Controls on Capital Inflows: Do they Work?*

José De Gregorio — Universidad de Chile

Sebastian Edwards — UCLA and NBER

Rodrigo O. Valdés† — Banco Central de Chile

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Abstract

This paper analyzes the effectiveness of controls on capital inflows. In particular, we analyze in great detail the Chilean experience with the use of the unremunerated reserve requirement. We examine the effects of the controls applied in Chile in 1991–98 on interest rates, real exchange rate, and the volume and composition of capital inflows. The effects are elusive and it is difficult to pin down long-run effects. Although after the unremunerated reserve requirement was introduced there was an increase in the interest rate differential, the econometric evidence does not show it has a significant long-run effect. Also we detect very small effects on the real exchange rate. However, the more persistent and significant effect is on the composition of capital inflows, tilting composition toward longer maturity.

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†Corresponding author. Address: Banco Central de Chile, Agustinas 1180, Santiago, Chile. E-mail: rvaldesx@condor.bcentral.cl

1 Introduction

In the aftermath of the East Asian, Russian and Brazilian currency crises, a number of authors have argued that capital mobility can be highly destabilizing in emerging markets. As a consequence, an increasing number of analysts - including senior World Bank and IMF officials - have argued that, in order to prevent future crises, emerging markets should restrict capital mobility. In this discussion a distinction has been made between controls on inflows and outflows, as well as on market-based-restrictions and quantitative controls (Edwards 1998, 1999). Most supporters of imposing some form of market-based controls on capital inflows have argued that emerging countries should implement a system similar to that adopted by Chile during most of the 1990s (Stiglitz 1999). In spite of the increasing popularity of controls on inflows, there has been very limited empirical work on the subject. More specifically, to date there has been no comprehensive attempt at evaluating the different aspects of Chile's recent experience with capital account restrictions.[1]

The purpose of this paper is to provide a detailed quantitative evaluation of the of Chile's experience with controls on capital inflows. Our goal is to cover as many angles as possible, and we concentrate on the effects of the controls on the level and composition of capital flows, on domestic interest rates, and on real exchange rates. In an attempt to produce robust results we examine the data using a variety of methods, including traditional econometrics, and the estimation of a series of vector autoregressions (VARs).

The paper is organized as follows. Section 2 presents an overview of the Chilean macroeconomic experience during the last ten years and reviews some institutional details related to the Chile's unremunerated reserve requirements (URR) on capital inflows. Section 3 discusses and quantifies the interest rate-equivalent cost of the URR. Section 4 analyzes the impact of the URR on capital flows, its level and composition. Section 5 presents evidence on the effect of the URR on short and long term capital flows, on interest rates and on real exchange rates, using a semi-structural VAR approach. Finally, section 6 presents some concluding remarks.

[1]However, there have been several studies examining the effects of the URR on specific macroeconomic variables using a variety of methods. A partial list includes Valdés-Prieto and Soto (1996, 1998), Budnevich and Le Fort (1997), Le Fort and Sanhueza (1997), Laurens and Cardoso (1998), Soto (1998). Some of this work is reviewed in detail in Nadal-De-Simone and Sorsa (1999), and more recently Gallego, Hernández and Schmidt-Hebbel (1999) revisit some of the issues we examine in this paper.

2 Overview

Between 1987 and 1997 the Chilean economy experienced a stellar performance, with GDP growing in excess of 7.5% per year. One of the major achievements during this period was the reduction of inflation to one-digit levels, quite a success in a country historically prone to very high inflationary inertia. This result has been the combination of both monetary and fiscal policies. On the money side the Central Bank – which has been independent since 1989 – has implemented tight monetary policy, via high interest rates, whenever signals of inflationary pressures appear. On the public finance side there was a surplus in the budget between 1987 and 1998.

Since (at least) the mid 1980s Chile's growth strategy has relied on a rapid expansion of exports. This, in turn, has been the result of both Chile's trade liberalization strategy and the authorities' efforts to maintain a depreciated real exchange rate (see figure 1). During the early 1990s, however, Chile's currency began to strengthened in real terms. This stemmed from two factors: the surge of capital inflows into emerging markets in general, and Chile in particular and the rapid growth in productivity (the Harrod-Balassa-Samuelson effect). The real exchange rate appreciated at average rates between 4 and 5% per year between 1990 and 1997. Despite this appreciation, during this period exports continued to grow strongly.

The massive capital inflows of the early 1990s also affected monetary policy. Since the mid 1980s Chile's Central Bank had pursued a disinflation policy based on real interest rate targeting. However, after Chile regained access to international capital markets, high domestic interest rates attracted foreign funds, putting pressure on money creation. The URR allowed a differential in interest, but was certainly limited by the magnitude of the URR. Figure 2 shows the difference between the forward discount and the interest rate differential in Chile between 1994 and 1997. The forward discount corresponds to UF/dollar 90-day forwards contracts while the interest rate differential uses UF-indexed 90-day central bank notes and 90-day Libor in dollars.[2] Due to the URR this difference moves between two bounds: zero and approximately 3%.[3]

It is precisely in this context of an appreciating real exchange rate, and a loss of

[2]The UF, "unidad de fomento," is a unit of account indexed on a daily basis to the CPI of the previous month.

[3]In contrast to the full capital mobility case, the forward discount does not take a unique value given by interest rate differential, but it must fluctuate within a range implicitly defined by the existence of the URR, see Cowan and De Gregorio (1998). The exact wide of this band is complicated to calculate since it involves an option value, see Herrera and Valdés (1997).

monetary control that the authorities introduced, in June of 1991, capital controls on inflows. These capital controls took the form of unremunerated reserve requirements (URR), at a rate of 20%, (table 1 presents a chronology of the most important changes in the URR administration). During the initial phase of this policy, the 20% deposit applied for the term of the credit, with limits of 90 days and one year, and was denominated in the currency of the credit. This meant that an agent who borrowed $1 internationally had to deposit 20 cents at the Central Bank in a non-interest bearing account. In order to avoid liquidity problems arising from this requirement, foreign creditors were given the option to pay an up-front fee marginally higher than the implied opportunity cost of the URR. This was done through a promissory note with a repurchase obligation at a discount.

In May and July, 1992 important changes were introduced to this policy. The reserve requirement was raised to 30% and the holding period was fixed at one full year, regardless of the term structure of the credit. In addition, at this time the controls' coverage was extended to credits associated to foreign direct investment.[4]

From early on a war of sorts developed between the authorities and the private sector. As the latter found ways to get around the controls, the authorities discovered new way of closing loopholes. In this context, important changes were introduced in mid 1995: Secondary market ADR's (American depository receipts) became subject to the URR. In addition, all portfolio flows entering through the so-called chapter XIV of the Chilean payments regulation, became subject to the URR. In 1998, and under strong pressures against the peso, the Central Bank reduced the URR to 10% in late June, and later on in September the URR was set at zero.

In addition to the URR, Chile has attempted to control capital inflows by imposing a minimum stay requirement to FDI and portfolio flows. The nature of this "minimum stay" requirement changed through time, however. In early 1990s foreign investors had to wait three years to repatriate capital. In 1992, this requirement was reduced to one year. This has limited participation of foreign institutional investors in Chile's capital markets, significantly reducing its liquidity. Although we recognize that this restriction has been (very) important, in this paper we we restrict our attention to the case of the URR.

[4] Bank deposits in foreign-denominated currency in Chile also had a similar URR. This one has a different holding period from the foreign credit URR, lasting as long as the deposit is in place.

3 The Interest Rate-Equivalent Cost of the URR

In this section we derive the implied interest rate-equivalent cost that agents face with the reserve requirement on capital inflows. We first assume that the URR is the only tax and that there is no exchange rate risk. We then analyze a more general case.

The reserve requirement is a fraction (u) of a credit; it has to be deposited in a non interest-bearing account at the Central Bank. At the end of the holding period (h months) the Central Bank reimburses the reserve requirement in the same currency it was deposited in. Since this is a restriction to inflows we concentrate in the case of borrowing abroad at i^* to invest in Chile for a period of k months (maturity).

