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**Managing Capital Flows: Lessons from the Experience of Chile**

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**Abstract**

As a result of the Asian crisis, methods of coping with volatile international capital markets have received considerable attention from observers and policymakers. It has been argued that the imposition by Chile of a nonremunerated reserve requirement on external borrowing played a useful role in the smooth liberalization of its capital account by allowing Chile to deal effectively with short-term capital inflows and thus to reduce its vulnerability to external shocks, and that such measures should be adopted by other countries. In light of this, this paper reviews Chile's experience in managing capital flows and draws lessons for policymakers.

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## SUMMARY

This paper reviews the recent experience of Chile in managing capital flows. In response to the financial crisis of the 1980s, the authorities embarked on a program of economic reforms that resulted in a restoration of market confidence and eventually in sustained capital inflows. Policy responses involved sterilization, controls on capital inflows, liberalization of capital outflows, greater exchange rate flexibility, and an enhanced prudential framework. In particular, a nonremunerated reserve requirement on short-term external borrowing was introduced to enhance monetary policy autonomy so that the effects of a tight monetary policy on the exchange rate would be minimized. Results from empirical tests suggest that it had no long-term effect on total inflows, the exchange rate, or domestic interest rates.

Prudential considerations were also a driving force in policy design. The reserve requirement was designed to support efforts in enhancing Chile's prudential framework by discouraging potentially volatile inflows while maintaining a liberal environment for foreign direct investment. Some research work would seem to suggest that the reserve requirement had a long term, though small, effect on the composition of inflows, but we only found a temporary effect. Misreporting, which is not reflected in data used for empirical testing, may further weaken the results of any empirical testing in this regard.

In view of our analysis policymakers should not expect Chile's measure to bring about a lasting solution to the problems posed by short-term inflows. What matters is a robust prudential framework and strong macroeconomic fundamentals. Some may see merits in using the measure for prudential purposes. However, because it operates through macroeconomic variables it offers a weak response to the prudential problems posed by capital flows volatility. Finally, in view of the high level of enforcement capacity it requires not any country would seem to meet the conditions for its implementation.

## **I. INTRODUCTION**

The recent Asian crisis has motivated a renewed interest on means to cope with volatile international capital markets, particularly short-term external borrowing. It is in this context that capital controls imposed on short-term inflows by Chile since the early 1990s have received considerable attention from some observers and policymakers. Would capital controls as practiced by Chile be a useful policy instrument to ensure a smooth liberalization of the capital account? In particular, would they be effective in discouraging international flows perceived as short-term and volatile while maintaining a liberal environment for foreign direct investment? Would they be effective in helping reduce maturity mismatch on external debt at the corporate level? What are the lessons from Chile's experience for policymakers considering a liberalization of the capital account, or confronted with volatile capital inflows? In the case of emerging and developing economies can such measures be a proxy for prudential regulation when limited capacity of the authorities in this regard may result in financial markets more prone to crisis?

An answer to these questions in the light of Chile's experience calls for a review of the motivations of the Chilean authorities when the reserve requirement was introduced, and an assessment of its effectiveness in view of its expected effects. There is an abundant literature on methodologies to test the effectiveness of capital controls, some of them reviewed in Appendix I, and several recent papers report on research to test the effectiveness of Chile's capital controls, in particular Valdes and Soto (1996), Soto (1997), Edwards (1998a, and 1998c). This paper draws on these papers as well as on further testing which are detailed in Appendix II. The remainder of it is organized as follows. Chapter II reviews Chile's background and the factors which motivated the introduction of capital controls, Chapter III reports on the results of empirical tests on the effectiveness of capital controls. Chapter IV discusses the results in the context of Chile's overall program of economic reforms. Chapter V offers concluding remarks, including lessons from Chile's experience.

## **II. BACKGROUND AND MOTIVATIONS FOR CAPITAL CONTROLS**

### **A. Responses to the 1982-83 Crisis**

In the mid 1970s Chile undertook a comprehensive program of economic liberalization which involved a drastic overhaul and deregulation of the financial system. However, after an extended period of financial repression the supervisory agencies lacked the experience necessary to design and enforce prudential regulations effectively. These weaknesses, combined with a deep recession beginning at the end of 1981, generated a sharp reduction in capital inflows, a deterioration of the terms of trade, and resulted in a financial crisis that spread throughout the financial system by the beginning of 1983.

The volatility of international capital flows played an important role in triggering the crisis. A large fraction of the capital inflows that entered the country in the period prior to the 1982 crisis had been intermediated by the financial system which was facing financial

difficulties. The resulting change in market sentiment, and the external debt problems of the country caused a drastic change in the direction of capital flows which in turn deepened the crisis of the financial system (Le Fort and Budnervich, 1996).

### **Enhanced Prudential Framework for the Financial Sector**

The financial crisis had shown the risks arising from financial and external liberalization in a context of a weak prudential framework. Starting in the mid-1980s the Chilean authorities embarked on an ambitious program to upgrade the prudential framework for the financial system. In 1986, the General Banking Law and the Organic Law of Superintendency of Banks and Financial Institutions were revised and strengthened, with the aim of strengthening prudential regulations, minimizing the need for state intervention in the financial system, and facilitating market self-regulation. These changes also addressed connected lending issues which had been one of the causes of past problems; required the publication of information on banks' assets quality; tightened capital requirements; and imposed strong liquidity management rules (Velasco, 1991). Moreover, in 1989 Congress enacted a constitutional law establishing the legal autonomy for the central bank, which received the mandate to ensure stability of the financial system. Finally, in 1997 a new banking law was enacted that increased banks' capital requirements in line with the Basle Committee recommendations.

Over the years, Chile has develop a prudential framework for the financial sector which establishes, inter alia, high disclosure standards, stringent rules for loan classification and provisioning, strict limits on connecting lending, and clear procedures for correction of liquidity or solvency problems. The banking reform initiated in 1986 created a strong banking system by establishing strict rules for banks activities and instituting a broad system of on-site inspections (Edwards, 1998b).

### **Macroeconomic objectives and external policies**

After the 1982–83 crisis, Chile's main macroeconomic objectives were to reduce inflation and to bring the fiscal accounts into balance. The objectives for the external sector were to contain the current account deficit through an export-oriented economic strategy supported by an appropriate exchange rate policy. Within such a policy framework, monetary policy was geared at limiting inflationary pressures.

The Real Exchange Rate (RER) became a key variable to strengthen the external sector. Since it had experienced a sharp appreciation as a consequence of the large and sustained capital inflows prior to the 1982–83 crisis, a somewhat depreciated RER was required to restore competitiveness. The peso was devalued by 220 percent in the four-year period 1982–85, while inflation during the same period amounted to only 100 percent. By the end of 1985, the RER had depreciated by about 70 percent compare to its level four years before.

The objective to maintain competitiveness motivated the introduction of a crawling peg to replace the fixed exchange rate. The new exchange regime introduced in December 1983 was designed to maintain a constant level of the RER against the U.S. dollar by following a purchasing power parity (PPP) rule. Furthermore, discrete devaluations added to the depreciation resulting from the PPP rule: 19 percent in September 1984; 3.6 percent in December 1984; 8.2 percent in February 1985; 7.2 percent in June 1985. The adoption of a band arrangement in which the exchange rate could float freely allowed some flexibility in the conduct of monetary policy. The initial band was set at  $\pm 0.5$  percent, then raised to  $\pm 2$  percent.

### **Background for monetary policy in Chile**

Monetary policy in Chile operates in a context of high indexation which affects goods and services, labor, and financial instruments. Chile's indexation mechanism is based on past inflation. It was facilitated by the introduction, in 1967, of a unit of account (the "Unidad de Fomento" or UF) which is linked to the consumer price index with a one month lag. Although mandatory indexation in the labor market was abandoned in 1982, indexation clauses are still pervasive. They allow wages to be adjusted on the basis of past inflation plus some measure of past productivity increase. The indexation of financial instruments is also widespread, including most central bank paper. Such a mechanism of indexation based on past inflation tends to perpetuate inflation and thus, can place a heavier burden on monetary policy in reducing inflation. An additional constraint for monetary policy is the lack of a nominal anchor due to the PPP rule which rules out the use of the exchange rate as nominal anchor.

Within this broad context, monetary policy is operated through a framework which uses interest rates on indexed assets as the operational target.<sup>2</sup> Real interest rate targeting, which is a reflection of the widespread indexation of the economy, is for the purpose of closing the gap between aggregate demand and supply. As this gap is reduced, inflation falls at a speed that will depend on how effective are the transmission mechanisms. Because the elasticities of expenditure to the real interest rate are not precisely known, interest rate management has involved a great amount of pragmatism, with changes being made only through discrete and small adjustments.

### **Macroeconomic performances**

The strengthening of the external sector worked well during the five-year 1984–88 period. The current account deficit was cut from 11 percent of GDP in 1984 to one percent at the end of 1988 (Statistical Appendix, Table 2). Also, the economy grew at an average of 5.7 percent during the five years period. However, boosted by strong investment and buoyant

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<sup>2</sup>Before May 1995, the central bank influenced interest rates through its operations in its 90-day promissory notes denominated in UF. Since May 1995, the central bank influences interest rates through its overnight operations which are also denominated in UF.

consumption, the economy started overheating in 1989, year during which the GDP grew by 10 percent in real terms, unemployment went down to 6 percent from 12 percent in 1985, and inflation on an annual basis increased to 26 percent.<sup>3</sup> The authorities reacted by gradually increasing the central bank real reference interest rate from 5 percent in July 1988 to 7 percent in November of 1988, and finally to 8.7 percent in January of 1990. High domestic real interest rates, the fall in world interest rates, and an improvement of market sentiment toward Chile combined to produce a resurgence of capital inflows beginning in 1989, which caused a policy dilemma.

### **B. Response to the Policy Dilemma of the Early 1990s**

As market confidence returned and capital inflows accelerated, the tradeoff between the RER and the real interest rate became more acute. Attempts to set the real interest rate at a higher level than the "arbitrage" level (that is the international real interest rate plus a country specific risk premium) would most likely result in capital inflows and a nominal and RER appreciation. There was the risk that the high interest rate needed to control aggregate demand and inflation would cause a surge in capital inflows and an appreciation of the RER. In turn, this appreciation could deteriorate competitiveness and make the economy more vulnerable to external shocks. In particular, there was the danger that pressures on the exchange rate could defeat the objective of the authorities to achieve an orderly appreciation of the exchange rate.

At the same time, the case could have been made that RER appreciation combined with a current account deficit could work as an automatic corrective mechanism to encourage investors to internalize the increased risk thus reversing capital flows. However, previous experiences in the stabilization programs of Chile and other southern hemisphere countries had shown that such a corrective mechanism did not work well since investors generally tend to become aware of the country risk at a late stage.<sup>4</sup> This situation may result in larger and more painful macroeconomic adjustment that would have been required otherwise.

In view of these difficulties, the authorities reacted with a combination of measures including: foreign exchange intervention, partial sterilization, further liberalization of capital outflows, further widening of the exchange rate band, imposition of capital controls, and the continuation of a strong and sound fiscal policy.

In reaction to a widening interest rate differential the monetary authorities initially intervened heavily in the foreign exchange rate market to prevent the appreciation of the

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<sup>3</sup>See Fontaine (1991) for a detailed explanation of the surge in inflation.

<sup>4</sup>Most notably this had occurred in the failed stabilization plans of Argentina (1979) and Uruguay (1979) which together with the Chilean program are known as the "Southern Cone Tablitas."



nominal and real exchange rate. By the end of 1990 international reserves were up to 5.4 billion dollars, that is 80 percent higher than a year earlier. In order to prevent a monetary expansion, the central bank initially sterilized most of the intervention. This policy resulted in large costs for the central bank given the large interest rate differential between Chile and the international interest rate levels. This made the policy unsustainable in the long run.

To reduce the net inflows of capital the authorities liberalized outflows (Appendix III). However, the effect of the measure is not clear. Liberalization may result in increased inflows since foreign investors see it as a signal of greater openness of the economy, which tends to increase confidence. Also, as outflows are liberalized the demand for domestic assets falls, which makes asset prices even more attractive for foreign investors. In the end, the net inflow of capital may not decrease; only the ownership of domestic assets is modified.

In order to increase the flexibility of monetary policy and amplify the ex-ante volatility of the exchange rate so as to deter short-term speculative capital inflows, the exchange rate band was widened in 1989 from  $\pm 3$  percent to  $\pm 5$  percent. In addition, to avoid a RER appreciation the authorities lowered the ad valorem import tariff from 15 percent to 11 percent and continued a policy of fiscal restraint.

Eventually, the authorities responded to continued upward market pressure by introducing controls on capital inflows. In mid-1990 a stamp duty on credit instruments of one tenth of a percent of the value of the credit per month was extended to all foreign loans. In June of 1991 the non-remunerated reserve requirement on new foreign borrowing was introduced; it was subsequently extended to new transactions and the rate was increased. As described in the next section, capital controls helped reduce the net flows of capital in 1991. However, in 1992 private capital inflows resumed and, as pressure on the currency mounted, the central bank had to revalue the reference rate by 5 percent and widened the band from  $\pm 5$  percent to  $\pm 10$  percent. In 1994, because of favorable terms of trade and a still strong capital inflow, the central bank revalued the reference rate by an additional 10 percent. In 1995 additional measures were taken: the central bank announced that it would use the overnight rate as the main instrument of monetary policy so that increased volatility in the money market may discourage private inflows. Also, the reserve requirement was extended to include transactions which may had been used to circumvent the measure. Finally, in 1997, the exchange rate band was further widened from  $\pm 10$  percent to  $\pm 12.5$  percent. This was the last in a series of changes intended to promote an orderly appreciation of the exchange rate in response to upward market pressures.

