.) A finding that sterilized intervention is successful at affecting the exchange rate under floating exchange rates does not necessarily translate into the conclusion that sterilized intervention would be successful at determining the money supply under a fixed exchange rate.

Tests of interest parity conditions for Pacific countries, over the period September 1982 to March 1992, indicate that none of Reisen's four Southeast Asian countries in fact satisfy interest parity (Chinn and Frankel, 1993b). In the case of Singapore, it is true that the nominal interest differential decreased over the sample period, and the covered interest differential was particularly small to start with. But Singapore's exchange risk premium is significant, and rises rather than falls in the course of the decade.10/ For Taiwan, Malaysia and Indonesia, the trend in the magnitude of the nominal interest differential was, if anything, upward, and significantly so in the Indonesian case.

Fry (1993) studies six East Asian economies (including Indonesia, Malaysia and Taiwan) and finds that they have been able to sterilize substantially, because the offset coefficient is relatively low. He suggests that this contradicts assertions of high capital mobility.11/

But Reisen (1993a, p.5) makes clear that a failure of interest parity due to possible exchange rate changes is not what he has in mind as the central phenomenon:

"Many economists tend to explain the effectiveness of sterilized intervention with foreign exchange risk and expectations thereof alone. Such explanations ... ignore the art of central banking in South-East Asia which

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10/ The expected depreciation component of the risk premium is measured by means of survey data. An appendix to the current paper explains why this method is used.

11/ Fry (1993, p. 153) also mentions as possible explanations of his findings of monetary independence in these countries, in addition to capital controls, "capital market imperfections, non-price rationing of bank loans or exchange rate flexibility." Claasen (1993) argues that exchange rates in Malaysia and other Southeast Asian countries have not in fact been fixed, so that it is not valid to estimate a low offset coefficient and infer low capital mobility. But he does agree with Fry on another point: "in practice, the arbitrage mechanism of interest rates only affects a limited menu of financial assets which are generally at the short end of the maturity structure such as short-term bank deposits or government bills. Many borrowers of these countries are captive to their domestic banking system, since they do not have access to the domestic and foreign bond markets. Thus, some, but not all interest rates converge to the international ones." The result is that broader criteria of capital mobility fail, even when interest parity holds.

consists in the pragmatic use of public institutions such as social security
funds, state banks and public enterprises as monetary instruments."

Nor does he have in mind a failure of interest parity due to barriers to
international capital mobility: The monetary authorities "have not been helped
by capital controls in their aim of targeting money supply and exchange rate
at the same time" (Reisen, 1993b, p.48). Nor, I believe, is he thinking of any
of the other complications in the model that are mentioned in the preceding
section.

My interpretation of Reisen's description of the Southeast Asian experience
is that, even to the extent that the domestic interest rate is tied to the foreign
interest rate, the domestic interest rate plays little role in the economy,
because domestic financial markets are not very liberalized or well-developed.
 Business fixed investment and other components of domestic demand A are
unresponsive to interest rates. Thus the IS curve is vertical. The demand for
money is also unresponsive to interest rates. Thus the LM curve is vertical
as well.12/ In terms of Figure 2, the response to a fall in world interest rates
is simply a vertical drop to point R, with no effect on income or the money supply.
 The economy is insulated from the foreign disturbance despite capital mobility
and a fixed exchange rate.

How, in these circumstances, does the government have an effect on domestic
economic activity if it wishes to do so [either upward, to promote output and
employment, or else -- consistent with the problem of capital inflows currently
under consideration -- downward, to fight inflation]?. The government must vary
spending and money together, in order to shift the vertical IS and LM curves,

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12/ In his survey of the financial structure of Asian countries, Fry (1990,
p.11) notes "Successful financial restriction is exemplified by...three effects
on the demand for money: a rightward shift of the function, a higher income
elasticity, and a lower interest-rate elasticity."

and therefore the economy, horizontally to the new desired level of domestic demand. If institutions like Singapore's Provident Fund function as government agents, then it is as good if they are the ones to undertake the spending as if a regular government agency does so.

