The unremunerated reserve requirement and net capital flows: Chile in the 1990s

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In the 1990s, Chile suffered the effects of a surge in external capital inflows that came to a sudden stop towards the end of the decade, despite its concentration in flows considered to be stable, implying that an appropriate composition of capital flows is not by itself adequate protection against capital flow volatility. The surge in capital flows responded to push factors associated with the supply of foreign financing that narrowed the spread between domestic and external returns. The unremunerated reserve requirement (known as *encaje*) helped to offset the push factors by widening the spread and restraining net capital inflows, particularly short-term, thus gaining additional room for monetary-policy manoeuvre. An early elimination of the *encaje* during the capital inflow surge would have boosted the inflows still further, thus aggravating macroeconomic imbalances. An intensification of the *encaje*, however, would have had limited marginal effectiveness due to circumvention and the bound imposed by short-term inflows, already close to zero. A more effective strategy would have been to apply the *encaje* on a wider basis, thus avoiding circumvention, or to complement its application with additional restraint on fiscal policy.

I

Introduction

Unrestricted liberalization of financial flows is an orthodox economic-policy recommendation that invokes a parallel between financial integration and its counterpart in international trade. Nonetheless, repeated experiences of financial crisis among developing countries that have embraced financial openness have raised major doubts as to the validity of this parallel. Renowned scholars such as J. Bhagwati,[1] and prestigious publications known for their support of liberal economic policies, such as *The Economist* (2003a and 2003b), have called for a review of the orthodoxy to acknowledge that some temporary restrictions on financial integration are justified in the light of practical experience. Far from promoting financial openness as an end in itself, in recent years the International Monetary Fund (IMF) has conducted studies projecting a more balanced attitude towards the benefits and costs of financial integration, and has recommended prudence in moving towards this.[2] Other authors have undertaken major studies of sudden stops of capital inflows and of how problems arising in the functioning of financial markets cause macroeconomic imbalances and costly recessions.[3] Without proposing outright restrictions on capital flows, their policy recommendations, nonetheless, imply public intervention in the free operation of financial markets.

A growing international financial integration is clearly beneficial only if it is compatible with the maintenance of macroeconomic equilibria, including a sustainable external-account position. Sudden stops of capital inflows, and the concomitant recessions and crises, impose major costs that may wipe out the benefits of integration altogether. To ensure the sustainability of the economy's external situation, it is essential that the trend growth of domestic aggregate demand be kept in line with the growth of potential gross domestic product (GDP), in order to stabilize the current-account deficit in a sustainable range and thereby forestall the effects of future reversals in external financing flows.[4]

From 1990 through 1997, the net inflow of foreign capital to Chile was exceptionally large, surpassing what would be considered a sustainable level of external financing. At the same time, real private expenditure, which accounts for over 75% of domestic aggregate demand, doubled as a result of a 10% annual average growth that outstripped the expansion of public expenditure and both actual and potential GDP. Although this vigorous expenditure growth was to some extent driven by national income, which grew at about 8% per year thanks to favourable terms of trade, it also represented a response to massive capital inflows.[5]

Neither monetary nor fiscal policy could have been the origin of the explosion of private expenditure. Escalating private expenditure led the Central Bank of Chile to apply a relatively tight monetary policy in which real interest rates were kept at high levels. In fact, the real 90-day lending rate averaged 8.8% in 1990-1997, and peaked around 15% in the first quarter of 1990.[6] Moreover, as it was private expenditure that over-expanded, fiscal policy cannot be considered as the origin of such behaviour, especially since the growth of tax revenue kept pace with the expansion of private

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[1] See Bhagwati (2003).

[2] See Kose, Prasad and others (2003).

[3] See Calvo and Reinhardt (2000), and Caballero (2003).

[4] Keeping the current-account balance within sustainable bounds should avert the need for precipitous expenditure adjustments in response to sudden stops in capital flows. The policy framework defined by the Chilean authorities in the early 1990s originally considered a current-account deficit target of between 3% and 4% of GDP, but this was later widened to a range of 3% to 5% of GDP. International experience shows that deficits larger than 5% of GDP are likely to result in abrupt adjustments (Agosin and Ffrench-Davis, 2001; Milessi Ferreti and Razin, 1996).

[5] A Granger causality test provides evidence that capital flows cause private domestic spending, but causality is rejected in the opposite direction.

[6] The buoyancy and high level of profitability of the real economy in the 1990s made it possible to reconcile rapid expansion of private expenditure with high real interest rates during the period studied.

spending. Nonetheless, fiscal spending acquired a procyclical bias, which made monetary management more difficult and led to higher interest rates than would have been necessary under a cyclically neutral fiscal policy.[7]

As a way of preventing interest-rate hikes from attracting even larger foreign capital inflows, thereby diluting the effect of monetary tightening and pressuring towards currency appreciation, in June 1991 the Central Bank imposed an unremunerated reserve requirement (URR), also known as the *encaje*, on certain types of foreign capital inflow. This formed part of a system of regulations aimed at restricting the volume of capital inflows and shifting their composition towards more stable flows. These regulations, in turn, formed an integral part of a macroeconomic policy framework based on a crawling-band exchange-rate system, gradually falling annual inflation targets, budget surpluses, trade openness, open markets and a central role for the private sector in economic activity—particularly investment.

The URR was selectively applied to certain categories of capital inflow and consisted in a compulsory non-interest-bearing deposit in foreign currency to be lodged with the Central Bank for one year, in an amount proportional to the size of the inflow (the rate was set at 30% for most of the period of application). This deposit created an additional cost to external financing, the URR financial cost (CFE), thereby discouraging external financing entering through channels covered by the URR mechanism. The policy was designed essentially to restrain short-term borrowing. Between 1990 and 1996, it was strengthened in various ways, such that the financial cost associated with the URR peaked in the third quarter of 1996 at 350 basis points. To prevent the URR from losing effectiveness over time, steps were taken to hinder its circumvention through exempted channels of external financing, with the last of such measures being introduced in the last quarter of 1996.[8] When capital-inflow pressures eased, the URR rate was reduced to zero in two stages in 1998, and the mechanism was subsequently eliminated, along with the remaining foreign capital controls, in 2001.