The Asian crisis and its effects on emerging market economies offers an epilogue for our analysis. In the immediate aftermath of the Asian crisis Chile was able to withstand contagion. However, as the crisis deepened, contagion ended up affecting Chile's financial markets too. In June 1998 the authorities lowered the reserve requirement from 30 percent to 10 percent in response to capital outflows which made the high former level no longer warranted. At the same time the width of the exchange rate band was reduced from  $\pm 12.5$  percent to  $\pm 2.25$  percent so that exchange rate uncertainty prevailing in the market

would be dampened. Continued downward market pressures prompted the elimination of the reserve requirement in September 1998 (i.e., the rate was brought to zero) however the exchange rate band was somewhat widened to  $\pm 3.5$  percent with the objective of bringing it up to  $\pm 5$  percent at the end of 1998.<sup>5</sup>

### **C. Motivations and Objectives of the Reserve Requirement<sup>6</sup>**

The introduction of the reserve requirement was motivated by macroeconomic and prudential considerations. Regarding macroeconomic considerations, the measure was expected to expand the autonomy of Chile's monetary policy and thus help alleviate the policy dilemma arising from assigning two targets (interest rate and exchange rate) to monetary and exchange policy. The reserve requirement was expected to enhance the autonomy of monetary policy so that the effects of a tight monetary policy on the exchange rate would be minimized, and would not disrupt the orderly appreciation of the exchange rate.<sup>7</sup> Regarding prudential considerations, the measure was expected to discourage short-term external borrowing and to favor equity over debt financing. By reducing the volume of external short-term debt the measure was expected to enhance financial stability and, thus, reduce external vulnerability.<sup>8</sup>

The reserve requirement is a price-based control which operate as an "asymmetric Tobin tax."<sup>9</sup> The implied tax on external borrowing can be expressed as follows:

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<sup>5</sup> The authorities motivated the reduction of the reserve requirement ratio from 30 to 10 percent and ultimately to zero by the need to counteract the effects of shifts in market sentiment on Chile's country risk premium which occurred in the aftermath of the Asian crisis.

<sup>6</sup> A timetable and motivations for changes in reserve requirement is provided in Appendix III.

<sup>7</sup> While the CBC's inflation target is the prime objective of monetary and exchange management, the objective of keeping the exchange rate within a target band is an important policy objective. Inter alia, the reference exchange rate target path is set and adjusted in a backward-looking fashion, that is on the basis of the previous month's recorded inflation less an estimate of external inflation (based on a weighted average of Chile's trading partners rates) and until recently, an estimate of domestic productivity growth.

<sup>8</sup> See also Le Fort and Budnervich (1996): "The first objective [of the reserve requirement] is to favor equity over debt financing and long-term financing over short-term financing. The second is to allow the operation of a tight monetary policy without resulting in large current account imbalances."

<sup>9</sup> A Tobin tax is one which is a fixed percentage of the capital flow independently of the duration of the loan; an asymmetric Tobin tax would discriminate between outflows and inflows (Tobin, 1996).

$$t = \frac{r^*(i^* + s)^* \text{time}/(1 - r)}{\text{duration}}$$

where  $t$  represents the tax rate per unit of time as a percentage of loanable funds,  $r$  the non-remunerated reserve requirement,  $I^*$  the nominal interest rate corresponding to the currency in which the reserve requirement is constituted,  $s$  the spread over the interbank interest rate at which the investor will borrow funds to cover the reserve requirement,  $\text{time}$  the duration of required deposit, and  $\text{duration}$  the duration of the foreign investment.

The reserve requirement increases the cost of foreign borrowing (or conversely reduces the rate of return for a foreign investor), thus filling all or part of the gap between domestic and international interest rates. The level of the tax will depend on the level of international interest rates, the percentage of the reserve requirement, the duration of the investment, and the duration of the deposit. In effect, the reserve requirement modifies the covered interest rate parity condition for short-term maturities. In particular it allows the country to maintain higher domestic short-term interest rates for a given covered parity than without the capital controls (Table 1).<sup>10</sup>

Table 1. Implied Tax Due to The Non-Remunerated Reserve Requirement  
(in percent per year)

Reserve Requirement Rate: $r$		20%			30%		
Cost of Funds ( $I^* + s$ )		5	7	8	5	7	8
Required Deposit Duration: ( $\text{time}$ )		1 year	1 year	1 year	1 year	1 year	1 year
D	1 month	15.0	21.0	24.0	25.7	36.0	41.1
U	3 months	5.0	7.0	8.0	8.6	12.0	13.7
R	6 months	2.5	3.5	4.0	4.3	6.0	6.9
A	9 months	1.7	2.3	2.7	2.9	4.0	4.6
T	1 year	1.3	1.8	2.0	2.1	3.0	3.4
I	3 years	0.4	0.6	0.7	0.7	1.0	1.1
O	5 years	0.3	0.4	0.4	0.4	0.6	0.7
N	10 years	0.1	0.2	0.2	0.2	0.3	0.3

<sup>10</sup>The imposition of the non-remunerated reserve requirement on external borrowing would require either a rise of short-term domestic interest rates, or a fall of the forward exchange rate. A fall of the forward exchange rate could result from a depreciation of the spot exchange rate in response to the expected reduction of capital inflows (Johnston, 1998).

Since it was introduced, the reserve requirement underwent a number of modifications (Appendix IV). Most of the changes regarding the type of transactions subject to the reserve requirement were meant to close loopholes that had developed over time. The changes in the ratio, and ultimately its reduction to zero in September 1998, were meant to adjust the implied tax to prevailing market conditions: an increase would respond to the need to further dampen capital inflows, while a reduction would respond to the need to attract more of them.

### **III. EFFECTIVENESS OF CAPITAL CONTROLS**

Several studies report on research to test the effectiveness of Chile's capital controls, in particular Valdes and Soto (1996), Soto (1997), and Edwards (1998a, and 1998c). The methodology and results of these studies are summarized in Appendix I. Appendix II reports on additional test we have made on the effectiveness of the reserve requirement on total inflows and their composition. This Chapter summarizes empirical evidence on the effectiveness of the reserve requirement on macroeconomic and prudential variables.

#### **A. Macroeconomic Considerations**

From a macroeconomic point of view the reserve requirement can be expected to help maintain domestic monetary policy autonomy (which in Chile meant high domestic interest rates compared to international levels) in an exchange regime with limited flexibility, and to minimize exchange rate appreciation pressures in the face of substantial capital inflows. Three different macroeconomic variables are at play: the exchange rate, the differential of interest rates between Chile and the rest of the world, and total capital inflows. Empirical evidence of the effectiveness of the reserve requirement can be tested on each of these variables: (i) what is the impact of the measure on the dynamic response of the exchange rate to capital flows; (ii) what is the effect of the measure on total capital flows recorded in the balance of payments;<sup>11</sup> (iii) is there a significant effect of the measure on the differential of interest rates between Chile and the rest of the world. The discussion below draws on tests which have been performed and on results reported in some other studies.

#### **Impact on total inflows**

The results of the tests we have made (Appendix II) suggest that the measure had some initial effect on total inflows. The effect on impact in our tests, that is during the first quarter of implementation, is between US\$200 million and US\$700 million, depending on the specification; over a one-year period the effect is between US\$450 and US\$1500 (i.e., between 1.2 percent and 3.8 percent of GDP). However, the effect of the measure tends to vanish with time, and one year after it was introduced, it appears to be ineffective. Consistent

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<sup>11</sup>Whether the capital inflow is short- or long-term, or takes the form of portfolio investment rather than foreign direct investment is indifferent since pressure on the exchange rate on the foreign exchange market is irrespective of the form of the capital inflow.

with our tests Soto (1997) finds that the measure had no systematic or statistically significant effect on total inflows in the medium or long term.

### **Impact on the exchange rate**

In view of the limited effectiveness of the reserve requirement on total inflows one does not expect to find empirical evidence of a long term effect on the exchange rate. In effect, Chile's RER followed an appreciation trend of 4 percent a year during the period 1991–94 (Statistical Appendix, Table 1). The Chilean authorities have argued that, due to the non-remunerated reserve requirement, Chile's RER rate has appreciated less than in other countries of the region. However, the literature we have reviewed do not provide empirical evidence that would support a prolonged effect of the reserve requirement on the real exchange rate. Valdes and Soto (1996) use a capital control index in the context of a single equation model. The results of the regressions they ran suggest that the capital control had no impact on the real exchange rate and the authors conclude that there is no evidence of a positive long-run effect. Edwards (1998a) and Soto (1997) use the vector autoregression methodology (VAR). While Soto finds a small and short-lived positive effect on the RER, Edwards concludes that the behavior of the RER was not affected by the capital controls. In sum, although the capital control may have had at best a positive effect on the RER, its economic importance would appear to be minimal.

### **Impact on interest rates**

Chile was able to maintain a wedge between domestic and international rates throughout an extended period of time (Statistical Appendix, Table 1). However, Edwards (1998a and 1998c) finds no evidence over the long run that such behavior was due to the reserve requirement. Soto (1997) does find a small positive effect on the domestic interest rate which lasts only between a year and a year and a half. These results suggest that the capital controls increased only in the short-term the authorities' control over domestic interest rates. Over the longer run the reserve requirement does not appear to have increased Chile's ability to control interest rate differentials.

## **B. Prudential Considerations**

The reserve requirement is expected to discourage short-term inflows without affecting long-term foreign investments. The expected prudential effect is to reduce the volatility of international capital flows into the country. This is a desirable objective for the economy at large as capital flows volatility can be a source of difficulties for macroeconomic management, particularly in countries with fixed exchange rates (Edwards, 1998a). This is also desirable from a microeconomic point of view as the measure can limit the scope for maturity transformation by financial institutions and corporations and thus reduce their vulnerability in the event of deterioration of market sentiment. Finally, reduced capital flows volatility can reduce exchange rate volatility which can be a source of vulnerability when adequate hedging instruments are not available. In the following paragraphs we discuss the

effectiveness of the reserve requirement on the composition of Chile's foreign liabilities and on the volatility of the exchange rate.

### **Impact on composition of inflows**

Empirical evidence on the effectiveness of the reserve requirement in discouraging short-term inflows is mixed. Soto (1997) finds that it has significantly altered the composition of capital inflows, leading to a relative decline in short-term flows. Moreover, Soto finds that this effect is prolonged over time. The tests we made do not corroborate this conclusion. As reported in Appendix II, the measure had the expected negative effect on short-term inflows on impact, that is during the first two quarter after it enters into effect. However, after two quarters, regardless of the specification, not only the negative impact vanishes, but a positive impact develops. The effect during the first year, when it is expected to be the largest, ranges from a maximum negative impact of US\$439 (-1.1 percent of GDP), to a maximum positive impact of US\$337 (0.9 percent of GDP). In the case of medium- and long-term flows, there is no effect on impact, and the results for subsequent quarters are contrary to the expected effect, which is an illustration of the difficulty to model quarterly flows of capital.

### **Exchange rate volatility**

Soto (1997) finds a negative relationship between the reserve requirement and exchange rate volatility. A 30 percent reserve requirement would reduce volatility by approximately 20 percent. While this may be the case, it is worth mentioning measures implemented by Chile whose specific objective was to reduce market volatility. First, Chile has been implementing a dual foreign exchange market composed of the official market and the informal market. All current payments and authorized capital transactions, including loan receipts, must be transacted in the official market, while all transactions not required to be channeled through the formal market take place in the informal market (AREAER 1998). The rationale for such an arrangement was to isolate trade flows from the volatility of capital flows, particularly portfolio transactions (Le Fort, Budnervich, 1996).<sup>12</sup> Second, the introduction of a band played an important role in reducing volatility. Finally, one should not underestimate the role of central bank smoothing intervention in this regard.

## **IV. DISCUSSION**

### **A. Overall Assessment**

The results of empirical studies reviewed in this paper point to the limited effectiveness of the reserve requirement on macroeconomic variables; they show that the effect in the expected direction is at best short-lived. Thus, it would seem that policymakers should not

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<sup>12</sup>Transactions can be carried out in both markets, the exchange rate on the two markets are able to converge.

expect gaining much autonomy for the conduct of monetary policy from the capital control. These conclusions are consistent with those by Cardoso and Goldfajn (1998) concerning Brazil, and Cárdenas and Barrera (1996) concerning Colombia. Cardoso and Goldfajn (1998) found that capital controls in Brazil were temporarily effective in altering levels and composition of capital flows, but could find no sustained effects in the long run. Cárdenas and Barrera (1996) conclude that in Colombia withholding taxes might have had some temporary effect in reducing speculative capital inflows; however, reserve requirements were unable to discourage total capital inflows.

The conclusions concerning the effect of the measure on the composition of the foreign liabilities are somewhat less definite. While the measure may at best have had some long term effectiveness, its economic importance appears small. This would be consistent with the conclusion of Cárdenas and Barrera (1996) who found preliminary evidence of some effectiveness in inducing a re-composition of foreign liabilities in favor of long-term maturities in the case of Colombia, although no actual duration is reported.