If this interpretation is correct, Reisen is saying that Southeast Asian governments have retained the ability to sterilize while undertaking international financial liberalization because they have delayed domestic financial liberalization. The one well-known conclusion that appeared to have been agreed upon ten years ago in the literature on the optimal order of liberalization is that capital controls should be removed last, <u>after</u> domestic financial liberalization, not before. Others have noted that some East Asian countries have tended to reverse this recommended order. Some justifications have been suggested.<u>13</u>/

Perhaps one should add to the list of items on the balance sheet in favor of slowing domestic financial liberalization that it will make sterilization easier. But there remain other reasons for promoting domestic liberalization, particularly when a country reaches the stage of economic development where investment can no longer be efficiently financed by government-allocated credit or by earnings retained through family enterprises. The inconvenience of being forced to choose between a fixed exchange rate and monetary independence might not be a sufficient reason to delay the development of financial markets.

<u>13</u>/ For example, where domestic financial interests are able to oppose liberalization politically, or lack the know-how to compete, opening up to international financial markets may be a way to overcome this resistance, as the domestic institutions are given the example of foreign banks and securities traders to emulate, and are forced to compete.

Any concerns about sterilization of inflows raising interest rates must
pertain to a world where arbitrage is not powerful enough to tie down the interest
rate. We now consider the case where capital mobility, though high, is not perfect,
due to the continued presence of some capital controls, transactions costs,
default risk, foreign exchange risk, or perceived risk of future capital controls.
This case is probably the more realistic one for most newly industrializing
countries, despite financial liberalization.

The left panel in each of the figures illustrates the case of imperfect
capital mobility. The BP curve is now an upward-sloping relation between Y and
i. An increase in income sucks in imports; if the overall balance of payments
is to be zero, the interest rate must rise a bit to attract capital to finance
the trade deficit.

BP = TB(E/P, Y; ...) + KA(i-i*; $\Delta_S e$ 7, ...) = 0.   *(BP=0)*

Let us consider the same four possible disturbances. A deliberate
contractionary monetary policy to fight inflation moves us to point S in Figure
1. Because capital mobility is merely high, but not perfect, sterilization of
the inflow so as to remain at point S for awhile is a viable option. As long
as the central bank continues to sterilize, it can maintain the interest rate
at the higher level. If it chooses to stop the sterilization, money will flow
in through the balance of payments (rather rapidly, if capital mobility is high),
and the economy will move down the IS curve toward the starting point *M*. The
ultimate outcome is much as observed earlier in the right panel, but it takes
a finite time interval to happen.

If the central bank chooses to abandon the exchange rate peg, the currency appreciates, rendering producers less competitive on world markets and reducing net exports. The result is to shift both the IS curve and the BP curve to the left, until all three curves intersect at point *A*. The results are qualitatively similar to the right panel, but less extreme.

Next comes the exogenous fall in world interest rates, the case of Calvo, Leiderman and Reinhart. At point *S*, the reserve inflow is sterilized. For the time being, while the central bank continues to sell bonds to sterilize the inflow, the interest rate is kept above the world level. Eventually, the authorities let the money supply increase. When they do, the economy begins to move to the right. Eventually it reaches point *M*. ["M" still stands for Monetary Approach to the Balance of Payments. But it could now be thought of as also standing for "Medium Run," signifying that the money stock has had time to adjust, though the price level has not, and the higher level of international indebtedness has not yet had an effect on saving behavior or other economic variables.] If the central bank chooses to let the currency appreciate, the outcome is *A*. As common sense would suggest, the increase in demand for domestic bonds lowers (or at worst leaves unchanged) the domestic interest rate, regardless the degree to which the authorities respond by allowing the currency value or money supply increase.

The third experiment, the increase in demand for money, can be examined under conditions of imperfect capital mobility in the left panel of Figure 1. This is the disturbance considered by Calvo (1991). The sterilization point *S* entails needlessly high interest rates and a contraction of economic activity. Better not to attempt sterilization, rather letting the money that residents want to hold gradually flow in to return the economy to *M*. It would be better

still to increase domestic credit deliberately to return the economy to its starting point right away.

