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Capital Account Liberalization and the Real Exchange Rate in Chile

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Abstract

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After the failure of the early 1980s, a second attempt at capital account liberalization was gradually carried out in Chile during the 1990s, this time in parallel with increased exchange rate flexibility. Capital account regulations were applied to support the independent monetary policy committed to the inflation target, while the exchange rate was quasi-pegged within a band that targeted the real exchange rate (RER). Still, the policy framework directed at stabilizing the RER appears to have been of limited effectiveness, with the surges and sudden-stops in capital flows playing an important role in RER dynamics. Foreign exchange market intervention appears not to have affected the RER while reserve requirement appears to have exerted a depreciating effect. Government spending and import tariffs, appear to be significant tools to moderate the real appreciation thus providing one additional reason for adopting a countercyclical fiscal policy and accelerating trade openness when a country is facing strong capital inflows.

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I. Introduction

It is now widely accepted in economics that trade integration enhances efficiency in resource allocation and opens opportunities for growth and diversification, while financial integration allows the optimizing of intertemporal consumption path and managing of financial risks, by increasing the array of assets available in local markets as well as efficiency and competition in the provision of financial services. The latter also has the spillover effect of increasing competition and efficiency throughout the economy. It is also stated that international financial integration helps to preserve policy discipline. However, the frequency of financial crises, partly induced by capital flow volatility, highlights the imperfections with which this benefit is delivered to emerging markets. Volatile capital flows leading to swinging financial conditions justify a prudent approach to financial liberalization, and several experiences show that they pose very serious challenges to macro and financial stability.

The repeated financial crises in developing countries that have embraced financial liberalization without much regard for preconditions—including Chile in 1982— have raised significant doubts about the validity of the orthodox recommendation of immediate and unconditional liberalization. Over time, the International Monetary Fund's view of financial opening up has become more cautious, and it has developed well-crafted and detailed studies on the experience of financial integration in which costs and benefits, and preconditions for success are specified and carefully balanced².

Stability is endangered by credit booms fueled by capital inflows that fuel an expansion in domestic aggregate demand that considerably exceeds potential output, resulting in an unsustainably high current account deficit, a swinging real exchange rate, and a vulnerable banking system. The challenge, then, is to manage macroeconomic risks associated with the transition to financial integration, but without renouncing efforts to eventually reap all the benefits of financial integration. Further research is needed to adequately explain the behavior of international financial markets leading to boom-and-bust cycles in foreign financing and to derive optimal policy strategies. The literature has given increasing attention to current account reversals³ and sudden stops in capital flows⁴, identifying financial problems as the origin of instability and costly crisis. The recent mainstream policy recommendations, falling short of restrictions on capital flows, imply some form of policy intervention in the operation of financial markets.

This paper analyzes the role that has been played by exchange rate policy and regulations in Chile's macroeconomic framework over the last decade. Section II presents the nature and evolution of the exchange rate policy and capital account regulations, discussing the effects of external financing shocks and the policies used to confront them. Section III presents an

² Eichengreen and others (1998), International Monetary Fund (1998) and Prasad and others (2003).

³ Edwards (2003), Milesi-Ferretti and Razin (1996), refer to current account reversals and sustainability problems as sources of macroeconomic imbalances.

⁴ Calvo and Reinhart (2000).

empirical analysis on the real exchange rate, including the effects of fundamentals, financing conditions, and policy intervention. Finally, Section IV presents some policy recommendations and concluding remarks.

The paper concludes that the gradual liberalization of Chile's capital account was carried out opportunistically, in parallel with increased exchange rate flexibility and after important conditions had been met. Capital account regulations were applied to support an independent monetary policy that was considered essential, given the idiosyncratic shocks the country has experienced. The policy framework directed at stabilizing the real exchange rate (RER) appears to have been of limited effectiveness, as the ample swings in the RER appear to have been induced by the surges and sudden stops in capital flows. The financial policy variables do not appear to have affected the RER trend. The unremunerated reserve requirement (URR) and foreign exchange intervention had only temporary effects on the RER trajectory toward a new equilibrium. Given the weak and short-lived effect of foreign exchange intervention on the RER, it appears inconvenient to devote intervention policy to attaining a specific level of the RER. The transitory effects of the URR on the RER also imply that capital account restrictions can be used only transitorily to smooth out the adjustment process and not as a permanent policy variable. Finally, a fiscal policy that stabilizes the growth rate of government spending throughout the business cycle and a policy of trade opening appear to be significant potential tools with which to moderate the RER appreciation induced by capital flow surges.

II. External Financing Shocks and Macroeconomic Policy

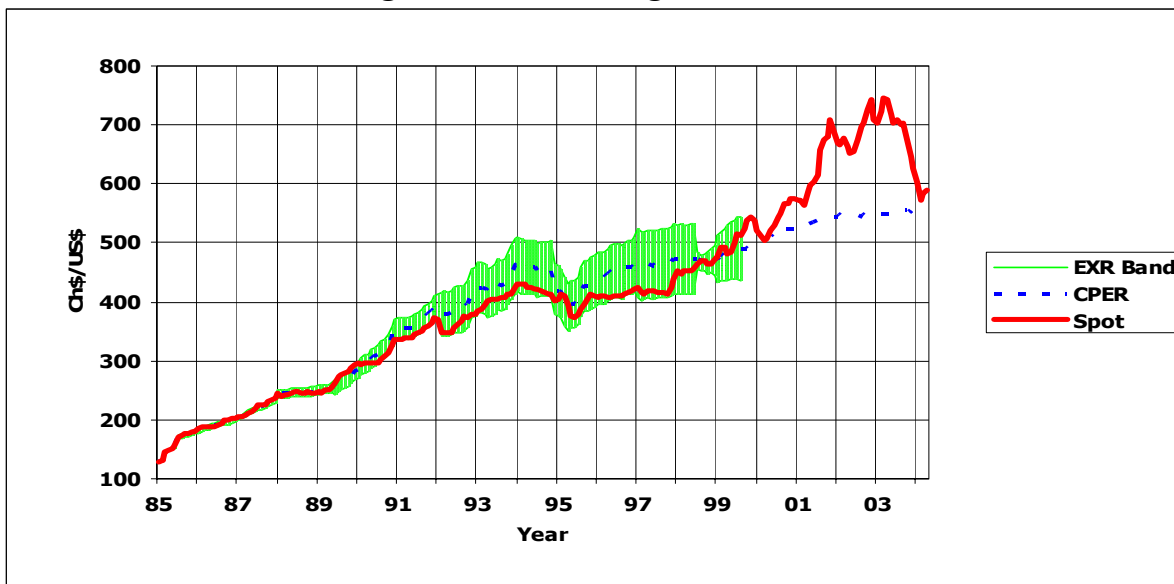
Policy responses to volatile capital flows often consist in offering implicit insurances through the exchange rate. The coverage of such exchange rate insurance has proven to have limits, and under more or less extreme conditions a run on domestic assets have rendered even the strongest defense of the exchange rate system unable to fulfill its commitments, thus breaking the arrangement together with the loss of macroeconomic stability and some times also with the failure of a significant portion of the financial system, as it was the case in Chile in 1982. Sometimes, to enhance the effectiveness of the exchange rate insurance, the attempts at moderating exchange rate volatility have been accompanied by restrictions to capital movements. In Chile, during the second half of the 1980s, capital flows and holdings of foreign assets by residents were severely restricted, and the exchange rate was managed within a narrow crawling band, with the rate of crawl following the difference between domestic and external inflation.

An important policy concern in Chile after the 1980s crisis has been the misalignments of the RER. Such misalignment may be associated to boom and bust cycles in external financing that result in reversals in the current account deficit, slow-downs in economic activity, and in many cases financial crisis. Misalignments of the RER may also result in resource misallocation, moving resources away from otherwise competitive tradable sector industries during the excessive appreciation phase. On the other hand, an excessively depreciated exchange rate may build up inflationary pressures and help to develop non-competitive tradable activities that become rent seekers after the return to a more normal condition.

A. The Crawling Exchange Rate Band and Inflation Targeting

From the mid 1980s and until September of 1999, the exchange rate of the Chilean peso was kept within a crawling band defined around an implicit target for the RER, the central parity exchange rate (CPER) (see Figure 1). The CPER crawled with daily adjustments made to reflect the estimated inflation rate differential between Chile and its main trading partners⁵. Initially, the last month's CPI inflation rate was used to represent domestic inflation, while a projection for trading partners' WPI measured in U.S. dollar represented external inflation. Undoubtedly, this form of calculating the CPER contributed to inflation inertia already present in the Chilean economy due to widespread indexation of wages and key prices. Only in 1998, the lagged inflation rate was replaced by the inflation target in the calculation of the CPER.

Figure 1. The Exchange Rate Band¹



¹Chilean pesos per U.S. dollar, monthly averages

For most of the period of its application, the band did not fully work as a space within which the value of the Chilean peso floated in response to market pressures. The exchange rate repeatedly hit the edges of the band; in the 1980's the band ceiling, in most of the 1991-97 period the band floor, and again the ceiling for a short period in 1998 after the transitory narrowing of the band.⁶ The modifications of the exchange rate band usually implied a band widening or otherwise an accommodation of market pressures, with the single exception of the measures implemented in

⁵ The central parity rate, the “acuerdo” exchange rate for the Chilean peso, is still published by the Central Bank more than five years after the elimination of the band. However, it is no longer the Bank's reference exchange rate, the one used in official foreign exchange transactions, or to value the Bank's foreign exchange assets and liabilities as it was the case a few years ago.

⁶ The exchange rate is defined as pesos per dollar, thus the floor of the band represents the most appreciated edge and the ceiling the most depreciated.

June 1998. The band width was increased from +/- 5% in 1990 to +/- 10% in 1992, and to +/- 12.5% in 1997. In June of 1998, however, the band was transitorily narrowed to +2% and - 3.65% around the CPER. This anomalous episode ended in September 1998 when the Central Bank announced the continuous widening of the exchange rate band from an initial band width of +/-4%. The continuous widening of the band ended in December 1999 with the free floating of the Chilean peso.