A word of caution is warranted when trying to draw conclusions from these tests because none of them have attempted to take account of misreporting that may have arisen as the reserve requirement was introduced.<sup>13</sup> Misreporting may have involved reporting short-term inflows as long-term investment inflows, or portfolio investment as foreign direct investments. Various indications suggest that circumvention of the requirement has been an issue for the authorities. "Errors and Omissions" in the balance of payments for Chile exhibited a surge when the reserve requirement was first introduced in 1991, and broadened in 1995, suggesting that short-term inflows recorded on the balance of payments may have been underestimated. Another word of caution is warranted in view of the imperfection of Chile's balance of payments statements which do not provide the appropriate classifications and aggregations of capital flows for use in testing the effect of the measure on the recomposition of the inflows. In view of these uncertainties we cannot conclude that there is strong evidence of effectiveness of the reserve requirement on the recomposition of the capital inflows.

In summary, we have not found no strong empirical evidence that would suggest that the reserve requirement had a significant effect on the macroeconomic and prudential variables likely to be influenced. The capital controls were just one element of a broader policy package including a prudent fiscal policy, a monetary policy aimed at maintaining a low inflation, and an enhanced prudential framework for the financial sector.

## **B. Capital Controls: A Way to "Buy Time"?**

The economic literature supports the use of capital controls with the argument that controls are welfare enhancing insofar as they are a second-best policy for mitigating the

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<sup>13</sup>While misreporting could involve under- as well as over-reporting, the cost associated with the imposition of the reserve requirement would seem to make the later highly unlikely.

effects of another market failure (Dooley, 1996). For countries with weak financial sector regulatory framework, properly designed capital controls could offer a second best solution until such time when markets and institutions are strengthened. Capital controls may be a way to "buy time," allowing the authorities to implement the structural reforms needed for an orderly integration of the domestic economy with international markets. Does the experience of Chile would support the use of the reserve requirement to this effect?

During the period 1992–97 Chile did not achieved significant progress in bringing the level of domestic interest rates closer to international levels.<sup>14</sup> The differential of real interest rates between Chile and the United States (considered to be representative of international rates) increased from 3.1 percent during the period 1995–91 to 5.2 percent during the period 1992–97, with part of the increase only due to a fall in international rates (Figure 1). In this regard, tests by Edwards (1998c) would seem to confirm that after capital controls on inflows were imposed in Chile, interest rate differentials became more sluggish and tended to disappear more slowly than during the free capital mobility period. This would tend to suggest that the capital controls may have delayed the integration of Chile's economy with international markets.

The high degree of restrictiveness of Chile's regulatory framework for current and capital transactions is additional evidence of the limited progress in the integration of Chile's financial system with international markets. The measure of the restrictiveness of Chile's regulatory framework presented in Table 2 compares an index of restrictiveness for current and capital account transactions for Chile with those for 15 industrial and 26 developing and emerging economies. The indices are established on the basis of a description of the regulatory framework for current and capital international transactions as described in the Annual Report on Exchange Arrangements and Exchange Restrictions published by the IMF.

Table 2. Chile: Index of Restrictiveness

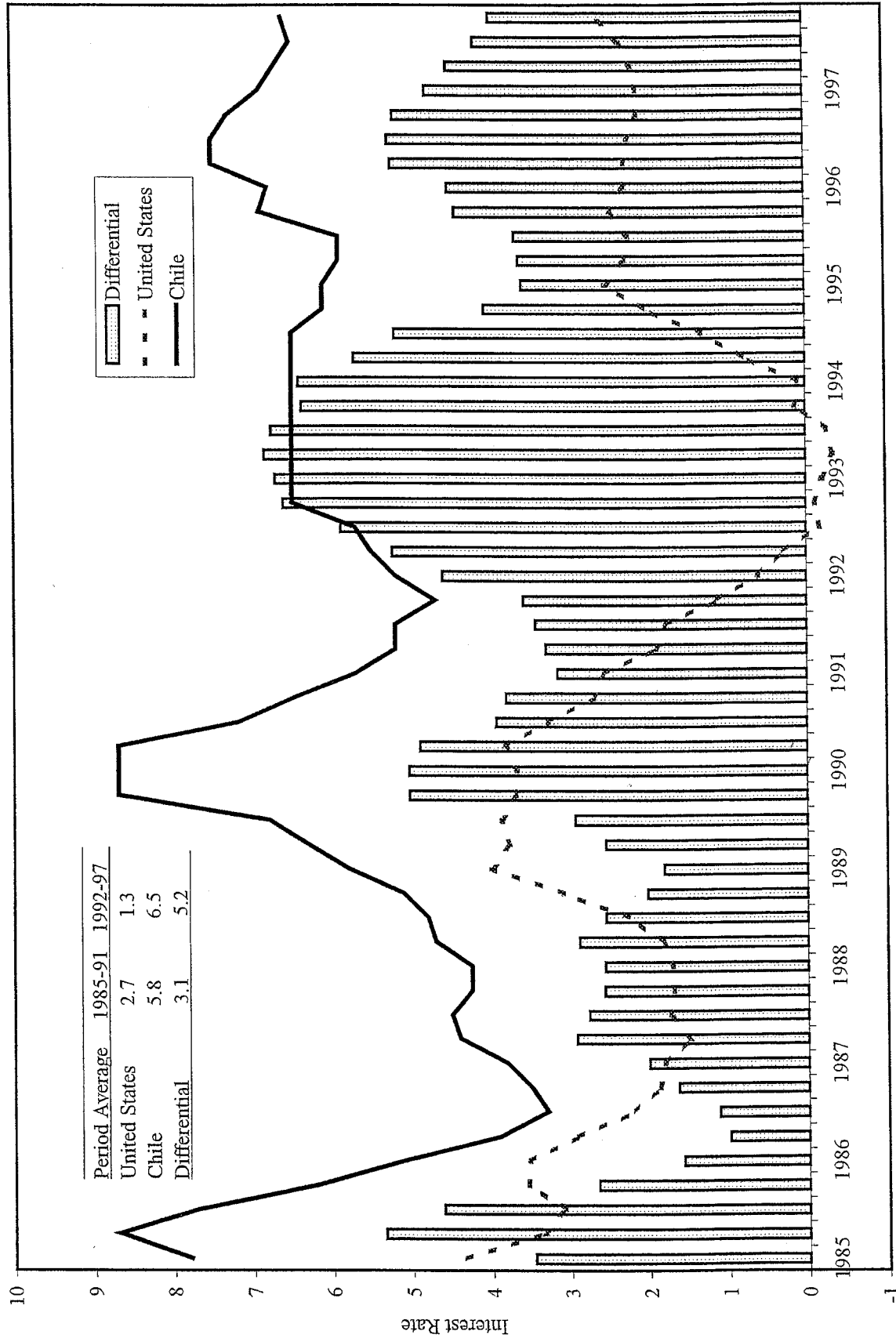
	Chile	Mean	Industrial Countries	Developing Countries
Current account index	0.22	0.13	0.05	0.18
Capital account index	0.89	0.39	0.12	0.55
Overall index	0.56	0.26	0.09	0.36

Source: IMF, AREAER (1997), Tamarisa (1998) and Staff Estimates.

<sup>14</sup>See Guerguil and Kaufman (1998) for a discussion on the rebalancing of the policy mix aiming at easing the burden on monetary policy.



Figure 1. Chile - Differential of Interest Rates, 1985-1997



Source: Chile: From January 1985 to June 1989, average deposit rate for 90-365 days bank deposits (Central Bank of Chile); from June 1989 to December 1997, 90 days CBC Notes rates (CBC and Fund staff estimates). United States: 3 month Treasury Bill rates (Federal Reserve Board and Fund staff estimates).

The high level of Chile's indices reflects the imposition of the reserve requirement as well as a number of other measures including those related to the dual foreign exchange market, repatriation and surrender requirements for selected transactions, extensive reporting requirements, and capital controls for prudential purposes. Chile's exhibits a system of exchange controls which is, on average, more pervasive than for developing and emerging economies, not to mention industrial countries. This suggests that the effectiveness of the reserve requirement is questionable even in the context of a restrictive regulatory framework for current and capital transactions.<sup>15</sup>

### **C. Chile's Prudential Framework for Capital Transactions**

In addition to enhancing the prudential framework for the financial sector Chile introduced prudential limits on domestic corporations borrowing abroad (Appendix V) which helped reduce external vulnerability as discussed below. In May 1992 financial and non-financial corporations were required to secure a favorable rating from the National Risk Classification Commission. In June 1993 the previous requirement was replaced by the requirement to obtain from a foreign rating company a credit rating equal to or better than that assigned to Chile. In April 1994, the previous requirements for non-financial corporations were replaced by the requirement that they be rated BBB, that is "Investment Grade". In September 1994, the previous requirement for financial institutions was replaced by the requirement that they be rated BBB+. These measures had several effects. First, domestic corporation borrowing on the international capital markets was made subject to the best accepted international practices regarding disclosure and accounting standards. Second, only sound corporations, or with a business structure enabling them to rely on external borrowing without taking excessive risks, were allowed to tap international capital markets. Third, the requirement that financial institutions secure a rating higher than non-financial corporations prevented the loophole of poorly rated non-financial corporations borrowing heavily from banks relying heavily on external financing.

The authorities have also introduced limits on outward direct investment by financial institutions (Appendix V). In particular, commercial banks, pension funds and insurance companies are allowed to invest only in foreign securities issued or guaranteed by foreign governments or central banks and private enterprises rated "Investment Grade" by a foreign rating company. The measure aims to prevent a deterioration of the quality of their assets.

Chile's prudential framework for capital transactions helped reduce external vulnerability in two ways. First, by not allowing financially weak corporations to borrow abroad, the risks of an external crisis in response to the default of a large borrower were reduced. Second, by placing a minimum risk rating on foreign assets purchased by financial institutions, the ability of these institutions to trade credit risk for higher return was curtailed.

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<sup>15</sup> Along the same lines one should also mention Chile's well recognized law-abiding tradition and its well established law enforcement capacity, particularly at the central bank.

## V. CONCLUSIONS AND POLICY LESSONS

Testing for the effectiveness of the reserve requirement in Chile has proven to be a difficult task. First data problems impose difficulties: balance of payments statements do not provide appropriate classifications and aggregations of capital flows for use in testing, and the extend of misreporting cannot be taken into account.<sup>16</sup> To further complicate matters, capital controls are interlinked with a number of policy measures, making it difficult to isolate the effect of a specific instrument. Furthermore, the motivations and objectives of the reserve requirement may have shifted since it was first introduced, which makes it difficult to assess the effectiveness of the measure against its expected benefits. In particular, while the introduction of the reserve requirement was motivated by macroeconomic and prudential considerations, in the most recent period greater emphasis seems to be given to the effects of the measure on external short-term borrowing by domestic entities, in particular the corporate sector which cannot be made subject the comprehensive prudential oversight that applies to financial institutions. However, for the sake of drawing policy lessons the experience of Chile is valuable in both respects, that is macroeconomic and prudential.

A first conclusion has to do with the effectiveness of the reserve requirement on macroeconomic variables. The empirical tests reported in this paper provide evidence of the limited effectiveness of capital controls. In particular, the reserve requirement had no long term effect on total capital inflows and the exchange rate. This finding suggests that the measure has a limited capacity to generate autonomy for implementing monetary policy.

Second, concerning the composition of capital inflows, which relates directly to the expected prudential effect of the measure, tests reported in this paper suggest that empirical evidence of the long term effectiveness of the reserve requirement is low. On the basis of our tests, it would seem that the effectiveness of the measure on the composition of capital inflows would only be short-lived. Furthermore, it is in this area that data problems, including the extend of misreporting, have the most serious consequences, thus making fragile any definite conclusions in this regard.

Third, the use of the reserve requirement, as implemented by Chile, as a prudential measure calls for caution in view of some shortcomings inherent to the very nature of the instrument: (i) the reserve requirement has an intrinsic macroeconomic nature since it applies irrespective of the structure of the assets and liabilities of the entities subject to it. Indeed, one would expect prudential measures to discriminate between entities subject to them on the basis of certain risks elements of their assets and liabilities, or both,<sup>17</sup> and (ii) the measure

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<sup>16</sup>Cárdenas and Barrera (1996), Johnston and Ryan (1994) and Edwards (1988) have mentioned the difficulties imposed by data problems.

<sup>17</sup>The intrinsic macroeconomic nature of the reserve requirement is also attested by its  
(continued...)

applies across the border, including to financial institutions already subject to prudential oversight. Therefore, the reserve requirement would not seem to be the most appropriate instrument to address prudential concerns such as those related to excessive external short-term borrowing by corporations. What matters most in this regard is greater transparency under an international accepted set of principles or standards conducive to enhanced market discipline so that policy weaknesses in the international architecture of the monetary system can be adequately addressed.<sup>18</sup> In this regard, the measures applied to Chilean corporations borrowing abroad would be more consistent with such an approach than a taxation of inflows.

Fourth, the emphasis given to prudential motivations makes the reserve requirement a permanent element of the policy mix, rather than an instrument to “buy time.” This seems to be confirmed by Chile’s recent measure to bring to zero the reserve requirement, rather than simply eliminating it altogether. The decision, which aims at compensating for the higher risk premium imposed by international market in the aftermath of the Asian crisis, illustrates the true nature of the reserve requirement. It serves as a device to counteract the effects of shifts in market sentiment on the country risk premium in a situation where structural rigidities prevent domestic interest rates from adjusting to the new external environment.