If the increase in money demand is the result of a monetary stabilization, as in Calvo (1991), there is a fine line between failing to accommodate the increase in demand for money and failing to convince residents in the first place that inflation has genuinely been eliminated. This fine line may be too fine to be tenable. In other words, it may in practice be impossible credibly to reduce the expected rate of money growth while simultaneously increasing the level of the money supply. Under these circumstances, it may indeed be best simply to allow the money to flow in through the balance of payments.

The final experiment, illustrated in Figure 3a, is an improvement in the trade balance, shifting the *IS* and *BP* curves to the right. We have already mentioned the example of an exogenous commodity boom, like the coffee booms experienced by Colombia in the 1970s.[14] Another possibility is an increase in exports engendered by a devaluation. This is the case with which Edwards (1991) identifies the Colombian balance of payments surplus of 1991. [A trade liberalization was accompanied by a devaluation so that the import-competing sectors would not be hit too badly; the outcome in 1991 was a sufficiently large increase in non-coffee exports to improve the trade balance sharply.]

Once again, sterilization can succeed in holding the interest rate up at point *S* for awhile. Eventually the central bank gives up on its attempt to hold the money supply fixed, and the money inflow moves the economy toward the equilibrium at *M*. Or, if it chooses to give up on its exchange rate target instead, the appreciation moves the economy to *A*, which in this case is the same as the

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[14] E.g., Edwards (1985), Kamas (1985) and Cardenas (1991).

starting point. [The attempt to devalue, if that is what shifted the *IS* curve out in the first place, is not successful.]

Now it is a simple matter to settle what is being claimed when we hear that sterilization of capital inflows raises the interest rate. Regardless of the disturbance, sterilization at point *S* in Figures 1a, 2a, or 3a results in a heightened interest rate <u>spread</u>, i-i*. What about the <u>level</u> of the interest rate i? In each case, sterilization at *S* results in a higher interest rate than if the money supply is allowed to increase at *M*. It is quite unsurprising that a tighter monetary policy entails a higher interest rate.

But when the disturbance is external, the case of Calvo, Leiderman and Reinhart (1993a, 1993b) illustrated in Figure 2a, the level of the domestic interest rate is not higher than it was before the inflow began, or than it would be if the inflow were shut off with effective capital controls. [To think otherwise would indeed be to expect an increase in the demand for apples to result in a reduction in their price.] Only when the disturbance is a rise in money demand, the case of Calvo (1991) illustrated in Figure 1a, or an improvement in the trade balance, the case of Edwards (1991) illustrated in Figure 3a (or some other increase in demand for domestic goods), is the interest rate higher with the disturbance than without it. These points are simple enough to be illustrated with the textbook model. One need not resort to a default premium, expectations of abandonment of the exchange rate peg, an exchange risk premium, multiple assets, heterogeneous expectations, or other complications, in order to make these points.

In each example above, we have examined a disturbance that gives rise to a reserve inflow, rather than the mirror image of the disturbance, such as a deliberate expansion in domestic credit, or an exogenous deterioration of the trade balance. One aspect of the conventional view is that (1) if it were a question of sterilizing an <u>outflow</u>, the central bank would eventually be forced to adjust or else face the threat of running out of reserves; while (2) there is much less pressure on a surplus country to adjust.

In the first case, the conventional view says that there is no alternative for the deficit country, when its stock of reserves is depleted. [In practice, it may be possible for countries to borrow reserves.]

In the second case, if the surplus-country central bank maintains the exchange rate peg, eventually it will run out of its inventory of Treasury securities to sell in its sterilization operations. But it can issue new government securities. This is in fact the way that Korea, Chile, Colombia, and other industrializing countries have tried to sterilize their reserve inflows in recent years [with varying degrees of success]. There appears to be little pressure on the surplus country to adjust. This asymmetry has been borne out among industrialized countries repeatedly, in exchange rate crises during the Bretton Woods system and most recently in September of 1992 (where the perfect capital mobility case is probably the most relevant): while there is pressure on the surplus currency (often the mark) to adjust, the pressure on the deficit countries (often the pound) is considered much greater.