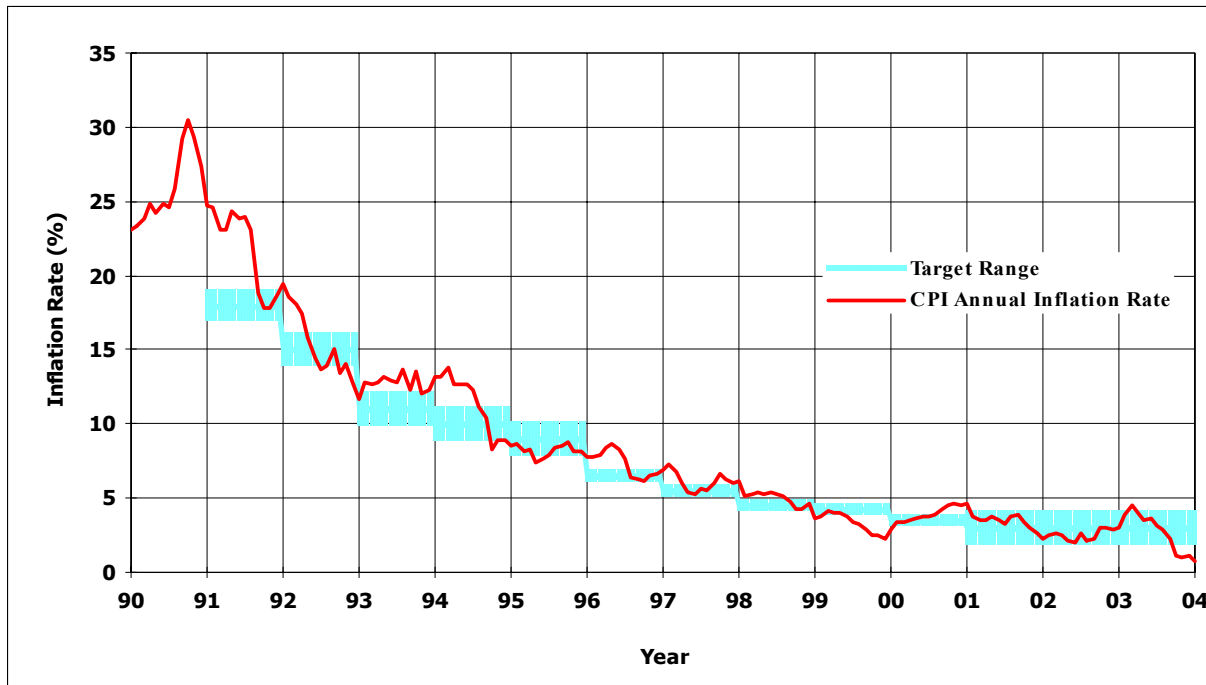
Several redefinitions of the level of the CPER also helped put some distance between the prevailing market rate and the edges of the band, and to alleviate the pressures on foreign exchange intervention. In 1992, the CPER was redefined from the U.S. dollar to a basket of currencies that included, in addition to the dollar, the deutsche mark (DM) and the Japanese yen (JY). The inherent exchange risk due to the co-movements of the band and the international value of the dollar against the DM and the JY was expected to act as a wedge between the market exchange rate and the band limits, i.e. the floor during the period of surging capital inflows. The DM and the JY progressively gained relative importance in the definition of the CPER throughout most of the period so that the currency composition of the exchange rate basket approached that of the Chilean international trade with the different currency areas and at the same time resulted in a more volatile CPER against the U.S. dollar. However, in 1997 the currency basket was modified sharply increasing back the weight of the U.S. dollar, in a moment in which the resulting recalculated CPER was 2% more appreciated. This measure helped to release some of the existing market pressures towards peso appreciation. However, the changes in the currency basket and the associated policy actions taken were not effective in separating the market exchange rate from the band's edges.

With an increasingly flexible exchange rate and a band that targeted the RER, an alternative nominal anchor was required, not surprisingly then, in 1991, the newly independent central bank put into effect an inflation targeting system. The long term objective was the reduction of the inflation rate that initially stood at Chile's long-term average in the 20th century (around 30 percent), to the single digit rates prevailing in advanced economies. Clear signals of the policy intentions were given through annual inflation targets, which were consistently met. The effort proved successful and the inflation rate fell to single digit rates in 1996, allowing for the announcement of the steady-state inflation target beginning in 1999, a range between 2 and 4 percent. (*Figure 2*).

A binding exchange rate band that limited currency appreciation resulted in additional capital inflows that complicated the task of monetary policy. This conflict between the exchange rate and monetary policy was reflected in the massive intervention in the foreign exchange market. The Central Bank increased its net foreign exchange position by more than US\$17 billion from the beginning of the 1990s to the maximum point in 1997, with NIR peaking at US\$ 20 billion, more than 12 months of imports and 25% of GDP. To preserve the control of monetary conditions, such massive forex intervention had to be sterilized through the issuance of Central Bank bonds and bills, thus contributing to the quasi fiscal losses of the Central Bank⁷.

⁷ The additional operating losses of the Central Bank, arising from sterilized intervention, have been estimated at around 0.5% of GDP. This is a little more than one-half of the total quasi-fiscal losses of the central bank, being the other half a consequence of the debt crisis of the 1980s.

Figure 2. Inflation Targeting



Source: Central Bank of Chile.

The “impossible trinity” indicates that to have an independent monetary policy and a pegged exchange rate, integration with international capital markets should be restricted. In order to pursue an independent monetary policy directed at reducing inflation while pegging the exchange rate within a band, controls had to be applied to international capital flows (NKF).

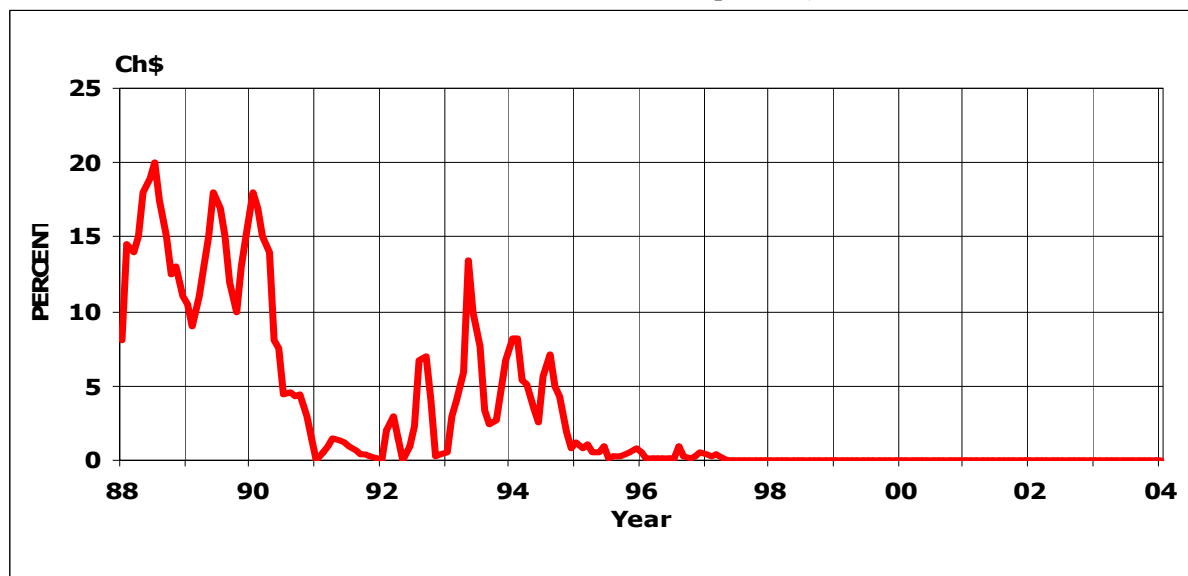
B. Foreign Exchange and Capital Account Regulations

The capital account regulations evolved over time in an opportunistic fashion following changes in external financing conditions and exchange rate policy to provide some support to the objectives of monetary policy. The foreign exchange and capital flow regulations applied in Chile throughout the 1980s and 1990s represented a form of adaptation to an external environment characterized by wide swing in important variables. They were backed by a well-developed institutional system that could efficiently enforce them. The rules were transparent and non-discriminatory, published in the Central Bank Compendium of Foreign Exchange Regulations, leaving room for very little discretion in their application. The system of information and control included the registration of foreign exchange operations carried out in the formal exchange market (MCF), through which all capital account transactions had to be channeled.⁸ Other forex transactions could be affected in the legal but informal foreign exchange market, at a freely floating exchange rate that at times was significantly different from the

⁸ The formal exchange market comprised the central bank, commercial banks, and specially authorized foreign exchange houses.

official exchange rate. Forex market segmentation was characteristic of the 1980s, and as a result, Chile had to obtain waivers from the IMF Board for not fulfilling the conditions under Article VIII of the Fund Articles of Agreement. The main exchange restrictions included the obligation to sell in the banking system the foreign exchange proceeds from export and capital inflows within strict time limits.⁹

Figure 3. The Informal Exchange Rate Margin of the Peso
(Spread of the informal and formal market exchange rates of Chilean peso vis-à-vis the U.S.dollar, percent.)



The non-financial private sector was always authorized to acquire foreign exchange in the rapidly expanding informal market. The spread between the rates in the formal and informal foreign exchange markets is a good indicator of the degree with which exchange restrictions were applied (see Figure 3). The spread, which in the 1980s typically fluctuated around 20 percent, fell in the early 1990s to around 5 percent. Following important liberalization measures, the spread fell below 2 percent in 1995 and finally disappeared completely in April 1997, when all exchange restrictions were discontinued.

⁹ See Box 1 for measures related to the foreign exchange restrictions.

Box 1. Measures Related to Foreign Exchange Restrictions

In 1990, all export proceeds were to be sold in the formal foreign exchange market within 90 days of shipment, without deductibles or minimum amounts. Over time, this exchange restriction was gradually lifted, allowing exporters to keep an increasing share of their foreign exchange proceeds and extending the period for the compulsory sale in the formal market. The liberalization process was completed in April 1995. In a parallel process, the compulsory sale of the foreign exchange proceeds from capital inflows was also gradually eliminated and transformed into an obligation to inform on the capital account transaction.

Exchange restrictions also applied to the purchase of foreign exchange, in the formal market. The restrictions included minimum financing periods and quantitative limits for importing goods and services, so that in 1990 imports of goods were subject to 120 days of minimum financing, while foreign travel and other imports of services were subject to a quantitative limit for accessing the formal exchange market of US\$3,000, per month, per individual. Import financing requirements were promptly abolished, while the quantitative limit of market access was gradually increased and completely eliminated in April 1997.

Institutional investors, including banks, mutual funds, pension funds and insurance companies were subject to strict limitations in their holdings of foreign assets. Beginning in 1997, all restrictions limiting the purchase of foreign exchange in the formal markets to finance investments abroad were eliminated and the restrictions on institutional investors were gradually lifted or transformed in limits to the exposure to exchange risk.

Under the pressures towards peso appreciation, the main regulation to capital inflows was introduced in 1991 in the form of an unremunerated reserve requirement (URR) on capital inflows.¹⁰ The URR consisted in compulsory and non-remunerated deposit in foreign exchange that had to be maintained at the Central Bank for a period of one year. The URR was applied to almost all debt creating flows and to some portfolio inflows increasing the cost of external financing through the covered channels, and particular that of short-term indebtedness.

Circumvention reduced the effectiveness of the URR, and a continuous confusion regarding the aim of the regulations—between improving the composition of capital flows and containing the size of total flows—, weakened the policy response. Although coverage of the URR was extended over time, certain flows that were heavily used for circumvention remained exempted, being the most important foreign direct investment (FDI) and import suppliers' loans. In addition to the legal circumvention, URR avoidance could have taken the form of illegal evasion by way of capital flowing into Chile outside of the regulations. But according to the balance of payments errors and omissions and other assets flows, that represent an estimation of the repatriation of non-identified assets and are a proxy for non-registered inflows, remained

¹⁰ The rationale for including the regulations on inflows as part of the macroeconomic policy framework is presented in Zahler (1996) and Massad (1998).

significant but stable over time, not showing any pattern or reaction that would be indicative of their use for circumventing the URR.

To the extent that the financing costs associated to the URR could be avoided, the arbitrage would become more intense and the effectiveness of the URR weaker. The URR coverage fluctuated around 50% of capital inflows, without showing a systematic trend.¹¹ Actions of economic agents modified the composition of external financing, partly to elude the URR, while changes in the regulation closed loopholes and improved the effectiveness of the instrument. Immediately after its imposition in 1991, less than 40% of the gross inflows were covered, the extensions and adjustments of 1992 increased the URR coverage to 60% of gross capital inflows, but then the coverage fell to 30% by 1994. New policy adjustments in 1995 and 1996 once again increased the coverage to 40%, keeping it around that value for the remainder of the URR period. The partial coverage of the URR may have originated microeconomic costs by further differentiating the access to external financing.¹² Through a generalization of the URR coverage, perfectly viable on technical grounds, it was possible to eliminate most of the leaks and strengthen the effectiveness of the mechanism while reducing its microeconomic costs. Closing the main loopholes on FDI, suppliers' credit and direct trade financing, the URR coverage would have doubled, as additional flows for a value of US\$ 4,000 million per year in 1996 and 1997 would have been covered by the mechanism.¹³

The efforts towards a more generalized application of the URR and related regulations were discontinued after the Asian crisis and related events implied the end of the surge in capital inflows and the beginning of a drought in external financing.¹⁴ In 1998, after the very sharp reduction in capital inflows—to Chile and to emerging markets in general—the URR rate was reduced first to 10% and then to zero. In the following year, the minimum withholding period for foreign investment was eliminated and, finally, two years later all remaining restrictions and regulations were discontinued and transformed into a system of statistical information requirements. At the end of the process of gradual liberalization, the degree of international financial integration of the Chilean economy, measured on the basis of foreign assets and liabilities, was higher than the average for emerging market economies with investment grade.¹⁵ In addition, Chile's debt indicators improved continuously over the period and remained at the top of emerging markets.