Fifth, the importance given in some research work to the potential effectiveness of the reserve requirement in reducing exchange rate volatility may overshadow the contribution of institutional factors which, in our view, play an important, if not major, role in this regard. In particular the microstructure of the domestic foreign exchange market may have greatly facilitated the orderly appreciation of the exchange rate, including the deterring effect on short-term capital inflows of flexible arrangements for the exchange rate, and expertise at the central bank in conducting smoothing intervention to iron out temporary imbalances.

Chile’s experience with managing capital flows teaches lessons for policymakers. First, Chilean-type capital controls cannot be expected to have a significant or long-term effect on the total volume of capital inflows or the exchange rate. Reserve requirements on external borrowing cannot be expected to ease the pressure on the exchange rate to appreciate arising from an excess of capital inflows in response to high interest rate differentials. A lasting solution to potentially destabilizing short-term capital inflows calls for a re-balancing of the macroeconomic policy mix which ultimately will allow domestic interest rates to converge with the level of international interest rates. Second, the use of the reserve requirement as a prudential measure aimed at curtailing the ability of domestic corporations to rely extensively

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<sup>17</sup>(...continued)

elimination in late 1998 at a time when the risks associated with external short-term borrowing may not have decreased.

<sup>18</sup>See for instance “*Strengthening the Architecture of the International Monetary System*,” Report of the Managing Director to the Interim Committee, International Monetary Fund, October 1998.

on short-term external borrowing is not exempt from difficulties. This is because the mechanism through which it operates, that is the implied tax, is based on macroeconomic rather than prudential considerations. Third, circumvention through misreporting is most likely to be an issue. Thus, countries considering the introduction of Chilean type measures should not underestimate the costs of such regulations in terms of enforcement capacity. In this regard, such measures should not be recommend in countries whose institutions, in particularly the central bank, do not have the expertise and resources to enforce them. Fourth, high capital mobility, which may call for some exchange rate flexibility, calls also for advanced dealing skills on the part of the central bank to undertake smoothing intervention so that exchange rate volatility is minimized.

## **Selective Review of Testing Methodologies<sup>19</sup>**

This appendix reviews specific empirical literature on the effectiveness of capital controls, including methods by which researchers have tried to quantify or assess in descriptive ways, the macroeconomic effects of controls on capital movements. Given the abundance of literature on this topic, the focus will be on a detailed description of some methodologies, particularly on those designed for countries which do not have fully developed financial markets, and which take into account the broadening and intensifying of the controls as time passes.<sup>20</sup>

The first problem to address when assessing the effectiveness of a specific measures is that there is no accepted definition of what constitutes an effective program of capital controls. As Dooley (1996) points out, effective control programs have been defined, on the one hand, "as differences observed over extended time periods in the average behavior of selected economic variables between countries with capital controls and countries without them. At the other extreme, effectiveness has been defined as a government's ability to maintain an inconsistent macroeconomic policy regime indefinitely."

Second, the effectiveness of specific measures have to be assessed against their expected benefits. An understanding of the rationale for the imposition of the controls and the objectives of the authorities is necessary. Only then, can one assess whether the measures were effective. A well-known example is the 1992 European Monetary System (EMS) crisis. At the time, some European countries imposed controls to prevent a currency realignment, at least in the short-run. The effectiveness of the measures should be assessed on the basis of their ability to prevent a realignment of the currency, and not merely on their ability to generate a wedge in the interest rate differential between domestic and offshore deposit rates.

### **A. Traditional Methods**

#### **Methods for countries with developed financial markets**

In countries with a well-developed offshore market or futures market for the currency of the country under analysis, the absence of restrictions on the flow of capital will result in a convergence between domestic and offshore interest rate counterparts through arbitrage activities, once country risk and arbitrage costs are taken into account. An alternative to this approach in countries where there is a futures market, is to calculate the covered interest rate and compare it to the rate offered by a reserve currency, for example, the London interbank offered rate (LIBOR).

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<sup>19</sup>This Appendix was prepared by Jaime Cardoso.

<sup>20</sup>For a more traditional review of the empirical literature on capital controls, see Obstfeld (1995), Dooley (1996), Epstein and Schor (1992), Mathieson and Rojas Suarez (1993).

In the 1992 European crisis, countries whose currencies were under attack experienced sharp interest rate increases, in part because of sizable short-term borrowing to build short positions in the currencies under attack. In a situation of free capital movements, such arbitrage transactions generate an increase in offshore and domestic interest rates. A way to avoid the increase in domestic interest rates, which may have negative consequences on aggregate demand, would be to restrict capital flows. Capital controls make it more costly (in the case of price-based measures) or more difficult or even impossible (in the case of direct measures which can be enforced) for speculators to borrow in the domestic money market to finance short positions. Provided capital controls can effectively isolate the euro market from the domestic market, a wedge between the domestic and euro rates will appear. If controls are effective in preventing outflows, domestic interest rates should be below corresponding foreign rates.

Large and sustained capital inflows have the potential to create a policy dilemma. This is particularly true in countries in which the policy mix combines the maintenance of a competitive real exchange rate (RER) with high domestic interest rates to control aggregate demand and inflation. One can see that in this case, high domestic real interest rates attract foreign capital which tends to appreciate the RER.<sup>21</sup> Imposing capital controls on inflows will allow a country to maintain domestic interest rates above international levels. Research following this methodology test for this kind of results.

Given the nature of the information needed to perform these tests, countries to which this methodology can be applied are limited, as evidenced by the case studies in the literature. Among others, these studies include Germany for the period 1970–74, Italy and France during the period 1979–86 and Spain Ireland and Portugal during the ERM crisis in 1992.

Eichengreen, Rose and Wyplosz's conclusions suggest that the effectiveness of controls is limited: "Controls do not allow countries which pursue policies inconsistent with a peg to keep their exchange rate unchanged forever. They do not prevent attacks or they permit countries to avoid reserve losses or interest rate increases when attacks occur. Controls merely render expansionary monetary policies viable for a longer period by attenuating the link between crises and exchange rate regime collapse."

### **Methods for countries with less developed financial markets**

The starting point of the literature in the case of countries without offshore markets or a forward exchange market is Edwards and Khan (1985). The authors propose a framework to ascertain what are the factors that influence the determination of domestic interest rates

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<sup>21</sup>The definition of the real exchange rate in this paper is the price ratio of tradable to non tradable goods measured in domestic currency, which is the inverse of the definition in International Financial Statistics. An appreciation in our definition implies that the price of home goods increases relative to foreign goods, meaning that the real exchange rate falls.

when capital controls are in place and it is likely that both open and closed economy determinants will affect the nominal interest rate. In an open economy characterized by a complete financial liberalization the Fisher equation for an open economy holds:<sup>22</sup>

$$i_t = I_t^* + e_t + \rho_t$$

where  $i_t$  represents domestic nominal interest rates,  $I_t^*$  world interest rates,  $e_t$  expected devaluation rate, and  $\rho_t$  a time varying risk premium.

In a closed economy, arbitrage is achieved through the goods markets and the corresponding equation for the nominal interest rate is as follows:

$$i_t = rr_t + \pi_t^e$$

where  $rr_t$  represents the real ex ante rate of interest, and  $\pi_t^e$  the expected rate of inflation

Edwards and Khan combine these two polar cases and determine the following expression for the nominal interest rate in an economy which is neither completely open nor closed:

$$i_t = \delta_0 + \delta_1 (I_t^* + e_t) + \delta_2 \log y_t + \delta_3 \log m_{t-1} + \delta_4 \pi_t^e + \delta_5 i_{t-1} + \rho_t + \varepsilon_t$$

Tests on the effectiveness of capital controls can be done by running the above regressions during the period while controls are in place. If the domestic factors play no role in the determination of domestic interest rates, then the conclusion is that controls are ineffective in insulating the country from the rest of the world, and they do not provide room for an independent monetary policy.

Edwards and Khan estimate the above equation by the ordinary least squares method for both Colombia, a semi-open economy, during the period 1968–82, and Singapore, an open economy, during the period 1976–83. The authors found that domestic and foreign factors played a role in the determination of the domestic rate in Colombia, although the results showed a degree of openness higher than expected. In the case of for Singapore foreign factors played the dominant role.

A number of practical problems arise in using this approach. First, the above equation includes three unobservable variables: expected devaluation, expected inflation and a time varying risk premium. The simplest way to obtain estimates of expected devaluation is to assume that expectations are exogenous and to use the forward premium. Since very few developing countries have a forward market for their currency, after invoking rational

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<sup>22</sup>The Fisher effect states that nominal interest rates in each country are equal to the required real rate of return plus compensation for expected inflation.



expectations, it is best to use the actual rate of devaluation instead. One can approximate the expected rate of inflation by using the actual rate. Finally, Edwards and Khan ignore the time varying risk premium, although they suggest a model with a constant term plus a random term, which is incorporated into the regression error term. This simplification is a major one, as evidenced by the correction that the authors have to make for autocorrelation.<sup>23</sup>

Second, the exogeneity of the right hand side variables poses additional problems. Good examples are devaluation expectations and the interest rate level which are determined simultaneously: expectations affect the interest rate level (see the Fisher equation for instance), the interest rate level affects expectations. In order to solve this problem, an additional equation modeling the determination of exchange rate expectations would have to be added. However, little can be expected from such an approach given the limited predictability of models attempting to predict the exchange rate.

A final problem is that Edwards and Khan assume the parameters of interest remain constant over time. In particular their model assumes a constant degree of openness of the financial sector, meaning that the effectiveness of the control does not change as time passes. This simplification does not conform to the fact that, over a span of time, market participants find ways to circumvent capital controls, and the authorities themselves modify the controls periodically. A way to overcome this difficulty would be to define an index of restrictiveness of the control, and to make the openness parameter a function of this index.

Haque and Montiel (1990) further develop the approach of Edwards and Khan for cases in which domestic market-based interest rates are not available or if available, do not reflect market conditions. Following Edwards and Khan, the authors design a model based on the assumption that the domestic market interest rate can be expressed as the weighted average of the uncovered interest rate and the domestic market rate that would be observed if the private capital account were completely closed. Hence:

$$i_t = \varphi (I_t^* + e_t) + (1 - \varphi) i_t$$

where  $i_t$  represents domestic nominal interest rates,  $I_t^*$  world interest rates,  $e_t$  expected devaluation rate, and  $\varphi$  a structural parameter of interest.

If  $\varphi$  is equal to one, the domestic market clearing interest rate is equal to its uncovered parity value and external factors determine domestic interest rates. Conversely if  $\varphi$  is equal to zero external factors play no role in the determination of the domestic interest rate. Intermediate

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<sup>23</sup>This in turn determines that the estimated coefficients will be biased if lagged dependent variables are included in the regressors. Alternatively, the autocorrelation may indicate an omitted variable (the time varying risk premium) which will also induce a bias in the estimated coefficients.

values of  $\varphi$  would arise when both domestic and foreign factors interact in the determination of the domestic interest rate. Since  $\varphi$  is not an observable variable, the authors derive an analytical expression for the unobserved interest rate as a function of the observable variables and then estimate a reduced form equation which allows them to recover the structural parameter  $\varphi$ . Haque and Montiel find that, for most countries they analyze, domestic and external factors influence the determination of domestic interest rates. However, external variables seem to carry the largest weight, suggesting that the degree of capital mobility is large.<sup>24</sup>

In summary, the literature reviewed above has not developed specific tests to assess the effectiveness of a given control or control program. Typically, research following these approaches find that the degree of capital mobility among developing countries is high, implying that the controls on capital flows were not effective in providing some margin for an independent monetary policy.

## **B. Non-Traditional Methods**

### **Dummy variables and direct measures of capital flows**

In view of the shortcomings of the methodologies based on the analysis of interest differentials discussed above, research has attempted to test the impact of capital controls on the capital flows recorded on the balance of payments. In contrast to the large number of studies dealing with interest rate differentials, there have been very few attempts to determine the effects that control programs have on private capital flows. This can be attributed to the difficulty of modeling the determinants of capital flows, particularly so when trying to model the determinants of short-term capital flows. Also, the frequency and availability of the data has played an important role. The speed at which the financial markets develop innovations to avoid controls can be measured in weeks or months for which data on capital movements is generally not available.

To solve this problem, Johnston and Ryan (1994) attempt to analyzing the impact of controls on private capital flows by the use of dummy variables. Their study deals with the impact of controls on capital movements on private capital flows recorded on the balance of payments of a sample of 52 countries for the period 1985–92. The results indicate that: (i) capital controls in developing countries have not been effective in insulating the private capital accounts of these countries' balance of payments, and (ii) capital controls operated by industrial countries significantly affected the structure of their capital flows mainly by inhibiting net foreign direct and portfolio investment outflows.