One of the contributions of Calvo (1991) is to illustrate the nature of the pressure on the surplus country to adjust, in a two-period example. Sterilization entails a steadily increasing stock of domestic debt. The logic is then that eventually, as the debt-service becomes increasingly expensive

relative to GNP, the authorities will have to monetize the debt. Rational

expectations of this future monetization and inflation undermine the

stabilization that led to the surplus in the first place.

What are the implications if investment and money demand are relatively

unresponsive to the interest rate, so that the *IS* and *LM* curves, respectively,

are steep? These are the circumstances to which we have interpreted Reisen as

attributing ease of sterilization in SouthEast Asia, when the disturbance is

external as in Figure 2. But when the disturbance is an increase in money demand

in Figure 1, or an improvement in the trade balance in Figure 3, these

circumstances result in an especially large increase in the interest rate. The

perils Calvo (1991) warns of are that much greater. The country would be better

off if domestic financial markets were sufficiently well-developed that investors

were willing to absorb sterilization bonds without demanding a big increase in

the interest rate.

6. Conclusions

The desirable strategy regarding treatment of capital inflows depends on

the nature of the disturbance. To take one case, assume investors (either domestic

or foreign) shift preferences into domestic bonds from foreign assets. The shift

could be in response to market reforms, or in response to a decrease in the

attractiveness of assets abroad (Calvo, Leiderman, and Reinhart, 1993a,b). One

can discuss the possibility of market failures whereby the country becomes

excessively indebted and vulnerable to a sudden reversal of confidence, as

happened in 1982.[15] Such market failures would call for direct measures to

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[15] Harberger (1989?, p. 165) proposes dealing with "congestion externalities"
in borrowing by instituting an "international borrowing tax." For possible

discourage capital inflows. Otherwise, given that a country has decided to allow the inflows, there is a case for sterilizing them, for supplying the domestic bonds that investors want.

To take another disturbance, assume that domestic residents increase their demand for money, which could be in response to a domestic exchange-rate-based stabilization program (Calvo, 1991). Then the central bank should <u>not</u> attempt to sterilize the reserve inflow, but rather should supply the domestic money that residents want. In practice, a program of stabilization and liberalization might cause investors to increase their demand for both domestic money and domestic bonds. Then the inflow should be sterilized, but only partly, supplying both assets that are desired.

We have taken for granted the exchange rate peg. There are circumstances where the best response is to allow the currency to appreciate. A country undergoing rapid productivity growth over the longer term, for example, will have to allow a real appreciation to take place eventually, either in the form of a nominal appreciation or the form of an increase in the price level (in particular, increases in wages and the prices of non-traded goods). This is the situation that Korea and Taiwan found themselves in during the 1980s. Of the two standard objectives in sterilized intervention -- maintaining international competitiveness and maintaining a nominal anchor for monetary policy -- the first is irrelevant in these circumstances. As regards the second, if the nominal anchor is meant to be a means to price stability, then it makes more sense to let the currency rise and to stabilize the price level than vice

(..continued)
disadvantages of unrestricted borrowing, see also the papers by Williamson and others in Reisen and Fischer (1993).

versa. A sufficiently small and open country, on the other hand, might want to keep the exchange rate fixed for other reasons, e.g., to encourage trade.16/

In practice, of course, it can be difficult to distinguish the source of the disturbance, or its likely duration. But an attempt to discern the nature of the disturbance in a particular situation is likely to be most useful in deciding the appropriate response, regardless of the model.

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16/   The literature on nominal anchors for monetary policy is enormous. One review of the relevant issues is Frankel (1992) which evaluates alternative anchors: the money supply, exchange rate, price level and nominal GNP.

Appendix: Can Expectations be Inferred from Ex Post Exchange Rate Changes?