The unremunerated reserve requirement represented a restriction to international financial integration and, like any other measure of this type, it had both benefits and costs. The controversy surrounding the URR has generated a wide-ranging literature, including empirical works that have attempted to measure its effects. The URR defence has been based on its macroeconomic-policy effects, including giving greater room for manoeuvre to monetary policy, and averting the amplification of the business cycle that could result from massive but transitory external capital inflows. Underlying this idea is the belief that the probability of sudden stops in capital flows and the damage they cause are likely to be lower, since the intensity with which foreign financing is used is lower.[9] Against this, the URR's detractors claim that it was ineffective in achieving its objectives, particularly in regards to limiting the size of total capital flows, and that it generated microeconomic costs by making it harder for some local agents to obtain foreign financing and thereby raising its cost.

The core of this paper is to study the macroeconomic effectiveness of the URR as applied in Chile during the 1990s. It does not analyse the advisability or otherwise of its current or future use, either in Chile or elsewhere. Clearly, the instrument's effectiveness is one of the key factors to be considered when evaluating its future application, but it is not the only one. Other relevant considerations include the conditions of the supply of external financing, the capacity of the economy and local financial system to cope with the volatility of capital flows, the legal and regulatory infrastructure within which the URR policy would be applied, and the limitations imposed by international treaties and other legal instruments. In short, application of the *encaje* today is a different issue, with wide-ranging complications pertaining to each particular case; this subject is not addressed in this paper.

Econometrics using macroeconomic data is far from a purely objective method of analysis (even though many of its practitioners act as if it were so), and prior

[7] Although the fiscal balance was in surplus through 1990-1997, the elasticity of public expenditure with respect to the output cycle was significantly positive, and similar in value to the response of public revenues to the output cycle. Both the surplus and the procyclical behaviour of expenditure went into reverse as from 1998, when the economy entered a downswing; but public expenditure continued to expand, partly compensating the slowdown in activity.

[8] An analysis of the coverage of the *encaje* and the way the regulations evolved is provided in Le Fort and Sanhueza (1997).

[9] The policy strategy followed in Chile, including the regulation of capital flows, is described in Massad (1998) and in Zahler (1996). Studies by the International Monetary Fund (IMF) have viewed the *encaje* as a positive factor for the stability of the financial system, as it discourages excessive dollarization of liabilities and financial intermediation. See Gulde-Wolf, Hoelsher and others (2003).

beliefs play a major role in model specification.[10] The authors of this paper were directly involved in designing the application of the URR and related measures in Chile; and the null hypothesis of our study is that it was an effective mechanism, despite the existence of channels that were not covered and were used as ways to circumvent it. A good indicator of the macroeconomic effects of the policy is reflected in the annual revenue obtained by the central bank from the URR (between 0.2% and 0.3% of GDP), and in the systematic spread in favour of assets denominated in pesos compared to those denominated in foreign currency that was registered while the *encaje* was in force.

Clearly, the URR was not entirely effective for otherwise the excessive growth of private expenditure would not have occurred, nor the widening of the current-account deficit that Chile suffered by 1997. But less-than-full effectiveness does not mean it was ineffective or did not make a significant contribution. In an attempt to evaluate the URR's effectiveness, we pose the following two questions to be answered empirically: (i) What would have happened to capital inflows and private spending if the URR had been eliminated earlier at the height of the surge in capital inflows?, and (ii) Could a more intensive application of the URR have avoided the inflow surge and associated macroeconomic imbalances, or should it have been complemented with other policies?

The article is organized as follows. Section II studies the characteristics of the surge in capital inflows, assesses its origins, and examines the role of the URR in absorbing foreign financing shocks, in particular, whether the reserve requirement helped to drive a wedge between domestic and external interest rates, thereby giving additional room for monetary-policy manoeuvre. Section III estimates a simple econometric model that aims to analyse the effects of the *encaje* on net capital flows and domestic demand. In particular, it studies whether the mechanism managed to reduce capital flows and thus helped moderate the expansion of private spending. Section IV simulates first, the effect of eliminating the URR in the period when the surge of capital flows took place, and second, the different adjustment scenarios for dealing with the surge in inflows, including a more intensive use of the URR supported by countercyclical fiscal policy. Section V summarizes the main results and conclusions of the study.[11]

II

Characteristics of capital flows and external shocks

The scale of the net capital inflows that took place in Chile between 1990 and 1997 is indicative of a long-lasting foreign-financing shock, the so-called capital-inflow surge, which came to a sudden stop in 1998 (see table 1). Total net capital flows into Chile averaged more than 7% of GDP in 1990-1997, and only 0.5% of GDP in 1999-2000. While short-term flows were highly volatile and lacking in any clear trend, the flow of medium and long-term capital trended upward on a sustained basis, growing by an average of around 23% in 1990-1997; but beginning in 1998 the capital inflow slackened in all categories (short-, medium- and long-term). The sudden stop was verified as total net capital flows declined by over five percentage points of GDP in 1998 (to 4.5%) and again in 1999 (to -1.2%).[12]

It is broadly accepted that an economy's vulnerability to an interruption of external financing is greater, the more such financing is concentrated in short-term flows, the most volatile and least persistent type of capital flows. Nonetheless, it has also been

[10] See Leamer (1983).

[11] Appendix A provides a glossary of the variables used in this paper; and appendix B contains graphs tracking the behaviour of the main variables.

[12] Short-term capital flows are the most volatile and the least persistent category of capital flow, as measured by the autocorrelation coefficient. See Le Fort and Lehmann (2000); however the sudden stop affected also medium- and long-term flows, including net foreign direct investment.