Johnston and Ryan combine elements of a portfolio model specification together with balance of payments ones and estimate an equation of the following form:

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<sup>24</sup>The shortcomings of the approach by Edwards and Khan also apply to Haque and Montiel.

$$Nf = \alpha_0 + \alpha_1 Gdp + \alpha_2 i + \alpha_3 GB + \alpha_4 (I - \pi) + \alpha_5 (I^* - \pi^*) + \alpha_6 C + \alpha_7$$

where  $Nf$  represents private net flows of capital,  $Gdp$  the Log of gross domestic product expressed in dollars,  $GB$  the Government budget balance as a ratio to gross domestic product,  $I - \pi$  domestic real interest rates,  $I^* - \pi^*$  foreign real interest rates,  $C$  a set of dummy variables representing the various capital regime changes, and  $e$  the Log of the nominal exchange rate.

Johnston and Ryan are concerned about the impact of changes of the legal framework on private capital flows, which would allow testing controls on inflows and outflows. To this end, five dummy variables corresponding to the variable  $C$  in the above equation are defined. Each dummy variable represents a capital regime or a change in regulations within a given regime. The authors then take values of zero or one depending on the following parameters: (i) countries with liberalized or restricted capital movements; (ii) countries with restricted capital movements which liberalize outflows; (iii) countries with restrictive capital movements which liberalize inflows; (iv) countries which intensify controls on outflows; and (v) countries which intensify control on inflows.

Jang-Yung Lee (1996) applies an approach similar to the one by Johnston and Ryan to look specific measures taken by Indonesia, Korea, Thailand, and Spain in the context of a surge in capital inflows. Thus, the study by Jang-Yung Lee is better suited to the analysis of the effectiveness of Chile's control program, although this program is more complex than the ones analyzed by Jang-Yung Lee.

Jang-Yung Lee's regression, which is based on Kouri and Porter's (1974) monetary approach to the balance of payments, is as follows:

$$Nf = \alpha_0 + \alpha_1 \Delta Gdp + \alpha_2 \Delta Nda + \alpha_3 CAB + \alpha_4 \Delta (I - I^* - \pi^e) + \alpha_5 dummy$$

where  $Nf$  represents private net flows of capital measured in dollars,  $\Delta gdp$  the change in gross domestic product expressed in dollars,  $CAB$  the current account balance,  $I - I^* - \pi^e$  the change in covered interest rate differential,  $dummy$  a dummy variable that takes a value of one when a control on inflows is imposed until it is removed.

The controls analyzed by Jang-Yung Lee are specific and of short duration. In Indonesia the dummy variable representing the controls takes a value of one for the fourth quarter of 1990, representing the central banks' provision of currency swap facilities at a premium aimed at encouraging inflows. In Korea the dummy variable corresponds to the reduction of swap facilities for foreign banks and the temporary reversal of interest rate deregulation during the fourth quarter of 1989 and the first quarter of 1990 aimed at discouraging inflows. In Thailand the dummy variable for the second quarter of 1988 first quarter of 1990 corresponds to the suspension of a 10 percent withholding tax on interest payments on long-term foreign loans aimed at encouraging inflows. In Spain the dummy variable corresponds to the imposition of reserve requirements on nonresidents Spanish bank accounts in the first quarter of 1987, and a 30 percent non-remunerated reserve requirement

on new foreign loans in the first quarter of 1989 aimed at discouraging inflows. In all cases, the capital controls are specific and of short duration, which facilitates an assessment of their effectiveness.

Jang-Yung Lee methodology, which uses a variable that takes a value of one when the measure is in effect and zero otherwise, allows however only for a change in the level of the dependent variable, in this case net private flows. Thus, if the dynamics of the imposition of capital controls are to be estimated, more sophisticated techniques are required. Also, given the short duration of the controls, an analysis of the dynamics would require monthly or weekly data which is generally available only for interest rates. In Jang-Yung Lee's analysis, measures do not change over time, which mean that they are not intensified or broadened, nor is the tax rate changed. If this were the case, the dummy variable approach would no longer be appropriate because each change in the control would require a new dummy variable. However, since it is more than likely that each small change in the control by itself does not have a measurable effect, but the cumulative effect is significative, a new method is called for to analyze this feature. Finally the short-term dynamics of private capital flows are extremely difficult to model as evidenced by the coefficient of determination (the R-squared) that Jang-Yung Lee reports. The best fit is obtained for Korea where 53 percent of the total sum of squares is accounted for. In the case of Indonesia, which displays the worst fit, only 40 percent of the total sum of squares can be explained by the regression.

In summary, Johnston and Ryan, and Jang Yung Lee's methodologies are similar. They look directly at the impact of the controls on the net private flows of capital using dummy variables in a regression that takes into account the most important determinants of capital flows. Then, the impact of the changes in regimes in one case, and of the introduction of capital controls on the other, is assessed by looking at the statistical significance of the coefficients of the defined dummy variables.

### **Capital Control Indexes and Single Equation Estimations**

A way to assess the effectiveness of a control program which changes over time is to define an index of restrictiveness. Tamarisa (1998) for instance, establishes indices of restrictiveness for current and capital transactions on the basis of exchange controls as identified in the Annual Report on Exchange Arrangements and Exchange Restrictions published by the IMF. Once the index is designed, there is no longer the constraints of working with dummy variables. The variable testing for the impact of the control program will have the characteristics of a real time series, as opposed to a sequence of zeros and ones, and can be used accordingly. Once the index has been defined, the methodology can be modified to take account of changes in the degree of openness of the country over time.

Another route would be to replace the dummy variables used in the previous section by a function of the defined index. Any convenient functional form  $F$ , and the equation would be as follows:

$$Net\_flows = \beta X_t + F(controls\_Index) + u_t$$

where for convenience all the fundamental determinants of capital flows are grouped in the variable  $X_t$ . Thus, in addition to estimating the change in the level of net flows implied by the control, which is all that can be achieved with the dummy variables, it becomes possible to assess the dynamics of the control program by an appropriate choice of the functional form.

An example of a capital control index in the context of a single equation model is discussed by Valdes and Soto (1996) which applies the methodology to the imposition of the non-remunerated reserve requirement on capital inflows by Chile in 1991 so as to prevent a real appreciation of the currency. Valdes and Soto argue that even though the control can drive a wedge between the mean domestic and foreign interest rates, the marginal rate will probably not be affected so that there will be no significant effect either on the capital flows or on the real exchange rate. Theoretically, if the control program were effective, the domestic real interest would be higher. This in the long run is only consistent with a lower capital stock, so a net outflow of capital and a depreciation of the real exchange rate should be expected. On the other hand if the market finds ways to circumvent the control, then the theoretical model is no longer valid and the effect of capital controls on the real exchange rate will be at most temporary. To test this proposition Valdes and Soto estimate an equation of the form:

$$ln(RER)_t = \beta X_t + u_t$$

$$X_t = (CA, GB, FDI, PROD, TOT, RES, FA, r, r^*, Supply, Rating, Tax)$$

where  $CA$  represents the trade balance as a percentage of GDP,  $GB$  Government spending as a percentage of GDP,  $FDI$  foreign direct Investments,  $PROD$  the productivity growth in the tradable goods sector relative to the non tradable,  $FA$  purchases of foreign assets,  $r$  the domestic real interest rate,  $r^*$  the foreign real interest rate,  $Supply$  the supply of loanable funds to Latin America,  $Rating$  as measured by Standard and Poors,  $Tax$  the effective tax rate expressed as basis points per year.

The variable of interest in this study is the coefficient of the variable that represents the imposition of the controls program, that is " $Tax$ ". The non-remunerated reserve requirement implies a cost in lost interest, which the authors use to construct the capital control index. The control makes borrowing abroad by residents more expensive or investing domestically by nonresidents less profitable. This should discourage capital inflows, which in turn determines a positive expected coefficient for the parameter attached to the tax variable.

In the case of Chile, the results of the regression suggest that the tax had no impact on the real exchange rate. In the estimation of the reduced form equation presented above, the index appears with a wrong sign, which does not help in establishing a stable relationship between the real exchange rate and its fundamentals; its elimination improves the cointegration statistics. Based on this analysis, the authors conclude that the non-remunerated reserve requirement has had no long-run effect on the real exchange rate. When the effects of

short-term dynamics are allowed to play a role (the error correction representation of the equation is estimated), the parameter representing the dynamics of the index also appears with the wrong sign, and is not statistically significant at the standard five percent confidence level. Thus, no short-term effect on the real exchange rate can be found either. However, the tax revenues generated by the measure indicate that controls have not been altogether circumvented, which suggests that the controls have been poorly designed since they did not prevent the appreciation of the real exchange rate they were expected to achieve.

The methodology used by Valdes and Soto has two shortcomings. First, the index takes into account consideration the tax rate and not the tax base. Thus, the definition of the index is flawed since it does not take into account the continued changes in the tax base intended to close loopholes and make the control more restrictive. Second, the authors use the single equation estimation methodologies, which imply an exogeneity of the regressors. In this particular case five variables could possibly cause a simultaneity bias: the current account balance, the domestic real interest rate, the capital controls index, the purchases of foreign reserves by the central bank, and government spending. For example, in the case of Chile the domestic real interest rate is a policy variable, which is determined by the monetary authorities taking into account past and expected inflation which in turn is influenced by the real exchange rate. Thus, a second equation relating these variables would be missing in the above specification. Similarly, purchases of foreign exchange by the central bank depend on the level of the exchange rate. Similar reasoning apply to the other possible endogenous variables.<sup>25</sup>

### Capital control indexes and vector autoregressions

As explained above, a main shortcoming of the single equation models is the possibility that the regressors are endogenous, and, as a consequence, the estimated parameters are biased:

$$net\_flows + \alpha_0 + \alpha_1 RR_t + \alpha_2 X_t + \varepsilon_t \quad (1)$$

$$RR_t + \beta_0 + \beta_1 net\_flows + \beta_2 Z_t + v_t \quad (2)$$

where  $RR_t$  represents domestic real interest rate,  $X_t$  other determinants of net flows of capital,  $Z_t$  other determinants of the domestic real interest rate.

In equation (1) private capital flows are determined by the level of domestic real interest rates and other variables which, for convenience, are grouped in  $X_t$ . As an illustration of the simultaneity bias, the real interest rate is considered the endogenous variable, which is likely to be the case in Chile. Other variables that might also be endogenous are discarded for simplicity.

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<sup>25</sup>For a technical explanation, see next section on the possible endogeneity of the domestic real interest rate.

Equation (2) represents the policy reaction function of the monetary authorities. In Chile the central bank targets the real interest rate in view of domestic and external considerations. If domestic inflation rises due to overheating of the economy the central bank will increase the real interest rate. Let us assume that, on the external side, the economy receives a positive shock due to a fall in international interest rates. Other things being equal this will cause capital inflow to surge and an appreciation of the real exchange rate, which would be avoided only if domestic real interest rates were to be lowered as well. It is clear that the real interest rate is an endogenous variable.

If we replace equation (1) into two equations, after rearranging terms we get:

$$RR_t + \delta_0 + \delta_1 X_t + \delta_2 Z_t + v_t^*$$

and

$$\delta_0 = \frac{\beta_0 + \alpha_0 \beta_1}{1 - \beta_1 \alpha_1} \quad \delta_1 = \frac{\beta_0 + \alpha_1 \beta_1}{1 - \beta_1 \alpha_1} \quad \delta_2 = \frac{\beta_0 + \alpha_2 \beta_1}{1 - \beta_1 \alpha_1}$$

$$v_t^* = \frac{v_t + \epsilon_t \beta_1}{1 - \beta_1 \alpha_1}$$

and

$$COV(RR_p, \epsilon_t) = COV(v_t^*, \epsilon_t) = \frac{\beta_1 VAR(\epsilon_t)}{1 - \beta_1 \alpha_1}$$

This means that the estimation of equation (1) above by ordinary squares will only yield consistent estimates for the parameters if the domestic real interest rate is exogenous  $\beta_1 = 0$ , or if the real interest rate does not enter the equation determining the net flows of capital, or  $\alpha_1 = 0$ . There are two ways to solve this problem. First, the policy function of the monetary authority could be modeled, and a system of simultaneous equations could be estimated. The analysis may become complex as more than one of the variables may be endogenous, and more than one equation would have to be included. Second, a vector autoregression (VaR) could be estimated, and the data would dictate the nature of the implicit policy function.

Other reasons would suggest the use of VaR methodology. As previously mentioned, a difficulty in identifying the effect of capital controls arises because the short-term dynamics of capital flows are difficult to account for. Typically an equation similar to (1) would be

estimated. However, even after correcting for autocorrelation, which allows for richer dynamics, the fit of the regression is still poor. One way to proceed would be to allow more lags of the regressors. However, this does not solve the problem of simultaneity. Thus, in the absence of a structural model, a vector autoregression is a convenient way to capture the dynamics implied by the data.

Cardoso and Goldfajn (1997) define a capital control index for Brazil and use it in the context of a VaR methodology. The authors define a capital control index taking into account changes in the regulatory framework for capital inflows and outflows during the period 1983–96. Changes are classified as all those directed at increasing and decreasing capital inflows and outflows. Then an index of restrictiveness on inflows (outflows) can be established which starts with a value of zero and increases (decreases) by an increment of one every time a new restriction is introduced or an old one intensified. Conversely the index is reduced (increased) by one unit every time a measure is removed or relaxed. Cardoso and Goldfajn argue that restrictions on outflows may have a negative impact on inflows so that the net result of a change on restrictions on outflows on the net flows of capital is ambiguous. To deal with this difficulty the authors define two indexes that measure the overall degree of restrictiveness. The new indexes are formed by simple linear combinations of the previous indexes for inflows and outflows, and are used in the context of a VaR.