There is no reason to believe that interest rates should converge with financial integration unless one believes that <u>both</u> country barriers <u>and</u> the perceived likelihood of exchange rate changes move towards zero. To see this, notice that the differential for interest rates of common maturities can always be decomposed as follows:

(1)　　　　$i - i^{US} \equiv (i - i^{US} - fd) + (fd - \blacktriangle s^e) + \blacktriangle s^e$

Where:
    fd is the forward discount for a consistent maturity
    $\blacktriangle s^e$ is the expected depreciation over a consistent horizon

This identity merely breaks the nominal interest differential into its constituent parts: country factors (including capital controls, differential tax treatment, default risk, localized information, risk of future capital controls), which give rise to the covered interest differential $(i - i^{US} - fd)$, and currency factors (an exchange risk premium, $fd - \blacktriangle s^e$, and expected depreciation, $\blacktriangle s^e$).[17]

While exchange risk and expected depreciation are difficult to assess, one can examine capital controls and country risk directly by looking at the covered interest differential, or country premium. (What we are here calling the country premium is sometimes called a political risk premium.)

We can only examine covered interest differentials for a subset of countries, those with relatively well-developed forward markets, which lets out most Latin American countries. An alternative way to measure the country premium, when a Euromarket exists for a given country's currency, is to compare the Eurocurrency interest rate to the local interest rate. But it is rare for a Euromarket to exist in a currency if a forward market does not. Another alternative, where the country offers dollar interest rates to local residents, either in the form of dollarized bank accounts or exchange-indexed bonds, is to compare those interest rates to dollar interest rates in New York. One example where such assets are available is Mexico.[18] An example in Colombia is the secondary market in exchange certificates (U.S.dollar-denominated, non-interest-bearing bonds issued by the Banco de la Republica to exporters in return for their foreign exchange[19]).

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[17] Frankel (1991).
[18] Reisen (1993c). Studies of sterilization and offset (i.e., the rate at which money flows back out through the capital account) in Mexico include Cumby and Obstfeld (1983) and Kamas (1986).
[19] Rennhack and Mondino (1988, pp.13-16a) use this data source to measure expected depreciation of the Colombian peso. (They, like others before them, realize that they are being inconsistent in using a forward rate to measure expectations in the context of a model that relies on imperfect substitutability and the existence of the risk premium.) They find significant scope for sterilization in Colombia in the short run (50 per cent of the stock of net foreign assets has adjusted after one year) over the period 1977-1985, due in part to capital controls. Other studies of the determination of interest rates in Colombia include Edwards (1985), Edwards and Khan (1985), and Kamas (1985).

A common approach is to skip from covered interest differentials directly to uncovered interest differentials. In other words, one tries to measure the magnitude of the expected return differential, expressed as $i-i^{US} - \blacktriangle s^e$. The problem is the unobservability of expected depreciation, $\blacktriangle s^e$. The most common approach to measuring expected returns or the exchange risk premium is to infer expectations from the ex post behavior of the exchange rate itself. But this "rational expectations methodology" is likely to get one into trouble in practice: there is in fact little information in ex post exchange rate changes to tell us what investors expected ex ante. This point is illustrated in Table A, for the case of five Latin American currencies. Investor expectations are measured directly, from surveys of market participants conducted monthly by Currency Forecasters' Digest.

The first five columns look at unconditional bias during the sample period, April 1988 to February 1991. They find clear signs of bias for Argentina, Brazil, and Mexico, at either the 3-month or 12-month horizons. The last three columns look at conditional bias, by regressing the ex post change against the expected change as measured by the survey data (together with a constant, not reported). The null hypothesis of unbiased expectations says that the coefficient should equal one. The null hypothesis is rejected for the same three currencies, and for Venezuela as well. (A complete test, with data for 25 currencies, finds strong evidence of bias. It uses the GMM technique of Lars Hansen to correct the standard errors for the problems of heteroscedasticity and autocorrelation induced by overlapping observations; for details, see Chinn and Frankel (1993)).

These findings of biased expectations for four out of the five Latin American currencies, and most of the others as well, need not necessarily be attributed to a failure of rationality on the part of investors. They could instead be examples of the "peso problem": the possibility of a discontinuously-large devaluation makes the test statistic more sensitive than it should be to the chance event of whether the devaluation happens to occur during the sample period. Appropriately enough, the results for Mexico during our sample period appear to suffer especially from the peso problem. But it is important to realize that the technique of inferring investor expectations from ex post developments, common in tests of uncovered interest parity, is called into question by findings of bias, regardless whether the cause is a failure of rational expectations or a peso problem.

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