Given a cost of borrowing abroad (i^*), and the reserve requirement implicit parameters, we can compute the interest rate (ignoring risk premia) for a k-months investment, i_k, at which an investor makes zero profits. Once we compute this rate, we can compute the tax-equivalent of the unremunerated reserve requirement μ_k using:

$$i_k \equiv i^* + \mu_k. \tag{1}$$

3.1 Short-run Investment

We first consider the case of $k < h$ months; where k is the number of months the investors will keep his money in Chile, and h is the number of months the URR has to be deposited at the Central Bank. Therefore, borrowing abroad one dollar at (an annual) rate of i^* to invest at i_k in Chile, for k months, would have the following cash flows consequences:

1. At $t = 0$ the investor has available the remaining after depositing the reserve requirement. That is, he invests $(1 - u)$ at i_k.
2. At $t = k$ the loan has to be paid. The cash flow is: $-(1 + i^*)^{k/12}$.
3. At $t = h$ the reserve requirement is returned, and hence, the cash flow is u.

Therefore, the annual rate i_k, at which the investor is indifferent between investing at home and abroad (computing all values as of time h, when u is returned) is:

$$(1-u)(1+i_k)^{k/12}(1+i^*)^{(h-k)/12}+u=(1+i^*)^{h/12}. \tag{2}$$

Solving for i_k we find the tax-equivalent of the URR:

$$(1+i_k)^{k/12}=\frac{(1+i^*)^{k/12}-u(1+i^*)^{(k-h)/12}}{1-u}\equiv(1+i^*+\mu_k)^{k/12}. \tag{3}$$

3.2 Long-run Investment

The tax equivalence of the URR is somewhat more complicated when the investment horizon exceeds one year (the required URR period). In this case, the investor has to decide whether, at the end of the year, to maintain the 30% corresponding to the URR in Chile, or to deposit it outside the country. For simplicity we first assume that this decision is made in $t=0$. If the returned reserves are deposited at i^*, then the no-arbitrage condition is the same as in the case of $k<h$ (given by equation (3)). However, if the returned reserves are deposited domestically at a rate i_k, then the implied interest rate-equivalent cost is smaller. We denote it by μ'_k and is implicitly defined by:

$$(1+i_k)^{k/12}=\frac{(1+i^*)^{k/12}-u(1+i_k)^{(k-h)/12}}{1-u}\equiv(1+i^*+\mu_k)^{k/12}, \tag{4}$$

which has no closed form solution and has to be solved numerically for given parameters. Of course, in the case $k=h$ we have that $\mu_h=\mu'_h$.

More generally, given that the decision of what to do with the returned reserves will be optimal, investors will consider the following no arbitrage condition:

$$(1-u)(1+i_k)^{k/12}+u(1+E[\max\langle i_k,i^*\rangle])^{(k-h)/12}=(1+i^*)^{k/12}, \tag{5}$$

where $E[\max\langle i_k,i^*\rangle]$ denotes the expected maximum interest rate at which it will be possible to invest the reserves.

Using the approximation that $(1+j)^x\approx 1+xj$ on (3), and that the proceeds of the reserve requirement is invested at i^*, we have that the approximate tax equivalent (denoted by $\tilde{\mu}_k$) is found solving the following equation:

$$1+ki^*-u(1+(k-h)i^*)=(1-u)(1+k(i^*+\tilde{\mu}_k)), \tag{6}$$

which yields:

$$\tilde{\mu}_k = i^* \frac{u}{1-u}\frac{h}{k}. \tag{7}$$

This simplified equation has been used in the URR literature by, among others, Cárdenas and Barrera, 1997 and Valdés-Prieto and Soto, 1998).

3.3 Other Taxes

We can also consider two other taxes applied to foreign borrowing in Chile. First, there is 4% tax on interest paid abroad that we denote as τ. With this tax the borrower has to pay $i^*(1+\tau)\%$ on interest abroad. And second, there is a tax of 0.1% per month (denoted by w) for all credits, foreign and domestic, with a ceiling of 12 months. To simplify we assume that this tax is paid at date 0.

We denote by $\overline{\mu}_k$ and $\overline{\mu}'_k$ the implied interest rate-equivalent cost that agents face when considering all taxes and investment of reserves is done at i^* and i_k, respectively. These costs are given by:

$$(1+i_k)^{k/12} = \frac{(1+i^*(1+\tau))^{k/12} - u(1+i^*)^{(k-h)/12}}{(1-u) - w\min\langle k, 12\rangle} \equiv (1+i^*+\overline{\mu}_k)^{k/12} \tag{8}$$

and

$$(1+i_k)^{k/12} = \frac{(1+i^*(1+\tau))^{k/12} - u(1+i_k)^{(k-h)/12}}{(1-u) - w\min\langle k, 12\rangle} \equiv (1+i^*+\overline{\mu}'_k)^{k/12}. \tag{9}$$

3.4 Currency of Denomination

During some periods investors were allowed to choose the currency denomination of the reserve requirement. At a first sight one may think that given covered interest rate parity the choice was innocuous, but this is not the case. Since the reserve is unremunerated, an investor prefers to choose the currency for which the interest rate was the lowest. For example, if the interest rate in yen was the lowest, as it was the case for a long time, a reserve requirement of u dollars would be converted at the spot exchange rate of e^y (yen/dollar) to ue^y yen. In order to cover the operation, the investor could buy dollars h months forward at a rate of f^y. Hence, at the end of the holding period the investor would receive ue^y/f^y. Using covered interest rate parity, and denoting by i^* the interest rate in dollars and by i^y the interest rate in yen, the investor would receive back $u(1+i^*)/(1+i^y)$, which is greater than u as long as $i^y < i^*$. The intuition behind the relevance of the currency denomination is that being the reserve requirement unremunerated, the investor can minimize its costs choosing the currency which is expected to appreciate.

In this case the second term in equation (2) would be $u[(1+i^y)/(1+i^*)]^{h/12}$, which would change the tax equivalent accordingly. We denote by μ_k^y the tax equivalent when there is a choice to choose the currency.

3.5 URR Cost-equivalent and Power

In the previous discussion we defined the following alternative measures for the tax equivalent of the reserve requirement for an investment of maturity equal to k:

μ_k and μ_k' are the tax equivalents for the case of no additional taxes.

$\overline{\mu}_k$ and $\overline{\mu}_k'$, are the tax-equivalents when the tax on interest paid abroad and the credit tax are included and after the holding period the reserve is invested abroad at i^* or at home at the same return i_k, respectively.

μ_k^y and $\mu_k^{y'}$ are the tax equivalent when the investor is allowed to deposit the URR in a currency other than the dollar. We can define similarly $\overline{\mu}_k^y$ and $\overline{\mu}_k^{y'}$ for the case when other taxes are considered.

$\tilde{\mu}_k$ is a simplified formula that assumes no taxes. Similarly, an analogous simplification may be done for the case in which the deposit can be done in other currency than the dollar, leading to an expression like (7), but with i^y instead of i^*.

To illustrate the difference among these alternative definitions, table 2 shows four measures for the case of 12 months as holding period and considering a Libor of 6%. As expected, given that the holding period is fixed, the cost is decreasing with maturity. For 1 to 2 months this cost is quite important to prevent short-term inflows unless a large change in the exchange rate is expected. The first two measures include all taxes applied on foreign borrowing.

Notice that the only difference between $\overline{\mu}_k$ and $\overline{\mu}_k'$ is the assumption about the alternative cost of the reserve requirement, i^* or i_k. As expected, when the opportunity cost is i_k, the cost before 12 months is greater for $\overline{\mu}_k'$, but for a longer period the situation reverses since i_k is greater than i^*. Columns (1) and (3) differ only on the effect of taxes. The difference are relatively small. Finally, the last column shows the approximation used in most of the literature. The difference is more important at maturities less than a year.

