On the use of reserve requirements in dealing with capital flow problems

Carmen Reinhart and Vincent Reinhart

University of Maryland, College Park, Department of Economics

January 1999

In *International Journal of Finance and Economics*, Vol. 4 No. 1, January 1999, pp. 27-54.

On the Use of Reserve Requirements in Dealing with Capital Flow Problems

by

Carmen M. Reinhart
University of Maryland

and

Vincent R. Reinhart1/
Board of Governors of the Federal Reserve System

Final version: October 1997

ABSTRACT

In recent years, many developing countries have intervened in foreign exchange markets to offset to some extent the effect on their economies of large capital flows. Often, changes in reserve requirements were used to mitigate the impact of that intervention on domestic money supplies. Because reserve requirements are a tax, however, changes in reserve requirements can have real effects. This paper shows that the exact implications for output, the real exchange rate, and the capital and current accounts depend importantly on who--whether depositors or borrowers--pays the tax. In any case, foreign exchange intervention matched by changes in reserve requirements that keep the money supply fixed do influence the exchange rate in the short and, sometimes, the long run. The recent experiences of ten developing countries establish that, while the incidence of the tax varies considerably across countries and time, both deposit and lending rates of interest respond to changes in reserve requirements.

JEL codes: F310, F320, F410, E500.
Keywords: Capital inflows; reserve requirements; intervention.

1/ The views expressed in this paper are those of the authors and do not necessarily reflect those of the organizations with which they are affiliated. The authors wish to thank Guillermo Calvo, Michael Gavin, Peter Montiel, Miguel Sevastano, Klaus Schmidt-Hebbel, Alejandro Werner, and seminar participants at the Interamerican Development Bank, the International Monetary Fund, and the Network of American Central Bank Researchers for helpful comments and suggestions.

I. Introduction

The experience of the 1990s provides ample evidence that international capital flows can be both sizable and changeable. Mexico and Thailand are but two recent examples in a long list of countries that have found that investors' favor can sour quickly. Given this history, it is not surprising that most of the developing countries receiving sizable inflows this decade resisted, in varying degrees, the nominal exchange rate appreciation that is typically associate with an increase in the demand for a country's assets. Policies aimed at offsetting the pressures on the currency to appreciate have included a variety of fiscal austerity measures, liberalization of capital outflows, quantitative controls or taxes on capital inflows, and an opening of commercial policy. 1/

Most countries have also resorted to sterilized intervention at one time or another.2/ This reliance on sterilized intervention is at odds with the advice from theory. It is a standard result in international finance dating back to the Mundell-Fleming model of the early 1960s that, when assets are perfect substitutes internationally, sterilized intervention has no real effects. Sterilized open-market operations--the simultaneous sale (purchase) of domestic currency on the foreign exchange market and the offsetting purchase (sale) of domestic currency in the bond market--merely represents an exchange between the central bank's holdings of foreign and domestic securities. But when those assets are perfect substitutes, such a transaction should not affect prices of financial assets (Mundell, 1963).

International economists have long struggled with the issue of whether this theoretical result holds in practice. Schadler et al., (1993) conclude that, in most of the developing countries that they examine, there is some scope for sterilization policies in the short run--i.e., changes in domestic credit are not instantly offset by changes in net foreign assets. Frankel and Ok ungwu (1996), however, finds stronger

---

1/ Discussions of this issue include Calvo, Leiderman, and Reinhart (1994 and 1996) and the papers in the special issue of the *International Journal of Finance and Economics* devoted to international capital flows (July 1996).

2/ Indeed, to our knowledge, Argentina was the only country that experienced a surge in capital inflows in the early 1990s and did not attempt to sterilize its foreign exchange intervention.

evidence of perfect capital mobility in many of the developing countries that have experienced heavy capital inflows--casting greater doubt on any ability to influence exchange rates through sterilization.

Another line of work has argued that even if assets were perfect substitutes, sterilized intervention might serve an important role in signaling policy intentions. In effect, foreign exchange intervention might be viewed as the first step in a sequence of policy actions. In pricing foreign exchange, market participants would look past those essentially irrelevant operations to the changes in the domestic money stock that they foreshadow, leading to an association between intervention and changes in currency value (Mussa, 1981). The evidence on this issue is mixed: Kaminsky and Lewis (1996) find little empirical support for the signaling hypothesis in the United States, while Dominguez and Frankel (1993) do.

Most of this literature, however, has neglected an important feature of the current practice of sterilized intervention in many developing counties. Central banks have tools to neutralize the effects on the money stock of their foreign exchange operations beyond offsetting domestic open market transactions. Importantly, they can move past their own balance sheets: The effect of the sale (purchase) of domestic currency could be offset by raising (lowering) reserve requirements to keep the money stock constant. However, as long as domestic reserves do not pay a competitive interest rate, reserve requirements are a tax on the banking system.1/ Changes in the tax can have real effects, including on the exchange value of the currency. Moreover, depending on the incidence of the reserve tax, domestic spending and production may change as well.

Determining the incidence of the reserve tax requires assessing the competitive position of the depository sector. We examine the two polar cases that appear in the banking literature, beginning with a reserve tax that is borne by those bank customers who only have poor substitutes for banking products. If deposits are somewhat unique while borrowers have open access to market finance, then depositors will pay the reserve tax in the form of below-market deposit rates of interest. Second, we examine the case where depositors have ready access to competing and equivalent market instruments while borrowers rely

---

1/ Indeed, in most instances, reserve requirements are not remunerated.

exclusively on banks. Under these circumstances, the latter will pay the reserve tax in the form of above-market loan rates of interest.

This heterogeneity among rates of return can have important macroeconomic consequences. Even if global financial trading enforces real interest parity across market interest rates (such as in the Treasury market), there is room for central bank policy to affect deposit and loan rates if not all of the customers have ready access to international capital markets. Indeed, it could be argued that in many developing countries capital market integration is asymmetric, with the liability side of bank balance sheets more integrated than the asset side. To draw this point formally and to trace the consequences for income, prices, and the exchange rate, we extend Dornbusch's (1976) overshooting model. No matter our assumption about the incidence of the reserve tax, foreign exchange intervention paired with an offsetting change in reserve requirements has an immediate impact on the real exchange rate. Intuitively, if the central bank, say, were to sell domestic currency and raise reserve requirements to keep the money stock constant, it would also potentially make deposits less attractive (if depositors pay the reserve tax) or loans more expensive (if borrowers pay the reserve tax). In either case, the pair of policy actions would tend to exert downward pressure on the value of the home currency on foreign exchange markets on impact. Thus, foreign exchange intervention can work, even if it does not affect the domestic money supply and market assets are perfect substitutes.

While there has been some recent work on the impact of reserve requirements on economic activity in industrial countries, notably Loungani and Rush (1995), much less has been done with regard to developing countries.1/ As stressed by Dooley (1994), this has been a serious omission, both because the range of policy variation in reserve requirements in developing countries has been large and because those

---

1/ Most of the work on developing countries has focused on the use of reserve requirements as a form of financial repression (see, for instance, McKinnon and Mathieson, 1981, and Brock, 1989). In that vein, this paper shares some similarities with Sussman's (1992) analysis of Israel's financial liberalization in the late 1970s. Like what will follow, Sussman emended Dornbusch's (1976) overshooting model. Unlike this paper, Sussman does not provide a microeconomic rationale for his assumed parameters representing financial repression. Papazoglou and Karadeloglou (1997) offer a model of exchange rate determination that explicitly includes a banking sector in which reserve requirements figure importantly. However, they do not consider alternative assumptions about the incidence of the reserve requirement tax or policy exercises varying that reserve requirement. On the real side of the economy, they assume that purchasing power parity holds.

economies typically rely more on their banking sectors, giving those institutions important scope to exercise market power in deposit and loan pricing. To help fill that gap in the literature, this paper examines the experience of ten countries that have changed reserve requirements often in the past few years. The list of countries that have used changes in reserve requirements as a tool for sterilizing foreign exchange intervention includes Brazil, Chile, Colombia, Costa Rica, the Czech Republic, Kenya, Malaysia, Sri Lanka, Thailand, and, more recently in the wake of the December 1994 Mexican financial crisis, Argentina.1/

The next section briefly reviews the experiences of these developing countries that, when confronted with heavy capital inflows over the past few years, have used reserve requirements to offset the effects of their foreign exchange operations. Section III provides a brief exposition of the incidence of the reserve tax, while Section IV embeds that behavior into a fully specified macro-model. In light of these theoretical results, Section V examines the behavior of loan and deposit rates, as well as the evolution of money multipliers, in the developing countries that have changed their reserve requirements. Section VI offers concluding comments.

II. Some Background

Most of the literature on the use of reserve requirements in developing countries has focused on their role as a source of revenue for the government and as a tax on the banking system (see, for instance, McKinnon and Mathieson, 1981, and Brock, 1989). This public finance perspective has been instructive because, indeed, developing countries have tended to maintain higher reserve requirements than industrial countries. Brock (1989), for instance, finds evidence of a positive correlation in Africa and Latin America between the level of reserve requirements and the inflation rate, suggesting high reserve requirements were often used as a way of extracting a higher inflation tax. More recently, McKinnon and Pill (1994) have suggested that reserve requirements can play a useful role in mitigating some of the less desirable side-

1/ In the cases where nonresident or foreign currency deposits were the main targets of the reserve requirement, the policy is tantamount to a capital control (see Dooley, 1995, and Reinhart and Smith, 1995).

effects associated with exchange-rate-based inflation stabilization plans (i.e., consumption booms and "overborrowing"). However, relatively few studies on developing countries have focused on the frequent use of reserve requirements as a tool of monetary control.1/ Yet, the experiences of many developing countries during the 1990s highlights the importance of the use of reserve requirements in counter-cyclical monetary policies.