TABLE 1

Chile: Foreign capital flows, 1990-1999
(Percentage of GDP)

	Gross medium- and long-term inflows			Net short-term flows	Medium- and long-term outflows	Total net flows
	Direct investment	Portfolio investment	Loans			
1990	2.2	1.2	7.4	4.0	5.2	9.6
1991	2.7	0.8	4.1	1.0	5.8	1.8
1992	2.5	1.1	3.9	4.5	4.7	6.7
1993	2.9	2.7	4.4	2.9	5.9	7.1
1994	5.4	3.3	5.6	2.8	6.6	10.5
1995	5.3	1.9	5.2	0.4	9.4	3.5
1996	7.2	2.7	7.8	0.4	10.3	7.8
1997	7.3	4.8	8.2	-2.1	8.4	9.8
1998	7.3	1.8	8.3	-1.5	11.5	4.5
1999	14.8	4.7	6.2	-8.0	18.7	-1.2
Average 1990-1997	5.6	2.2	5.8	1.7	6.9	7.3

Source: Prepared by the authors using data from the Central Bank of Chile.

shown that concentrating external financing in medium- and long-term flows does not necessarily eliminate the risk of a sudden stop. The capital inflow surge that took place in Chile between 1990 and 1997 was concentrated in medium- and long-term flows, with short-term inflows reduced to a minimum; but even so, total net capital flows came to a halt as from 1998. Even when using exclusively medium- and long-term external financing a sudden stop can take place; investors holding medium- and long-term liability positions in foreign currency can access the foreign-exchange markets, spot or forward,[13] to hedge their exchange-rate risk. This hedging implies the acquisition of foreign-currency denominated assets, thus generating short-term capital outflows that in fact originated from medium-and long-term external liabilities.

1. Surge of capital inflows: External push or domestic pull?

The capital inflows surge may be an endogenous response to domestic conditions that result in a high interest rate, which, in turn, "pulls" a heavy inflow of external capital by demand or arbitrage conditions.[14] Under this option, the widening of the spread of expected returns between domestic and foreign assets that result from changes in domestic macroeconomic conditions (e.g. structural reforms that increase the rate of return on real investment and thus raise the domestic interest rate, or expansionary fiscal policy) attracts or "pulls" capital into the country. The endogenous surge involves a positive correlation between capital inflows and the domestic interest rate, or between capital inflows and the spread of returns between domestic and external assets (*Spread*).

$$Spread = rc90 - (libo90 - E\prod{}^{*} + ss) - E[\hat{TCR}]$$

The *spread* of expected asset returns[15] is measured as the differential between the domestic and external real interest rates, corrected for expectations of devaluation and Chile's sovereign risk ratio (calculated on the basis of the Chilean government bond issued in April 1999);[16] *rc*90 is the domestic real interest rate on

[13] A unified "spot" market for foreign exchange free of restrictions exists in Chile since early 1996, when the gradual elimination of exchange restrictions was completed; investors are able to use this market to acquire and remit foreign exchange abroad. Moreover, a quite deep "*forward" foreign-exchange market*, in operation since the early 1990s, has been intensively used for buying or selling foreign exchange against Chilean pesos with delivery or compensation at a future date.

[14] See Kruger (1998) and Le Fort (1998).

[15] The definition of the *Spread* is presented in the equation. Appendix A presents additional details on the definitions and the sources of the variables used in the paper.

[16] The sovereign spread or country risk on Chilean debt from 1992 to 1998 is estimated by splicing series representing the spread on Chilean corporate bonds, calculated on the basis of 10-year bonds issued by the National Electricity Corporation (Endesa/Enersis). For the period 1985-1992, this is spliced with the risk index for Chile calculated by Euromoney.

TABLE 2

Chile: Correlations of capital inflows and asset returns
(1990.1 to 2000.4) [a/]

	Expected spread (*spread*)	Observed spread (*spread_* 2)	Dom. interest rate (*rc*90)
Total net flows (FKN)	-8% (4.22)	11% (5.57)	13% (5.98)
Net short-term flows (FKNCP)	28% (0.46)	19% (0.48)	7% (0.02)
Gross medium- and long-term flows	-18% (5.10)	-31% (6.28)	-9% (7.95)
Net medium- and long-term flows (FKM&LP)	-38% (3.76)	-8% (4.93)	5% (6.11)

Source: Prepared by the authors using data from the Central Bank of Chile.

[a/] Figures in parentheses correspond to t-statistics.

90-day loans[17]; *libo*90 is the Libor rate on three-month loans in dollars, *ss* is Chile's sovereign spread, $E[\prod^*]$ is the expected external inflation rate represented by the variation in the wholesale price index in the United States, and $E[\hat{TCR}]$ represents the expected real depreciation of the Chilean peso, and is defined as the difference between the equilibrium real exchange rate (Soto and Valdés, 1998) and the observed real exchange rate. Alternatively, $E[\hat{TCR}]\_2$ is the expected real depreciation assuming perfect foresight, i.e. is equal to the observed future real depreciation. This second measure of the anticipated real depreciation is used in calculating the spread of actual returns (*spread_2*).

Alternatively, the capital inflow surge may respond to the push of external factors not related to arbitrage but reflecting changes in international investors' perceptions and inclination to accept risks that cause them to modify the composition of their portfolios. These changes in portfolio composition modify the general conditions of supply of external financing to the country. Exogenous surges that result form the push of external factors are identified by negative correlation of capital inflows with domestic interest rates or with the spread of asset returns. Therefore, larger capital inflows mean a greater supply of financing from abroad, which moderates domestic interest rates and narrows the spread.