Table 2 is also useful in giving an idea of the potential economic importance of the URR. At face value, the interest rate differentials are substantial. Loans with a 90-day maturity can have a differential equivalent to 7% (annual rate), while loans with maturities of 12 months have a differential of approximately 2.5%.

The main source of short-run fluctuation in the URR arises from changes in foreign interest rates. Figure 3 shows the evolution of the cost of the URR when we assume that for the whole period investors used the dollar to denominate the URR ($\overline{\mu}_k$), or when the lowest rate (Libor) between the dollar and the yen determined the denomination ($\overline{\mu}_k^y$).[5] As may be seen, the cost of the URR could have been reduced substantially by choosing the yen to denominate the reserves. For this reason, starting January 1995 the authority only allows the reserve requirement to be in dollars. By looking at the actual composition of the reserve requirement, one can conclude that only in the second half of 1994 the option of denominating the URR in yen was actually used. Therefore, in the empirical analysis reported in sections 4 and 5 we mainly consider and only-dollar denominated URR and a mixed dollar and yen denominated URR. The latter measure yields further variation in the URR implied cost.

Because of the existence of loopholes, the URR gradually looses power, regaining it each time a loophole is closed. This fact poses an important problem in an empirical application for it would bias the estimated effects of the URR towards zero because of the existence of measurement error. We try to overcome this issue by creating a URR "power index" P that tries to measure how restrictive the implied tax was in each moment. Each time a loophole was closed we reset P to 1. Afterwards we slowly decrease it towards a minimum P that we (subjectively) consider appropriate to reflect the importance of the loophole next to be closed.[6] Figure 4 describes the P index.

[5] During the period when this operation was allowed.

[6] Cardoso and Goldfajn (1997) construct a similar index for Brazil in which the try to summarize different regulations in one index.

4 URR and Capital Flows

Supporters of Chile-style controls on inflows have argued that, by discouraging speculative flows, this policy reduces a country's degree of vulnerability to external shocks. In this section we investigate formally whether the URR affected the volume and/or composition of capital inflows to Chile.

4.1 The Composition of Debt: Evolution and International Evidence

The original objectives of the URR were to reduce the volume of capital coming into the country, increase the degree of monetary autonomy, and avoid the appreciation of the real exchange rate. However, by imposing a fixed cost – regardless of the loan maturity – the URR would, in principle, also affect the composition of capital inflows. Indeed, as table 3 shows, the share of short term debt declined from 19% in the early 1990s to 5% in 1997. The sharper decline occurred between 1995 and 1997, a period in which the URR was strengthened. Of course, that trend could be just re-labeling of flows, or just a reflection of the way in which the data from the Central Bank are constructed.[7] For this reason it is useful to undertake an international comparison.

We use Bank of International Settlement (BIS) data on the composition of debt to make a comparative assessment on Chile's debt maturity structure. More specifically, to the extent that BIS reporting norms are roughly the same for all countries, we can use BIS data to make useful comparisons. There are two fundamental differences between BIS and national data on debt maturity. First, the BIS focuses on "residual maturity," while most countries (including Chile) concentrate on contracted maturity. Second, domestic loans of foreign banks in local currency, as well as loans to residents made abroad (trade credit), are considered part of foreign debt by the BIS, but not by the national authorities.

Figure 5 shows the data of the BIS for all reporting countries with more than 2 million people, and a foreign debt above 6 billion of US dollars, plus Hong Kong and Taiwan. We plot short term debt as a proportion of total debt for June 1997, and the change in this ratio between 1990 and 1997.[8] The figure shows clearly the large increase in the share of short term debt in most emerging markets, with few

[7]For further discussion on measurement issues see Nadal-De-Simone and Sorsa (1999).

[8]We consider June 1997 in order to avoid some drastic changes that followed the Asian crisis. In any case, the main conclusion does not change if one includes data up to June 1998.

exceptions. What is particularly interesting for the purpose of this paper is that the data in figure 5 show that Chile has a low level, and experienced a decline in of short term to total debt ratio.

4.2 The Composition and Volume of Capital Flows in Chile

In order to evaluate the effect of the URR on capital inflows we pursue two alternative methodologies. First, we use instrumental variables techniques to estimate reduced-form capital flow equations. We report the results obtained from these estimations in this subsection.[9] Second, we estimate VAR systems using monthly capital flows data. The results from these VARs are reported in Section 5 of this paper.

In a recent paper Valdés-Prieto and Soto (1998) found out that, under a nonlinear specification, the URR had a small effect on short term flows. Soto (1997) estimates a VAR system using monthly capital flows data and concludes that the URR has statistically significant but economically unimportant effects on both flows and the exchange rate. He finds interesting results for exchange rate volatility (it decreases with the URR) and flows composition (a tilt towards long-term maturities). Eyzaguirre and Schmidt-Hebbel (1997) find similar results estimating a structural model of capital flows using the data compiled by Soto (1997). Finally, Laurens and Cardoso (1998) find no evidence of the URR affecting flows, and claim (without putting forward any formal evidence) that misreporting is what explains the eventual change in composition of flows.[10]

Three main issues arise in the estimation of the effects of the URR on capital flows . First, there is a simultaneity problem: controls are put in place when most needed, that is when there is a surge of inflows.[11] Second, and related to the previous point, there probably exist an exogenous upward trend in inflows. Since the URR is also increasing, the regressions may be capturing a common trend. Third, because of the existence of loopholes, the URR gradually looses power, regaining it each time a loophole is closed. If this power lost is important, all estimates would be biased

[9] Valdés-Prieto and Soto (1998) estimate equations of this sort for short-term flows in Chile. Cárdenas and Barrera (1997) estimate reduced-form equations for Colombia.

[10] It is worth mentioning that the measure that Laurens and Cardoso (1998) use for the effect of the URR generates an important bias in their results. Specifically, they construct a restrictiveness index as the tax rate times the base (flows) and find that its is positively correlated with flows. However, this positive correlation obviously follows from the fact that flows appear in both sides of the regression.

[11] Cardoso and Goldfajn (1997) study the case of capital controls of Brazil concluding that they are largely endogenous.

toward zero, since there would be measurement error.

In the estimations reported in this paper we address these three issues simultaneously. As mentioned, we use both instrumental variables and VAR estimations to control for the potential endogeneity problem. As for trending exogenous flows we use proxies for both credit rating ($RANK$) and capital inflows to emerging markets as measures of exogenous flow push. And for the effect of loopholes, we use the power index P described above.

Our estimation is based on a reduced-form equation for capital flows. If there is imperfect capital mobility, capital flows will depend on interest rate differentials and other variables such as country-risk, "push" factors, and country-specific characteristics. In particular, we assume that there is a portfolio allocation problem that yields a (linear) solution of the following type for flows in period t, F_t:

$$F_t = \beta_0 + \beta_1(i_t - i_t^* - \hat{e}_t^e - \mu_t) + \beta_3 Z_t. \tag{10}$$

where $\hat{e}^e$ denotes expected devaluation, μ is the interest rate equivalent of the URR and Z is a vector of other macroeconomic variables (Taylor and sarno, 1997).

Throughout the estimations we consider two alternative measures for expected devaluation:[12] (i) the effective rate of depreciation; and (ii) the one-step-ahead forecast obtained from on a rolling ARMA model, which also include as independent variables lags of the interest rate differential between dollar-indexed and UF-indexed contracts (since neither has URR this differential represents exchange rate expected depreciation), and the lagged relative distance of the nominal exchange rate to the floor of the exchange rate band (relative to its width). The R^2 of this procedure is around 0.23.