II. A. Reserve requirements as a response to shifting capital flows

Faced with a surge in capital inflows during the early 1990s, many developing countries in Asia, Latin America, Eastern Europe, and, to a lesser extent, Africa increased reserve requirements so as to reduce the money multiplier and curtail the monetary expansion associated with central bank purchases of foreign exchange (see Calvo, Leiderman, Reinhart, 1994 and 1996, Reinhart and Dunaway, 1996, and Calvo, Sahay, and Végh, 1995). Similarly, in the wake of the Mexican crisis of December 1994, some of the countries that experienced sudden capital outflows (notably Argentina and Brazil) lowered reserve requirements in an effort to inject some liquidity into the banking system at a time when foreign exchange reserves were being lost and domestic interest rates were approaching unsustainably high levels.

The reserve-requirement measures carried out recently have taken a broad variety of forms. Tables 1a and 1b document the considerable cross-country variation in the form and timing of these measures for periods of capital inflow and Table 2 looks at more recent episodes of outflows. Some countries have opted simply to increase the statutory reserve requirements in all or some categories of domestic currency deposits. Leading examples of this policy are Brazil, Costa Rica, Kenya, Malaysia, and Sri Lanka. Other countries, such as Brazil and Colombia, imposed high *marginal* reserve requirements. In several countries where banks offer foreign currency deposits--including Chile, and Sri Lanka--reserve requirements on these accounts were either imposed for the first time or increased. While this latter measure does not affect the narrow money multiplier, it does reduce the expansion in the broader aggregates, which include foreign currency deposits. In some instances the eligible liability base subject to reserve requirements was

---

1/ Dooley (1994) is a recent exception.

expanded (Brazil, Chile, Malaysia, and Thailand) by including previously exempt transactions (such as some types of loans) or some categories of deposits (such as nonresident deposits). In other instances, efforts were undertaken to strengthen the compliance with existing reserve requirements (Egypt).1/

Often, however, reserve requirement increases were complemented by other liquidity-absorbing measures, such as open market sales of Treasury bills or central bank paper and the shifting of government deposits from the banking system to the central bank (see Reinhart and Dunaway, 1995). Hence, in some instances it is difficult to isolate empirically the effects on interest rates and deposit-lending interest rate spreads of the increase in reserve requirements.

II. B. The dominant role of banks in developing country finance

As the next sections show, determining the incidence of the reserve tax requires assessing the competitive position of the depository sector. A reserve tax is borne by those bank customers who only have poor substitutes for banking products. In many developing countries, both depositors and borrowers have limited options outside the banking system. As noted by Rojas-Suarez and Weisbrod (1994) in their analysis of the financial structure of Latin American countries, banks played a central role in providing short-term financing during the 1980s. Even in the early 1990s, despite a rapid expansion in other sources of finance (notably international placements of bonds and equity), bank loans remained the most important source of finance for the private sector.2/

As late as 1992, in eight of the eleven Latin American countries examined by Rojas-Suarez and Weisbrod, commercial banks accounted for more than three-quarters of the stock of net credit to the private sector. This differs markedly from patterns observed in most industrial countries, where bank finance competes with other sources of financing, such as issuance of bonds, equities, and commercial paper. By way of illustration, Table 3 compares the composition of financing in Chile, Germany, and the United States. At one end of the spectrum is the United States, where bank loans account for less than 12

1/ See Schadler, et. al. (1993).
2/ Rojas-Suarez and Weisbrod (1994).

percent of corporate liabilities--at the other end is Chile, where banks account for three-fourths of corporate financing. For many other Latin American countries, that share is even higher.

In his analysis of the behavior of interest rates in selected Latin American countries, Rodriguez (1994) points to evidence of highly segmented credit markets. For countries that receive foreign currency deposits (for example, Argentina, Bolivia, Chile, Peru, and Uruguay), there is evidence of a two-tier loan market. The prime customers, which have access to international capital markets, tend to borrow in U.S. dollars at interest rates that are comparable to those charged to AAA grade customers. Small- and medium-size enterprises, which may represent higher credit risks (or higher information or transactions costs), usually borrow in domestic currency at interest rates that are well above those warranted by expected changes in the exchange rate.

The heavy reliance on commercial banks, however, is not limited to Latin America alone, but, in varying degrees, characterizes most developing countries. When comparing firms' financing patterns in a sample of developing countries from Africa, Asia, and Latin America to those in industrial countries, recent studies suggest that developing countries are unique because of their corporate sector's comparatively low reliance on internal sources of finance (i.e. retained earnings).1/ Firms in developing countries rely more heavily on external (that is, to the firm) financing sources, with the bulk of that financing done through banks. While many developing countries saw a dramatic rise in international issues of corporate bonds and equity during the early 1990s, this trend toward reduced reliance on bank financing appears to be thus far limited to large, top-tier enterprises.

III. The Incidence of the Reserve Tax

The conventional analysis of the effects of reserve requirements on bank behavior takes a public finance approach by considering it a problem of calculating the incidence of a tax. The requirement to hold noninterest-bearing reserves in some proportion to deposits imposes a tax, which is passed through to some extent to the firm's customers. As an intermediary, a banking firm has customers on both sides of

---

1/ See, for instance, Singh and Hamid (1992).

their balance sheets--borrowers and depositors. Who pays the reserve tax depends on the structure of those markets, both on the competition of other financial intermediaries with the banking system as a whole and on the degree of competition within the banking system. As will become clearer below, the first margin--who competes with banks--determines whether depositors or borrowers pay the reserve tax. The second margin--how banks compete amongst themselves--determines the extent to which the reserve tax is shared among the customers and owners of banks.

III. A. When depositors pay

The standard approach to this issue (represented by Baltensperger, 1980, and Cagan, 1972) examines the behavior of a depository exploiting its market power over the provision of deposits but acting as a price taker in a national loan market.1/ As shown in the upper panel of Figure 1, this financial intermediary faces an upward sloping supply-of-funds schedule, presumably because it has little local competition for its deposits or because product differentiation has made its deposits somewhat unique. Taking account of this market power, the marginal cost associated with each additional unit of deposits slopes more steeply upward and lies above that supply curve.

The intermediary uses those deposit funds to make loans at the national rate of i. Because it is small in that national market, the demand schedule for loans is horizontal at i. Accordingly, the marginal revenue of each additional loan coincides with this line. The point of maximum profits for the bank, quite intuitively, is where this constant marginal revenue equals the marginal cost of deposit funds, or point A in the figure. The rate paid on deposits corresponds to point B on the supply schedule directly below A. Profits equal the rectangle bounded by A, B, and the vertical axis.

In the lower panel of the figure, we consider the consequences of the imposition of reserve requirements. If this banking firm must set aside noninterest-bearing reserves on these deposits according to a proportional reserve requirement of $\hat{o}$, each unit of lending (which earns i) is associated with $\hat{o}^{th}$ of a

---

1/ Double-entry bookkeeping makes this language somewhat arbitrary. We described depositors as supplying funds and borrowers as demanding funds. We could as well have written about demands for deposits and supplies of loans.

unit of reserves (which has an opportunity cost of i). Thus, the marginal revenue of lending falls from i to (1-ô)i, seen in the figure as a shift down in the horizontal line.1/ With lower marginal revenue and unchanged marginal costs, the bank reduces the scale of its intermediation and earns less profit (moving from point A to D in the lower panel of the figure). Intermediation through this bank has declined. As is standard in public finance, the incidence of the tax falls on the price--here the deposit rate--according to the slope of the supply schedule.2/ Thus, bank depositors and owners share the burden of the reserve tax.

The same diagram can be used to explain tax incidence in the absence of market power, if the supply-of-deposits curve were reinterpreted as applying to aggregate behavior. The banking system as a whole might face perfect competition in the market for loans, and no individual bank may be large enough to have any power in the deposit market. In that case, the market-equilibrium deposit rate is set at the intersection of the supply schedule and the horizontal lending schedule (point C in the upper panel). An increase in the reserve requirement shifts the horizontal line down by ô, implying that the deposit rate is reduced by a similar amount (seen as the move from points C to F).3/ If banks have no market power individually and face stiff competition in the loan market, depositors pay the whole of the reserve tax.

III. B. When borrowers pay

In 1985, Eugene Fama introduced an alternative paradigm for the incidence of the reserve tax. Fama (1985) noted that, in the United States, interest rates on large certificates of deposit usually equaled those on commercial paper. At that time, the former was subject to reserve requirements while the latter was not. To explain this, he reversed the assumptions about market power by considering a financial

---

1/ This assumes that the bank held no reserves before the imposition of the reserve tax. More likely, the bank held reserves to meet customer clearing needs and to defend against runs (as in Diamond and Dybvig, 1983). In that case, the marginal revenue schedule already embodied some added expense related to reserve holding. It would only shift with the imposition of reserve requirements to the extent that the tax was binding--that it required the bank to hold more reserves than it would voluntarily do.

2/ For example, under the assumptions already given, profits are written:
$\pi = iL - dD$.
For this intermediary, the imposition of a binding reserve requirement drives a wedge between loans and deposits, $L=(1-\tau)D$, so that profits are written:
$\pi = [(1-\tau)i-d]D$.
If deposit supply is written, $D = Ad^{\alpha}$, profits will be maximized when $d = [\alpha/(1+\alpha)](1-\tau)i$.