The estimated VaR includes three variables: the capital control index, capital flows, and interest rate differentials. To make sense of the impulse responses some identifying restrictions have to be imposed. Cardoso and Goldfajn assume that the system is recursive in the following order: interest differentials, capital flows, and capital controls. This means that there is no contemporaneous response of capital flows to capital controls, which would seem to be an appropriate restriction in the case of direct investment flows.

Such methodology allows inference on the dynamic response of the system to a shock in any of the variables. Concerning testing the effectiveness of a capital control program, there would be a need to calculate the responses to an impulse (a shock of one standard deviation) in the control index. In this regard the authors find that "... a permanent increase in controls has a temporary negative effect on capital flows with a peak five months after the increase and fading out fast after the sixth month. This result implies that policy makers were able to change temporarily but not permanently the amount of capital flows to Brazil."

Edwards (1998a) and Soto (1997) offer examples of the VaR methodology applied to Chile. Edwards uses the VaR methodology to test if there have been significant changes in the way the RER responds to capital flows in a period with controls (1991–96) and without controls (1981–91). He finds that the behavior of the RER was not affected by capital controls. Edwards looks also at the behavior of interest rates. With capital controls, the interest rate differential should be higher and should converge at a slower pace. Using the same methodology for testing the behavior of the RER, Edwards analyzes the behavior of the interest rate differential during periods with and without capital controls. He finds no evidence



that the introduction of capital controls allowed the authorities to control the interest rate differential over the longer run.

The methodology used by Edwards is not exempt from shortcomings. Unlike Cardoso and Goldfjan, Edwards does not incorporate an index of restrictiveness of capital controls which would have allowed to test the response of the variables to an increase in restrictiveness. In addition, the analysis of the interest rate differential presupposes the data on devaluation expectations which, since they are not available in Chile, need to be estimated. The estimations by Edwards are based on forecasting the one period ahead of the devaluation. This estimations are generally not very reliable and introduce a lot of “noise” in the analysis.

Soto (1997) provides an empirical assessment of the non-remunerated requirement applied in Chile to foreign borrowing using a set of structurally identified VaRs. An important added value of the study by Soto is due to the fact that Soto uses monthly data for a capital flows series which were constructed especially for the study. Soto assesses the effect of the measure on capital flows, the interest rate and the volatility of the exchange rate, on the basis of monthly data. Soto finds that the positive effect of the reserve requirement on the domestic interest rate and nominal exchange rate lasts between a year and a year and a half. The measure has a long-run depreciation effect on the real exchange rate of approximately 1.3 percent, with a reduction in volatility of about 20 percent. Soto also finds that the response of capital flows to the reserve requirement is rather ambiguous, and in fact, the flows perform quite erratically. Initially the reserve requirement appears to have a positive effect on both total and short-term flows. However, during subsequent months this effect reverses, producing a fairly small net capital outflow of US\$400 million in total flows and US\$75 million in short-term flows. No effect on these flows is found in the medium or long term. Conversely, the reserve requirement significantly alters capital flow composition, leading to a relative decline in short-term capital flows. This latter effect is prolonged over time, although no quantitative assessment is provided. Soto concludes that “... the impact of the measure is in the expected direction, i.e., it reduces capital inflows, keeps domestic interest rates higher, depreciates the real exchange rate, and changes the composition of capital inflows. However, the economic importance of these effects are minimal.” In sum, Soto’s study confirms that capital controls played at most a minor role in Chile’s resilience. The Table below summarizes the results of empirical research by Valdes and Soto, Edwards and Soto.

Chile: Summary Conclusions of Empirical Studies

	Valdes Soto	Soto	Edwards
<b>Methodology</b>			
Capital control index	•	•	
Single equation		•	
Vector autoregression		•	•
<b>Variables Tested</b>			
Domestic interest rates		•	
Interest rate differential			•
Real exchange rate	•	•	•
Nominal exchange rate		•	
Overall inflows		•	
Inflows composition		•	
<b>Empirical Evidence of Effectiveness on Macroeconomic Variables</b>			
Domestic interest rates • In the short term • In the long term		Small	None
Interest rate differential		Small	None
Real exchange rate • volatility • level	None	Small None	Small Short-lived
Nominal exchange rate		Limited	
<b>Empirical Evidence of Effectiveness on Balance of Payments Variables</b>			
Total inflows • In the short term • In the long term		Small None	
Composition of inflows • In the short term • In the long term		Small Significant	

## **Chile: Tests of Effectiveness on Net Capital Inflows and their Composition<sup>26</sup>**

This Appendix analyses the results of tests on the effectiveness of Chile's non-remunerated reserve requirement on total inflows and their composition.

### **A. Capital Flows to Chile**

Two main features characterize the time series properties of capital movements to Chile: the magnitude of the flows and their volatility. In 1981 net capital inflows, including private and government flows were close to US\$7 billion, that is 14.9 percent of GDP. Two years later Chile experienced a reversal of capital flows amounting to 16 percent of GDP. In two years time, the cumulative amount of the capital outflow flows amounted to about a third of the GDP. The capital account showed a deficit until 1988, and in 1990 Chile started experienced capital inflows of a magnitude similar to those before the 1982 crisis (Statistical Appendix, Table 2).

The decision of the authorities to implement measures to discourage short-term inflows and favor net direct investment and equity over debt financing was understandable given Chile's experience of the late 1970s/early 1980s. In the four years preceding the 1982 crisis, total capital inflows averaged US\$4.8 billion, with only US\$276 million a year for FDI, and portfolio investments outflows of US\$5 million. The bulk of the capital inflows had been in the form of short- and medium-term financing. During the period 1984-88, even though the economy was experiencing large outflows of capital, net direct investment averaged US\$174 million a year, and no portfolio investment was registered. This situation changed dramatically in the 1990-96 period, during which net FDI averaged almost one billion U.S. dollars a year, and "Net Portfolio Investment" increased from zero to an average of half a billion U.S. dollars a year (Statistical Appendix, Table 3).

Although data on the composition of capital flows is annual, a descriptive analysis of the impact of the introduction of the non-remunerated reserve requirement on each of the components of the balance of payment flows can be attempted. When the measure is introduced in 1991, there is a fall relative to the two previous years in all of the components of the balance of payments, excluding "Errors and Omissions." Also as expected, the largest reversal occurred in "Other Short-Term Capital." In July of 1995 the reserve requirement was extended to all investment flows except for those which constitute an increase in the capital stock. However, the December 1994 Mexico crisis, which caused an immediate cutback in capital flows to Latin America, calls for a word of caution when interpreting the changes in the composition of flows in 1995. Quarterly capital inflows data and the behavior of the exchange rate suggest that most of the impact of the Mexico crisis was experienced in the first quarter, during which outflows of "Other Short-Term Capital" reached about US\$ 900 million dollars. This would imply that the drop in the category "Other Medium Term Capital" was

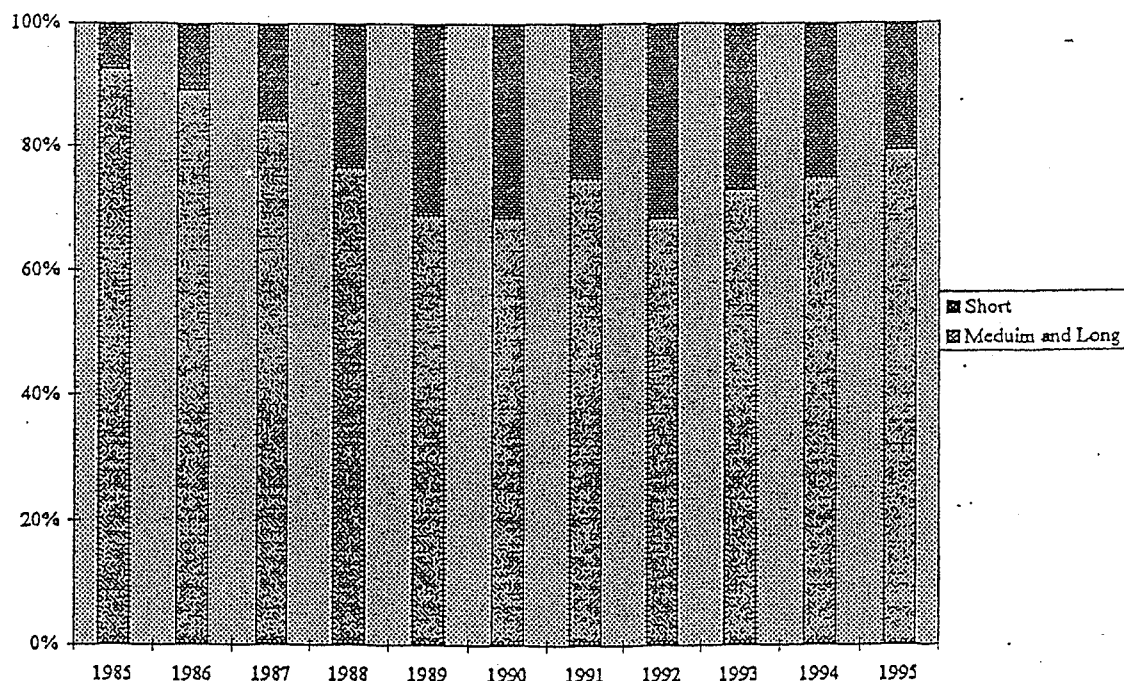
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<sup>26</sup>This Appendix was prepared by Jaime Cardoso.

more than likely caused by the broadening of the reserve requirement since this particular reversal occurred in the second third and fourth quarters of 1995. Similar developments can be seen with the behavior of "Net Portfolio Investment," and with the atypical behavior of "Errors and Omissions." These flows experienced an increase of US\$600 million between 1990 and 1991, a further increase of US\$500 million between 1994 and 1995, and a drop of US\$600 million between 1995 and 1996. These unspecified flows, which coincide with the introduction of the measure in 1991 and its broadening in 1995, suggest that markets may have found ways to evade capital controls.

Although quarterly data desegregated by categories of flows (Statistical Appendix, Table 3) is only available since 1989, and monthly data would be preferable, an analysis of the volatility of the different categories of flows is made. Figure 2 illustrates the increased volatility over time for all categories of inflows. The impact of the non-remunerated reserve requirement on inflows can also be assessed on the basis of a distinction between the medium- and long-term and the short-term stock of private external debt. Until 1989 the share of short-term debt increases, whereas during the period 1989–1992 the composition of the private debt remains stationary with medium- and long-term amounting to 70 percent of the total. From then onwards there is a trend toward a reduction of short-term debt, so that by 1995, the share of short-term debt had decreased from 30 percent to 20 percent. The introduction of the non-remunerated reserve requirement was followed by a lengthening of the maturity of private external debt. Whether this development is a consequence of the measure or of other policies, reflects re-denomination of debt, or is a consequence of a combination of factors is a question open to debate. One could argue that as country risk for Chile is reduced, longer alternatives of debt financing are created.

Figure 2. Chile: Composition of Private External Debt



Source: Central Bank of Chile

## B. Defining an Index of Restrictiveness

A direct approach to test the effectiveness of the measure on the RER is to define an index that measures the degree of restrictiveness of the capital controls and, as Valdes and Soto (1996) did, to test for the effect of this variable on the RER. Alternatively, the following methodology is followed: first, the effect of capital controls on net inflows is estimated; then, given the relationship between the RER and capital inflows, the effect of the non-remunerated reserve requirement on the RER can be indirectly inferred.

The combination of the broadening and intensifying of the non-remunerated reserve requirement does not allow for the use of a dummy variable approach in a single equation model. Rather, a Capital Control Index (the Index) can be structured that attempts to measure the degree of restrictiveness of the control. The Index is constructed by multiplying the estimated tax base times the actual tax rate.<sup>27</sup> The tax base can be estimated by a series of flows taken from the balance of payments, which are added from 1985 onwards for the category "Short-Term Banks."<sup>28</sup>

There are some outstanding empirical issues to be addressed. First, the non-remunerated reserve requirement was introduced in June of 1991, that is the end of the second quarter. This raises the issue whether the Index should be given a positive value for that quarter or whether it should be assumed that the entire impact of the measure starts in the following quarter. Second, when the non-remunerated reserve requirement was introduced, it only applied to new borrowing, and as early as July 1991 the requirement was broadened, so that by the end of the year the tax base already included all outstanding external credits. Thus, the tax is applied to a base which is broadening over time.