Since both measures of expected depreciation are measured with errors (at least the effective depreciation has an expectational error), the estimates of β_1 will be biased towards zero. This bias can mask the true effect of the URR on capital flows. In the actual estimation of the flows equation we allow for a differntial effect of interest rate differential and the URR:

$$F_t = \beta_0 + \beta_1(i_t - i_t^* - \hat{e}_t^e) + \beta_2 \mu_t + \beta_3 Z_t. \tag{11}$$

[12]Because we compare the nominal interest rate in dollars (Libor) to the indexed rate in Chile (in UF), the relevant exchange one has to model is UF/dollar.

We consider two alternative measures of F_t. First we analyze the effect of the URR on short-term flows as a proportion of GDP. These flows include balance of payments' recorded short-term capital flows (flows with maturity shorter than 12 months) plus errors and omissions. Second, we analyze the behavior of total flows – including flows with maturities longer than 12 months, foreign direct investment, portfolio investment, and short-term flows – as a percentage of GDP. According to ADF tests the two series we consider are stationary at the usual levels of confidence.

Credit rating and interest rate differentials are considered to be the basic determinants of capital inflows in developing countries. For example, in Taylor and Sarno (1997), capital flows respond to credit ratings, international interest rates, the black market exchange rate premium and industrial production. Fernandez-Arias (1996) explains capital flows to a group of developing countries using international interest rates and debt prices in the secondary market (as a proxy for credit worthiness). In our analysis we also consider GDP growth as a determinant of flows, as it often provides a good signal of a county's creditworthiness and investment opportunities. Of course, it is expected that a higher interest rate differential, higher growth, and a better credit rating increase inflows; that is, all three variables are expected to enter with a positive sign in the regression equation. In addition to these variables, we included as a regressor the (instrumented) current account deficit. This is because, ultimately, it is excess expenditure what drives capital movements. Thus, what we actually test, when we control for the current account deficit, is whether the URR affects flows that are not explained by excess expenditure (although they certainly cause excess expenditure). For the credit rating, denoted by $RANK$, we use the index developed By Euromoney. This rating is published once a year and is constructed trough an assessment of a series of indicators.[13] In order to have quarterly data we interpolate this figure.[14] We mainly focus on Z-variables with statistically significant coefficients. Because, as explained above, there is an endogeneity issue between the variables we consider in Z and capital flows we estimate (11) using TSLS, with lagged variables as instruments.

The two panels of table 4 presents the results for the short-term and for total inflows, both as percentage of GDP. The first four regressions in each panel are for

[13] See Haque et al. (1996) for details.

[14] We also considered real capital inflows to Latin American emerging markets (other than Chile) as a proxy for "push factors." However, it never appeared with a significant coefficient. The same happened with Institutional Investor's credit rating.

short term inflows; the next four are for total flows. In the estimation we used alternative measures of the cost-equivalent of the URR, with and without the interaction with the power index, and the two measures of exchange rate depreciation. In the top panel we consider effective depreciation, and in the bottom one we use expected depreciation.[15]

The results presented in table 4 show that in almost all specifications interest rate differentials have the correct sign and are highly significant in explaining short term inflows. GDP growth, the current account deficit, and the credit rating proxy have significant coefficients with the expected sign. More importantly, the URR has large and significant effects in all of the equations for short term flows. Notice that the effect of the URR is between 5 and 10 times larger than the effect of interest differentials.[16] Economically, the effect of the URR on short-term flows appears quite important, as they imply that the presence of the URR implied that, on average, quarterly short-term flows were between 0.5 and 1.0 percentage points of GDP lower than what they would have been otherwise.

The results for total flows are reported in equations 4.5 through 4.8 and show that interest rate differentials continue to be important (and significant) in explaining flows, although the size of its effect is marginally smaller than in the case of short-term flows.[17] Among Z-variables, only the current account surplus is significant. As expected, external financing needs - captured in our specification by the current account deficit– increase these flows one-to-one. What is particularly important for the purpose of this paper is that in not a single regression for long term flows is the coefficient of URR significant. That is, there is no evidence that aggregate capital inflows in Chile have decreased with the URR. Of course, when the results from the short and long term flows are taken together, the conclusion is that the URR had a large and economically meaningful impact on the composition of capital inflows, without affecting their overall volume.

Two additional comments are in order, however. First, it is possible that we are in the presence of a relabeling process of flows: what would have been classified as

[15] We also considered the following cost-equivalent of the URR for an investment with a 12 month horizon: (i) only-dollar deposit (μ_{12}); (ii) possibility of investing in yens during the last 2 quarters in 1994 (μ_{12}^{y}); (iii) only-dollar deposit times the power index ($\mu_{12} \times p$); and (iv) yens deposit in 1994:III and 1994:IV times the power index ($\mu_{12}^{y} \times p$). The full set of results is reported in the appendix.

[16] This has two explanations: either measurement error in our proxies for expected depreciation or large effects of the URR on the composition of flows. The results below tend to confirm the latter.

[17] The results are similar if one leaves out portfolio flows (i.e., considers short- plus long-term flows.)

short-term without URR is classified as long-term with URR. The fact that flows appear less sensitive to interest rate differentials than the URR is in line with this interpretation. Second, it is possible that URR changes affects Chile's country risk premium. This would be the case if changes in the composition of external liabilities reduce the probability of a banking and/or a Balance of Payment crisis (driven by either fundamentals or sunspots). This could well generate larger inflows for risk-adjusted yields may increase.[18]

5 Evidence from VARs

In this section we go a step further and we inquire whether, in addition to affecting the composition of capital flows, Chile's URR helped the authorities accomplish their interest rate and real exchange rate objectives. More specifically, we estimate a VAR system using monthly data to investigate: (a) whether the URR resulted in significantly higher interest rate differentials and, thus, in a greater degree of monetary autonomy; and (b) whether the URR reduced the extent of real exchange rate appreciation.

The estimation of a VAR system allows us to address the potential simultaneity problems in two ways. First, in a VAR we implicitly estimate a reaction function for the URR based on past macroeconomic variables. Thus, even if the URR reacts to capital flows, impulse-response functions would isolate the simultaneity problem. Second, monthly data allows us to interpret in a structural way the impulse-response functions of all endogenous variables to an URR shock. All we need to assume is that the authority does not react during the same month in which other shock take place. Because the international interest rate is exogenous, if the URR rate (or loophole controls in the case of the P index) does not respond to innovations in other variables, then a triangular ordering in the VAR, with the URR as the most exogenous variable, will have a semi-structural interpretation. Notice, however, that the structural interpretation is only partial. We are not able to identify the impulse-response functions that follow from other shocks.

Because of data availability we estimate VAR systems using monthly data for the period January 1991 to July 1998. We consider the following **endogenous variables**:

[18] Cordella (1998) goes further, arguing that it is incorrect to evaluate the URR according to its impact on capital inflows.

1. An indicator of the cost-equivalent of the URR (we report the results for $\mu \times p$ and $\mu^y \times p$).[19]

2. The domestic indexed interest rate (the banking system 90-day deposit rate in UF).

3. A proxy for expected depreciation in the UF/US dollar exchange rate. We use the measure described section 4, based on a rolling ARMA.

4. Short- and long-term real capital flows (in dollars on 1990).[20]

5. Real exchange rate effective depreciation.

In addition, we consider two **exogenous variables**:

1. 6-month libor in dollars.

2. The JP Morgan Emerging Markets Bond Indicators (an average of the premium that country bonds pay in the secondary market).

The two VARs we report consider one lag, which is the model recommended by the Schwarz criteria.

Figures 6 and 7 plot the impulse-response functions of these two VARs to a one standard deviation shock. Figure 6 plots the impulse-response for a shock in $\mu \times p$. Figure 7 is the analogous to 6 but uses instead $\mu^y \times p$ as measure of the URR. The two figures show similar responses of the endogenous variables. The impulse-response functions show that an URR shock dies relatively quickly. After 8 months they are no longer statistically significant different from zero. Therefore, URR returns quickly to its mean.