3/ In terms of the example in the previous footnote, assuming no market power is equivalent to making the coefficient α (the elasticity of supply) arbitrarily large. In that case, $d = (1-\tau)i$.

intermediary confronted with a fixed cost of deposit funds, likely because its customers have alternative investment choices that are perfect substitutes for the bank's deposit product. As in the upper panel of Figure 2, the average and marginal cost of funds would be constant at i, the national market rate. This bank, however, is assumed to have some market power in lending, perhaps because it has superior information about its local market that enables it to ascertain risks better than its potential competitors. In that case, the demand for loans slopes down and the marginal revenue from lending slopes more sharply down and lies below that curve. The profit maximizing scale of lending takes place where marginal revenue equals the constant cost of funds (point A) and loans are priced according to demand (point B).

If a reserve requirement is imposed, the bank cannot pass it through to its depositors because they are footloose. The cost of one unit of deposits, then, is the national market rate, i, plus the opportunity cost of the idle reserve balances, iô. That is, the reserve tax shifts up the horizontal deposit supply schedule by ô, seen as the shift in the bottom panel of the figure. The scale of intermediation declines, along with profits, and

the loan rate rises (from points B to E in the upper panel of the figure).1/ The important conclusion from Fama's work is that the reserve tax, in this case, is borne by borrowers and bank owners, not depositors.

Again, this diagram can be used to explain market equilibrium if banks individually had no market power. Banks as a whole may face a downward sloped demand for funds but compete away any monopoly power among themselves. In that case, equilibrium is determined at the intersection of that demand schedule and the horizontal line representing the cost of funds. The imposition of reserve requirements shifts that horizontal line up by ô, which gets fully passed through to loan rates (seen as the move from

---

1/ In this case, optimal lending volume determines the extent to which the bank taps the national deposit market, so that profits are written:
$\pi = [1 - i/(1-\tau)]L$
if loan volume is given by, $L = B\, l^{-\beta}$, then the optimal lending rate equals:
$l = [\beta/(\beta-1)][(1-\tau)]i$

point C to F in the lower panel). If the banking system faces perfect competition for deposit funds and competes away any power in the loan market, then borrowers pay the reserve tax.1/

Experience in a particular country most likely lies somewhere between the two extremes presented here. The general message from these two examples is that the incidence of a reserve tax will fall on those classes of assets or liabilities for which banks enjoy some market power. It cannot fall on a market where there are close substitutes for the services that banks provide, because those bank customers will simply disappear.

IV. Wider Consequences of Reserve Requirements

In this section, we weave together the two strands of our previous discussion. Faced with capital inflows, some central banks have intervened in the foreign exchange market, purchasing foreign currency with their own currencies. To prevent the changes in its balance sheet from affecting their domestic monetary aggregates, they have often sterilized those interventions. In many cases, these policy actions to sterilize have included raising reserve requirements. Our brief consideration of a simple banking model suggests that a change in reserve requirements will be passed through in whole or in part to those markets--whether for deposits or loans--where banks have some monopoly power. Thus, the broader consequences of a reduction in the supply of money through an increase in reserve requirements depend importantly on the incidence of that tax.

IV. A. A simple macro model

We take a short-term focus, tracing the implications of a change in reserve requirements in a model in which capital flows are not explicitly modeled, but expectations about the exchange rate enter and monetary policy has potent, transitory real effects. That is, we adapt the workhorse of the international

---

1/ Relative to the example in the previous footnote, competition makes β (the sensitivity of loan demand) arbitrarily large. As a result, $l = [1/(1-\tau)]i$.

literature--Dornbusch's (1976) overshooting model--to this issue, following fairly closely the version of that model presented by Mussa (1984).

We assume that international arbitrage is enforced by the depository sector by virtue of their perfect access to the world capital market. Domestic banks can lend or borrow in foreign currency at the world nominal interest rate of i^*. The nominal return on the sole domestic market instrument, which is denominated in the home currency, is denoted by i. Domestic banks issue deposits bearing a nominal return of d in home currency terms and make loans at the rate l in the home currency. The spreads of these rates to the comparable market rates are,

$$\ddot{a} = d - i;$$
$$\ddot{e} = l - i,$$

and depend on the monopoly power of banks in each of those markets and the structure of reserve requirements. Modeling the incidence of the reserve tax, then, reduces to describing the extent to which the two margins (ä,ë) vary as reserve requirements change. We follow the simpler of the assumptions of market structure that were examined in the previous section: (i) Banks compete amongst themselves sufficiently that none can exploit monopoly power, and (ii) there exists a perfect substitute provided by a nonbank intermediary for the products on one side of bank balance sheets. The first assumption implies that bank customers bear the reserve tax completely. As for the second assumption, because there are two sides to a balance sheet, we will have to consider two cases for the incidence of a reserve tax.

In case A, we assume that there is a perfect substitute for the banking system's loans, while in case B we assume that there is a perfect substitute for the banking system's deposits. To simplify the algebra, define an indicator variable, E, that takes two values,
$E = 1$ for case A and $E = 0$ for case B. The equations for deposit and loan rates in both cases can be expressed compactly as:

(1)
$$d = i - E\hat{\alpha},$$
$$l = i + (1 - E)[\frac{\hat{\delta}}{(1-\hat{\delta})}]i,$$

with corresponding spreads

(2)
$$\ddot{a} = -E\hat{\alpha},$$
$$\ddot{e} = (1 - E)[\frac{\hat{\delta}}{(1-\hat{\delta})}]i.$$

As for the rest of the economy, there are two types of goods, which are imperfect substitutes in consumption: those produced domestically and priced at p and those produced abroad and priced at p^* in terms of the foreign currency.1/ The exchange rate, s, is quoted as foreign currency per unit of domestic currency so that the relative price of home goods (i.e., the real exchange rate) can be defined:

(3)
$$\grave{e} = s + p - p^*.$$

Note that equation (3) implies that an increase in è represents a real *appreciation.*

Aggregate expenditure, y, consists of real-interest- and relative-price-sensitive domestic demand and net exports,

(4)
$$y = a_1 - a_2(l - \eth) - a_3\grave{e}, \qquad \textit{where } a_2,\ a_3 > 0$$

where l is the nominal lending rate and ð is the expected change in home goods prices. The presence of a lending, rather than a market, interest rate in the equation explaining aggregate demand is done to capture the stylized fact described by Rojas-Suarez and Weisbrod (1994): In developing countries, firms rely on

---

1/ Lower case nominal magnitudes are in logarithms. Time subscripts will be suppressed unless absolutely necessary. This assumption of imperfect substitutability is one of the key differences of this model with that of Papzoglou and Karadeloglou (1997).

external finance, predominantly supplied by banks, to fund spending projects.1/ By including a loan rate in aggregate demand, we are implicitly assuming that the effects of credit on the economy can be described in terms of prices alone. Thus, as in Bernanke and Blinder (1988), credit supply can be important even in the absence of nonprice rationing.

Domestic goods prices respond sluggishly to excess demand, with the markup over foreign prices written:

(5) $$\dot{p} = \dot{p}^* - \dot{s} + b(y - \bar{y}), \qquad where\ b > 0$$

where a dot above the letter denotes the time derivative and an overscore represents the steady-state value of a variable; thus, $\bar{y}$ is the economically-efficient long-run level of output. Rearranging terms, we obtain a relationship that explains the behavior of the real exchange rate over time,

(5') $$\ddot{q} = b(y - \bar{y}).$$

Domestic investors choose among three types of assets: the home money (which comprises currency and local-currency-denominated deposits and is denoted *m* in logarithmic terms) and home and foreign market instruments. Foreigners do not hold domestic currency and the demand for money is assumed to depend positively on the return to domestic deposits and negatively on the return on the competing domestic asset:

(6) $$m - p = h_0 + h_1 d - h_2 i \qquad where\ h_2 > h_1 > 0.$$

Because the currency component of the monetary aggregate does not earn interest, it follows that h_2 should be greater than h_1 to retain the familiar downward slope between real balances (which are defined as $x = m$-

1/ Calculating inflation in terms of an index that averages domestic and foreign prices does not materially alter the discussion. Similarly, it is a simple matter that does not affect the results to allow the possibility that some domestic borrowers--presumably large firms--have access to the world capital market and can transact at i rather than l.

p) and the nominal market interest rate.1/ As for monetarypolicy, we assume that the central bank keeps the nominal stock of money along a constant growth rate path of μ.

The cornerstone to the Dornbusch model holds that the domestic and foreign marketable instruments are perfect substitutes so that, adjusted for any expected change in the exchange rate, they provide the same return; assuming perfect foresight, this implies:

(7) $$i = i^* - \dot{y}$$

We assume that it is the actions of depositories that makes this so. The arbitrage condition can be written in a form that links real rates of return across countries, as in:

(8) $$i - \delta = r^* - \dot{q},$$

where r^* is the foreign real interest rate. Thus, real interest parity obtains, as differing real rates of return across countries compensate for expected changes in the real exchange rate.

Adding the loan rate-spread to both sides of the previous equation yields an explanation for the real cost of capital at home that can be substituted into our behavioral explanation of expenditure, equation (4),

$$y = a_1 - a_2(r^* + \theta - \dot{q}) - a_3\theta.$$

Note that we have two implicit explanations of the level of real output, from the spending relationship and the Phillips' curve. Equating these two explanations yields a differential equation explaining the change in the real exchange rate,

(9) $$\dot{q} = \frac{b}{(1 - a_2 b)}[a_1 - a_2(r^* + \theta) - a_3\theta].$$

1/ The results that follow still hold if money demand was allowed to depend positively on output.