The surge of medium- and long-term capital inflows in Chile mostly had an exogenous nature (table 2). The correlations between gross medium- and long-term capital flows on one hand, and the expected spread of returns, actual spread of returns, and the domestic interest rate, on the other, are all negative: -31% with respect to the actual spread, -18% in relation to the expected spread and -9% with the domestic interest rate. These negative correlations are statistically different from zero in all cases. When using the medium- and long-term net capital flows as opposed to the gross flows, the correlations with the spread of both expected and actual returns are also negative and statistically significant, being more marked in the first case. However, the correlation of the net flows with the real domestic interest rate is positive. The surge in medium- and long-term capital inflows thus seems to have been exogenously driven by external push factors, and has been associated with reductions in domestic interest rates and a narrowing of the expected and effective spread between domestic and external returns.[18]

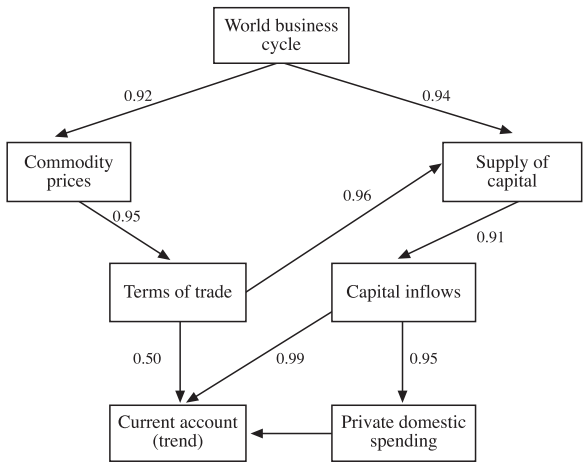
Contrary to medium-and long-term capital flows, short-term flows are positively associated with the returns spread, and as such represent endogenous responses to arbitrage. This type of flow is positively correlated with the domestic interest rate (7%), and with the spread of expected and effective returns (28% and

[17] Loans denominated in UFs, a widely used unit of account that has a daily adjusted value in Chilean pesos indexed to the CPI.

[18] These results, obtained on the basis of simple correlations, are also reflected in the multiple regressions reported in the following section for total net capital flows and net short-term flows. The spread of expected returns appears as a statistically significant attractor for short-term flows only.

FIGURE 1

Granger causality diagram [a/]
(1990.1 to 1997.4)



Source: Authors' calculations using variables presented in appendix A.
[a/] The arrows indicate the directions of significant Granger causality. The significance level is also presented.

32% respectively); but in neither case is the positive correlation statistically significant.

A possible link between external shocks on foreign financing and domestic aggregate demand should not come as a surprise. The most widely recognized transmission mechanism for external shocks to Chile arises from the effect of the world business cycle on commodity prices and thus Chile's terms of trade. But there is also a second channel for the transmission of external shocks, the supply of foreign financing. The results of the causality analysis are presented in figure 1.[19] The supply of foreign financing (OFCA) is (according to Granger) caused by the world business cycle and the terms of trade.[20] The supply of foreign financing, in turn, causes capital flows to Chile, and this affects private domestic spending.[21] Lastly, the current account at trend prices[22] is caused by private spending, capital inflows, and, to a lesser extent, the terms of trade.

2. Effects of the URR on the spread of returns

The unremunerated reserve requirement imposed on capital inflows sought to raise the cost of using external financing, in order to partially discourage it and gain additional room for monetary-policy manoeuvre. This additional room would be reflected in the arbitrage conditions and, hence, the spread of returns or its key domestic components, the domestic real interest rate or the expected real depreciation. The financial cost of the URR (CFE) arises from having to maintain a non-interest bearing foreign-currency deposit, and its value is determined by the reserve requirement rate, the maturity of the deposit, the relevant external interest rate, taxes on intermediation, and the currency in which the URR is constituted.[23] The mechanism acts as a wedge that raises the cost of obtaining external financing —analogous from a financial standpoint to a rise in the external interest rate— by an amount equal to the value of the CFE. Given the associated higher cost of external financing, this wedge depreciates the local currency, thus reducing expectations of future depreciation, or else makes it possible to raise the domestic interest rate. Either way, the spread of expected returns widens.

An initial empirical analysis of the effects of the URR is made by examining its potential impact on the spread of effective returns and on two key macroeconomic variables that are closely linked to its component elements: the real domestic interest rate and the real exchange rate. The first column of table 3 shows the results of a simple econometric exercise consisting of regressing by ordinary least squares (OLS) the actual spread of asset returns, *spread_2*, against a variable representing the supply of external capital (LOFCA, the logarithm of OFCA) and the financial cost of the URR (CFE).[24] The estimation shows that the CFE resulted in a widening of *spread_2*, while the supply of foreign

[19] Appendix C displays causalities and correlations.
[20] The variable that measures the supply of external financing (OFCA), is defined on the basis of sovereign debt spreads and net capital flows to the main Latin American countries, excluding Chile. Net flows to Argentina, Brazil and Mexico are added weighted by the ratio between their own sovereign spread and that of Chile. In this way, the indicator of the supply of foreign financing to Chile rises if capital flows to the region increase, or if Chile's sovereign spread falls relative to those of other countries in the region.
[21] Econometric estimations recognise a favourable structural break in the supply of foreign financing as from 1995, likely related to advances in financial development and openness in Chile, and the differentiation of Chile from other emerging economies following the Mexican crisis. This break was reversed from 1998 onwards.
[22] See Guajardo and Le Fort (1999).
[23] The series for the financial cost of the *encaje* was derived in Le Fort and Sanhueza (1997). For further details see appendix A.
[24] Appendix D presents the unit root test for the variables considered. Of the variables included in this relation, the spread and LOFCA appear not to be integrated of order one. The relation cointegrates according to the Engle Granger test, Appendix E.

TABLE 3

Chile: Effects of the financial cost of the *encaje* (CFE) on financial arbitrage variables [a/ b/]
(1990.1-2000.4)

Variable explained	=>	*Spread*_2	*Rc*90	LTCR
Method	=>	OLS [c/]	2SLS [d/]	2SLS [d/]
Explanatory variables:				
Constant		0.0799	0.1272	4.6409
		(0.224)	(0.000)	(0.000)
CFE +REXT-rc90		–	–	2.2624
		(–)	(–)	(0.006)
LDDA-LPIB		–	–	-2.2657
		(–)	(–)	(0.000)
CFE		2.1826	0.5633	–
		(0.157)	(0.001)	(–)
DUM98		–	0.0093	–
		(–)	(0.011)	(–)
EdTCR+REXT		–	0.0362	–
		(–)	(0.420)	(–)
LOFCA		-0.0163	-0.0121	-0.0360
		(0.298)	(0,000)	(0.019)
Adjusted R^2		0.0125	0.821	0.3585
Durbin-Watson statistic		2.133	1.195	1.125
F-statistic		1.272	45.840	11.407

Source: Prepared by the authors.