Short term capital flows: As may be seen from the impulse response functions, short-term capital inflows marginally decrease between months 7 and 12 after the shock by approximately USD 15 million/month. Long-term flows, on the other hand, show a very small, and very marginally significant, increase between months 3 and 10 after the URR shock. These results are similar to those found in section 4, namely there is decline in short term flows, with no significant effect on aggregate flows.

[19]Recall all URR measures are for 12-month horizon, and μ^y is the URR were the US dollar is assumed to be the currency in which the URR is denominated except for the second half of 1994 where the yen appeared to be the chosen currency. The general results do not change if one considers μ alone, without the power index, although statistical significance decreases.

[20]We use the same definition of short-term as before.

To summarize, then, the evidence examined here supports the contention that Chile's URR affected the composition of capital flows, reducing the importance of short term inflows. Aggregate flows, however, were not affected. To the extent that short term flows are more easily reversed, this suggests that the URR will tend to reduce the country's degree of vulnerability to sudden changes in sentiment by international investors.

Interest rates: One of the fundamental objectives of Chile's URR was to increase the Central bank's ability to undertake independent monetary policy. In particular, by (implicitly) taxing inflows, the authorities expected to target domestic interest rates at a relatively high level, without encouraging massive capital inflows into the country.

The impulse response functions in Figures 6 and 7 show that, in response to a one standard deviation shock to the URR, domestic interest rate increases after two months, peaking after 6 months and dying slowly 12 months after the shock.[21] The magnitude of this peak is small, at about 0.1% to 0.15%. These results also suggest that the expected depreciation of the UF/dollar exchange rate increases on impact, dying out after 4 months (just when domestic interest rates increase). Overall, then, these results suggest that the URR policy did result in a temporary, and rather small, increase in real (indexed) interest rates. From a broad perspective, this has two consequences: on the one hand, the URR did allow (at least in the short run) the monetary authorities to target interest rates, without generating a vicious circle of higher rates, increased inflows, sterilization, even higher rates and even larger inflows. On the other hand, this means that, as a result of the URR, there was an increase in the cost of capital in the country. We return to this point in the conclusions.

Real exchange rates: As pointed out above, at the center of the successful recovery of the Chilean economy in the second half of the eighties was a highly depreciated real exchange rate that helped encourage exports. From a political economy perspective, a competitive real exchange rate was so important, that during 1989 every presidential candidate promised to maintain a stable, or even depreciated, real exchange rate. Reality turned out to be different, however, and starting the early 1990s the real exchange rate appreciated substantially. This created a political and economic problem,

[21]The responses plotted correspond to reactions of interest rate URR-equivalent shocks of size 0.18% and 0.20%, respectively. According to the equivalent-cost of μ that we use in the estimations, a 30% URR interest rate-equivalent corresponds to approximately 1.75%. Thus, the *total* effect of a 30% URR is approximately nine-fold what the responses show

and the authorities attempted to prevent the appreciation through the imposition of the URR. A reduction in the volume of capital inflows was indeed expected to prevent further appreciation.

The VAR system estimated in this section can be used to analyze whether, as the authorities expected, the imposition of the URR indeed affected the RER. The impulse response function reported in Figures 6 and 7 indicate that the real exchange rate experience a slight depreciation between one and four months after the shock. These results are in conflict with those obtained by other authors (Edwards 1999b) and by ourselves in the estimation of an error correction equation for the real exchange rate (De Gregorio, Edwards and Valdes 1998). In that paper we reported results indicating that the real exchange rate appreciated marginally with an increase in the URR. These conflicting results illustrate the lack of robustness in empirical estimates of the effects of capital controls on real exchange rates. We are afraid that more conclusive results will have to wait for longer time series. At the time of this writing, however it is not possible to know whether Chile will reimpose the controls in the future.

Finally, it should be noted that the impulse response functions reported in Figures 6 and 7 show a transitory effect of an URR shock mainly because the shock itself dies out relatively quickly. Since fluctuations in the URR are mainly due to changes in P and i^*, the results imply that they are mean reverting.[22] This is important, since transitory URR shocks should not have permanent effects. A more appropriate evaluation, however, would be based on the the estimated elasticities obtained under the assumption of a permanent shock in the URR. The point estimates indicate the following numerical effects of the Chilean 30% URR (according to the VARs reported that include short- and long-term flows). The domestic interest rate increases between 130 and 150 basis points. Short-term flows decrease by around USD 750 millions, long-term inflows increase around USD 1300 millions, whereas the overall inflow is practically unaffected. The real exchange rate effect, on the other hand, is rather small. A 30% URR results in a depreciation of the RER of approximately 2.5%.

[22] Recall that the interest rate equivalent of the URR moves because of movements in Libor and its reserve requirement rate (u). Movements in the reserve requirement rate can be considered permanent if loopholes are under permanent control. This interpretation issue is one of the reasons why the results reported in Soto (1997) differ from ours (besides data definitions, exogenous variables considered in the VAR and sample period).

6 Concluding Remarks

This paper has explored macroeconomic implications of the reserve requirement implemented in Chile in 1991. Clearly the URR allowed for interest rate differentials with annual averages ranging from 5 to 16% (real ex-post) during 1991–1997. Those differentials were partly sustained by the URR. In this closing section we summarize our findings, and discuss other aspects that this paper have not covered, but that must be taken into account when evaluating the usefulness of capital controls.

Our results suggest that the controls altered the composition of capital inflows. Short term flows declined, but long term flows increased, with the aggregate level not being affected. It should be noted, however, that although the composition of "contracted" flows was reduced significantly, that of "residual" flows remained quite high, as indicated by the BIS data. We also found that the controls generated a small and temporary increase in interest rates. This, in turn, gave the Central Bank some additional room for conducting a more independent monetary policy in the short run. Finally, our VAR estimates indicate that the URR resulted in a very small depreciation of the peso - approximately 2.5 percent.

The increase in the domestic cost of capital associated with higher interest rates is, of course, an important cost of the URR. Why must firms borrow with a tax if the world is willing to lend cheaper? Additionally, since the URR penalizes more short-term credit, the yield curve tends to be inverted. Small firms, that cannot issue long-term bonds in international capital markets, have to borrow at a differential interest rates higher than similar firms in other countries. In other words there is a bias against firms that cannot borrow long, which are usually small business and firms that are starting operations.

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Table 1: **Main Changes in the URR Administration**

Jun-91		20% URR introduced for all new credit
		Holding period (months) = min ⟨max ⟨credit maturity, 3⟩ , 12⟩
		Holding currency = same as credit
		Investors can waive the URR by paying a fix fee (through a repo agreement at discount in favor of the central bank)
		Repo discount = USD libor
Jan-92	1	20% URR extended to foreign currency deposits with proportional HP
May-92	2	Holding period (months) = 12
		URR increased to 30% for bank credit lines
Aug-92		URR increased to 30%
		Repo discount = USD libor + 2.5%
Oct-92		Repo discount = USD libor + 4.0%
Jan-95	3	Holding currency = USD only
Jul-95	4	URR extended to secondary ADR
Sep-95	5	Period to liquidate USD from Secondary ADR tightened
Dec-95		Foreign borrowing to be used externally is exempt of URR
Oct-96	6	FDI committee considers for approval productive projects only
Dec-96		Foreign borrowing < USD 200,000 (500,000 in a year) exempt of URR
Mar-97	7	Foreign borrowing < USD 100,000 (100,000 in a year) exempt of URR
Jun-98		URR set to 10%
Sep-98		URR set to zero

Sources: Le Fort and Sanhueza (1997) and Laurens and Cardoso (1998).
The numbers identify a change we consider in constructing the power index.