This system is not closed, however, because ë may depend on the level of the nominal domestic market rate, depending on who bears the reserve tax, as in equation (2). The nominal rate itself, depends on the level of real balances, which we can see by inverting the money demand equation (6),

$$i = \frac{(x - h_0)}{[h_1(1 - E\hat{o}) - h_2]}. \tag{10}$$

Substituting the explanations for the spread and the nominal rate into equation (9) we obtain a relationship in the real exchange rate and real balances,

$$\ddot{e} = \tilde{a}[(a_1 - a_2 r^* + \acute{a} h_0) - \acute{a} x - a_3 \grave{e}], \tag{11}$$

where:

$$\tilde{a} = \frac{b}{(1 - a_2 b)},$$
$$\ddot{o} = \frac{1}{[h_1(1 - E\hat{o}) - h_2]},$$
$$\acute{a} = a_2(1 - E)[\frac{\hat{o}}{(1 - \hat{o})}]\ddot{o}.$$

As already explained, both ö and á must be negative to preserve a negatively sloped money demand equation. The standard assumption in this literature holds that ã is positive (as in Mussa, 1984), which we maintain here. Also note that both ö and á depend on the incidence of the reserve tax, *E*.

Equation (8) can be rearranged to explain domestic inflation, which implies that real balances change according to:

$$\dot{x} = \mu - \ddot{e} - i + r^*.$$

This is an equation in two parameters, µ and r^*, and two behavioral relationships, è (which is explained by equation (11)) and *i* (which is explained by equation 10). Making

those substitutions yields,

$$\dot{x} = \mu - \delta a_1 + (\delta a_2 + 1) r^* + (\phi - \delta\alpha) h_0 + (\delta\alpha - \phi) x + \delta a_3 \theta, \tag{12}$$

a differential equation in the real exchange rate and real balances.

Equations (11) and (12) define a system in real balances, a continuous variable, and the real exchange rate, a jump variable. Putting those equations in more compact form, we have:

$$\begin{bmatrix} \dot{\theta} \\ \dot{x} \end{bmatrix} = \begin{bmatrix} -\delta a_3 & -\delta\alpha \\ \delta a_3 & \delta(\alpha - \phi/\delta) \end{bmatrix} \begin{bmatrix} \theta \\ x \end{bmatrix} + \begin{bmatrix} \delta(a_1 - a_2 r^* + \alpha h_0) \\ \mu - \delta a_1 + (\delta a_2 + 1) r^* + (\phi - \alpha\delta) h_0 \end{bmatrix} \tag{13}$$

These equations determine two steady-state relationships between real balances and the real exchange rate, but the parameters of those relationships depend on the reserve-incidence indicator, E. However, note that the determinant of the transition matrix equals $\delta a_3 \phi$, which is always negative, regardless of the assumption about the incidence of the reserve tax. Thus, this system always satisfies the saddlepath-stability condition of having one positive and one negative characteristic root. As a result, for any given level of real balances, there is one level of real exchange rate that sets off a dynamic path toward the steady state. The determination of the steady state and exact dynamics about that steady state depends on who pays the reserve tax.

IV. B. When depositors pay

If the incidence of the reserve tax falls on depositors, then the indicator variable E equals 1 and the parameter α equals 0. As a result, the dynamic system given by equation (13) simplifies to:

$$\begin{bmatrix} \dot{\theta} \\ \dot{x} \end{bmatrix} = \begin{bmatrix} -\delta a_3 & 0 \\ \delta a_3 & -\phi \end{bmatrix} \begin{bmatrix} \theta \\ x \end{bmatrix} + \begin{bmatrix} \delta(a_1 - a_2 r^*) \\ \mu - \delta a_1 + (\delta a_2 + 1) r^* + \phi h_0 \end{bmatrix} \tag{14}$$

As shown in Figure 3, the real exchange rate is only at rest at its long-run value of $\bar{x}$ --the $\dot{\theta} = 0$ locus determines a unique long-run real exchange rate. As a result, there is no scope for the growth rate of the

nominal money stock or the specification of the demand for money (which only appears in the $\dot{x}=0$ locus) to influence the real exchange rate in the long run. If depositors pay the reserve tax, a long-run, classical dichotomy holds, and money is superneutral. The $\dot{x}=0$ locus slopes downward, because higher values of real balances provide stimulus to spending that, to keep real balances unchanged, must be offset by an appreciated real exchange rate. The intersection of these two schedules determines the unique steady-state solution to the model.

As suggested by the arrows in the figure, the unique, convergent transition path to the steady state--the saddlepath--slopes downward, which is the essence of Dornbusch's overshooting result. An increase in the nominal stock of money raises the level of real balances on impact (as goods prices only adjust gradually). With real balances higher, the domestic nominal interest rate must be lower. To satisfy the interest-parity condition, this implies that the exchange rate--in real and nominal terms--must be expected to appreciate over time. However, because money is neutral, a once-off change in the nominal money stock cannot affect the value of real variables in the long run. Thus, the expected appreciation must commence from a lower base level if the real exchange rate is to end unchanged. That is, the nominal and real exchange rate must depreciate on impact so that they can then appreciate gradually over time. If an event makes x larger than its steady-state value, market participants can choose a unique level for the real exchange rate (one that is lower than its steady-state value because the saddlepath is negatively sloped) consistent with perfect foresight and a stable return to the steady state.

The core exercise of this paper is to consider the impact of a *permanent* change in reserve requirements, which is depicted in Figure 4. Specifically, we consider an increase in domestic reserves in the banking system--which would follow from the intervention purchase of foreign currencies on the exchange market--matched perfectly by an increase in reserve requirements that leaves the nominal stock of money constant. That is, m and x are predetermined but $\hat{o}$ rises.

As already noted, monetary matters do not enter the $\dot{e} = 0$ locus, so that it remains fixed at its stead-state value. Only the parameter ö, which is the inverse of the interest semi-elasticity of money demand, changes by the amount,

$$\frac{\partial \ddot{o}}{\partial \hat{o}} = h_1[h_1(1-\hat{o}) - h_2]^{-2} > 0$$

The parameter ö becomes less negative when ô rises, because when depositors pay a larger reserve tax, a given change in market rates spurs a larger change in money demand than before.

The parameter ö affects both the slope and the intercept of the $\dot{y}=0$ locus. An increase in reserve requirements, as shown in Figure 4, flattens the $\dot{y}=0$ line and shifts it to the left (as from the dashed to the solid line). The tilting down to the steady-state locus rotates the saddlepath down as well. Essentially, raising ô to keep the money supply unchanged lowers the demand for money by making deposits less attractive. With the nominal stock of money predetermined by its fixed-growth-rate rule, there has to be a bit extra inflation (above µ) temporarily to erode the level of real balances. The currency depreciates on impact in recognition of that acceleration in domestic prices, generating excess demand through net exports. The spending boom is ephemeral, as real balances decline to their new lower steady-state level and the real exchange rate appreciates back to its unchanged long-run level. Even though marketable assets are perfect substitutes internationally, the purchase of foreign currency offset by an increase in reserve requirements puts downward pressure on the value of the currency in exchange markets, raises the velocity of money in the long run, and has transitory effects on the real exchange rate and spending.1/ Likewise, a *temporary* increase in reserve requirements also results in an initial depreciation of the real exchange rate followed by an eventual appreciation and return to the original equilibrium level.

IV. C. When borrowers pay

1/ It is important to remember that reserve requirements might be raised for prudential reasons as well as to further macro objectives (which is the topic of Dooley, 1996). For instance, a central bank might raise τ to induce disintermediation in order to reduce distortions in the conomy related to an overreliance on deposit guarantees. In this example, that policy aim is achieved: In the steady state, spending is unchanged but real balances are lower. However, the model also suggests that such prudential policy can have real effects on spending during the transition to that steady state.

If the incidence of the reserve tax falls on borrowers, then the indicator variable E equals 0. No simplification of the two-variable system defined in equation (13) is possible, although the parameters of behavior that appears in those equations and that depend on E now reduce to:

$$\ddot{o} = \frac{1}{[h_1(1-\hat{o}) - h_2]},$$
$$\acute{a} = a_2[\frac{\hat{o}}{(1-\hat{o})}]\ddot{o}.$$

The lack of any simplification in the dynamic system, itself, is a significant result: The steady-state values of real balances and the real exchange rate must be determined mutually, implying that this assumption of the incidence of the reserve tax breaks down the classical dichotomy associated with the superneutrality of money. How real and nominal magnitudes interact depends on the properties of the two steady-state loci.

Inspection of the $\dot{e} = 0$ locus, equation (13), shows that the classical dichotomy was lost because the premium depositories charge on their loans enters directly into the determination of spending, in the same manner as the world real rate. The loan spread depends positively on the level of the domestic nominal market interest rate. If the nominal interest rate rises, then the loan rate spread widens and the home currency must depreciate in the new steady state to attract net exports to replace the portion of interest-sensitive spending that was choked off. By the money-demand equation, the nominal rate is negatively related to the level of real balances, so the $\dot{e} = 0$ locus must slope up.