¹¹ Le Fort and Sanhueza (1997).

¹² Forbes (2003) presents evidence of financing constraints faced by small and medium-size enterprises during the URR period that would have disappeared afterwards. Sources of external financing not accessible to SMEs and not covered by the URR may explain this phenomenon. The issuance of stocks abroad through the primary ADRs appear to be a central candidate as a source of this distortion.

¹³ Even though in 1996 the balance of payment surplus amounted to only US\$ 1000 millions, this figure is minimized by the prepayments of public foreign debt for about US\$ 3000 million that took place that year. Without them, the surplus would have been precisely US\$ 4 billions.

¹⁴ In a CNN interview in 1998, the then President of the Chilean Central Bank Carlos Massad, referred to the URR as an umbrella that was closed and put away after the end of the rain.

¹⁵ See Jadresic et. al. (2003)

Box 2. Capital Inflow Measures

Regulations to capital inflows included, in addition to the URR, the minimum withholding period applied to foreign direct investment and to portfolio flows, and limitations to issue publicly traded financial instruments in foreign markets; however, their contribution appears small as compared with that of the URR. The minimum withholding period for foreign investments attempted to reduce the use of FDI as a vehicle for short-term arbitrage. Most portfolio investments, with the exception of American Depositary Receipts (ADRs), were subject to this restriction. The ADRs that allows the trading abroad of registered domestic stocks was authorized in 1990, initially with restrictions on the amount of issue and the minimum credit rating of the issuer. In parallel, similar conditions applied for the issuance of bonds and notes in foreign markets. There were also other restrictions that limited the denomination of foreign liabilities to authorized foreign currency. In 1997, an amendment was introduced authorizing the denomination of foreign indebtedness in Chilean pesos and in the Chilean indexed unit, UF.

Several measures were taken over time to ensure a better coverage and effectiveness of the URR. When it was introduced, the term of the URR deposit was associated to the maturity of the loan and the rate stood at 20 percent. The term of the URR deposit was soon unified in one year irrespective of the maturity of the loan and the rate was raised to 30% and kept at that level until 1998 when it was reduced to 0. All along, the URR deposit could be substituted by the payment of an upfront fee, equivalent to the financial cost of the URR. From 1995, the URR deposit had to be constituted in U.S. dollars, irrespective of the currency of denomination of the loan. Reductions in the nominal interest rates in yens and in gold had created circumvention opportunities.

The coverage of the URR was also extended to secondary operations with American Depositary Receipts and other forms of portfolio investment flows, which were being actively used in the circumvention of the URR. Loans used in paying expenses abroad were also affected by the URR, while those directed at prepaying foreign financial obligations and extending the duration of the debt were exempted. The URR control was focused on large transactions, and individual foreign operations for less than US\$ 200.000 were exempted when the participating foreign investor had registered capital inflows for less that US\$ 500.000 accumulated over the last 12 months.

C. Policy Responses to Surges and Sudden Stops

The real exchange rate is a key relative price for macroeconomic stability and resource allocation in emerging market economies. The RER volatility is a characteristic of emerging market economies that affects more severely those that are less advanced in the process of integration to the global economy. While Poland and Colombia appear to have a highly volatile RER, Singapore and Malaysia present more stable conditions, and Chile and Philippines are in an intermediate position. See Table 1.

Table 1. International Comparison on the Volatility of RER
In percent

Real Exchange Rate Variability Coefficient (St. Dev. / Mean)						
Sample	Colombia	Chile	Malaysia	Philippines	Poland	Singapore
1990 - 2003	15.17%	10.67%	9.08%	10.86%	21.49%	5.10%
1990 - 1997	16.62%	10.42%	5.02%	10.83%	20.09%	5.58%
1998 - 2003	13.02%	10.62%	4.85%	7.50%	8.18%	4.09%
Real Exchange Rate Cumm Deviations from Mean over 48 months						
Max	17.81%	12.72%	8.80%	12.54%	22.63%	6.71%
Min	-15.37%	-9.80%	-9.74%	-8.56%	-26.02%	-3.99%
Std Deviation	9.83%	7.11%	6.51%	6.20%	13.62%	3.21%

Note: Author calculation on the basis of IMF data for monthly real exchange rates. With IMF data, an increase in the RER index represents an appreciation.

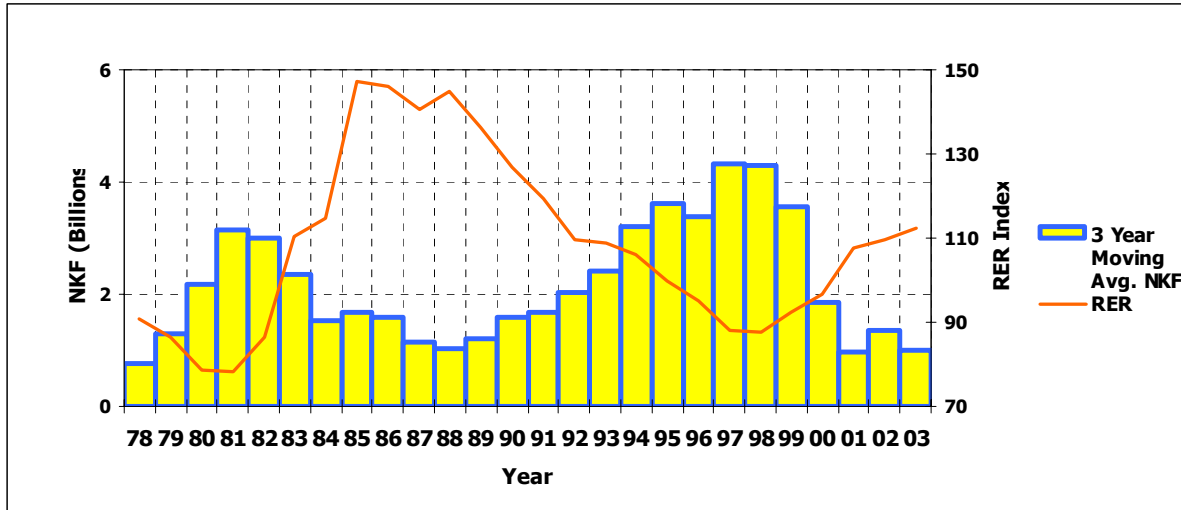
Chile has kept a relatively constant RER volatility in the pre and post Asian crisis periods, while the RER volatility in all the other countries considered have been falling. This feature is revealing, given the change in Chilean policy from volatility repression to volatility adaptation in the latter period, as was implicit in the liberalization and float. The implication would be that during the period of volatility repression, Chilean policies reduced RER volatility, and that the volatility adaptation of the second period has taken place during a time of relative calmed waters. It is also worth noting in this respect that using a volatility indicator on the basis of deviations of the RER from its long term mean over a period of rolling 48 months, Chile's RER volatility also appears higher than that of Singapore, Malaysia and now also the Philippines, but lower than Colombia and Poland. Moreover, the deviations of the rolling 48 month averages with respect to the long term average in Chile appears more tilted towards deviations caused by excessive appreciation (12.72%) than excessive depreciation (-9.8%).

Chile's real exchange rate depreciated over 60 percent from 1981 to the end of that decade because of the drought in external financing that followed the Latin American debt crisis of the early 1980s. Immediately after that, and during a period of large capital inflows to emerging markets, the Chilean peso appreciated strongly almost reaching in 1997 the levels of the early 1980s. However, another period of scarce foreign financing as result of the Asian and Russian crisis of 1997-1998, generated yet another strong real depreciation through March 2003, after which a new period of real appreciation has begun (*see Figure 4*).¹⁶ The real appreciation episodes followed a sustained surge in net capital inflows (NKF) and the depreciations a sudden stop. Three year moving average NKF peaked in 1981 and again in 1997, while the sudden stops in external financing that followed the surges are somewhat hidden in the graph because of the

¹⁶ The RER in official Central Bank of Chile figures is associated to the relative price of tradable over non-tradable goods, that is an increase in the RER represents a real depreciation.

moving averages used for NKF. In any case under this metric, minimum capital inflows depicting the final part of the sudden stop were registered in 1988 and again in 2001 and 2003.

Figure 4. Capital Inflows and Real Exchange Rate



Note: An increase in the RER Index represents a real depreciation. Source: Central Bank of Chile.

The swings in the real exchange rate have a dual in the significant deviation from what could be considered sustainable use of external financing. During the real appreciation of the 1990s Chile's current account deficit deteriorated, up to a point that doubts about its sustainability aroused, and then a reversal in the current account took place with a few years of surpluses. In 1990-97, private domestic expenditure ($\frac{3}{4}$ of domestic demand) doubled after growing at an annual average rate of 10%. Reduction in the current account deficit was initiated in 1998 through a contraction in domestic demand, and continued its adjustment in 1999 and beyond, reaching almost balance in 2001-02 despite the unfavorable terms of trade.

The rapid expansion of private spending in 1991-1997 co-existed with a high level of the domestic interest rate, the average of the 90-day deposit rate in 1991-97 stood at 6.5%, much higher than the average rate of the second half of the 1980s or than the rate observed since the Asian crisis (1998-2000). Inflation fell, and in addition, a stream for fiscal surpluses averaging 2 percent of GDP also took place in the same period. All these elements eliminate expansionary monetary or fiscal policy as the possible origin of the over heating of the economy. External conditions seem a more likely origin of the macroeconomic swings, including the improvement in the terms of trade. However, the effects of terms of trade in domestic demand would be of little significance to the extent that foreign financing were available to confront what ends up being temporary income changes.¹⁷ To understand the macroeconomic ups and downs affecting Chile, the role of capital flows is crucial, thus we should focus on them.

¹⁷ Caballero (2003) defends the idea that the cycle of domestic demand is a financial problem that results from changes in financial solvency of residents induced by ups and downs in the price of copper (main

(continued...)

A surge in net capital inflows to Chile took place in the first half of the 1990s and during this period annual net capital inflows averaged 7.3 percent of GDP. In addition, the cost of external financing for domestic borrowers in Chile fell significantly, from 1.8% over LIBOR for the average Chilean borrower in 1991 to 0.7% above LIBOR in 1996-97.¹⁸

The surge ended abruptly in mid 1998, inducing a large depreciation of the peso and a sharp tightening of monetary policy to prevent an acceleration of inflation. The fiscal balance deteriorated to a small deficit, mostly as a result of lower revenues associated to the recession that affected Chile from mid 1998 to mid 1999, being clearly a consequence rather than a cause of the sudden stop.