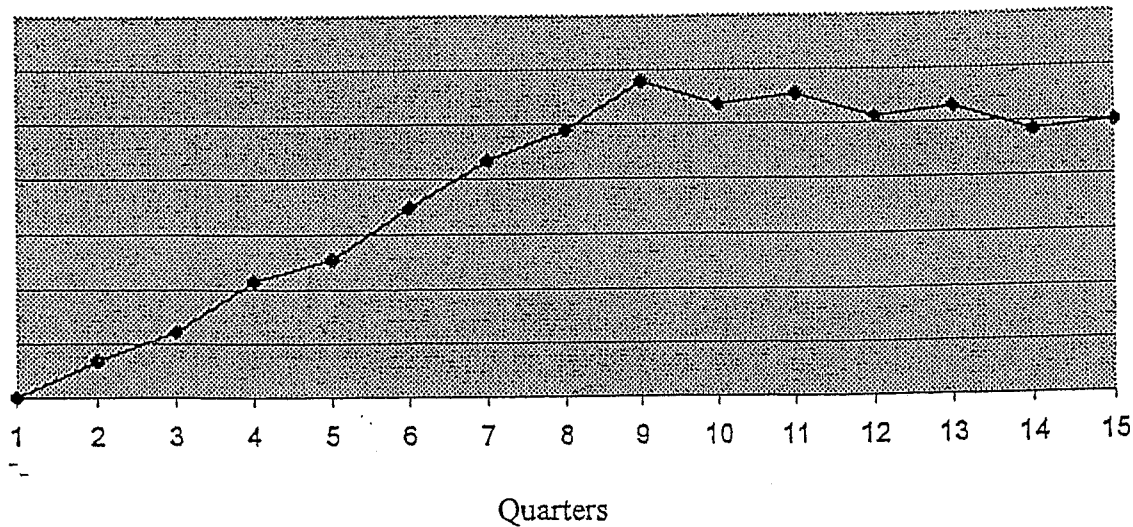
Two Indices were constructed to deal with timing. Index I is based on the assumption that the fall in the net inflows of capital in the second quarter of 1991 can be attributed to the reserve requirement. Conversely Index II assumes that all of its effects were felt from the third quarter onwards. To deal with the second problem of the broadening of the tax base, the Indexes were computed as follows. Index I, multiplying the tax rate times 50 percent of the potential tax base for the second quarter of 1991, when the measure was introduced, times 75 percent of the potential tax base in the third quarter of 1991, and times 100 percent from then onwards. Index II differs from Index I in that the value for the second quarter of 1991 is zero. Figure 3 shows the degree of restrictiveness, as reflected in Index I. As can be seen, it seems to capture the essence of the controls by increasing over time as the tax base is broadened, while remaining stationary afterwards.

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<sup>27</sup>If the Index was a linear function (i.e., 20 percent of net inflows) it would not be a valid Index. However, the Index is a non-linear function of net inflows.

<sup>28</sup> Another choice would have been to use long-term debt flows, but this variable experienced continuous outflows in the year previous to the imposition of the tax as a consequence of the repayments of the external debt.

Figure 3. Chile: Degree of Restrictiveness for Index I, 1991–95



The next step is to assess if the capital control had any impact on the net flows of capital, or on the composition of the inflows, and whether the impact was permanent or just a stock adjustment effect. In other words, does the effect of the control increase over time as the tax base is broadened or, does the effect decrease over time? To answer these questions a number of regressions, with “Net Private Inflows” (to test the effectiveness on net inflows) and “Short-Term” or “Medium- and Long-Term Inflows” (to test the effectiveness on the composition of inflows) as the dependent variables are specified. The regressors ( $X$ ) include the real interest rate differential between Chile and the rest of the world, domestic GDP measured in U.S. dollars, quarterly dummy variables, and polynomial functions of the Index measuring the degree of restrictiveness of the capital controls ( $F(Controls\_Index)$ ).<sup>29</sup> The estimated regressions take the following functional form:

$$Net\_flows = \beta X_t + F(Controls\_Index) + u_t$$

In addition, three different specifications for the functional form  $F$  in the above equation were used: a simple linear function, a quadratic, and a cubic polynomial function. In the case of the linear relationship, then the function would be as follows:

$$F(Controls\_Index) = a + b * Controls\_index$$

<sup>29</sup>The constant term in the polynomial functions is a dummy variable which takes the value of one from the time the reserve requirement is introduced.

The parameter  $a$ , the intercept in the linear equation, gives the adjustment in the level implied by the imposition of the control on inflows. It is expected to be negative. The parameter  $b$  provides an estimate of the dynamics. If the intercept is negative as expected, and the slope of the equation (i.e., parameter  $b$ ) is zero (which would amount to including only a dummy variable), then the control has a permanent effect on the net inflow of capital. This would also imply that the control is not circumvented so there would be a permanent effect on the RER. If the intercept is negative and the slope is positive, the control has an effect which can be negative or positive depending on the relative magnitudes of the parameters (for a given Index). Notice that even though the function is linear in the parameters,<sup>30</sup> the argument of the function, the Index, does not necessarily have to be so,<sup>31</sup> and in most cases it will not be linear. Thus, a slope different from zero allows for much more substantive dynamics.

### C. Effectiveness on Net Inflows

The effectiveness of the measure is tested on a dependent variable including: "Net FDI," "Net Portfolio Investment," "Errors and Omissions," "Short-Term Banks" and "Long-Term Banks." In the linear approximation case, independently of whether Index I or II is used the intercept is negative and the slope estimate is positive (Statistical Appendix, Table 5). For Index I specification, the relative magnitude of the parameters determine that the imposition of the control reduced the net total private flows of capital by US\$519 million on impact (Statistical Appendix, Table 6), and by 3.8 percent of GDP over a one-year period. By construction, there is no impact effect on the second quarter of 1991 in the Index II specification. In this case the impact is felt in the third quarter of 1991, with a magnitude of US\$377 million, and a 2.2 percent of GDP over a one year period. For both cases the estimation suggests that as the broadening of the measure had an impact on net private inflows, but not for very long. The linear specification suggests that there were net outflows until the second quarter of 1992, that is one year after the measure was introduced. Afterwards, the control appear to be ineffective.

The results are not as homogeneous in the case of the cubic function specification. For Index I the cubic approximation implies a larger effect on impact than in the linear case (Statistical Appendix, Table 5): net total inflows are reduced in the second quarter of 1991 by US\$719 million, and by 2.2 percent of GDP over a one year period. For Index II, the impact in the third quarter of 1991 is close to US\$200 million. The cubic specification has the advantage of allowing for richer dynamics, but one has to be careful of the possibility of getting an artificial good fit when interpreting the results. This is specially the case when the fit of the regressions is low, implying that the short-term dynamics are not correctly modeled. From the fourth quarter of 1991 onward and after adjusting for the level, the results for Index

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<sup>30</sup>In the regression context linearity refers to the manner in which the parameters enter the equation and not necessarily to the relationship between the variables and the control Index.

<sup>31</sup>Since the Control index that we defined is not a straight line, even if the functional form is linear the dynamics recovered do not have to be a line with no changes in its slope.

I and Index II are not significantly different. These results suggest that two quarters after the control has been introduced the cubic specification is merely capturing the mis-specified dynamics and that after this period the control program did not have a significative effect on net inflows. Finally, the quadratic specification was dismissed on statistical grounds (the parameters were not significant).

In summary, the above specifications seem to indicate that the introduction of the non-remunerated reserve requirement in June of 1991 and its broadening in subsequent quarters had a negative impact on the net private flows of capital as expected. Depending on the specification regarding both the functional form and the Index, the impact varies from a minimum of about US\$200 million for the Index II, cubic specification, to a maximum of about US\$700 million in the Index I, cubic specification. If the true value of the net private flows of capital were to lie in the middle, this would mean that on impact the control has prevented a net inflow of capital of about US\$500 million, which is roughly the quarterly average of the variable for the sample period.

What happens two quarters after the controls were introduced is not clear. The linear specification by construction, given that there is a strong impact effect, will imply that there is a slow adjustment so that the control is still effective in preventing inflows two quarters after the control was introduced. On the other hand, if this restriction were not imposed as in the cubic specification, the impact of the control would seem to be even more limited, and as from December of 1991 onward, only two quarters after the non-remunerated reserve requirement was introduced, the index seems to indicate that the capital controls were ineffective from then onward.

#### **D. Effectiveness on the Composition of Inflows**

This section reports on the tests to assess the effect of the non-remunerated reserve requirement on the composition of inflows, that is short-term versus medium- and long-term inflows. Available data (taken from the quarterly balance of payments of the central bank of Chile) differentiates FDI, portfolio investment, short-term inflows and medium- and long-term inflows. As a result, the variables used to measure short-, medium- and long-term inflows only account for part of the flows that should be included in these categorizations, in as much some of them may be included in portfolio investments. Tests on the effectiveness of the capital controls are conducted using similar regressions than in the previous section, with a dependent variable of short-term flows or medium- and long-term flows.

In the case of short-term inflows, all the specifications exhibit a similar pattern: the non-remunerated reserve requirement has a clear negative impact soon after it enters into effect. Then, after two quarters, regardless of the specification, not only the negative impact vanishes, but a positive impact develops. The effect during the first year, when it is expected to be the largest, ranges from a maximum negative impact of US\$439 for Index I, cubic specification, and 1.1 percent of GDP over a one year period, to a maximum positive impact



of US\$852 for Index II, linear specification, and a 2.2 percent of GDP over a one year period (Statistical Appendix, Tables 6 and 7).

In the case of medium- and long-term flows, there is no impact effect whatsoever, that is the introduction of the controls did not have any initial effect on these category of flows. The results for subsequent quarters are contrary to the expected effect (Statistical Appendix, Table 6). The non-remunerated reserve requirement appears to discourage such capital inflows, although the implied tax on these inflows is lower than for short-term capital inflows. These results have to be analyzed with care. It is more likely that this increasing effect on long-term flows is only capturing the mis-specified dynamics. The same regressions were estimated with a broader dependent variable for long-term inflows (which included net FDI); the results did not change significantly.

In summary, the non-remunerated reserve requirement had a negative effect, as expected, on short-term flows. However the effect is short-lived: the reduction of the rate of growth of short-term inflows lasts for less than a year. On medium- and long-term flows, the negative effect increases with time, which was not expected. A word of caution remains in so far as the short-term and medium- and long-term series used included only part of all the short-, medium- and long-term flows in that FDI and portfolio investment were not included in the regression.

### **Chile: Liberalization of Capital Outflows**

**1991:** In a number of steps (February, April, May and October), commercial banks were permitted to increase external trade financing and use up to 25 percent of foreign exchange time deposits for foreign trade financing. Joint-venture rules were simplified, and the waiting period for remitting capital invested in Chile under the debt conversion program was shortened. Procedures for enterprises to directly invest abroad were modified and made easier.

**January 1992:** Pension funds were allowed to hold a proportion of their portfolio in foreign assets. Limit on these investments increased gradually to 10 percent of investment portfolio.

**March 1992:** Limit on net foreign exchange holdings of commercial banks was doubled. Share of export receipts exempt from surrender requirements increased. Allocations of foreign exchange for a variety of payments abroad were raised. Period for advance purchase of foreign exchange for debt service were extended.

**March 1993:** The restriction of profits until the fifth year was liberalized by allowing a one-year period, until August of 1993, for the remittance of all profits reacted to investment undertaken before June 30 of 1992.

**August 1995:** Chapter xix was eliminated, thus lifting restrictions on the remittance of profits and the three year holding period for capital.

**November 1994:** The Central bank announced that the limit for foreign investment of private pension funds will be increased to 6 percent of their portfolio. The corresponding limits of other institutional investors will be established at the following levels: 10% for general insurance companies and 30% for mutual funds.

**April 1995:** Sets a 12% ceiling for foreign investment of the pension funds. Within that ceiling the Central bank will determine the annual limit.

**May 1995:** The Central Bank increases the ceiling of foreign investment by private pension fund to 9% of their assets, and authorizes for the first time that the fund may invest in equity abroad up to a sub-ceiling of 4.5%.

### Chile: Timetable and Motivations for Changes in Reserve Requirement

Measure	Motivations
<b>June 17, 1991:</b> A 20 percent non-remunerated reserve requirement (RR) on new foreign borrowing is introduced (to be held for up to 90 days for 90 days credits; to the maturity of the credit for 90 days to one year credits; for one year for credits of more than one year). RR is in the same currency as the foreign borrowing, is not remunerated, and is applicable to all foreign loans to banks or others. Commercial credits are not subject, but a maximum period of six months is allowed for shipment. Collections on borrowing are not included in the RR.	Give greater flexibility to conduct monetary policy; prevent an appreciation of the real exchange rate; allow a high interest rate differential. Discourage short-term inflows and favor equity and long term financing.
<b>June 27, 1991:</b> Borrowers allow to meet RR by entering on a repurchase agreement in which Central Bank of Chile (CBC) sells and the borrower repurchases immediately a note equivalent to 20 percent of the foreign loan. CBC charges discount equal to LIBOR.	Repurchase agreement mechanism allows the tax to be paid up-front, which facilitates enforcement and monitoring.
<b>July 1, 1991:</b> RR extended to current borrowing that is renewed.	Close a loophole.
<b>January 23, 1992:</b> RR extended to foreign-currency denominated deposits by residents and nonresidents held by commercial banks.	Close a loophole.
<b>May 28, 1992:</b> RR rate raised to 30 percent, but in the case of direct borrowing abroad by firms RR is maintained at 20 percent. RR deposit is to be held for one year for all borrowing regardless of the loan maturity.	Increase the cost only for banks, and unify the duration of the RR because of difficulty of distinguishing loan maturity.
<b>August 19, 1992:</b> RR is raised to 30 percent for direct borrowing by firms (i.e., uniform 30 percent requirement); deposit to be held for one year regardless of loan maturity. Discount on CBC notes is raised to LIBOR plus 2.5 percent.	Increase to 30 percent was made to close a loophole. The discount rate was raised to increase the cost of the implied tax.
<b>October 30, 1992:</b> Discount on CBC notes is raised to LIBOR plus 4 percent.	Increase the cost of the implied tax.
<b>November 1994:</b> Starting January 1995 RR deposit must be in U.S. dollars only.	Stop building open positions in domestic currency.
<b>July 1995:</b> Starting in July, secondary market American Depository Receipts (ADRs) become subject to RR similar to those applicable to foreign borrowing.	Close a loophole (secondary transactions do not constitute a FDI).