[a/] Figures in parentheses are P-values.
[b/] Instruments: CFE LFIN(-1), LOFCA FKN(-1), GAPHPY(-1), LFBKF(-1), LPIB(-1), LTI TIEMPO DUM98 RC90(-1), LIBO90 SPREAD(-1), LRSTD(-1), LGOB FKNAY(-1), LTRIB(-1), LTCR(-1), REXT EDTR(-1).
[c/] Ordinary least squares.
[d/] Two-stage least squares.

financing (LOFCA) tended to reduce it. The results are barely significant.[25]

The specification shown in the second column of table 3 is based on the same arbitrage relation, but with the real domestic interest rate as dependent variable, and the other components of the *Spread* (external interest rate and expectations of real depreciation) included among the explanatory variables.[26] The instrumental variables method is used considering that the expected depreciation is an endogenous variable. The results show that the CFE generates statistically significant effects on the real interest rate, although the parameter associated with the real external interest rate (REXT) and expected real depreciation (EdTCR) appear as non-significant, and the results are affected by serial autocorrelation. The CFE generates a positive effect on the domestic interest rate which is statistically different from zero at the 99% confidence level, acting in the opposite direction to the supply of foreign financing (measured by LOFCA or by DUM98), which significantly reduces the real domestic interest rate. The variable DUM98 represents the reversal of capital flows, taking the value 0 during periods of strong capital inflow and 1 as from 1998, when the sudden stop of flows occurred.The estimation shown in the third column of table 3 seeks to measure potential effects of the financial cost of the reserve requirement on the real exchange rate. The estimation controls for the supply of external capital (which, as expected, lowers the real exchange rate) and for the difference between aggregate demand and outputs representing the excess demand for goods, which also tends to depress the real exchange rate. It is shown that the financial cost of the *encaje* acts by

[25] The coefficient measuring the effect of the CFE on *Spread*_2 is significant only at the 84.5% confidence level, and is not statistically different from one. This restriction is not rejected by the data at the 10% significance level; value of F-statistic (0.8), value of the likelihood ratio (0.8).
[26] All the variables included in this relation are integrated of order one (except LOFCA), and the relation between them cointegrates according to the Engle Granger test (Appendices D and E).

compensating one-for-one the negative effect exerted on the real exchange rate by the difference between the domestic and external interest rates.[27]

The results of estimations for the spread and the real interest rate lend some empirical support for the idea that the URR was effective in modifying international interest-rate arbitrage conditions, thereby giving monetary policy some additional room for manoeuvre. An initial measurement of this is obtained as the effect of the CFE at its peak (350 basis points) on *Spread_2*. As noted earlier, the estimated parameter is not statistically different from one, so the additional margin would be up to 350 basis points, although the limits of a confidence interval for this are very wide, given the low significance level of the corresponding parameter. If room for monetary-policy manoeuvre is calculated on the basis of the equation presented for the real interest rate, the financial cost of the *encaje* at its peak would have allowed a real domestic interest rate that was between 90 and 300 basis points higher, according to a 95% confidence interval. Based on the equation for the real exchange rate, the maximum level of the CFE would have allowed monetary policy flexibility equivalent to a real exchange rate that was 9% more depreciated. To the extent that the *encaje* increased the room for monetary-policy manoeuvre, it had to limit net capital inflows. The following section presents the results of a simple econometric model to empirically analyse the effect of the *encaje* on capital flows.

III

Empirical model for capital flows

Various studies have considered the effects of the *encaje* on capital inflows to Chile. Forbes (2003) presents information on the microeconomic costs for small firms, arising from the partial coverage of the deposit requirement and the fact that exempt capital flows made it possible to obtain financing under conditions that essentially favoured larger firms. Several other studies have measured the macroeconomic effectiveness of Chile's URR, but none of them considered the supply of foreign financing as a relevant factor when analysing the intensification of capital inflows during the 1990s. The paper by Valdés and Soto (1996), for example, concentrates exclusively on short-term flows and shows that the effect of the reserve requirement on such flows has been negative but small, while the effect on the real exchange rate has been nil. Chumacero, Labán and Larraín (2000) also find a negative effect for the *encaje* on short-term flows and a non-significant one on long-term flows. Soto (1997) reports an effect on capital flows which is statistically significant but lacking in economic relevance. Laurens and Cardoso (1998), meanwhile, find no evidence for any effect on capital flows. Nadal-De Simone and Sorsa (1999) claim that there is no evidence yet regarding the effect of the *encaje* on the Chilean economy. De Gregorio, Edwards and Valdés (2000) and Gallego, Hernández and Schmidt-Hebbel (2002) highlight the fact that the policy has enabled the Chilean economy to maintain a higher interest-rate differential with respect to rates abroad, but the effect of this on the exchange rate is inconclusive. Nonetheless, it is acknowledged that the *encaje* induces a change in the composition of financing, by increasing the proportion of medium- and long-term foreign financing.

The results of this paper show that the *encaje* policy played a major role in restraining capital inflows into Chile, particularly short-term flows, during the 1990s. Unlike earlier papers, the empirical study we present here aims to describe the effect of the policy on the macroeconomic framework. The model recognizes the link between private demand and capital flows, and seeks to understand the role played by the URR in the behaviour of these variables in Chile during the 1990s. Unlike the empirical studies commented on above, the model presented below includes the supply of foreign financing as a relevant factor in explaining external capital flows. In addition to pull factors associated with the demand for external financing that arise from the current-account deficit and are driven by domestic demand, the study takes account of elements that represent the availability

[27] The restriction that the parameter associated with the financial cost of the *encaje* is equal to that of the difference between the external and domestic real interest rates is not rejected by the data (value of F-statistic: 0.03). This third relation between the arbitrage variables, the cost of the *encaje* and variables representing the supply of capital does not cointegrate (appendix E).

of external financing, recognizing the structural change that occurred as from 1998 when capital flows towards emerging economies in general retreated sharply.