The slope of the $\dot{y}=0$ locus, in contrast, is ambiguous, because the term $\partial(\dot{y})/\partial x$ can be either negative or positive. The upper panel of Figure 5 considers the case when that term is negative, which holds when

$$\tilde{a}a_2[\frac{\hat{o}}{(1-\hat{o})}] > 1.$$

Algebraically, the change in the real exchange rate differs from domestic inflation (or from the change in real balances, which is just µ-ð) because of changes in foreign prices in terms of the home currency. That

wedge, in turn, can be explained by the interest parity condition. To capture that difference, the nominal interest rate is included in the $\dot{y}=0$ equation--which is essentially all that makes the two steady-state loci in equation (13) different. If $\tilde{a}a_2$ is relatively large, then any effect of changes in real balances on the nominal rate (and therefore on s) is swamped by the effects on the real exchange rate--so that the $\dot{y}=0$ locus slopes up in the same manner as the $\dot{e} = 0$ locus, although it is not as steep. The dynamic arrows imply that the transition path to the steady state slopes downward, preserving the overshooting of the real exchange rate for any unanticipated change in real balances. The lower panel of the figure examines the case when,

$$\tilde{a}a_2[\frac{\hat{o}}{(1-\hat{o})}] < 1,$$

so that movements in the nominal rate bulk larger relative to è when real balances change. As a result, the $\dot{y}=0$ locus slopes downward; here again, though, the saddlepath slopes downward and overshooting is observed.

As shown in Figure 5, assumptions about the incidence of reserve requirements do not matter for the general result that changes in real balances have potentially strong but transitory effects on the real exchange rate. Assumptions about the incidence of the reserve tax, however, have important consequences on the determination of real and nominal magnitudes in the long run. When borrowers pay the reserve tax, changes in the growth rate of the nominal stock of money, which shift the $\dot{y}=0$ locus, have an effect on the steady-state real exchange rate because there is slope to the $\dot{e} = 0$ locus. That is, money is no longer superneutral.

Figure 6 considers the impact of an increase in reserve requirements associated with an unchanged stock of money. Examining the two equations given by equation (13), it is straightforward to show that, at an unchanged level of real balances, both the $\dot{y}=0$ and $\dot{e} = 0$ loci shift by

$$[\frac{h_0}{(h_1-h_2)}](\frac{a_2}{a_3})(1-\hat{o})^{-2}\ddot{A}\hat{o}$$

in terms of è. The ambiguity of the $\dot{x}=0$ locus poses no problem for predictions about the effect of policy. An increase in ô shifts both schedules down in equals amounts, implying that the initial steady-state level of real balances is consistent with a lower steady-state real exchange rate. No dynamic adjustment is required--an increase in ô will be associated with an immediate step-down in the real exchange rate. As before, exchange-market intervention to support the foreign currency that is matched by an offsetting change in reserve requirements will lower the value of the real exchange rate. But when the incidence of the reserve tax falls on borrowers, the effect is permanent. A *temporary* increase in reserve requirements, when borrowers pay, also results in an initial depreciation of the real exchange rate followed by a further depreciation and an eventual reversal, as all variables return to the original equilibrium level.

IV. D. Reserve requirement changes and fixed exchange rates

Thus far, the model and the discussion have focused exclusively in the case where the nominal exchange rate is allowed to float freely. However, many of the countries that have recently employed countercyclical reserve requirement policies have either a fixed exchange rate or one that is heavily managed. Hence, it is useful to briefly discuss the effects on an increase in reserve requirements under such an exchange rate arrangement.1/

In a fixed exchange rate world, an increase in reserve requirements that exclusively alter deposit rates of interest will have no real short-run or long-run effects on the real variables. The increase in deposit interest rates reduces the demand for money, inducing the central bank to sell foreign exchange and buy domestic currency in order to keep the exchange rate fixed. Simply, the decline in the demand for money is accommodated by a reduced supply.

When borrowers pay, there are both short-run and long-run effects on output, the real exchange rate, and the trade balance. The increase in the real lending rate, tends to reduce output--now there is no immediate offset from the real exchange rate--the adjustments to the real exchange rate are gradual, as

---

1/ The formal model of fixed echange rates would follow Sussman (1992) by setting the expected change in the exchange rate equal to zero and solving for the implied path of the stock of domestic money.

these are effected through inflation. As the output gap widens, inflation falls and the real exchange rate depreciates to its new equilibrium level. The current account improves.

V. Some Evidence

This section examines the short-run behavior of deposit and lending rates of interest during more than twenty episodes in ten countries in which reserve requirements were adjusted as part of the macroeconomic policy response to large shifts in international capital flows. As the previous sections highlights, the macroeconomic effects of the reserve policy depend importantly on who pays the reserve tax. Furthermore, it can be expected that the macroeconomic effects of the policy also depend crucially on its effectiveness in collecting the reserve tax. If the reserve tax is easily circumvented through disintermediation and the establishment or growth of nonbank financial institutions, then the macroeconomic consequences of the reserve policy are likely to be limited. In that case, the effect of the change in reserve requirement on the money multiplier, particularly for a broader measure of money, is also bound to be small. In turn, if the growth of the monetary and credit aggregates is largely unaffected, then there is little reason to expect that economic activity, the real exchange rate, and the external accounts will be affected by the change in reserve requirement. Reserve requirement changes would be as ineffective as sterilized intervention under the usual assumption about perfect asset substitutability. To assess this issue, we examine the behavior of the money multipliers around the time of the change in the reserve requirement.

V. A. Interest rates and changes in reserve requirements

During most of the 1990s, all the countries in our sample experienced a surge in capital inflows and accumulated foreign exchange reserves. Hence, most of the episodes examined (20 out of 25) involve increasing reserve requirements to mop up the liquidity created by central bank purchases of foreign exchange. Tables 4a and 4b document the evolution of key deposit and lending rates of interest, as well as spreads, around the time of the changes in reserve requirements chronicled in Tables 1a and 1b. Monthly data are used to trace out the path of each variable from the month prior to the increase in reserve

requirements (labeled t-1 in the tables) until two months following the event. Several qualifications should be stressed before interpreting these figures. First, in some instances, interest rates do not respond contemporaneously to the change in reserve requirements and adjustments are not evident until the following month (t+1). This need not reflect a sluggish adjustment on the part of banks but may simply be due to the timing of the change in reserve requirements, which may occur late in the month.1/ Second, care is needed in interpreting the changes in individual interest rates. For example, on July 1, 1994 Brazil introduced substantive increases in reserve requirements while at the same time nominal lending rates fell sharply. On the surface this behavior appears inconsistent with profit maximizing banks. However, the decline in lending rates was entirely due to the abrupt decline in inflation associated with the implementation of the third phase of the "real" plan. Indeed, in this episode, the decline in deposit rates was even larger and the lending-deposit rate spread widened noticeably (Table 4b). Third, other factors that directly affect nominal interest rates, such as exchange rate and fiscal policy or foreign interest rates, were not constant as the changes in reserve requirements were implemented. Similarly, the decline in deposit rates of interest in Malaysia in January 1994 need not be entirely attributable to the reserve requirement change--capital controls, which barred domestic residents from selling short-term assets to foreigners, were also introduced at that time.

With these caveats in mind, the data presented in Tables 4a and 4b reveal two important regularities. First, in nearly all cases (17 out of the 20), deposit-to-lending interest rate spreads widen on the wake of an increase in reserve requirements. Second, both depositors and borrowers pay the tax; in 14 episodes deposit rates of interest fell on the month of the change in reserve requirements or in the following month. In 12 of the episodes lending rates rose; in about one half of the cases both interest rates adjusted in a way predicted by theory.2/ Further, in some cases where lending rates did not fall in

---

1/ Interest rates are monthly averages of daily rates.

2/ Further, in a number of additional instances *nominal* lending rates did not rise because there were marked declines in the inflation rate at the time of the change in the reserve requirement.

nominal terms at the time of the change in reserve requirements, inflation was also declining (Argentina, 1993 and Brazil, 1994 are examples of this phenomenon).

V. B. Money multipliers

Tracing the direct effects of changes in reserve requirements on macroeconomic variables is complicated because changes in other policy variables (exchange rate, fiscal, and structural policies) and exogenous factors (international interest rates and terms-of-trade) were also taking place. One can be certain that the transmission mechanism stressed in our theoretical model--through which monetary policy affects output, the real exchange rate, and the current and capital account balances--would not be operative if the reserve tax is circumvented. Hence, a necessary condition for these macroeconomic effects to materialize is that the "microeconomic" effects on interest rates and money multipliers are in place.

Tables 5a and 5b show the evolution of the money multipliers around the time when required reserves were changed. In almost all instances, the narrow money multiplier fell on or in the month following the change in reserve requirements. The exception is Chile, where in both of the episodes where reserve requirements on dollar deposits were raised, the broad money multiplier actually increases. However, this pattern need not suggest circumvention--it simply attests to the fact that, in Chile, dollar-denominated deposits account for a small share of total bank deposits. Declines in the broad money multipliers were less common (13 out 17). However, not all the decline in both narrow- and broad-money multipliers need be exclusively attributed to increases in reserve requirements. For instance, the marked declines shown for Brazil in mid-1994 are not likely to be entirely attributable to the hike in reserve requirements, as an abrupt decline in inflation (such as the one that takes place at that time) is likely to increase the public's demand for currency

--a factor that also reduces the multiplier. However, taken together, the evidence presented on Tables 5a and 5b suggests that policy was effective, at least in the short run, in curbing the monetary expansion.