Table 2: **Tax equivalents of the URR**

Maturity	$\overline{\mu}_k$	$\overline{\mu}_{k'}$	μ_k	$\tilde{\mu}_k$
1	23.38	45.53	22.85	30.86
3	7.95	11.42	7.13	10.29
6	3.95	4.66	3.51	5.14
9	2.77	2.93	2.32	3.43
12	2.18	2.18	1.74	2.57
18	1.60	1.51	1.16	1.71
24	1.30	1.2	0.87	1.29
36	1.01	0.91	0.58	0.86

Table 3: **External debt (million of US dollars)**

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total external debt	17425	16364	18242	19186	21478	21736	22979	26701	31691
Private	5633	5810	8619	10166	12343	14235	17816	21613	25977
Public	11792	10554	9623	9020	9135	7501	5163	5088	5714
Long and medium term	14043	14165	14767	15699	17613	18305	20344	25414	30081
Short term	3382	2199	3475	3487	3865	3431	2635	1287	1610
Short term/Total (%)	19.4	13.4	19.0	18.2	18.0	15.8	11.5	4.8	5.4

Source: Central Bank

Table 4: **URR, Short-term, and Total Capital Flows**

Dep. Var.:	Short-term Inflows/GDP				Total inflows/GDP			
	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8
	μ	μ	μ	$p \times \mu$	μ	μ	μ	$p \times \mu$
	$\hat{e}^e$: Effective UF/dollar depreciation							
$i - i^* - \hat{e}^e$	0.25	0.24	0.10	0.19	0.23	0.21	0.12	0.20
	(3.57)	(3.18)	(1.43)	(2.97)	(3.32)	(3.05)	(2.27)	(3.33)
μ or $p \times \mu$	-6.56	-4.37	-2.48	-7.84	-2.43	-0.70	1.25	-0.57
	(-3.53)	(-3.23)	(-2.56)	(-3.40)	(-0.93)	(-0.59)	(1.22)	(-0.44)
Curr.Acc./GDP	-0.67	-0.74		-0.67	-0.99	-0.95		-0.85
	(-3.76)	(-2.49)		(-2.06)	(-3.72)	(-3.98)		(-2.92)
GDP growth	1.03	1.05		1.03	0.07			
	(3.76)	(3.56)		(3.64)	(0.17)			
$RANK$	-0.21			-0.23	-0.15			
	(-1.86)			(-2.01)	(-1.82)			
R^2	0.23	0.15	0.13	0.22	0.12	0.12	0.09	0.16
N. Obs.	40	40	40	40	40	40	40	40
$F-stat$	3.15	5.04	5.06	3.09	2.57	4.36	1.88	3.69
$D.W.$	2.10	1.94	1.95	2.31	1.84	1.77	1.76	1.76
Dep. Var.:	Short-term Inflows/GDP				Total inflows/GDP			
	4.9	4.10	4.11	4.12	4.13	4.14	4.15	4.16
	μ	μ	μ	$p \times \mu$	μ	μ	μ	$p \times \mu$
	$\hat{e}^e$: Expected UF/dollar depreciation							
$i - i^* - \hat{e}^e$	0.78	0.66	0.08	0.63	0.56	0.42	0.29	0.41
	(3.26)	(3.13)	(0.66)	(2.80)	(1.97)	(2.69)	(2.81)	(2.82)
μ or $p \times \mu$	-6.32	-3.20	-2.34	-7.96	-1.63	-0.00	1.64	0.15
	(-3.58)	(-3.14)	(-2.37)	(-3.29)	(-0.79)	(-0.00)	(1.50)	(0.13)
Curr.Acc./GDP	-0.72	-0.59		-0.73	-0.93	-0.88		-0.82
	(-2.40)	(-1.96)		(-2.26)	(-3.32)	(-3.91)		(-3.03)
GDP growth	1.59	1.25		1.49	0.39			
	(4.18)	(3.05)		(4.08)	(0.79)			
$RANK$	-0.27			-0.29	-0.15			
	(-2.39)			(-2.67)	(-1.32)			
R^2	0.12	0.22	0.10	0.14	0.06	0.12	0.10	0.15
N. Obs.	40	40	40	40	40	40	40	40
$F-stat$	3.37	4.54	2.42	3.42	1.91	4.15	1.91	3.64
$D.W.$	2.29	2.18	1.72	2.42	1.75	1.64	1.80	1.64

Coefficients reported times 100 (effect measured over basis points). Constants not reported.

TSLS estimates with lagged variables as instruments. Quarterly data, 1988.I-1998.II.

Newey-West consistent t-statistics in parenthesis.

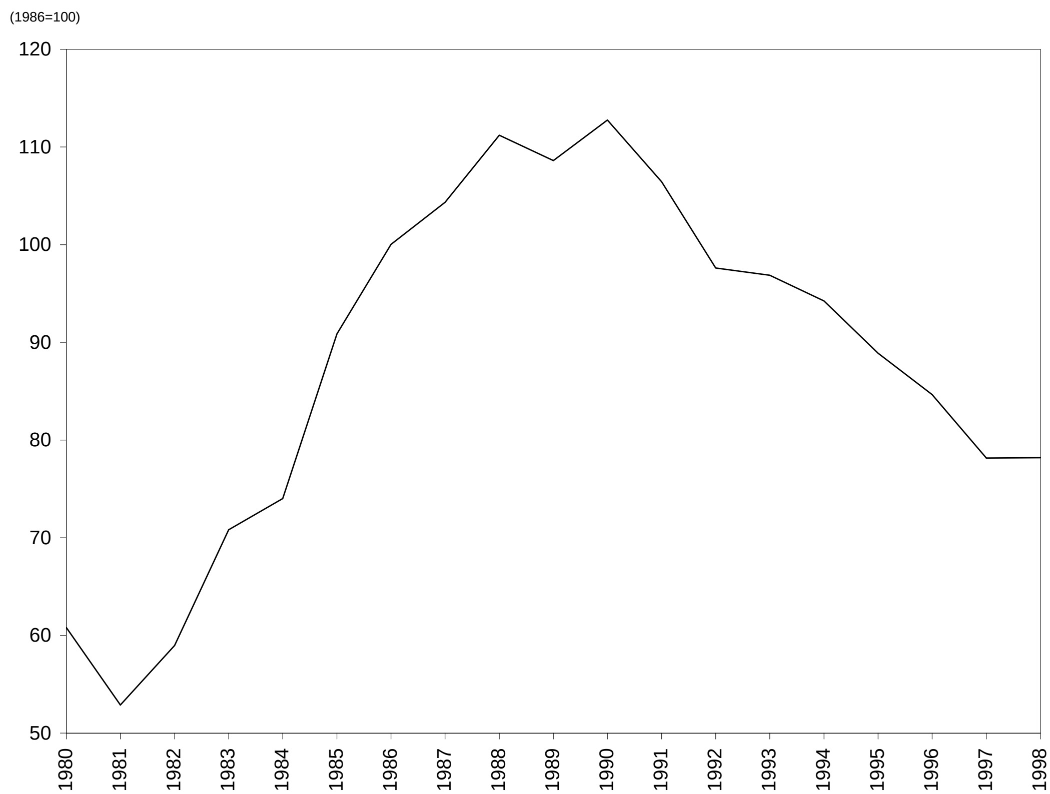
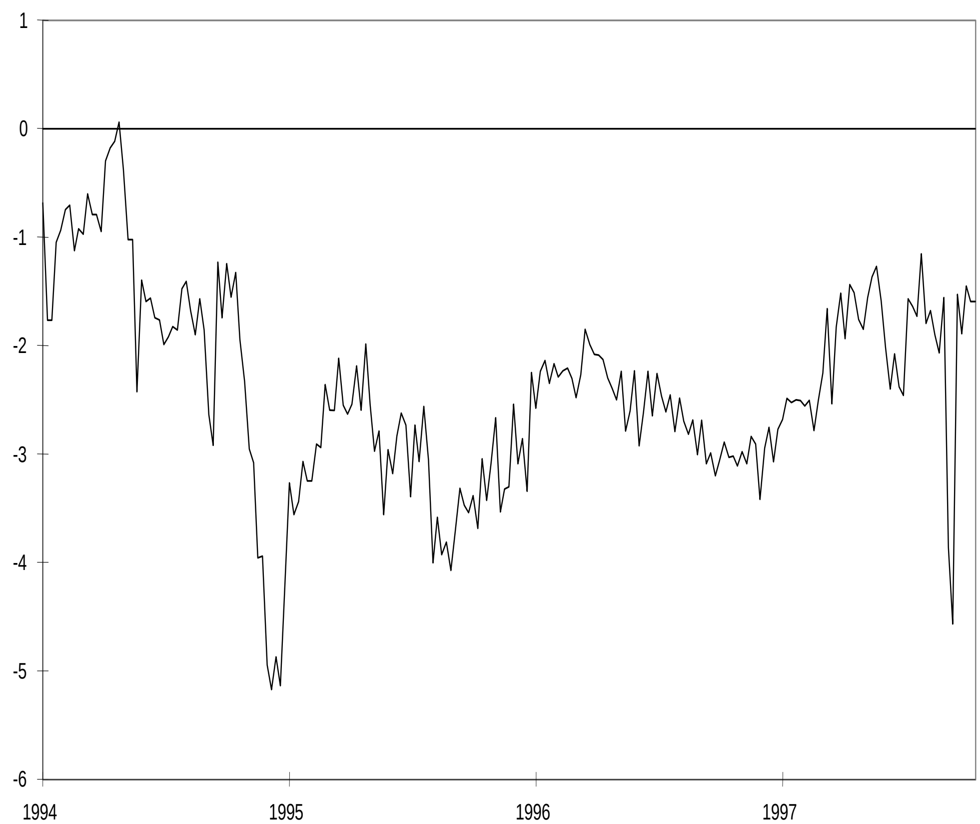