In an earlier paper (Le Fort and Lehmann, 2000) the authors attempted to measure the effect of the *encaje* on gross capital flows, and of these on private expenditure, in a type of feedback model where the reserve requirement affects gross capital inflows but not outflows, and net flows affect aggregate demand. That specification was developed using balance-of-payments and national-accounts series with 1986 as the base year, and the results could not be satisfactorily reapplied using the new series based on 1996. Using the new macroeconomic data series, this paper estimates behavioural functions for net capital flows and the two main components of private-sector aggregate demand. Causality runs from the *encaje* to net flows and then to aggregate demand; but the model also recognizes the effect of aggregate demand on the demand for financing and capital flows. The URR is measured by its financial cost CFE and is considered an exogenous policy variable, as it seems impossible to adequately represent the way it was managed during the decade in a single behavioural function. Moreover, rather than actively regulating the intensity of the reserve requirement according to policy goals, the URR policy actions sought from time to time to compensate for the erosion of its effectiveness by the redirection of capital inflows to channels that were exempt.

1. Cointegration of capital flows

Table 4 shows cointegration relations for total net capital flows, short-term flows, and medium- and long-term flows, respectively; each of them are estimated using instrumental variables, since some of the explanatory variables are endogenous. In general, the variables are represented in natural logarithm form, which is indicated by an L preceding the name of the variable. Exceptions to the use of logarithms were net capital flows, which change sign in the sample, and variables expressed in rate form, such as interest rates, spread and the CFE. The results of these estimations satisfy the standard conditions of a cointegration relation, including the requirement that their residuals be stationary; in each case the unit root hypothesis is rejected at the 1% significance level.[28]

The evolution of total net capital flows (FKN) can be reasonably explained by (i) the supply of foreign financing, represented by the dummy variable that measures the reversal of capital flows in Chile as from 1998 (DUM98);[29] (ii) the demand for external financing in the economy, represented by the ratio between domestic aggregate demand and GDP (LDDA-LPIB) and the terms of trade (LTI); and (iii) by arbitrage conditions, represented by the expected spread of returns between domestic and external assets (*spread*) and the financial cost of the URR (CFE). A trend variable is also included to capture the effects of economic growth, greater international financial

TABLE 4

Chile: Cointegration estimations for total net capital flows, short-term flows and medium- and long-term flows [a/] [b/]

Method: Two-stage least squares (1991.1-2000.4)

Explained Variable	FKN	FKNCP	FKNMYLP
Explanatory variables			
Constant	16514.34 (0.045)	18966.37 (0.063)	-15829.91 (0.097)
LTI	-3544.45 (0.054)	-4205.68 (0.061)	-2632.16 (0.211)
LDDA-LPIB	14644.23 (0.001)	15294.07 (0.005)	– (–)
Spread – CFE	6463.43 (0.059)	17917.80 (0.000)	– (–)
DUM98	-1508.24 (0.002)	-1031.57 (0.003)	-638.87 (0.059)
Time	30.39 (0.133)	– (–)	– (–)
LOFCA	– (–)	– (–)	105.5261 (0.303)
LFBKF	– (–)	– (–)	1977.47 (0.003)
Adjusted R^2	0.356	0.143	0.153
Durbin-Watson statistic	2.010	1.303	1.747
F-statistic	7.241	5.029	3.067

Source: Estimations by the authors.

[a/] Figures in parentheses correspond to P-values.

[b/] Instruments: CFE LFIN(-1), LOFCA FKN(-1), GAPHPY(-1), LFBKF(-1), LPIB(-1), LTI, TIEMPO, DUM98, RC90(-1), LIBO90, SPREAD(-1), LRSTD(-1), LGOB, FKNAY(-1), LTRIB(-1), LTCR(-1), REXT, EDTCR(-1).

[28] Appendix E presents Engle and Granger unit roots tests for the residuals of the cointegration relations.

[29] DUM98 is a dummy variable that takes the value 0 at the start of the sample, and 1 as from the first quarter of 1998, when capital flows into Chile faltered abruptly. This variable gave better results than the capital-supply index LOFCA in the equation for total net flows and short-term flows. Using LOFCA to represent the supply of foreign financing produces qualitatively very similar results, but with a weaker fit, as shown in appendix G. LOFCA is a better explanatory variable for medium- and long-term capital flows.

integration and worldwide inflation on total net capital flows that are measured in current United States dollars. The effects of the demand for external financing and foreign financing-supply conditions on capital inflows are statistically different from zero at the 1% significance level, while the terms of trade and the spread minus the CFE, are significant at the 6% level.

The individual influence of each variable on capital flows is affected by the collinearity that exists between them and by the small size of the sample. In fact, the *encaje* was an attempt to compensate for differences between domestic and external interest rates, and it may have had some moderating effect on the real appreciation of the peso, a reason why the CFE can be seen as compensating for the value of the spread. In view of the above, the effects of the spread and the CFE on capital inflows were constrained to be of equal value but opposite sign. To test the effectiveness of the *encaje* on capital flows, the cointegration equation was re-estimated for total capital flows, with *spread* and CFE as independent variables; then the exclusion of the CFE was rejected at the 5% significance level.[30]

We should emphasize, however, that the negative effect of the financial cost of the *encaje* on FKN depends critically on including a variable that measures the supply of foreign financing (DUM98 or LOFCA). If one ignores the fact that there was an extraordinary increase in the supply of foreign financing while the URR was in force, and variables like DUM98 and LOFCA are omitted, then the *encaje* appears to be weakly related to capital flows. Inclusion of variables associated with the effect of the supply of foreign financing is fully justified given the nature of the problem under study. Exclusion of DUM98 and CFE from the FKN equation is clearly rejected by the data at the 1% level (appendix G, table G2), as it significantly undermines the explanatory power of the regression for FKN — the adjusted R^2 falls from 0.44 to 0.14 (appendix G, table G1).