A common policy reaction to confront the effects on the real exchange rate of the capital flow volatility is the defense of some exchange rate level using *sterilized intervention*. However, such intervention does not modify the incentives for the private sector to take positions in foreign exchange and it is even possible that it may even favor additional speculation by rising domestic interest rates and by generating the expectations of a bigger pay-off when the resistance to the exchange rate adjustment is defeated. Speculators know that the defense of the exchange rate through sterilized intervention is costly, resulting in large open foreign asset position for the Central Bank that involve significant risks and generated sizeable losses.¹⁹

Non-sterilized intervention modifies incentives against holding liability positions in foreign currency and may be effective in containing the capital flow surge. The defense of the exchange rate band through non-sterilized intervention results in a more accommodative monetary policy that lowers interest rates and reduces the attraction of capital inflows. But such policy direction may also result in a far more expansionary monetary policy stance than the one consistent with the inflation targets. In Chile's experience of the 1990s, targeting the exchange rate by means of non-sterilized intervention would most likely have implied missing the inflationary target. Note that after the sudden stop in 1998, non-sterilized intervention was successfully used in the defense of the then narrowed exchange rate band, however, at the cost of an extremely high real interest rate, a drop in economic activity, and, more importantly a sharp reduction of the core inflation rate from 6.0 percent in June 1998 to 2.1 percent in December 1999, well below that years target of slightly above 4.3 percent (see Figure II. 2).

Chilean export). Incomplete financial markets prevent Chilean residents to take appropriate insurance against terms of trade fluctuations.

¹⁸ The available empirical evidence indicated that the capital inflow surge in Chile had mainly an exogenous character. Medium- and long-term capital flows that concentrated the inflows surge to Chile were negatively correlated to the domestic interest rate, and to the actual and expected spread of domestic and foreign asset returns. See Le Fort and Lehmann (2003)

¹⁹ The potential losses tend to be more important when intervention is asymmetric, when the pressure to intervene in the prevention of appreciation is stronger than during the depreciation period, resulting in a net foreign asset position of the public sector that grows over time. Conversely, if the intervention is asymmetric towards preventing depreciation the continued loss of reserves makes intervention unsustainable.

A more *neutral Fiscal Policy* aimed at a stable structural fiscal surplus rather than a stable nominal surplus would have helped to moderate aggregate demand expansion and thus help to limit the RER appreciation.²⁰ However, effectively controlling the excessive expansion of private spending would have required steep expenditure cuts or pro-cyclical tax increases, and would have resulted in even larger fiscal surpluses. Such demanding fiscal policies never had sufficient political backing.

The options to confront the surge of capital inflows were two, either imposing and reinforcing *restrictions on capital inflows*, or allowing the exchange rate to *float*. Accepting the importance of meeting the inflation target implied the need to keep the independent monetary policy focused on inflation rather than on the exchange rate, while the political constraints that limit the size of the fiscal surpluses eliminated a possible additional contribution from fiscal policy. Floating would, after all, have allowed monetary policy to regain full control over inflation and have eliminated the speculations surrounding band adjustments and discrete jumps in the exchange rate. But at the same time, it would have implied to fully realize the effects of the surges on capital flows on the RER, and this was subject to the fear of floating.²¹ An episode of ample RER volatility inducing financial distress was one that nobody wanted to see happen and doubts on the resiliency of the financing system to such event were still present.

Without the pre-conditions for a successful float, capital inflow regulations were used to confront the capital flow surge in the early and mid 1990s, with the URR being the most relevant. Since the term of the compulsory deposit was one year, irrespective of the maturity of the foreign financing, the financial cost of the URR (fc) was higher the shorter the maturity of the loan, being prohibitive for very short maturities and almost nil for long ones. Up to a certain value of the domestic-foreign expected spread of returns, the URR did eliminate arbitrage opportunities. However, when the expected spread exceeded the financial cost of the URR, the mechanism did not eliminate the incentives for arbitrage. The latter would have been the case under expectations of a sudden currency appreciation, or when the efforts of monetary policy to contain the expansion of domestic spending were intensified.²² Despite its limitations, the URR was effective in containing capital inflows and had a positive and statistically significant effect on the real interest rate giving additional room of maneuver to monetary policy.²³

²⁰ Fiscal policy was also restrictive, during the 1990-1997 period the public sector accounts were in continuous surplus; however, the growth rate of public expenditure tended to increase over the period following the accelerated expansion of public sector revenue under thus reinforcing the cyclical effect of private spending.

²¹ Misalignments of the RER were at the origin of the 1982 debt crisis when the real appreciation of the peso dwarfed the tradable goods sector and deviated resources towards the booming non-tradable goods sectors. In 1981, the current account deficit almost reached 14% of GDP, foreign financing then stop and the next year output fell by 15% and the banking system went bankrupt.

²² With the maximum URR rate 30% and deposit term of one year, the URR financial cost could deter arbitrages for interest differential up to 350 basic points for one-year operations. This calculation considers the prevailing international interest rates and risk margins during the period of URR application (7 percent relevant external interest rate).

²³ The URR effect was particularly concentrated on short-term capital flows, however that effect was strong enough for the URR to modify total capital flows. See Le Fort, Lehmann (2003).

D. Conditions to Liberalize and Float

As the gradual liberalization process advanced, the approach of the Chilean authorities to confront external volatility changed emphasis. The aim of using policy instruments to repress capital flow and exchange rate volatility was gradually replaced by the aim of adapting the economy and in particular the financial system to increased external volatility by meeting the conditions required for a successful float. The preservation of monetary independence under the constraints of the impossible trinity, required that financial opening had to be advanced in parallel with exchange rate flexibility, and capital account liberalization became associated to exchange rate floating.

In many cases, exchange rate floating is a policy used as a last resort when confronting a traumatic event; however, those cases of disorderly exits have important handicaps to become successful floats as they are many times associated to balance of payments or financial crisis. A float consistent with the preservation of macroeconomic and financial stability requires meeting a number of pre-conditions, including opportunity, nominal anchor, exposure to exchange rate risk, and financial markets development. In that regard, the opportunity to float is relevant to maximize the probability of success. Allowing the currency to float during a surge of capital flows or just after of a sudden stop entails the risk of an over or under shooting of the real exchange rate that may endanger macroeconomic stability and result in misallocation of resource. It appears much preferable that the capital account regulations and the exchange rate band are lifted when the risk of a large and sudden appreciation or depreciation of the currency is minimal. In Chile, the capital account liberalization was completed after the economy had gained recognition for its macroeconomic and financial stability. The indicators of external solvency and liquidity, of inflation, fiscal consolidation, and domestic financial system strength were all quite improved after the debt crisis was overcome, reaching levels among the best of emerging market countries.

Floating implies losing the exchange rate as a nominal anchor, thus entailing the risk that capital flows pressure or other shocks resulted in large depreciations (or appreciations) of the currency and lead to inflationary (or deflationary) spirals. Monetary policy should provide an alternative nominal anchor, but the independence of the monetary authority and the absence of fiscal dominance are preconditions for its effectiveness. With a credible monetary policy, the depreciation (or appreciation) is likely to be transitory and the effects on price stability can be satisfactorily dealt with at reasonable costs in terms of output. In Chile, a credible monetary anchor, alternative to the exchange rate was successfully established by the independent Central Bank, fiscal dominance was completely eliminated and the external liquidity position strengthened before the currency was let to float.

The exchange rate volatility that could result from the liberalization of the capital account and floating could affect the health of a financial system with a large exposure to exchange rate risk. As a precondition to float, the foreign exchange and interest rate exposures of financial institutions should be limited to adequately cope with increased exchange rate volatility. Under floating there are no guarantees that the exchange rate will be stable, or that the interest rate will have no need to adjust. It is important, then, to ensure that financial institutions can cope by limiting their exposure to market risks using financial regulations or internal risk management plans. In addition, financial system borrowers carry exchange rate risks that can be transmitted

to financial institutions through their credit exposure and become a source of systemic risk. The limits to credit risk should also be defined in consideration to the foreign currency exposure of debtors, and this secondary foreign exchange risk derived from the exposure of clients should also be explicitly monitored by financial institutions and supervisors, and considered in managing market risks.

In Chile, the liberalization of capital flows and the exchange rate float was advanced after implementing a system to prevent asset-liability mismatching in foreign currency. Limits for the asset liability mismatches of banks in currencies as well as in liquidity and interest rates were imposed in relation to the banks capital and reserves. Floating took place in Chile after the financial system was subject to a well-developed system of supervision and regulation, including special provisions for direct and indirect exposure of banks to exchange rate risk.

To help agents coping with exchange risk, the development of liquid local financial markets, particularly for foreign exchange instruments, spot and forward, is key. In this way, financial institutions and their clients would have access to markets in which their risk exposures can be covered. A continuous development of the local market for the coverage of exchange risk took place in Chile from 1995 on, with a continuous increase in the forward forex market deepness, not only in terms of larger daily average transactions but also in terms of a progressive extension in the contracts maturity. All this development increasingly allowed that foreign exchange risk could be shared and be transferred towards those parties better equipped to confront it.

Dollarization of domestic financial liabilities has been an important origin of currency mismatches in private portfolios and an impediment for floating in many countries in Latin America. In Chile, financial dollarization has not been important as the local financial market developed on the basis of domestic currency instruments. Nominal instrument at the short end of the maturity spectrum, and inflation indexed instruments for the long end. However, even in the absence of financial dollarization, currency mismatches were still relevant since a relatively large portion of the total financing need of the private sector was obtained through foreign debt, with many of the domestic borrowers being producers of non-tradable goods. The only way to reduce those mismatches is through deeper markets for financial instruments denominated in Chilean pesos, either by developing the local financial markets and enhancing foreign participation or through a further internationalization of the Chilean peso, by issuing in international markets foreign debt contracts and other financial instruments denominated in domestic currency.

Prospective reports on macroeconomic conditions and external vulnerabilities may provide a more clear risk evaluation to foreign investors, reducing information problems or surprises that may originate surges and sudden-stops in NKF. Transparency in informing markets should not only be limited to the policy framework, targets and instruments, but also encompass information on the evolution of macroeconomic and financial conditions. Although there are no guarantees that market behavior that leads to swings in capital flow like panics, mania or herd behavior will be avoided, information on policies, conditions and medium-term external prospects should contribute to market stability. In Chile, a communications policy of increasing transparency was implemented prior to floating including the publication of a monetary policy report three times a year, the publication of quarterly fiscal reports and the dissemination of the documents associated to the annual Article IV Consultation with the IMF.

III. An Empirical Approach to Real Exchange Rate Dynamics

Avoiding RER misalignments caused by the volatility in capital flows was a central motivation for the foreign exchange intervention and capital account regulations implemented in Chile in the 1990s. In this section we attempt to assess empirically to what extent capital flow volatility and the policy reactions had effects on the RER, of particular interest are the effectiveness of the URR and of the intervention in the foreign currency market. Other works have shown that the URR affected domestic interest rates, in principle then, it should also have affected the RER by way of international arbitrage.²⁴ However, an explicit econometric link between the URR and RER has remained elusive. Two empirical approaches are followed for the RER. The financial approach is based on short-term arbitrage conditions and uses monthly data; the second is a macroeconomic approach based on the fundamentals for the RER as the relative price between tradable and non-tradable goods, it uses quarterly data.