VI. Conclusion

The wider consequences of a distortionary reserve requirements tax will depend on where it falls. If it only affects depositors, then the only real variable altered in the long run with a change in reserve requirements is real balances. However, all nominal magnitudes must adjust. When prices are sticky, the adjustment necessarily entails transitory real effects.1/ If the incidence of reserve requirements falls on borrowers, then the real domestic loan rate in relation to the world real interest rate rises. The real exchange rate must depreciate to support spending. Intuitively, the larger the proportion of borrowers without access to world credit markets who must transact at the domestic loan rate, the greater is this effect.

The perfect substitutability of market assets internationally does not pose an insuperable barrier to exchange market intervention, as long as that policy action is paired with another policy action that has real effects. In the literature on signaling (as in Mussa, 1981, and Kaminsky and Lewis, 1994), sterilized foreign exchange intervention that presages a realignment in domestic policy will have real effects. In this paper, foreign exchange intervention that triggers a concurrent tax change--a change in the reserve tax--will have real effects. When central bankers pair the purchase (sale) of foreign currency with an increase (decrease) in reserve requirements, they get the effect on the currency that they expected, although perhaps not for the exact reasons that they had expected.

It is important to recognize that this model kept many dynamic aspects relevant to the discussion of reserve requirements in the background. Importantly, we implicitly held the distribution of capital in the financial industry fixed. Presumably, if some segment of the industry were disadvantaged by a tax, other firms that are exempt from the tax will flourish. Reserve requirements provide an incentive for the creation of new tax-free instruments and encourage potential customers of banks to consider other providers of financial services, including mutual funds, insurance companies, offshore financial

---

1/ Of course, the long-run fall in real balances when reserve requirements rise may be exactly the goal of a central bank attempting to shrink bank balance sheets for prudential reasons. A message from this paper is that this long-run outcome is associated with transitory consequences for spending and the real exchange rate.

institutions, and markets directly. Particularly when there are fixed costs to forming customer-firm relationships, business lost to the banking sector may be gone forever.

If such competitive matters concern policy makers, the distortionary effects of reserve requirements would be eliminated if the central bank were allowed to pay a market-related interest rate on its reserves. But then any macroeconomic consequences owing to the uneven incidence of reserve requirements that were considered in this paper would evaporate.

With regard to the evidence from developing countries that have used changes in reserve requirements for the purpose of sterilizing foreign exchange intervention (i.e. increasing reserve requirements when central bank purchases of foreign exchange are rising). Several empirical regularities emerge. First, in nearly all cases considered deposit-lending interest rate spreads widen on the wake of an increase in reserve requirements. Secondly, both depositors and borrowers pay the tax; in 13 out of 20 episodes deposit rates of interest fell on the month of the change in reserve requirements or in the following month, while in 12 of the episodes lending rates rose. Third, in almost all instances both the narrow and broad money multiplier fell on impact or in the month following the change in reserve requirements. Hence, the policy was effective, at least in the short run, in curbing the monetary expansion.

VI. References

Alfiler, F. Enrico, "Monetary and Exchange Rate Policy Responses to Surges in Capital Flows: The Case of the Philippines," paper prepared for the Eleventh Pacific Basin Central Bank Conference held in Hong Kong, October 31-November 2, 1994.

Asea, Patrick and Carmen M. Reinhart, "Real Interest Rate Differentials and the Real Exchange Rate: Evidence from Four African Countries," *Journal of African Economies,* (forthcoming, 1996).

Aziz, Zeti Akhtar, "Capital Flows and Monetary Management: The Malaysian Experience," paper prepared for the Eleventh Pacific Basin Central Bank Conference held in Hong Kong, October 31-November 2, 1994.

Baltensperger, E., "Alternative Approaches to the Theory of the Banking Firm," *Journal of Monetary Economics*, Vol. 6, (1980), pp. 1-37.

Bernanke, Ben J., and Alan S. Blinder, "Money, Credit, and Aggregate Demand," *American Economic Review*, Vol. 78, (May 1988), pp. 435-439.

Board of Governors of the Federal Reserve System, "Study on the Impact of the Payment of Interest on Reserves," Report to the Congress, April, 1995.

Brock, Philip L., "Reserve Requirements and the Inflation Tax," *Journal of Money Credit and Banking*, Vol. 21, (1989), pp. 106-121.

Cagan, Phillip D., *The Channels of Monetary Effects on Interest Rates*, (New York: Columbia University Press for the NBER), (1972).

Calvo, Guillermo A., Leonardo Leiderman, and Carmen M. Reinhart, "The Capital Inflows Problem: Concepts and Issues," *Contemporary Economic Policy* 12, July (1994), 54-66.

Calvo, Guillermo A., Leonardo Leiderman, and Carmen M. Reinhart, "Inflows of Capital to Developing Counties in the 1990s: Causes and Effects," *Journal of Economic Perspectives*, Vol. 10 (Spring 1996), pp. 123-139.

Calvo, Guillermo A., Ratna Sahay, and Carlos A. Végh, "Capital Flows in Central and Eastern Europe: Evidence and Policy Options," IMF Working Paper WP/95/57, May 1995.

Diamond, Douglas W., and Philip H. Dybvig, "Bank Runs, Deposit Insurance, and Liquidity," *Journal of Political Economy*, Vol. 91, (June 1983), pp. 401-19.

Dominguez, Kathryn M., and Jeffrey A. Frankel, "Does Foreign Exchange Intervention Matter? The Portfolio Effect," forthcoming in *American Economic Review*.

Dooley, Michael P., "Transmission of Monetary Shocks to Partially Open Economies," mimeo, University of California, Santa Cruz, (1994).

Dooley, Michael P., "A Survey of Academic Literature on Controls Over International Capital Transactions," mimeo, University of California, Santa Cruz, (1995).

Dooley, Michael P., "Capital Controls and Emerging Markets," *International Journal of Finance and Economics*, Vol. 1, (Jule 1996), pp. 197-206.

Dornbusch, Rudiger, "Expectations and Exchange Rate Dynamics," *Journal of Political Economy*, Vol. 84, (1976), pp. 1161-76.

Fama, Eugene, "What's Different About Banks?" *Journal of Monetary Economics*, Vol. 15, (1985), pp. 29-39.

Frankel, Jeffrey A., and C. Okongwu, "Liberalized Portfolio Capital Inflows in Emerging Markets: Sterilization, Expectations, and the Incompleteness of Interest Rate Convergence,'" *International Journal of Finance and Economics*, Vol. 1, (January 1996), pp. 1-23.

Gurria, Jose Angel, "Capital Flows: The Mexican Case," mimeo, December (1993).

Hettiarachchi, W., and U. Herat, "Coping with Capital Inflows - the Case of Sri Lanka," paper prepared for the Eleventh Pacific Basin Central Bank Conference held in Hong Kong, October 31-November 2, 1994.

Kaminsky, Graciela L. and Karen K. Lewis, "Does Foreign Exchange Intervention Signal Future Monetary Policy?," *Journal of Monetary Economics*, (forthcoming 1996).

Loungani, Prakash, and Mark Rush, "The Effect of Changes in Reserve Requirements on Investment and GNP," *Journal of Money Credit and Banking*, Vol. 27, (May 1995), pp. 511-25.

McKinnon, Ronald I., Donald J. Mathieson, "How to Manage a Repressed Economy," Essays in International Finance No. 145, Princeton University, December 1981.

McKinnon, Ronald I., Huw Pill, "Credible Liberalizations and International Capital Flows: The "Over-Borrowing Syndrome," prepared for the NBER's Fifth Annual East Asian Seminar in Economics held in Singapore, June 1994.

Mundell, Robert A., "Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates," *Canadian Journal of Economics and Political Science*, Vol. 29, (1963), pp. 475-85; also in R.A. Mundell, *International Economics*, (New York: Macmillan Co.), (1968), pp. 250-71.

Mussa, Michael L., "The Role of Intervention," Group of Thirty Occasional Paper No. 6, (New York, 1981).

Mussa, Michael L., "Economically Sensible Solutions for Linear Rational Expectations Models with Forward and Backward Looking Dynamic Processes," NBER Working Paper No. 1398, (1984).

Papazoglou, Christos and Pavlos Karadeloglou, "Credit Market Interest Rates and Exchange Rate Dynamics," *International Journal of Finance and Economics*, Vol. 2 (January 1997), pp. 73-84.

Porter, Michael G., "Capital Inflows as an Offset to Monetary Policy: The German Experience," *IMF Staff Papers* 19, (1972), pp. 395-419.

Reinhart, Carmen M., and Steven Dunaway, "Policy Responses to Previous Surges of Capital Inflows," in *International Capital Markets: Developments, Prospects, and Policy Issues*, (Washington, DC: International Monetary Fund, 1995).

Reinhart, Carmen M., and Todd Smith, "Capital Controls: Concepts and Issues" in *International Capital Markets: Developments, Prospects, and Policy Issues*, (Washington, DC: International Monetary Fund, 1995).

Rodriguez, Carlos A., "Situación Monetaria y Cambiaria en Colombia," mimeo, CEMA, Buenos Aires, November (1991).

Rojas-Suarez, Liliana, and Steven R. Weisbrod, "Financial Market Fragilities in Latin America: From Banking Crisis Resolution to Current Policy Challenges," IMF Working Paper WP/94/117, October 1994.

Schadler, Susan, Maria Carkovic, Adam Bennett, and Robert Khan, *Recent Experiences with Surges in Capital Inflows*, IMF Occasional Paper 108, (Washington D.C.: International Monetary Fund, 1993).