Measure	Motivations
<b>December 1995:</b> New foreign borrowing to prepay other loans exempted from RR.	Refinancing of current debt is likely to lower the cost and increase maturity.
<b>December 1996:</b> Foreign borrowing of less than US\$200,000 (or a cumulative US\$500,000 in 12 months) is exempt from the RR.	Reduce administrative burden of enforcing the measure.
<b>March 1997:</b> Minimum amount for exemption from the RR is lowered to US\$100,000 (or a cumulative US\$100,000 in 12 months).	Close a loophole.
<b>June 1998:</b> RR reduced to 10 percent to reduce cost of external borrowing (except for short-term credit-credit lines-and foreign currency deposits.	Adjustment to international capital market environment.
<b>September 1998:</b> RR eliminated. Requirement for foreign investors to keep their money in the country for at least a year maintained.	Adjustment to international capital market environment.

Source: IMF, AREAER (various issues).

**Chile: Selected Prudential Measures for Capital Account Transactions**

<b>Capital Transactions</b>	<b>Prudential Requirements</b>
Sale or issue abroad by residents of shares and other securities of participating nature	Two minimum international risk-rating requirement, for long-term debt of BBB+ for banks and BBB for other firms.
Sale or issue abroad by residents of bonds or other debt securities	Minimum rating of BBB+ for long term debt for non-financial institutions and of A/B (BBB+ in the case of subordinated bonds) for banking firms or financial institutions.
Outward direct investment	Investment by commercial banks abroad is restricted to bills and bonds issued or guaranteed by foreign governments of central banks and private enterprises with a minimum long-term international debt risk rating (and its equivalent for short-term debt) of BBB. Pension funds and insurance companies are subject to a minimum long-term international debt risk rating of BBB.
Specific controls on transactions by commercial banks and other credit institutions	Foreign financial investments are restricted to bills and bonds issued or guaranteed by foreign governments or central bank and private enterprises with a minimum long-term international debt risk rating (and its equivalent for short-term debt) of BBB-.
Provisions specific to institutional investors	Pension funds and insurance companies may hold only foreign instruments of a minimum international long-term risk rating of BBB. These investors may also acquire foreign instruments guaranteed by the U.S. Treasury, such as Brady Bonds.

Source: IMF, Annual Report on Exchange Arrangements and Exchange Restrictions (1998).

Table 1. Chile. Selected Economic Indicators, 1985-95

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
<b>Selected economic Indicators</b>											
Real GDP growth	2.5	5.6	6.6	7.3	9.9	3.3	7.3	10.7	6.6	4.2	8.5
Dollar GDP growth	-14.3	7.5	16.8	16.7	16.8	7.8	13.2	24.2	6.8	14.2	29.0
Inflation per annum	30.7	19.5	19.9	14.7	17.0	26.0	21.8	15.4	12.7	11.4	8.2
Terms of Trade	100	103.8	110.7	120.2	96.1	92	99.5	99	91.3	110.3	114.8
Real Exchange Rate	100.0	118.4	127.7	135.8	132.6	136.9	133.0	125.8	123.4	120.9	114.4
Fiscal Balance to GDP ratio	-4.4	-1.9	-0.4	2.5	5.3	2.7	2.1	2.9	1.8	2.2	3.5
<b>Real Interest Rates (1)</b>											
Real Domestic Interest Rate	6.2	3.5	4.2	5.1	8.7	6.5	4.7	6.5	6.5	6.1	6.9
Real International Interest Rate	3.5	1.9	1.7	3.8	3.7	2.7	1.1	-0.1	0.1	2.0	2.5
Real Interest Rate Differential	2.7	1.6	2.6	2.0	5.0	3.8	3.6	6.6	6.4	4.1	4.4
<b>Balance of Payments</b>											
Current Account	-1413	-1192	-735	-234	-705	-536	109	-703	-2073	-646	157
Financial Account	-1272	-1863	-969	-680	1341	3014	845	2931	2581	4539	1238
Net Direct Investment	142	313	885	952	1279	582	400	321	375	848	1008
Net Portfolio Investment	0	0	0	0	87	359	186	452	732	909	19
Net Banks	-1060	-1537	-1640	-1244	-561	-451	-621	1551	68	395	-211
Other Net Private Inflows	-416	-360	5	252	1165	2640	839	392	1722	2558	2181
Net Errors and Omissions	-69	224	-143	-117	-119	-144	302	319	-79	-744	-257
Overall Balance	103	-137	66	756	549	2122	1049	2344	171	2917	740
Net Private Inflow of Capital	-1403	-1360	-893	-157	1851	2986	1106	3035	2818	3966	2740

Source: IMF (International Financial Statistics, and Staff estimates), and Central Bank of Chile.

(1) Domestic interest rate: from 1985 to June 1989, average deposit rate for 90-365 days bank deposits and 90 days; central bank notes rate afterwards. International interest rate: 3 months U.S. T-Bills rates.

Table 2: Chile. Current and Capital Account Flows, 1980–95 (percent of GDP)

	Current Account	Capital Account	Net Private Inflows	Net Government Inflows	Net Total Inflows
1980	-7.1	11.8	12.3	-0.3	11.9
1981	-14.5	14.6	16.1	-1.1	14.9
1982	-9.5	3.4	3.3	-0.2	3.1
1983	-5.6	-16.3	-15.7	-0.2	-16.0
1984	-11.0	-0.4	-0.4	1.0	0.6
1985	-8.6	-7.7	-8.5	0.4	-8.1
1986	-6.7	-10.5	-7.7	-1.6	-9.2
1987	-3.6	-4.7	-4.3	-1.1	-5.4
1988	-1.0	-2.8	-0.7	-2.6	-3.3
1989	-2.5	4.8	6.6	-2.2	4.3
1990	-1.8	9.9	9.8	-0.4	9.4
1991	0.3	2.5	3.2	0.1	3.3
1992	-1.6	6.9	7.1	0.5	7.6
1993	-4.5	5.7	6.2	-0.7	5.5
1994	-1.2	8.7	7.6	-0.1	7.5
1995	0.2	1.8	4.1	-2.0	2.1

Table 3: Chile. Composition of Capital Flows, 1989–96 (million of U.S. dollars, annual data)

	Net Direct Investment	Net Portfolio Investment	Other Medium Term Capital	Other Short Term Capital	Errors and Omissions
1989	1279	80	-1298	1202	-121
1990	661	362	1092	1185	-347
1991	427	26	579	-224	282
1992	281	323	626	1667	182
1993	410	743	519	1097	-94
1994	846	908	1344	1281	-740
1995	1008	22	-228	366	-267
1996	3012	1101	575	328	-916

Table 4: Chile. Standard Deviation and other Descriptive Statistics (millions of US dollars, quarterly averages)

	Net FDI	Net Portfolio Investment	Medium Term Capital	Short Term Capital	Errors and Omissions
Standard Deviation					
1989–1990	143	74	352	167	70
1991–1992	76	49	115	489	86
1993–1994	216	124	208	359	157
1995–1996	327	257	433	722	370
Full Sample					
Mean (*)	252	131	133	194	- 63
Standard Deviation (*)	254	194	354	474	210
Coefficient of Variation (*)	1.01	1.48	2.66	2.45	- 3.35

Sources: Table 2: IMF, International Financial Statistics; Table 3: Central Bank of Chile; Table 4: IMF Estimates based on data in Table 3.

Table 5.1: Chile. Regressions on Net Inflows: Linear Approximation

Specification Dependent Variable	Coefficient Linear Index I Net Inflows	T Statistic	P value	Coefficient Linear Index II Net Inflows	T Statistic	P value
Constant	-113.5	-0.4	72.4%	-152.4	-0.5	61.8%
Trend	3.7	1.5	13.3%	4.0	1.7	10.3%
Real interest rate differential	-24.8	-0.3	73.4%	-24.2	-0.3	73.3%
AR(1)	0.5	3.3	0.3%	0.5	2.9	0.7%
Level	-620.8	-3.2	0.3%	-528.6	-2.9	0.8%
Degree of restrictiveness (b)	0.8	1.8	7.9%	0.6	1.7	10.0%
R-Squared	53.2%			53.1%		
Adjusted R-Squared	40.7%			40.6%		
Sample	1985.Q1 1994.Q4			1985.Q1 1994.Q4		

Table 5.2: Chile. Regressions on Net Inflows: Cubic Approximation

Specification Dependent Variable	Coefficient Cubic Index I Net Inflows	T Statistic	P value	Coefficient Cubic Index II Net Inflows	T Statistic	P value
Constant	-348.0	-1.3	21.1%	-299.0	-1.0	32.4%
Trend	5.0	2.4	2.5%	4.8	2.1	4.6%
Real interest rate differential	-5.4	-0.1	92.0%	-9.18	-0.2	87.6%
AR(1)	0.4	2.1	4.2%	0.5	2.5	1.8%
Level	-1699.2	-3.6	0.1%	-602.0	-4.4	0.0%
Degree of restrictiveness (b)	9.2	2.6	1.6%	2.9	1.2	22.2%
Square	0.0	-2.3	3.3%	0.0	-1.1	28.6%
Cube	7.26E-06	2.1	4.1%	3.07E-06	1.1	27.3%
R-Squared	61.0%			56.3%		
Adjusted R-Squared	47.1%			40.6%		
Sample	1985.Q1 1994.Q4			1985.Q1 1994.Q4		

Net Inflows = Portfolio investment + Direct Investment + Short term banks + Long Term Banks + Errors and omissions. In both equations quarterly dummy variables were used.



Table 6. Chile: Impact Per Quarter of the Reserve Requirement (million U.S. dollars)

Categories of Capital Inflows	1991Q2	1991Q3	1991Q4	1992Q1	Total	% GDP
Short Term, Linear, Index I	-455	-199	237	420	3	0.0%
Short Term, Linear, Index II	0	-82	371	563	852	2.2%
Short Term, Cubic, Index I	-967	-270	348	450	-439	-1.1%
Short Term, Cubic, Index II	0	-43	316	393	666	1.7%
Medium and Long Term, Linear, Index I	-59	-171	-361	-441	-1032	-2.7%
Medium and Long Term, Linear, Index II	0	-219	-395	-469	-1084	-2.8%
Medium and Long Term, Cubic, Index I	47	-213	-284	-221	-672	-1.7%
Medium and Long Term, Cubic, Index II	0	-311	-287	-239	-838	-2.2%
Net Flows, Linear, Index I	-519	-436	-294	-234	-1482	-3.8%
Net Flows, Linear, Index II	0	-377	-261	-213	-851	-2.2%
Net Flows, Cubic, Index I	-719	-245	56	48	-859	-2.2%
Net Flows, Cubic, Index II	0	-180	-135	-154	-469	-1.2%

Net Flows = Net FDI + Net Portfolio Investment + Errors and Omissions + Short- and Long-Term Banks.  
 Quarterly data from 1989.1 to 1994.4 was used for the short term, and medium and long term. Quarterly data from 1985.1 to 1994.4 was used for Net flows.

Source: Central Bank of Chile, and Staff estimates

Table 7.1. Chile. Regressions on Short-Term Flows: Linear Approximation

Specification	Linear Index I			Linear Index II		
Dependent variable	Short Term Flows			Short Term Flows		
	Coefficient	T-Statistic	Prob.	Coefficient	T-Statistic	Prob.
Constant	3137.3	3.6	0.3%	-3454.7	3.7	0.3%
Trend	-12.8	-2.6	1.9%	-14.4	-2.7	1.6%
Real Interest Rate Differential	-198.9	-2.4	2.9%	-221.6	-2.6	2.0%
AR(1)	0.2	1.2	25.2%	0.3	1.6	13.6%
Level dummy	-768.3	-2.2	4.9%	-674.6	-3.1	0.8%
Index	2.3	3.4	0.5%	2.4	3.9	0.2%
R-squared	53.1%			60.6%		
Adjusted R-squared	26.3%			38.1%		
Sample	1989.Q1			1989.Q1		
	1994.Q4			1994.Q4		

Table 7.2. Chile. Regressions on Short-Term Flows: Cubic Approximation.

Specification	Cubic Index I			Cubic Index II		
Dependent Variable	Short term flows			Short term flows		
	Coefficient	T-Statistic	Prob.	Coefficient	T-Statistic	Prob.
Constant	1404.8	2.6	2.2%	1570.3	2.6	2.5%
Trend	-4.7	-1.4	18.5%	-5.4	-1.4	17.8%
Real Interest Rate Differential	-75.9	-1.4	17.6%	-89.4	-1.4	18.7%
AR(1)	-0.2	-0.7	49.3%	-0.2	-0.7	52.1%
Level dummy	-2260.8	-4.2	0.1%	-1074.2	-5.3	0.0%
Index	11.7	3.3	0.6%	5.9	3.6	0.4%
Index squared	0.0	-2.7	2.0%	0.0	-2.2	4.8%
Index cubed	0.0	2.5	2.9%	0.0	1.8	9.2%
R-squared	71.5%			70.0%		
Adjusted R-squared	47.7%			45.1%		
Sample	1989.Q1			1989.Q1		
	1994.Q4			1994.Q4		

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