A. Arbitrage and Real Exchange Rate

The real exchange rate can be presented as a financial variable that responds to the arbitrage of returns between assets denominated in domestic and foreign currency.²⁵ The value of today's RER (LRER in log form) that would result from perfect arbitrage of returns is the arbitrage RER ($arb[LRER(t)]$). This value is given by the expected future exchange rate, $E[LRER(t+1)]$, minus the domestic-foreign interest rate differential ($r_{dom} - r_{ext}$)²⁶ as presented in equation (1).

$$arb[LRER(t)] = E[LRER(t+1)] - (r_{dom} - r_{ext}) / 12 \quad (1)$$

Where r_{dom} represents the short-term real interest rate in domestic currency paid by Central Bank of Chile in its short-term CPI indexed instruments and r_{ext} represents the short-term real interest in foreign currency relevant for the Chilean sovereign borrower. The foreign currency real interest rate is defined in equation (2) below, where $libo90$ is the 90 day libo rate for transactions in US dollars, $E\pi$ the expected US inflation rate, and $srcl$ Chile's sovereign risk premium. Given Chilean monetary policy of the last 15 years r_{dom} can be considered a policy variable, while the evolution of r_{ext} is considered to be largely determined by international financial conditions and hence exogenous, dismissing the possible effects of policies on the sovereign spread since the focus is in the short-term.

$$r_{ext} = libo90 - E\pi + srcl \quad (2)$$

²⁴ Some effects of the URR on real interest rate were found by Le Fort and Lehmann (2003), Gallego et al. (2002) and de Gregorio et al (2000). Williamson (2002) refers to the inconsistencies raised by the empirical finding that accept effects of the URR on real interest rates but no on the RER.

²⁵ For a more complete discussion, see Le Fort (1998).

²⁶ The domestic and foreign rates are expressed in annual terms, hence they were divided by 12 to represent the arbitrage RER calculated on the basis of RER expectations one month ahead.

Under perfect arbitrage conditions, equation (1) would guide the evolution of the RER, thus implying that the expected returns of holding assets in domestic or foreign currency would be the same, that is the interest differential would compensate any expected capital gains or losses resulting from *RER* realignments. However, it is possible that some profit opportunities remain unexploited and hence expected returns differ. On average, during the period under analysis (1990-2003), the annual returns of domestic currency assets exceeded those denominated in foreign currency by around 240 basis points.²⁷ The excess return for domestic currency assets is not associated to a higher counterpart risk, since domestic and foreign rates have been represented by the relevant borrowing rates for the Chilean “sovereign”. Behind the excess returns in domestic assets may be the effects of other risk premia —different from counterpart risk—that reflect limitations to domestic market liquidity, or the effect of policy actions directed at giving domestic monetary policy additional room for maneuvering, both through the use of the URR and by foreign exchange intervention of the Central Bank.²⁸

By definition, the arbitrage *RER* depends on the expected *RER*, which is an unknown variable. The estimation is then performed using two stage least squares assuming that the expectations on the *RER* are formed rationally using all the relevant available information.²⁹ The results are presented in table IV.1 and indicate that all the three different specifications for the financial RER model co-integrate according to the Engle Granger test.³⁰ The three of them present an important degree of error persistence as indicated by the low DW.

²⁷ During the period of application of the URR, 1991.07-1998.09, real returns in domestic currency exceeded those in foreign currency by more than 300 basis points.

²⁸ Foreign exchange intervention is defined as the cumulative net foreign exchange purchases by the Central Bank minus the exchange rate linked instruments issued.

²⁹ The instrumental variables are all the lagged endogenous variables $lrrer(-1)$, $volrer(-1)$ and $lfexint(-1)$ and the exogenous explanatory variables from the arbitrage equation. Intervention ($lfexint$) was treated as an endogenous variable in consideration to the reaction function of the authority that may lead to increased net purchases of foreign exchange as the RER appreciates.

³⁰ The relevant critical values of the Engle Granger test at 1 percent significance, reported in Table C, Enders (2004), for 100 observations are: -7.406 (10 variables), -4.441 (three), and -4.008 (two). In each of the estimated equation, the test value exceeds the requirements for co-integration.

Table 2. Chile: The Real Exchange Rate and Financial Arbitrage ¹

Method: Two Stage Least Squares (Monthly data 1990.1-2003.11)

Dependent Variable LRER	Equation 1.1	Equation 1.2	Equation 1.3
Constant	-0.8301 (0.100)	-0.2695 (0.001)	-0.1518 (0.029)
Arb[rer]	1.1203 (0.000)	1.0589 (0.000)	1.0340 (0.000)
Fc	0.3573 (0.384)	0.4358 (0.002)	-- (--)
Lfexint	0.0029 (0.867)	-- (--)	-- (--)
Nkf_abm	0.0002 (0.207)	-- (--)	-- (--)
Volrdom	0.3162 (0.528)	-- (--)	-- (--)
Volrer	0.2391 (0.357)	-- (--)	-- (--)
Volrext	-0.0115 (0.704)	-- (--)	-- (--)
Lcpr	0.0378 (0.246)	-- (--)	-- (--)
Dumband	0.0167 (0.249)	-- (--)	-- (--)
Adjusted R ²	0.961	0.966	0.966
Durbin-Watson statistic	1.265	1.333	1.290
Dickey-Fuller Estimation Residuals	-8.721 c/	-9.102 c/	-8.890 c/

Source: Estimations by the author.

¹ Figures in parentheses correspond to P-values. Instruments Lrer(-1), fc, rdom-rext, Lfexint(-1), Volrdom, Volrer(-1), Volrext, Nkf_abm, Lcpr, Dumband

²Significant at 1 percent according to the Engle-Granger test for Co-integration.

The first attempt at empirically asses the effectiveness of financial policies in guiding the *RER* consist of verifying whether other variables can explain its evolution. In the first specification for the *RER* under arbitrage (1.1), the policy variables considered are the financial cost of the URR (*fc*), the central parity rate in log form (*lcpr*), a dummy for the period of application of the exchange rate band (*dumband*), and the cumulative foreign exchange intervention by the central bank in log form (*lfexint*). In addition to the policy variables, considered as explanatory variables are the volatility of domestic real returns (*Volrdom*), of the foreign currency real returns (*Volrext*)

and of the *RER* (*Volrer*), and, finally the last explanatory variable of this first specification is the net foreign capital inflows to the largest Latin-American countries (*Nkf_abm*).³¹

In this first specification for the *RER* under arbitrage (equation (1.1)), the effects of several of the variables considered are not statistically significant. Eliminating those variables in steps with increasingly more demanding significance levels, only the financial cost of the URR (*fc*) and the arbitrage *RER* are left when the cut-off point of statistical significance gets to 5 percent. Those two are the only explanatory variables considered in the second specification (eq 1.2). The exclusion of the other variables (*Lfexint*, *Nkf_abm*, *Volrdom*, *Volrext*, *Volrer*, *Dumband* and *Lcpr*) is not rejected by the data at 10 percent significance.³² Moreover, the exclusion of the seven variables plus *fc* is rejected by the data at 10 percent significance.³³

In the third specification (1.3), the effect of *fc* is restricted to be equal to zero, so that the *RER* is regressed only on the constant and the arbitrage *RER*, however the exclusion of *fc* is rejected at 1 percent significance.³⁴ Consequently, the preferred specification (1.2) is the one that includes the effect of the URR financing cost as explanatory variable for the short-term evolution of the *RER*.

The financial approach tells us that given the expected future *RER*, and the domestic and foreign interest rate differential, the URR financing cost has a statistically significant effect on the *RER*. This effect consists in generating a more depreciated *RER* than the one that would result from arbitrage conditions in the absence of the URR. On the contrary, the foreign exchange intervention does not appear to have any statistically significant effect on the level of the *RER* within the arbitrage model.³⁵

The error-correction model (ECM) for the *RER* built around specification 1.2 does not include forex intervention or the *URR financing cost* as explanatory variables. The first difference is represented by a “d” preceding the variable, while the “p” values are presented between brackets below each estimated coefficient. Despite extending the lengths of the lags to 24, it was not possible to obtain an ECM estimation with a reasonable DW. In any case the results show a

³¹ Net cumulative capital inflows over the last 12 months to Argentina, Brazil and Mexico. The quarterly series available for this variable was interpolated using the routine *interpol* in the package *Win Rats 3.2*. For the variables considered in the equation, the unit root hypothesis cannot be rejected at 10 percent significance using the ADF test as presented in appendix B. The exceptions were the three variables representing volatilities: *volrdom*, for which the unit root hypothesis cannot be rejected at 10 percent using the DF-AGF test, *volrer* and *volrext*.

³² The exclusion of the seven variables from equation 1.1 leads to specification 1.2 and their comparison yields an F test value of 0.90 and a Chi Squared value of 6.34. Thus, the hypothesis of redundancy of those seven variables cannot be rejected at 10 percent significance.

³³ The exclusion of *fc* and the seven other variables leads to specification 1.3., and its comparison with specification 1.1 yields an F test value of 1.93 thus rejecting the exclusion at 10 percent significance.

³⁴ The exclusion of *fc* from Equation 1.2 leads to specification 1.3 and their comparison yields an F test value of 9.46 and a Chi Squared value of 9.46. Thus, the hypothesis of redundancy of *fc* is rejected at 1 percent significance. Moreover, the restriction that the intercept in equation 1.3 was equal to zero and the slope equal to one was also rejected by the data at 5 percent significance.

³⁵ It is possible that foreign exchange intervention could have been effective in reducing the volatility of the *RER*, we gather some preliminary indication at this respect but this should be the matter of a different study.

strong and very significant error correction response to the lagged residual of the co integration regression.

Table 3. Chile: Error-Correction Model for RER (Based on Equation. 1.2)

Method: Ordinary least squares (1991.01-2003.12)

$[dRER(t)] = -0.0007 - 0.1281 * [drdom(t) - drect(t)] - 0.0004 * dnkf(t)$		
.....(0.092).....	(0.004)(0.001)
$+0.0439 * [dRER(t - 9) + dRER(t - 11)] - 0.914 * RESID(t - 1)$		
..(0.004).....	(0.000)
<i>Adj.R2</i> ..0.93..... <i>DW</i> 0.23		

The URR appears to affect the *RER* in the context of a short-run financial model. However, these results are conditional on exchange rate expectations and the model does not give any indications on the variables that may affect the evolution of the *RER* over the medium- and long-term. To confront this issue a macroeconomic model for the determination of the *RER* is presented in the next section.

B. Real Exchange Rate (RER) as a Relative Price

We have already shown that the URR financing cost (*fc*) is the policy variable that has effects on the *RER* in the setting of a model for the international arbitrage condition. In this section we attempt to empirically assess the degree at which financial policy variables could modify the *RER* in the setting of a macroeconomic model for the relative price between tradable and non tradable goods. The *RER* plays a key role in the process of domestic macroeconomic adjustment responding to the fundamentals that affect relative supplies and demands. Empirical models for the *RER* can have different degrees of complexity, including sectoral, as well as domestic and foreign variables.³⁶ In a simple macroeconomic setting for quarterly data, five fundamentals are considered to define the equilibrium relative price:

- First, the net foreign asset position (NFA) represents wealth and affects domestic demand through inter temporal optimization. The larger the net foreign asset position and wealth, the higher the demand for goods in general. Higher domestic demand is expected to exert upward pressure on nontradables goods prices, thus lowering the relative price of tradable goods and appreciating the *RER*.
- Second, the terms of trade (LTT), or relative price of exported versus imported goods. An increase in terms of trade is associated with higher real domestic income and domestic demand, and thus with a higher demand for non tradable goods and in turn with a lower relative price of tradable goods (a more appreciated *RER*). However, the improvement in the terms of trade also affect the intra-temporal optimization of the consumption basket

³⁶ See Calderon (2004) , Montiel (1999), and Le Fort (1998)

between importables and exportables, so that its impact on the *RER* is uncertain depending on the structure of preferences and on the relative strength of the income and substitution effects.