Singh, Ajit, and Javed Hamid, *Corporate Financial Structures in Developing Countries*, IFC Technical Paper No. 1, (Washington, DC: International Finance Corporation, May 1992).

Sussman, Oren, "Financial Liberalization: The Israeli Experience," *Oxford Economic Papers* 44, (1992), pp. 387-402.

Table 1a. Changes in Reserve Requirements During Periods of Heavy Capital Inflows[1]
Africa and Asia: 1989-1994

Kenya (1992)

October 1993-March 1994. Statutory cash ratio is increased in three steps from 12 percent to 20 percent.

Malaysia (1989)

May 2, 1989. Reserve requirement is increased to 4.5 percent from 3.5 percent for commercial banks and 3.0 percent for finance companies.

October 16, 1989. Reserve requirement is increased from 4.5 to 5.5 percent.

January 16, 1990. Reserve requirement is increased from 5.5 to 6.5 percent.

August 16, 1991. Reserve requirement is increased form 6.5 to 7.5 percent.

September 16, 1991. All outstanding ringgit received through swap transactions with non-residents, including offshore banks, is to be included in the eligible liabilities base and be subject to the statutory reserve requirements.

May 2, 1992. Reserve requirement raised from 7.5 to 8.5 percent.

January 3, 1994. Reserve requirement increased from 8.5 to 9.5 percent. The reserve requirement is extended to cover foreign currency deposits and transactions (such as foreign currency borrowing from foreign banking institutions and interbank borrowing). Previously it had only applied to ringgit-denominated transactions.

1994. Reserve requirement increased in two steps to 11.5 percent.

Sri Lanka (1991)

November 1, 1991. Reserve requirement on demand, time and saving deposits raised to 13 percent.

January 24, 1992. Reserve requirement on demand, time and saving deposits raised to 14 percent.

September 4, 1992. Reserve requirement extended to include foreign currency deposits.

September 24, 1992. Reserve requirement on demand, time and saving deposits lowered back to 13 percent.

January 29, 1993. Reserve requirement on demand, time and saving deposits raised to 13.5 percent.

April 16, 1993. Reserve requirement on demand, time and saving deposits raised to 14 percent.

May 21, 1993. Reserve requirement on demand, time and saving deposits raised to 15 percent.

February, 1994. Reserve requirement on foreign currency deposits which are invested abroad was reduced to 5 percent.

Thailand (1988)

August 1, 1995. Reserve requirements on non-resident domestic currency deposits were raised from zero to 7 percent. These reserve requirements are nonrenumerated and must be deposited at the Bank of Thailand.

[1]The date next to the country name denotes the first year of the surge in inflows.

Sources: Asea and Reinhart (1996); Aziz (1994); Bank Negara Malaysia Annual Report, various issues; Bank of Thailand Quarterly Bulletin (1995); Hettiarachi and Herat (1994).

Table 1b. Changes in Reserve Requirements During Periods of Heavy Capital Inflows[1]
Eastern Europe and Latin America: 1990-1994

Argentina (1991)

August 15, 1993. Reserve requirements on domestic and foreign currency demand deposits were raised from 40 to 43 percent. A 3 percent reserve requirement on domestic and foreign currency 30-89 day time deposits was introduced.[2]

Czech Republic (1992)

August, 1994. Reserve requirements were raised from 9 percent to 12 percent.

Brazil (1992)

July 1, 1994. A 100 percent marginal reserve requirement on demand deposits and a 20 percent reserve requirement on time deposits is introduced. Reserve requirements on saving deposits are raised from 10-15 percent to 20 percent.

August 31, 1994. Reserve requirement on time and saving deposits are raised to 30 percent.

December 6, 1994. A 15 percent reserve requirement on loans for the purchases of goods is introduced.

Brazil (mid-April 1995)

April 28, 1995. Reserve requirement on time deposits is raised back from 27 percent to 30 percent. The marginal reserve requirement on certificates of deposit is raised to 60 percent. The reserve requirement on loans is raised from 6 percent to 18 percent.

Chile (1990)

January 23, 1992. Nonrenumerated 20 percent reserve requirement on deposits and loans in foreign currency held by commercial banks. The reserve requirement must be maintained for one year.

May 28, 1992. Reserve requirement on foreign currency deposits and loans held by commercial banks is increased to 30 percent. The requirement was designed to make the tax rate fall as the maturity increases. A 30 percent marginal reserve requirement on interbank deposits is introduced.

Colombia (1991)

January 1991. Marginal reserve requirement of 100 percent is imposed on all new deposits. The reserves are held as interest-bearing central bank bonds.

September 1991. The marginal reserve requirement is replaced by an increase in reserve requirements on most deposits.

Costa Rica (1991)

October 1992. Reserve requirement on domestic currency demand deposits is raised from 30 to 34 percent, and those on time deposits from 10 to 14 percent.

Mexico (1990)

April 1992. A compulsory liquidity coefficient for dollar liabilities was set at 15 percent. This coefficient must be invested in liquid securities denominated in the same currency.

[1]The date next to the country name denotes the first year of the surge in inflows.

[2]These increases in reserve requirements were intended to offset the liquidity increases associated with the privatization of YPF.

Sources: Banco Central de Chile Memoria Anual and Evolucion de la Economia, various issues; Banco de la Republica Colombia, Monthly Bulletin, various issues; Central Bank of Argentina; Gurria (1993); Calvo, Sahay, and Végh (1995); and Rodriguez (1991).

Table 2. Changes in Reserve Requirements During Periods of Heavy Capital Outflows
December 1994-1995

Argentina

December 28, 1994. In response to the outflow of deposits and resulting tightening of liquidity in the wake of the Mexican crisis, reserve requirements on domestic and foreign currency demand and savings deposits are lowered from 43 to 35 percent. The measure is retroactive to December 16.

January 15, 1995. Reserve requirements on domestic and foreign currency demand and savings deposits are lowered from 35 to 30 percent, while reserve requirements on domestic currency 30-to-89 day time deposits and foreign currency deposits with a maturities of less than a year are reduced from 3 percent to 1 percent. The measures are announced as temporary, with the intention of reverting back to the pre-December reserve requirements on February 1.

February 1, 1995. Reserve requirements on domestic and foreign currency demand and savings deposits are raised, not to the original 43 percent (as had been announced earlier), but to 32 percent.

March 1, 1995. Reserve requirements on domestic and foreign currency demand and savings deposits are raised from 32 to 33 percent. Reserve requirements on domestic currency 30-to-89 day time deposits and foreign currency deposits with maturities less than a year are increased from 1 to 2 percent.

August 1, 1995. Reserve requirements on domestic and foreign currency demand and savings deposits are lowered from 33 to 30 percent. Reserve requirements on domestic currency 30-to-89 day time deposits and foreign currency deposits with maturities of less than one year are eliminated and replaced by the introduction of a liquidity requirement of 6 percent on 30-to-59 day time deposits and 2 percent for 60-to-179 day time deposits.

Brazil

December 19, 1994. Marginal reserve requirements were reduced from 100 percent to 90 percent.

January 1995. Reserve requirement on time deposits were reduceed from 30 percent to 27 percent

Source: Central Bank of Argentina.

Table 3. Corporate finance structure[a]: Chile, Germany and the US[b]

	Bank Loans	Corporate Bonds	Equity	Other non-bank securities[C]
Chile				
1980	76.0	-	22.0	2.0
1985	86.0	3.0	11.0	0.0
1990	75.0	11.0	14.0	0.0
Germany				
1980	60.7	1.5	13.3	24.5
1985	55.4	1.4	20.7	22.5
1990	55.9	1.9	19.5	22.7
US				
1980	12.2	15.7	49.3	49.3
1985	11.8	16.1	48.6	48.6
1990	11.9	17.1	47.1	47.1

[a] As a percent of total financial liabilities outstanding.
[B] Only includes domestic sources of finance
[C] Includes commercial paper, loans from finance companies and government loans. Source: Rojas-Suarez and Weisbrod (1994)

Table 4. Interest rates, spreads and increases in reserve requirements[a]

	Deposit rate, 1 month	Base lending rate	Spread	Ratio of lending rate to deposit rate
ASIA				
Malaysia[b] May 2, 1989				
t-1	5.05	8.97	3.92	1.78
t	5.50	8.95	3.45	1.63
t+1	5.42	8.42	3.00	1.55
t+2	4.90	8.90	4.00	1.82
Malaysia October 19, 1989				
t-1	4.95	8.89	3.94	1.80
t	5.00	8.77	3.77	1.75
t+1	4.95	8.69	3.74	1.76
t+2	4.90	8.70	3.80	1.78
Malaysia January 16, 1990				
t-1	4.90	8.70	3.80	1.78
t	5.02	8.65	3.63	1.72
t+1	4.90	8.70	3.80	1.78
t+2	5.35	8.64	3.29	1.61
Malaysia August 16, 1991				
t-1	7.00	9.30	2.30	1.33
t	7.25	9.43	2.18	1.30
t+1	7.50	9.16	1.66	1.22
t+2	7.50	9.65	2.15	1.29
Malaysia May 2, 1992				
t-1	7.70	9.97	2.27	1.29
t	8.10	10.15	2.05	1.25
t+1	8.00	10.32	2.32	1.29
t+2	7.90	10.31	2.41	1.31
Malaysia January 3, 1994				
t-1	6.40	9.65	3.25	1.51
t	6.20	9.44	3.24	1.52
t+1	6.00	9.36	3.36	1.56
t+2	5.80	9.25	3.45	1.59