If net capital flows are broken down into their short-term (FKNCP) and medium- and long-term (FKNMYLP) components, the estimation of cointegrating relations for each type of flow shows clearly distinguishable behaviour patterns. In the estimation of short-term flows, presented in the second column of table 4, the response to the *encaje* is even more pronounced than in the case of total flows. The coefficient of *spread-CFE* in the FKNCP regression is more than double that corresponding to the estimation of total flows and is significant at the 1% level.

In the case of medium- and long-term flows (FKNMYLP), the results for which are shown in the third column of table 4, neither the effect of the *encaje* nor that of the *spread* was significant. Accordingly, both variables were omitted, accepting that returns arbitrage was not a dominant force driving medium- and long-term net capital flows to Chile in the 1990s. The evolution of FKNMYLP relates more directly to domestic investment and the evolution of foreign financing-supply conditions (LOFCA). It is, therefore, notable that the effectiveness of the *encaje* in influencing total capital flows is fundamentally determined by the response of short-term flows to the CFE. This confirms earlier results concerning the effect of the reserve requirement on the composition of external financing, namely that it favours a heavier relative use of medium- and long-term foreign financing, but not that it increased FKNMYLP.

2. Error-correction model for net capital flows

The short-term adjustment process represented by error-correction equations is estimated by ordinary least squares. Contemporary changes in the model's endogenous variables are not included, and lagged variables can be considered exogenous. To denote the first time-difference of the variable used in the cointegration estimations, the letter D is placed before the original name of the variable, and the number of lags is shown in parentheses.[31]

The results of the error-correction estimation for total net capital flows, shown in the first column of table 5, highlight the rapid and statistically significant error correction response of net capital flows, that is to the residual in the cointegration equation for FKN lagged by one period, RESIDFKN(-1). Total net capital flows also respond to arbitrage variables and to macroeconomic variables, including lagged changes in the terms of trade

[30] In the unrestricted estimation, the parameter associated with CFE in the cointegration equation for capital inflows was -26,712, and was significant at the 95% confidence level; whereas the parameter for *spread* was 2,505, and not significantly different from zero even at 25%. An F-statistic of 4.16 is obtained in the equivalence test for the two configurations that include and exclude the financial cost of the *encaje*, which shows that the hypothesis of *encaje* exclusion is rejected with 95% confidence.

[31] DX(-i) represents the "i"th lag of the first difference of variable X. In the case of variables expressed in log form (e.g. LTI), the first difference of the logarithm is expressed as if it were that of the original variable (e.g. DTI).

TABLE 5

Chile: Error-correction estimations for total net capital flows, short-term flows and medium- and long-term flows [a/]
Method: Ordinary least squares
(1991.2 - 2000.4)

Variable explained =>	DFKN	DFKNCP	DFKNMYLP
Explanatory variables			
C	-45.540 (0.300)	-89.425 (0.342)	–
DCFE	–	-73185 (0.000)	44082 (0.002)
DCFE(-1)	–	48807 (0,004)	–
DCFE(-4)	-17925 (0.029)	–	-44082 (0.002)
DCFE(-7)	-24118 (0.003)	–	–
DREXT(-5)	-18234 (0.002)	-34928 (0.002)	–
DREXT(-6)	–	-32400 (0.003)	–
DREXT(-1)	–	–	-24663 (0.018)
Drc90(-2)-DREXT(-2)	–	21010 (0,000)	–
DTI(-3)+DTI(-4)	-2287.3 (0.006)	-2287.3 (0.006)	-2521.6 (0.06)
DTI(-6)	-6375.2 (0.000)	-4449.8 (0.018)	-2521.6 (0.06)
DTI(-7)+DTI(-8)	2890.4 (0.001)	–	(–)
DLOFCA(-2)+DLOFCA(-4)	51.53 (0.083)	–	142.37 (0.010)
DLOFCA(-2)+DLOFCA(-3)	–	214.51 (0.001)	142.37 (0.010)
DLOFCA(-8)	108.68 (0.000)	113.57 (0.029)	–
DDDA(-4)-DPIB(-4)	11861 (0.000)	–	–
Dy (-4)	0.19736 (0.004)	–	–
Dy (-7) + Dy (-8)	-0.18124 (0.014)	–	0.30663 (0.08)
Drc90(-3)-DCFE(-3)		–	24160 (0.000)
RESIDY(-1)	-0.80752 (0.000)	-0.44856 (0.002)	-0.918 (0.000)
Adjusted R^2	0.934	0.775	0.781
Durbin-Watson statistic	1.995	2.119	2.001

Source: Estimated by the authors.

[a/] RESIDY(-1) represents the residuals of cointegration equation *y* (FKN, FKNCP or FKNMYLP) with a one-period lag, while Dy(-1) is the corresponding explained variable in the error-correction model, with *i* lags.

(DTI), in the demand for external financing represented by the difference between the changes in aggregate demand and output (DDDA-DPIB), and in the supply of external capital (LOFCA). Arbitrage-related variables include changes in the financial cost of the *encaje* (DCFE) and changes in the external 90-day real interest rate (DREXT), also with different lags. All the parameters associated with the explanatory variables are statistically different from zero at 5% significance or less according to the "t statistic test". Exclusion of arbitrage-related variables, DREXT(-4), DCFE(-4) and DCFE(-7), is rejected by the data, as is the exclusion of the variables related to the *encaje*, DCFE(-4) and DCFE(-7).[32]

The error-correction estimation for short-term capital flows, shown in the second column of table 5, provides similar results to the estimation made for total flows, but the response of short-term flows to the reserve requirement is more immediate and clearly stronger than that of total flows. Estimation of the error-correction model for medium- and long-term flows provides different results, which are shown in the third column of table 5. Firstly, the response of such medium- and long-term flows to the *encaje* seems to be weak. Even more, on impact the reserve requirement increases medium- and long-term flows, many of which were not covered by the URR and were used as a vehicle for circumvention. With several quarters' lag the circumvention is compensated and the *encaje* generates some weak negative effect on medium- and long-term capital flows.