- Third, import tariffs are also a fundamental variable. In general, for a higher protection rate, the relative demand for tradable goods would be lower implying that the *RER* appreciates with the level of protection, but also preferences and substitution effects may complicate the analysis.
- Fourth, the relative productivity in tradable and non-tradable goods is another of the fundamental variables that determine the equilibrium relative price of tradable goods. Avoiding sectoral variables due to data limitations, total labor productivity (*LPROD*) is included as an explanatory variable. Productivity advances take place primarily among tradable goods and thus higher productivity is associated with a reduction in the relative production costs and relative price of tradable over non-tradable goods, and, consequently with an appreciation of the real exchange rate.
- Fifth, government spending, which is considered to be more intensive in non tradable goods relative to other forms of domestic demand, tends to appreciate the *RER*.

The regressions for the real exchange rate under the macro model are presented in Table 4. The first regression, 2.1, includes only the fundamentals as explanatory variables and all the estimated coefficients have the expected signs being all of them, with the exception of the one for the terms of trade, statistically significant at 1 percent. But the residuals show some degree of error persistence, and furthermore, the relationship in 2.1 does not co integrate according to the Engle Granger test which could be related to the omission of relevant explanatory variables.³⁷

The fundamental variables do not suffice to explain the swings of the quarterly *RER* in Chile over the last 15 years. Several additional explanatory variables related to financing conditions or forms of policy intervention that affect financing conditions were considered. The second regression, equation (2.2), includes in addition to the fundamentals, seven additional explanatory variables, the financial variables are:

- First, the supply of foreign financing measured by net capital flows to major Latin-American countries (*nkf_abm*), that should exert an appreciating effect on the *RER*

³⁷ The critical value at 10% of significance of the Engle Granger test for 50 observation and 5 variables is -4.348 and the calculated ADF for the residuals in equation 2.1 is -3.148.

Table 4. Chile: Macro Model Estimations for Real Exchange Rate¹

Method: Two Stage least squares (1990.2-2003.3)

	Equation 2.1	Equation 2.2	Equation 2.3
Dependent Variable: LRER			
Explanatory variables			
Constant	18.1049 (0.000)	8.6977 (0.022)	16.0374 (0.000)
LPROD	-1.6484 (0.000)	-0.7872 (0.122)	-1.2907 (0.000)
NFA	-0.2099 (0.023)	0.00762 (0.971)	-0.2176 (0.005)
LTT	-0.1609 (0.207)	-0.0516 (0.812)	-0.3281 (0.003)
GOBMY	-2.0955 (0.004)	-1.2315 (0.3875)	-1.4774 (0.013)
LTARI	-6.8723 (0.000)	-0.5273 (0.8028)	-4.7295 (0.000)
FKN_ABM	-- (-)	-0.0010 (0.185)	-0.0014 (0.000)
Volrdom	-- (-)	-1.8649 (0.274)	-4.4666 (0.000)
rdom-rext-fc	-- (-)	1.0923 (0.394)	-- (-)
Lcpr	-- (-)	0.4921 (0.182)	-- (-)
Volrer	-- (-)	4.6939 (0.318)	-- (-)
Dumband	-- (-)	-0.0430 (0.524)	-- (-)
Lfexint	-- (-)	-0.1043 (0.335)	-- (-)
Adjusted R ²	0.702	0.707	0.832
Durbin-Watson statistic	1.598	1.843	1.941
Dickey-Fuller Estimation Residuals	-3.187	-6.798	-7.014 ²

Source: Estimations by the author.

1/ Figures in parentheses correspond to P-values. Instruments: lrer(t-1), volrer(-1), rdom-rext-fc, lgdp(-1), lempl(-1), ltt, gobmy, nfa(-1), ltarif, fkn_abm, lfexint(t-1), volrdom, lacdo, dumband.

2/ Significant at 1 percent according to the Engle-Granger test for cointegration.

- Second, the domestic-foreign real interest rate differential adjusted by the URR financing cost fc , ($r_{dom} - r_{ext} - fc$), represents the domestic pull that attracts capital inflows and is also expected to result in an appreciating response of the RER ;
- *Third*, the foreign exchange intervention (L_{fxint}) that represents the cumulative acquisition of net foreign assets by the Central Bank. Such intervention should have a depreciating effect on the RER ;
- *Fourth and fifth*, the presence of the foreign exchange band (D_{umband}), that could either prevent appreciations or depreciations, but most likely the former during the band years; and the central parity rate, that could serve as a point of attraction and guide for the RER ;
- *And finally*, the volatilities of the domestic real returns (Vol_{rdom}) and of the real exchange rate (Vol_{rer})

Adding the seven financial variables we obtain equation 2.2 and the data rejects the exclusion of those additional variables from the RER equation at 1 percent significance.³⁸ Even though the Durbin-Watson test improves to 1.84, the relationship represented by the regression 2.2 does not co-integrate at 10 percent significance according to the Engle Granger test.³⁹ Moreover, the seven additional variables result in multicollinearity that distorts the value and statistical significance of the estimated parameters.⁴⁰

The third regression, equation 2.3, is defined by the exclusion of some of the additional explanatory variables in 2.2. The five variables to be excluded were selected on the basis of their t-statistics, using increasingly more demanding statistical significance. The variables excluded were $r_{dom} - r_{ext} - fc$, L_{fxint} , L_{cpr} , D_{umband} , and Vol_{rer} , and the results indicate that such exclusion is not rejected by the data at 10 percent significance.⁴¹ All the explanatory variables in 2.3 have the appropriate signs and are statistically different from zero at 1 percent significance. This relationship co-integrates at 1 percent significance according to the Engle Granger test⁴², and the problem of residual autocorrelation appears to have been corrected, $DW=1.94$.

³⁸ Using both the F and log of Likelihood tests, the exclusion of seven additional variables from the RER specification in equation 2.2 is rejected at 1 percent significance. The comparison of equations 2.1 and 2.2 yields F statistic value of 3.65, and Chi Squared statistic value of 25.57.

³⁹ The critical value of the Engle Granger test at 10% of significance for five variables and 50 observations reported in Enders (2004) Table C is -4.348. A simple extrapolation to 13 variables yields a critical value of -8.839.

⁴⁰ The fundamental variables should form part of the RER equation on theoretical grounds, only the seven additional variables are subject to exclusion depending on their contribution to empirically explain the evolution of the RER .

⁴¹ The exclusion of the five variables from 2.2 lead to specification 2.3. Such exclusion is not rejected by the data at 10 percent significance being the F statistic value 1.71 and the Chi-Squared value 8.53 when comparing Eq. 2.2 and 2.3.

⁴² The critical value at 1% of significance of the Engle Granger test for 8 variables and 50 observations is -6.814 while the ADF test for the residuals in equation 2.3 is -7.014.

From the results, it is clear that the financial policy variables (*rdom*, *fc* and *Lfexint*) did not play an active role in explaining the *RER* swings by compensating for the effects of the capital flow variables. It is still possible, however, that the policy variables may have been relevant in affecting the *RER* by modifying the adjustment path towards its trend. That will be analyzed in the next section.

Table 5. Chile: Error-Correction Model for Real Exchange Rate (Based on Equation 2.3)^{1/}
 Method: Ordinary least squares (1991.1-2003.3)

$[dRER(t)] = -0.5608*dProd1 - 0.7634 *dprodl(t-1) - 0.1992* [dtt(t)+dtt(t-1)]$		
(0.000)	0.0000	(0.000)
- 0.1524*[dnfa (t) + dnfa (t-2)] - 0.8136*[dgobmy + dgobmy(t-2)] - 1.5064*dgobmy (t-1)		
(0.0000)	(0.0000)	(0.000)
- 3.715*dtari (t-2) - 0.0006*[df_abm (t)+df_abm(t-2)+df_abm(t-3)]		
(0.0000)	(0.0000).	
0.6065*[drdom (t-3)- drect (t-3)- dfc (t-3)+ drdom (t-4)- drect (t-4)- dfc(t-4)]		
(0.0000)		
-2.0631*[drect(t)- drect (t-2)] - 0.1022 *[dfexi (t-1)- dfexi (t-3)] - 0.3074*RESID(-1)		
(0.0000)	(0.0001)	.(0.0000)
Adj R-Squared 0.78		
Durbin Watson 2.06		

Source: Estimations by the author.

^{1/} Figures in parentheses correspond to P-values.

C. Policy Effectiveness and the RER

The error correction model (ECM) for the *RER* presented in table III.4 was developed in association with the co integration equation 2.3, where *dRER* is the first difference of the dependent variable (Real Exchange Rate in logs) and *dXi* are the first differences of the fundamental and financial variables included as explanatory in the macro model for the *RER*. Finally *RESID(-1)* is the lagged estimated residual in the co-integration equation 2.3.

The explanatory variables effectively included refer to current and lagged changes in fundamentals: in productivity (*dprodl*), in terms of trade (*dtt*) in net foreign assets relative to GDP (*dnfa*), in import tariffs (*dtari*), and in government spending relative to GDP (*dgobmy*). The explanatory variables also refer to financing conditions, including changes in the foreign capital flows to Latin American countries (*df_abm*); foreign exchange intervention (*dfexi*), and changes in the URR adjusted interest rate differential (*drdom-drect-dfc*). All the estimated coefficients associated to the selected explanatory variables are statistically significant at 1 percent and the regression presents no autocorrelation. Finally, the adjustment velocity of the real exchange rate towards its equilibrium trend is rather slow allowing for some persistence of the effects.

To assess the impact of key variables on the *RER*, total multiplier effects for relevant changes in those variables were constructed on the basis of the error correction model estimation results, and presented in Table 5. Those variables that are only included in the ECM but not in the co integration relationship like *fc* and *lfexint*, have only transitory effects on the trajectory of the *RER* but do not modify its equilibrium value.

For the *URR* financing cost, the sustained change in the policy variable (*fc*) was defined as 100 basic points. An increase in the *URR* financing cost of that magnitude depreciated the real exchange rate by 0.6 percent after three quarters, but after ten quarters the total effect on the *RER* fell to 0.1 percent completely disappearing afterwards. The real domestic interest rate had an effect of the same magnitude, but in the opposite direction of the *fc*. In the case of the intervention in the foreign exchange market, the sustained policy change was defined as 10 percent of the intervention stock. Such effect depreciated the *RER* by 1 percent after one quarter, but then the effect vanishes very rapidly, and even it was reversed to an appreciation of 0.5 percent after three quarters.

Table 6. Chile : Effects on *RER* of Sustained Changes in Key Variables
In percent

	DFC	DFEXI	DGOBMY	DF ABM	DTARI	DTT
delta	100	10	1	10	1	1
Periods						
1	0.00	1.02	-0.45	-0.80	-1.45	-0.44
3	0.61	-0.53	-4.94	-2.04	-5.42	-0.38
6	0.49	-0.18	-4.80	-1.59	-4.96	-0.35
10	0.11	-0.04	-4.75	-1.42	-4.78	-0.33
20	0.00	0.00	-4.73	-1.37	-4.73	-0.33

Source: Estimations by the author on the basis of Table 5. and Equation (2.3).

The financial policy variables have limited effects on the *RER*. The effect of the *URR* appears to have been enough to compensate for the wider domestic/foreign interest rate differential associated to the cyclical upswing, but completely insufficient to face the push of capital flows surge. On the other hand, the contribution of the foreign exchange intervention on the *RER* appears to be insignificant and short-lasting. Not only the effectiveness of the *URR* on the *RER* appears to be much stronger and long-lasting than that of the intervention in the foreign exchange market, but also appears to be more efficient when considering the fiscal costs involved. While the *URR* yielded 0.2 to 0.3 percent of GDP in revenue to the Central Bank during its application, the fiscal cost of using foreign exchange intervention is not irrelevant. International reserves yield the *libo* real rate and to the extent the net purchases of foreign exchange had to be sterilized, they were financed at the domestic real rate (*rdom*). The net return of such an operation, finance international reserves positions domestically have been negative, being the

historical average -400 basis points excluding the effect of changes in the real exchange rate⁴³. In recent periods the cost of domestically financing NIR has fallen reflecting lower sovereign spreads and a more accommodative domestic monetary policy.