Figure 1: Real Exchange Rate



Note: Calculated as the difference between 90-days/UF forwards and 90-dyas UF PRBC day and Libor

Figure 2: 90 days covered interest rate differential

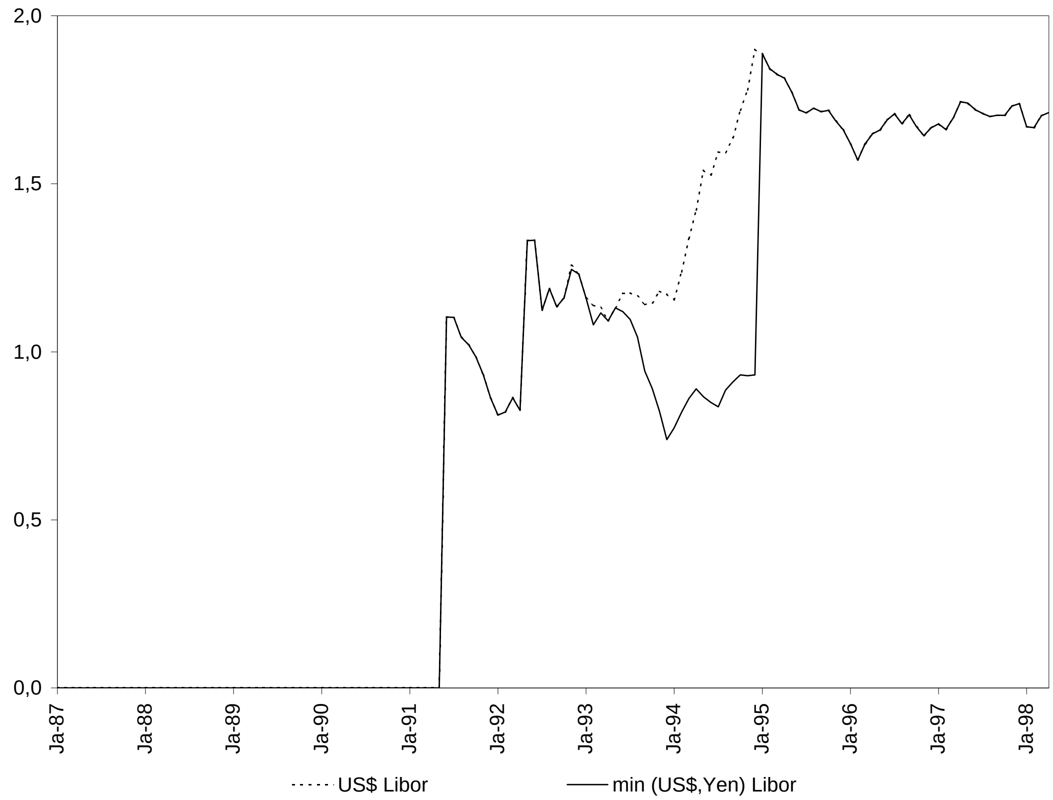


Figure 3: Tax Equivalent

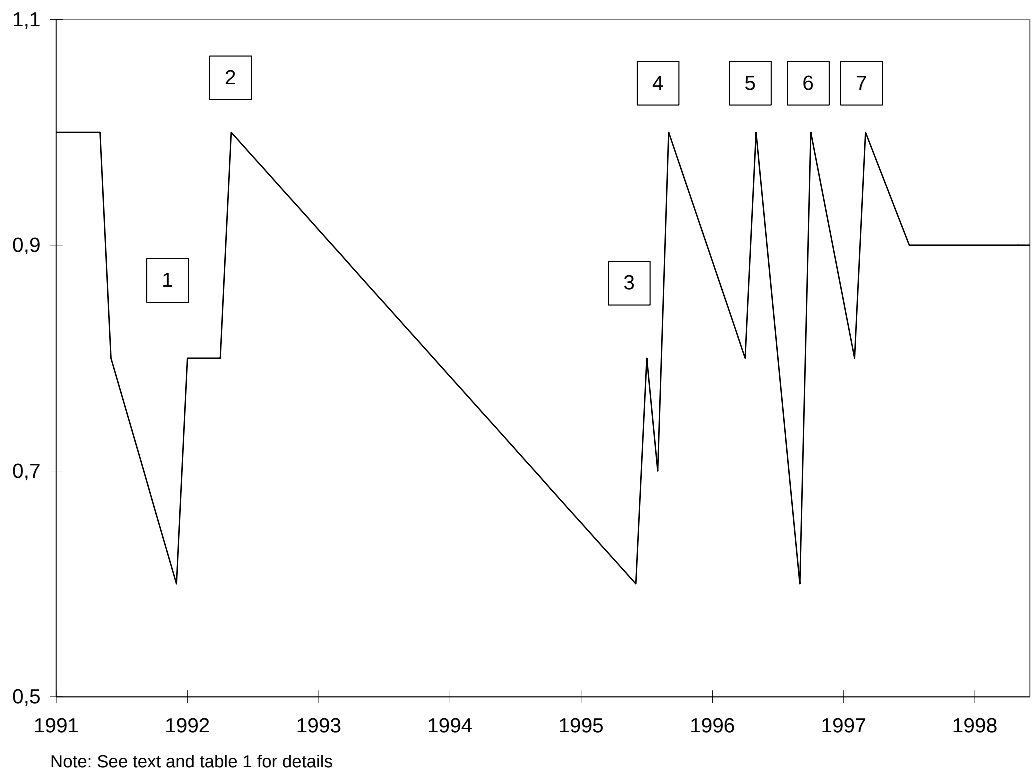


Figure 4: Power Index

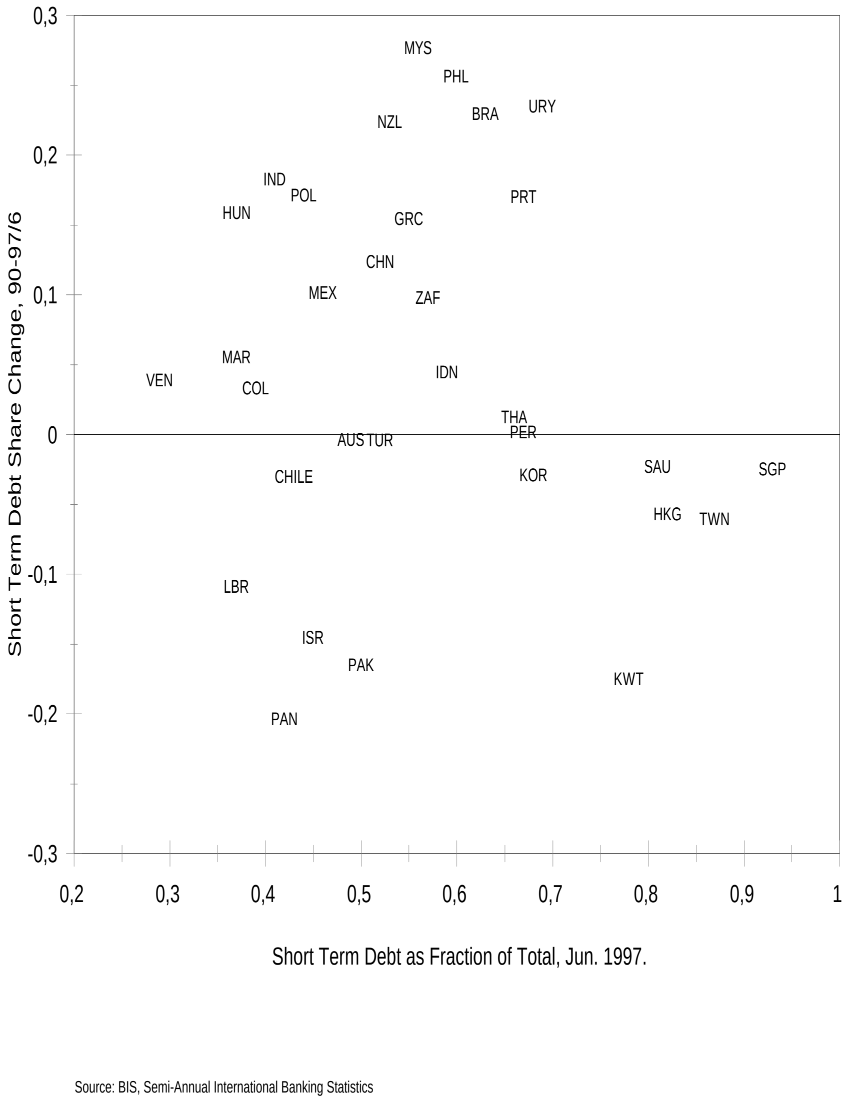
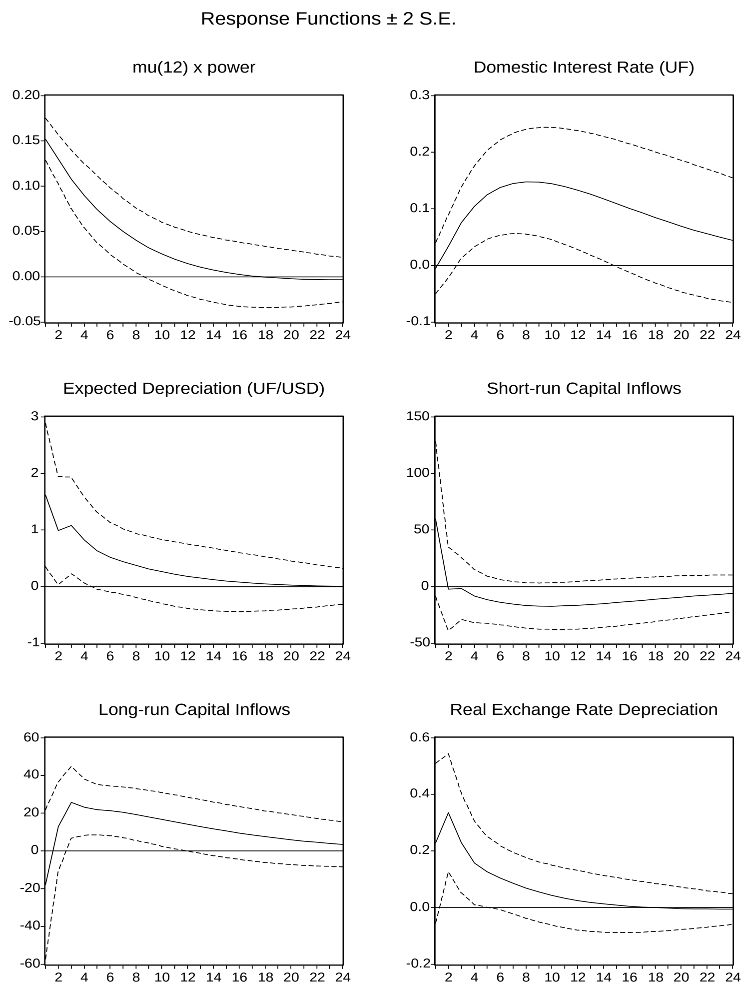
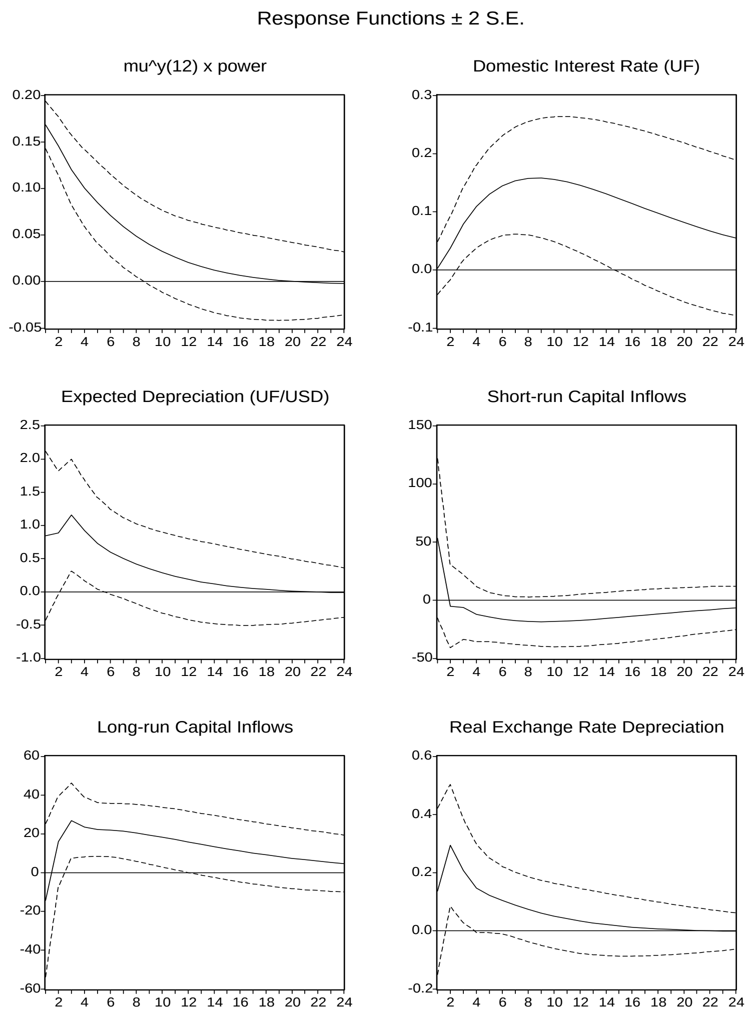


Figure 5: Debt Composition in a Comparative Perspective



Notes:
(1) Exogenous variables: - 6-month libor in dollars
- JP Morgan Emerging Market Bond Indicator
(2) Monthly data, 1991.1-1998.6.
(3) VAR estimation with 1 lag.

Figure 6: VAR1 Response Functions to a Shock in $\mu\times$Power



Notes:
(1) Exogenous variables: - 6-month libor in dollars
- JP Morgan Emerging Market Bond Indicator
(2) Monthly data, 1991.1-1998.6.
(3) VAR estimation with 1 lag.

Figure 7: VAR2 Response Functions to a Shock in $\mu\times$Power