	Deposit rate, 3 month CD	Weighted average prime lending rate	Spread	Ratio of lending rate to deposit rate
Sri Lanka[c] Novermber 1, 1991				
t-1	13.0	19.10	6.10	1.47
t	13.0	19.60	6.60	1.51
t+1	13.0	19.50	6.50	1.50
t+2	13.0	19.50	6.50	1.50
Sri Lanka January 24, 1992				
t-1	13.0	19.60	6.60	1.51
t	13.0	19.50	6.50	1.50
t+1	13.0	19.50	6.50	1.50
t+2	13.0	19.40	6.40	1.49
Sri Lanka September, 1992[d]				
t-1	13.0	19.90	6.90	1.53
t	13.0	19.90	6.90	1.53
t+1	13.0	20.0	7.00	1.54
t+2	13.0	20.20	7.20	1.55
Sri Lanka January 29, 1993				
t-1	16.50	20.00	3.50	1.21
t	16.50	19.90	3.40	1.21
t+1	16.00			
t+2	16.50			
Sri Lanka April 16, 1993				
t-1	16.50	19.90	3.40	1.21
t	16.50	19.90	3.40	1.21
t+1	16.50	20.00	3.50	1.21
t+2	16.10	20.20	4.10	1.25
Sri Lanka May 21, 1993				
t-1	16.50	19.90	3.40	1.21
t	16.50	20.00	3.50	1.21
t+1	16.10	20.20	4.10	1.25
t+2	16.50	20.40	3.90	1.24

	Deposit rate in pesos	Lending rate in pesos	Spread	Ratio of lending rate to deposit rate
LATIN AMERICA[e]				
Argentina August 15, 1993				
t-1	11.01	11.94	0.93	1.08
t	10.01	9.93	-0.08	0.99
t+1	8.84	9.85	1.01	1.11
t+2	8.36	9.71	1.35	1.16
	Deposit rate in US dollars	**Lending rate in US dollars**		
t-1	6.20	8.43	2.23	1.36
t	5.96	7.49	1.53	1.26
t+1	5.86	7.45	1.59	1.27
t+2	5.79	7.50	1.71	1.30
	Savings deposit rate	**Corporate lending rate**		
Brazil July 1, 1994(monthly rates)				
t-1	47.61	49.90	2.29	1.05
t	5.55	8.81	3.26	1.59
t+1	2.64	6.35	3.71	2.41
t+2	2.95	5.62	2.67	1.91
Brazil April 28, 1994(montly rates)				
t-1	2.81	6.62	3.81	2.36
t	3.95	7.05	3.10	1.78
t+1	3.76	7.16	3.40	1.90
t+2	3.40	6.99	3.59	2.06
	US dollar deposit rate, 30-89 day	**US dollar lending rate, 30-89 day**		
Chile January 23, 1992				
t-1	6.45	9.42	2.97	1.46
t	6.21	7.93	1.72	1.28
t+1	6.20	9.49	3.29	1.53
t+2	5.14	9.28	4.14	1.81
Chile May 28, 1992				
t-1	5.00	9.18	4.18	1.84
t	5.15	9.25	4.10	1.80
t+1	5.17	8.34	3.17	1.61

t+2	6.06	8.16	2.10	1.35
	Deposit rate, 90 day CD	**Lending rate weighted average**		
Colombia January 1991				
t-1	38.15	46.40	8.25	1.22
t	34.56	47.19	12.63	1.37
t+1	34.16	46.00	11.84	1.35
t+2	36.66	45.88	9.22	1.25
Colombia September 1991				
t-1	39.97	46.32	6.35	1.16
t	38.31	47.27	8.96	1.23
t+1	37.41	46.09	8.68	1.23
t+2	37.29	45.97	8.68	1.23
	Deposit rate	**Lending rate**		
Costa Rica October 1992				
t-1	15.50	25.73	10.23	1.66
t	16.50	26.73	10.23	1.62
t+1	16.50	28.04	11.54	1.70
t+2	16.50	28.21	10.96	1.64
Reductions[f] in reserve requrirements Latin America				
Argentina December 28, 1994				
	Deposit rate in pesos	**Lending rate in pesos**		
t-1	8.72	10.00	1.28	1.15
t	9.55	13.56	4.01	1.42
t+1	10.65	17.71	7.06	1.66
t+2	11.64	19.06	7.42	1.64
	Deposit rate in US dollars	**Lending rate in US dollars**		
t-1	5.82	8.33	2.51	1.43
t	6.14	9.80	3.66	1.60
t+1	6.54	11.34	4.80	1.73
t+2	6.88	12.11	5.23	1.76
	Narrow money multiplier	**Broad money multiplier**	**Credit to the private sector (% change)**	
t-1	8.72	7.52	-1.20	
t	9.55	13.98	4.43	
t+1	10.65	12.59	1.94	

t+2	11.64	12.85	1.21	
	Savings deposit rate	**Corporate lending rate**	**Spread**	
Brazil December 19, 1994(monthly rates)				
t-1	3.44	7.76	4.32	2.26
t	3.39	7.40	4.01	2.18
t+1	2.61	6.94	4.33	2.66
t+2	2.36	5.39	3.03	2.28

[a] The month in which the change in reserve requirement takes place is denoted by t.
[B] Sources:Bank Negara, Malaysia, Monthly Bulletin, various issues; IMF, International Financial Statistics
[c] Sources: Central Bank of Sri Lanka, Monthly Bulletin, various issues; IMF, International Financial Statistics
[d] The net effect of the two measures resulted in an increase in reserve requirements.
[E] Sources: Banco Central de Chile, Monthly Bulletin, various issues; Banco de la Republica Colombia, Monthly Bulletin, various issues; Banco Central do Brasil, Monthly Bulletin, various issues; Central Bank of Argentina; IMF, International Financial Statistics; SISBACEN
[f] Source: Banco Central do Brasil, Monthly Bulletin, various issues; Central Bank of Argentina, Monthly Bulletin, various issues; IMF, International Financial Statistics; SISBACEN

Table 5. Money multipliers, credit and increases in reserve requirements[a]

	Narrow money multiplier	Broad money multiplier	Credit to the private sector[b] (% change)
ASIA			
Malaysia[c] May 2, 1989			
t-1	**1.54**	**4.92**	**0.60**
t	**1.47**	**4.62**	**0.40**
t+1	**1.48**	**4.63**	**2.40**
t+2	**1.50**	**4.65**	**0.50**
Malaysia October 19,1989			
t-1	**1.52**	**4.77**	**1.50**
t	**1.44**	**4.50**	**1.50**
t+1	**1.48**	**4.65**	**4.00**
t+2	**1.49**	**4.68**	**1.70**
Malaysia January 16, 1990			
t-1	**1.49**	**4.69**	**1.70**
t	**1.36**	**4.03**	**1.40**
t+1	**1.46**	**4.47**	**0.60**
t+2	**1.43**	**4.45**	**0.70**
Malaysia August 16, 1991			
t-1	**1.42**	**4.44**	**2.10**
t	**1.35**	**4.24**	**1.20**
t+1	**1.37**	**4.26**	**2.90**
t+2	**1.33**	**4.26**	**1.00**
Malaysia May 2, 1992			
t-1	**1.33**	**4.36**	**-0.40**
t	**1.29**	**4.21**	**-0.80**
t+1	**1.30**	**4.30**	**-0.20**
t+2	**1.31**	**4.50**	**0.50**
Malaysia January 3, 1994			
t-1	**1.70**	**5.19**	**3.20**
t	**1.58**	**4.55**	**0.20**
t+1	**1.55**	**4.61**	**-1.50**
t+2	**1.52**	**4.84**	**0.80**

(Continues)

	Narrow money multiplier	Broad money multiplier	Credit to the private sector[b] (% change)
AFRICA, LATIN AMERICA AND AVERAGE OF ALL EPISODES			
Kenya October 1993			
t-1	**1.49**	**2.47**	**-0.60**
t	**1.27**	**2.49**	**3.00**
t+1	**1.35**	**2.42**	**0.80**
t+2	**1.24**	**2.62**	**2.30**
Kenya March 1994			
t-1	**1.26**	**2.51**	**0.80**
t	**1.20**	**2.44**	**1.80**
t+1	**1.07**	**2.44**	**4.10**
t+2	**1.18**	**2.38**	**-3.40**
Brazil July 1, 1994			
t-1	**0.79**	**8.90**	**-2.00**
t	**0.69**	**6.13**	**-14.00**
t+1	**0.73**	**5.70**	**3.20**
t+2	**0.70**	**4.80**	**6.40**
Chile January 23, 1992			
t-1	**0.17**	**1.05**	**1.90**
t	**0.16**	**1.08**	**1.70**
t+1	**0.18**	**1.07**	**1.30**
t+2	**0.24**	**1.09**	**0.30**
Chile May 28, 1992			
t-1	**0.19**	**1.05**	**0.20**
t	**0.18**	**1.05**	**0.60**
t+1	**0.15**	**1.06**	**1.50**
t+2	**0.18**	**1.10**	**1.50**
Average of all episodes			
t-1	**1.15**	**3.65**	**0.82**
t	**1.08**	**3.31**	**-0.27**
t+1	**1.09**	**3.33**	**1.74**
t+2	**1.08**	**3.31**	**1.12**

[a] The month in which the change in reserve requirements takes place is denoted by t.
[B] Deflated by the consumer price index.
[C] Sources: Bank Negara, Malaysia, Monthly Bulletin; Banco Central de Chile, Monthly Bulletin; IMF, International Financial Statistics