The effect of the financial policy variables was insufficient to confront the external push of capital flows during the surge. The increase of capital flows to Latin-American countries, *nkf_abm*, that took place during the time of the surge of inflows resulted in a strong and long lasting appreciation of the *RER*. The additional US\$10 billion in *nkf_abm* would have appreciated the *RER* by a cumulative 2 percent after 3 quarters, and by 1.4 percent over the long-term. Furthermore, a 1 percent increase in the terms of trade resulted in a real appreciation of 0.4 percent in the short-run and 0.3 percent in the longer term.

According to the estimation results, the policy variables that could be used to confront the *RER* appreciation are the import tariffs and government spending. Of course those policies have their own objectives, so that may not be available to manage the *RER*, but their potential contribution should not be dismissed and could in some cases be consider an additional benefit of pursuing certain structural policy directions. In this regard, the reduction of import tariffs during a period of capital flow surges add an element of *RER* stabilization to the welfare benefits associated to trade opening, a 1 percent reduction in the tariff index may depreciate the *RER* by 5 percent over the long term. Moreover, the use of a counter cyclical fiscal policy not also contributes to output stability, but in addition would help to avoid a rapidly growing government spending during the boom that may end up aggravating the *RER* appreciation resulting from the surge in capital flows. A reduction of 1 percent of GDP in government spending would depreciate the *RER* by almost 5 percent over the long term. No doubt both responses appear to be extremely strong and may represent an over estimation. However, they are indicative of the relative importance of structural policies over financial policies in determining the value of the real exchange rate in the medium- and long-term.

IV. Conclusions and Policy Lessons

An independent monetary policy is essential for a country like Chile that faces idiosyncratic shocks and where inflation control is the goal of the independent central bank. With a pegged exchange rate within a band, an independent monetary policy is possible to conduct only by limiting international financial integration; thus, capital account regulations were applied in Chile as a complement to the quasi-pegged exchange rate. Not surprisingly, the gradual liberalization of the capital account in Chile was carried out in a macroeconomically opportunistic fashion and in parallel with increased exchange rate flexibility. The elimination of outflow restrictions was done during the surge of capital inflows, while the elimination of the inflow restrictions took place after the sudden stop in capital flows. Finally, the liberalization

⁴³ The net cost of holding reserves could be mitigated to the extent that other financing sources for NIR like base money of foreign debt are considered. For base money, the net return would be equal to the *libo* rate, while for foreign debt financing the net return would be minus the sovereign spread. The monetary financing no doubt is limited while the foreign debt financing was not used at all by the Central Bank during the 1990s, period in which its foreign debt was fully prepaid.

was completed, together with the floating of the exchange rate, after the Chilean financial system had gained recognition for its strengths and stability.

The policy framework of the exchange rate band and capital account regulations appears to have been of limited effectiveness in stabilizing the (RER) as the surges and sudden stops in capital flows played an important role in the ample swings of the RER. In the 1990s, Chile suffered the effects of a surge of capital inflows followed by a sudden stop in the availability of external financing. However, it is fair to say that the consequences of the sudden stop of 1998 were much milder than in previous episodes, like in the early 1980s, when no capital flow regulations were in place and most of the conditions for liberalization had not been met.

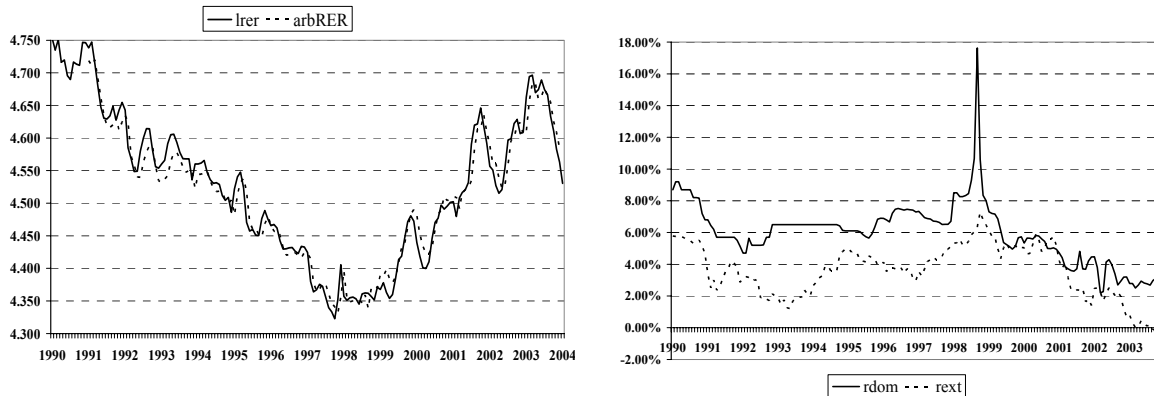
The financial policy variables that are often associated with RER stabilization do not appear to have affected its trend. In the setting of an arbitrage model, the URR, but not foreign exchange intervention, had short-run effects on the RER. The RER depreciated in response to the financing cost of the URR, for given values of the expected future RER and of the domestic-foreign real interest rate differential. In the setting of a macro model, the URR and foreign exchange intervention appear to have had only temporary effects on the RER trajectory, and even more the effects of the foreign exchange intervention were particularly weak and short-lived, while the URR was able to compensate for only the effect of independent monetary policy on the RER. The limited effects of the URR on the RER and its inability to compensate for the effects of the surge in capital flows indicate that selective capital account restrictions of the type used in Chile are only transitorily effective; thus they can smooth out the adjustment process but cannot successfully act as a permanent policy variable to control the RER. In the event of a new surge in capital inflows, and given the weak and short-lived effect on the RER it appears particularly inconvenient to use foreign exchange intervention policy to defend levels of the RER. Under those conditions floating coupled with intervention undertaken to moderate volatility appears clearly preferable to an exchange rate target.

Finally, a fiscal policy that stabilizes the growth rate of government spending throughout the business cycle appears to have significant potential as a tool with which to moderate the swings in the *RER* induced by capital flows. However, the strength of the surges in capital inflows may prove that stabilization of public spending growth alone is insufficient to compensate for their effects and eventually require a more active countercyclical fiscal effort, which, however, is not always possible owing to political or financial considerations. Lastly, trade openness shows an interesting impact on the RER that may justify a more aggressive policy of trade openness and tariff reductions during periods of strong capital inflows.

APPENDIXES

Appendix I. Glossary of Variables Used in Regressions

Real exchange rate (LRER= log RER). An increase in the RER Index represents a real depreciation. Source: Central Bank of Chile. **Arbitrage Real Exchange Rate (arb[RER(t)] = E[RER(t + 1)] - (rdom - rext)).** Where E[RER(t+1)] represents the anticipated RER for next period. Source: Calculations by the author.

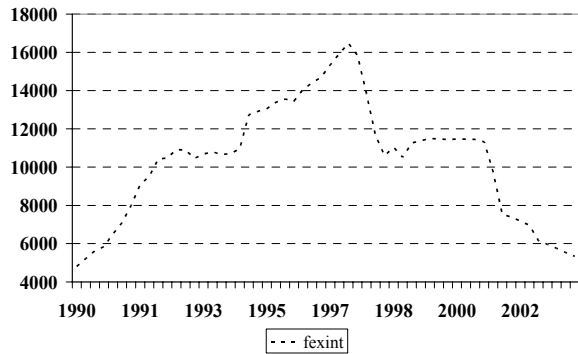
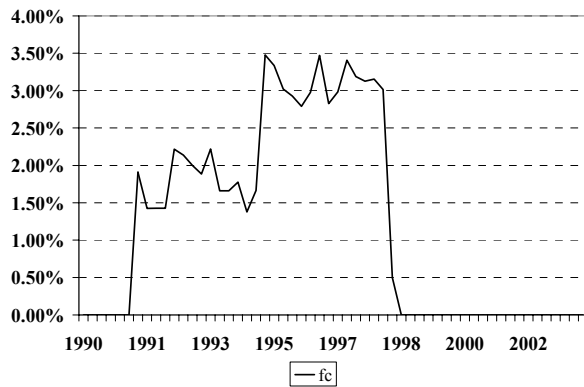


Domestic real interest rate (rdom). Average real interest rate of the Central Bank short-term financial instrument indexed to the CPI (denominated in UF). In general the rate of the 90 day PRBC was used, and when this instrument was not issued it was replaced by the alternative UF instrument with the shortest maturity issued by the Central Bank. Source: Central Bank of Chile.

Foreign real interest rate (rext = libo90 - EPI * +srcl). Real interest rate for loans to the Chilean sovereign. Source calculation by the author on the basis of: **Foreign nominal interest rate (libo90).** Libo rate in dollars for 90 days. Source: Central Bank of Chile; **Expected Foreign Inflation (EPI *)** Projected rate of Change of the Wholesale price index of the United States. Source: Calculation of the author based on information published by the Central Bank of Chile, and **Chile's Sovereign Spread (srcl).** Source: JP Morgan.

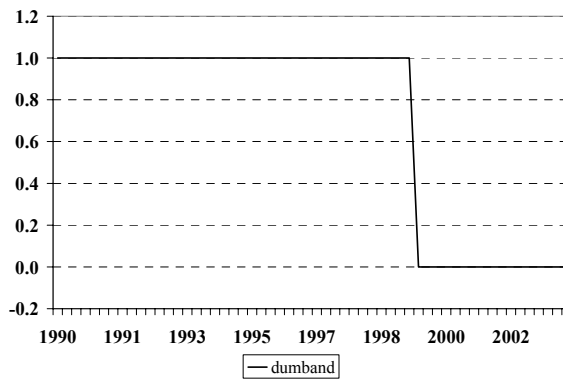
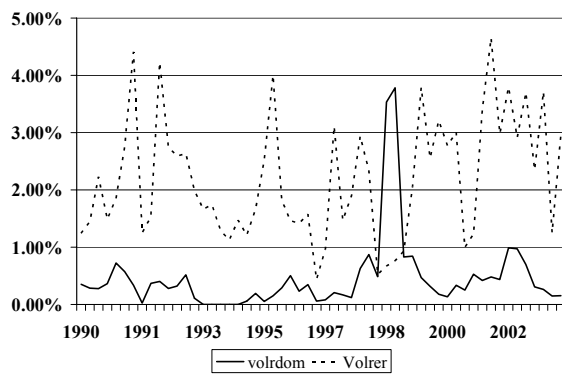
Financial cost of the Unremunerated Reserve Requirement on Capital Inflows

$(fc = \frac{\epsilon}{(1 - \epsilon)} \frac{(i^* + s)}{(1 - t)})$. Where ϵ is the URR rate for the period (30%), i^* the One-year Libo rate, s the average spread on short-term foreign loans to the Chilean private sector, and t is the tax on foreign interest payments (4%). This variable is calculated assuming a loan with the same maturity of the required deposit, one year (Source: Le Fort and Sanhueza, 1997).

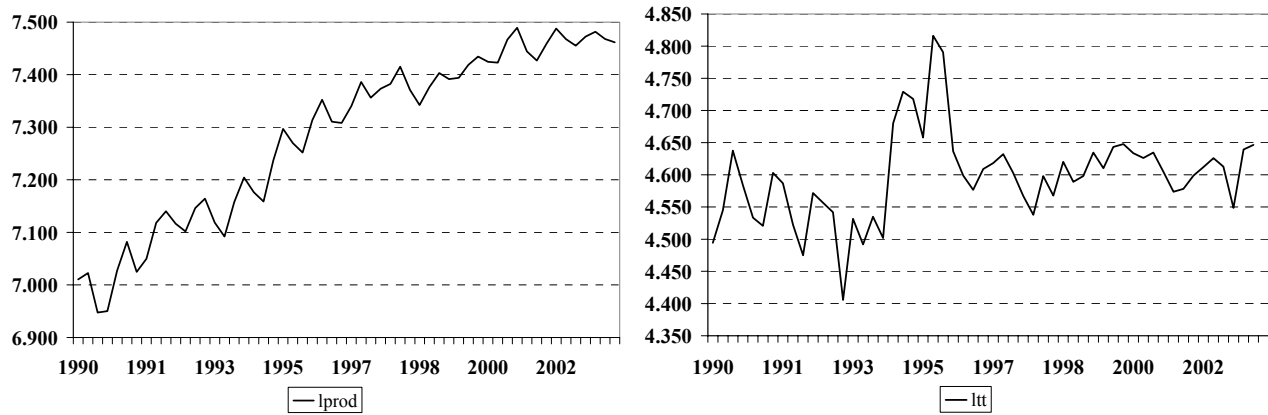


Foreign Exchange Intervention Stock (LFEXINT=log(FEXINT)): Fexint represent the cumulative net Purchases of foreign exchange by the Central Bank, minus the stock of exchange rate linked instruments issued by the C. Bank. Source: Central Bank of Chile. APPENDIX I

Volatility of Domestic Returns (Volrdom): Quarterly Average Standard Deviation of rdom, calculated on the basis of monthly information for the previous six months. Source calculations by the author on the basis of Central Bank data. **Volatility of the Real Exchange Rate (Volrer):** Quarterly Average Standard Deviation of rer, calculated on the basis of monthly information for the previous six months. Source calculations by the author on the basis of Central Bank data.

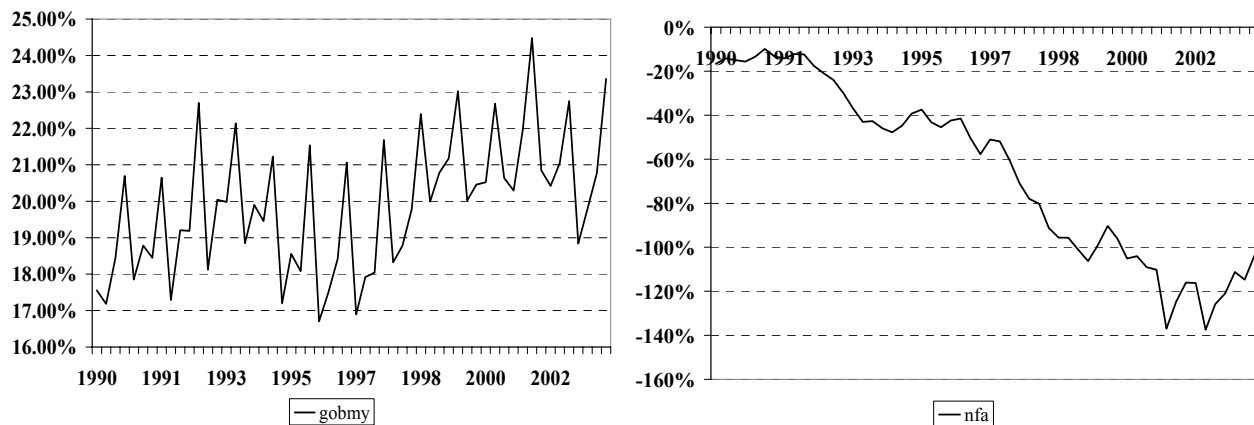


Dummy for the Exchange Rate Band (Dumband): Takes the value 1 during the period of application of the Exchange Rate band (1990.1-1999.3), and zero otherwise. Source calculations by the author on the basis of Central Bank data.

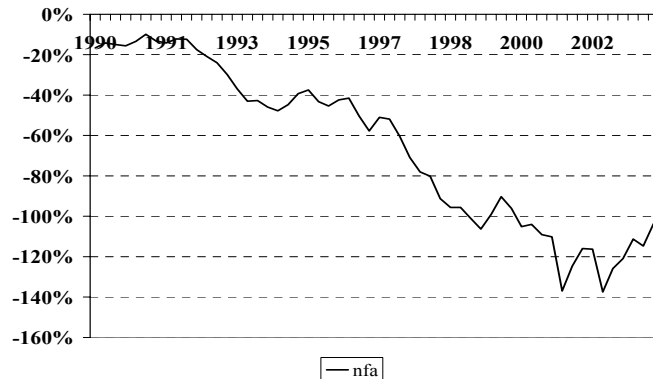
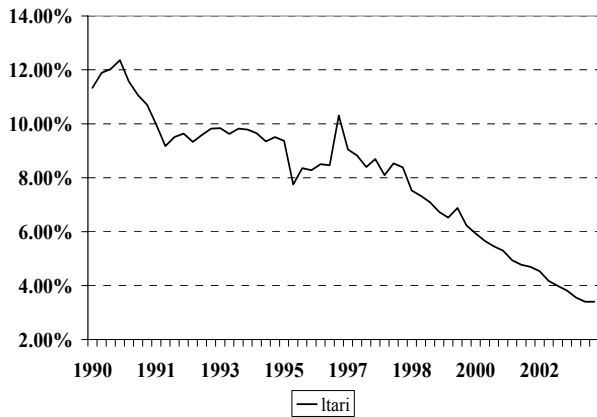


Labor Productivity ($Lprod=LGDP-LEmpl$): Source: Calculations by the author, on the basis of: *Gross domestic product, ($LGDP=log GDP$)* and total *Employment at national level, ($LEmpl=log Empl$)*. Source: Central Bank

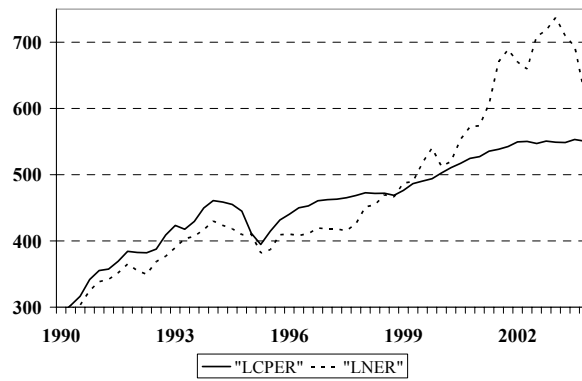
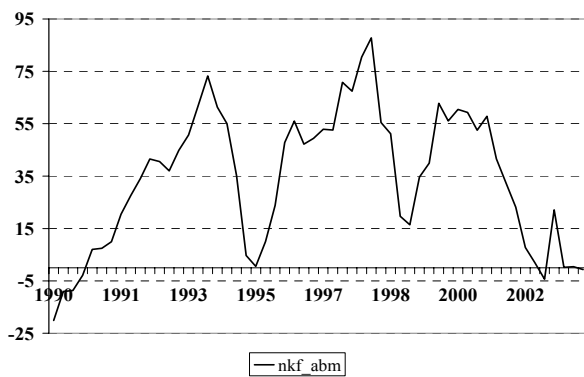
Index of the terms of trade ($LTT=log TT$). Source: Central Bank.



Government spending with Macroeconomic Relevance, ($GOBMY= GOBM/GDP$). Central Government Spending excluding interest payments to the Central Bank, presented as a percent of GDP. Source: Budget Office, Ministry of Finance.



Import tariff Index ($Ltari = \log(1 + \text{Av tariff})$) Index of Average import tariff rate. Source, calculated by the author on the basis of information for average tariff rates of the Budget office, Ministry of Finance. **Net Foreign Assets ($NFA = \text{Cumm. BOP CA/GDP}$)**. Stock estimated on the basis of accumulated external current account balances. Source: calculations by the author on the basis of **Balance of Payment** data from the Central Bank of Chile.



Net capital flows to main Latin-American countries (nkf_abm). Sum of annual net capital flows to Argentina, Brazil and Mexico. Source: IMF Balance of Payments Statistics.

Observed Nominal Exchange Rate in the Interbank Market ($LNER = \log(NER)$). Source: Central Bank of Chile. **Central Parity Exchange rate ($LCPER = \log(CPER)$)**. Nominal exchange rates in Chilean pesos per US\$. Source: Central Bank of Chile.

**Appendix II. Chile: Augmented Dickey-Fuller (ADF) Unit Root Test
(1990:1-2003:4)**

(First difference of each variable presented in the line immediately below)

<i>Variable</i>	ADF With Constant, Without Trend	ADF Constant and Trend	<i>Variable</i>	ADF With Constant, Without Trend	ADF Constant and Trend
LRER	-1.95	-1.42/	LCPR	-1.97	-2.95
dRER	-6.76 ^{1/}	-7.19 ^{1/}	dCPR	-5.03 ^{1/}	-5.00 ^{1/}
Rdom	-1.89	-2.22	NKF_ABM	-2.03	-1.24
Drdom	-7.84 ^{1/}	-7.76 ^{1/}	dNKF_ABM	-5.76 ^{1/}	-6.42 ^{1/}
REXT	-1.48	-1.02	Dumband	-0.64	-1.96
dREXT	-5.58 ^{1/}	-5.54 ^{1/}	dDumband	-7.35 ^{1/}	-7.34 ^{1/}
Fc	-1.53	-2.03	Ltt	-3.61 ^{1/}	-3.69 ^{2/}
dFc	-7.11 ^{1/}	-7.20 ^{1/}	Dtt	-8.58 ^{1/}	-8.50 ^{1/}
Lfexint	-1.36	-1.47	Nfa	-1.74	-2.77
Dfexi	-3.81 ^{1/}	-4.91 ^{1/}	Dnfa	-1.65 ^{5/}	-1.58 ^{5/}
Lprod	-2.04	-1.73	Gobmy	-1.69	-2.26
Dprod	-2.61 ^{3/ 5/}	-3.13 ^{5/}	Dgobmy	-3.31 ^{2/}	-3.28 ^{3/}
Rdom-rext- fc	-3.13 ^{2/ 6/}	-3.23 ^{2/ 6/}	Arb[ltrc]	-1.75	-1,35
d(Rdom- rext-fc)	-7.17 ^{1/}	-7.17 ^{1/}	dArb[ltrc]	-6.80 ^{1/}	-7.25 ^{1/}
Volrdom	-3.68 ^{1/ 4/}	-3.71 ^{2/ 4/}	Ltari	0.57	-2.57
Dvolrdom	-7.68 ^{1/}	-7.61 ^{1/}	dtari	-9.16 ^{1/}	-4.88 ^{1/}
Volrer	-5.14 ^{1/}	-5.26 ^{1/}	Volrext	-6.08 ^{1/ 4/}	-5.96 ^{1/ 4/}
Dvolrer	-10.00 ^{1/}	-5.05 ^{1/}	Dvolrext	-6.26 ^{1/}	-6.21 ^{1/}

Source: Prepared by the author on the basis of the data presented in Appendix A.

^{1/} The null hypothesis of a unit root is rejected at 1% significance.

^{2/} Rejected at 5%.

^{3/} Rejected at 10%

^{4/} The null hypothesis of a unit root cannot be rejected using the ERS test at 10% significance level.

^{5/} Using the Phillips Perron the unit root hypothesis is rejected at the 1% significance level.

^{6/} The null hypothesis of a unit root cannot be rejected using the DF-GLS test at 10% significance level.

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