[32] Based on an unrestricted estimation of parameter values presented in appendix H, table H2.

IV

Simulations of policy responses to confront external capital flows

The equations for net capital flows discussed in this section, in conjunction with estimations for gross capital formation and the rest of private-sector aggregate demand presented in appendix C, comprise a model that can be used to evaluate the macroeconomic effects of the *encaje* policy. Estimations for the two behavioural functions representing private expenditure —capital formation and the rest of private-sector domestic demand— give conventional results. The only outstanding feature of those estimations is that private expenditure responds significantly to net capital flows. Cumulative annual total net capital flows expressed as a percentage of GDP (FKNAY) were included as an explanatory variable in the equations for private expenditure.

The policy-evaluation simulations use the cointegration and error-correction relations to represent the dynamics of the variables. The first of the simulations was carried out on the basis of departures from the baseline scenario in order to calculate total response (multiplier effects) to changes in key variables. The second simulation was directed to answer whether or not the application of the *encaje* in Chile made a significant contribution to the stabilization of domestic demand by moderating the expansionary trend of capital flows; it presents the effects of eliminating the reserve requirement in 1996, the year in which capital inflows intensified. Finally, the third simulation attempts to answer whether a more intensive application of the URR could have averted the overexpansion of private expenditure on its own, or whether it would have needed support from other complementary policies. The simulation evaluates the policy adjustments that were needed to reduce aggregate demand by around 1.5% in 1997, in order to limit the economy's exposure to a sudden stop of capital flows.

1. Multipliers of key variables

Presented below are the response elasticities for domestic aggregate demand and net capital flows to changes in the *spread*, the CFE, the domestic interest rate, cumulative annual net capital flows as a percent of GDP (FKNAY) and government expenditure, sustained for two years (table 6). The exercise was carried out considering changes of 100 basis points in the real domestic interest rate, the *spread* and the CFE, and changes equivalent to 1% of GDP in cumulative annual net capital flows (FKNAY) and total government expenditure. The results confirm that the effects of changes in the CFE on aggregate demand and capital flows are quantitatively important.

Changes in the real interest rate directly affect private expenditure by altering the cost of domestic financing for consumption and investment. A sustained 100 basis-point rise in the domestic real interest rate reduces domestic demand by 1.06% after two years. If the returns spread were to rise in parallel with the interest rate, the total effect on aggregate demand would be moderated, but still be negative. A 100 basis-point increase in the spread would generate a cumulative annual increase in net capital flows equivalent to 0.24% of GDP; the capital inflow, in turn, has an expansionary effect on private-sector spending, such that a 100-basis point widening of the *spread* is associated with a 0.26% increase in private expenditure after two years. An increase in the reserve requirement can offset the spread's expansionary effect on capital flows and private expenditure. The 100 basis-point rise in the CFE —roughly equivalent to a 10 percentage-point rise in the *encaje* rate or extending the period of the required deposit for about four months— causes capital flows

TABLE 6

Chile: Proportional response of capital flows and total domestic demand in *t*+7 to a sustained change in the explanatory variable introduced in *t*

	Variation of FKNAY (Percentage of GDP)	Variation of domestic demand (%)
+1% *rc*90	–	-1.06%
+1% *spread*	0.24%	0.26%
+1% CFE	- 0.77%	-0.67%
+1% FKNAY	1.00%	0.42%
+1% LGOB	0.00%	0.21%

Source: Prepared by the authors.

to contract by 0.77% and reduces aggregate demand by 0.67%. A parallel and equal increase in both the *spread* and the CFE ends up reducing capital flows and aggregate demand, according to the estimation.[33] Lastly, a 1% increase in government expenditure raises aggregate demand by 0.21%, despite not affecting capital flows.

2. *Encaje*, early elimination scenario

To identify the macroeconomic consequences of discontinuing the URR during the capital flow surge, a simulation exercise is presented, using the results of the estimation discussed in the previous section. The simulation attempts to approximate the behaviour of net capital flows, gross capital formation and domestic aggregate demand if the reserve requirement on capital inflows had been lifted; i.e. if the CFE had been lowered to zero as from the first quarter of 1995. With the *encaje* having no effect, lowering the CFE to zero would not alter the value of other macroeconomic variables, particularly capital flows and domestic demand. As shown in figure 2, the simulation based on the estimations presented in the previous section neither shows that the URR was totally ineffective, nor that its effect on total capital flows and aggregate demand was irrelevant.

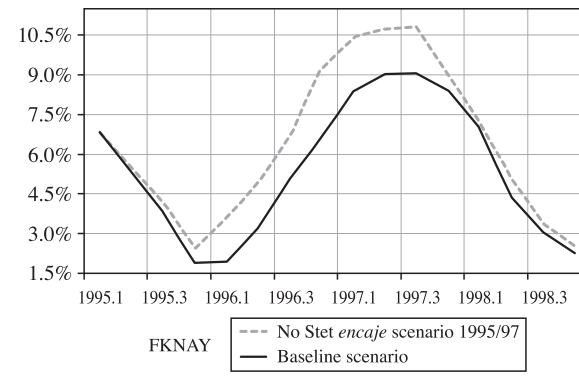
Without the URR, domestic demand would have expanded even more strongly in 1996 and 1997, surpassing the baseline scenario by 1.6% of GDP in 1997. As shown in figure 3, abolition of the reserve requirement in 1995 would have amplified the cycle. From the third quarter of 1996 to the fourth quarter of 1998 domestic demand is between one and two percentage points of baseline GDP higher than in the baseline scenario. Holding everything else constant, this additional expenditure would have caused the current account deficit in 1997 to widen to about 7%, instead of fluctuating around 5% of GDP as it did that year, thereby making the economy more vulnerable to a sudden stop in capital flows.

It can be concluded that although the URR policy was unable to avoid the overexpansion of private-sector spending in 1996 and 1997, it still had a significant

FIGURE 2

Chile: Simulation of *encaje* elimination, 1995-1997

Cumulative annual net capital flow (FKNAY), as a percentage of GDP

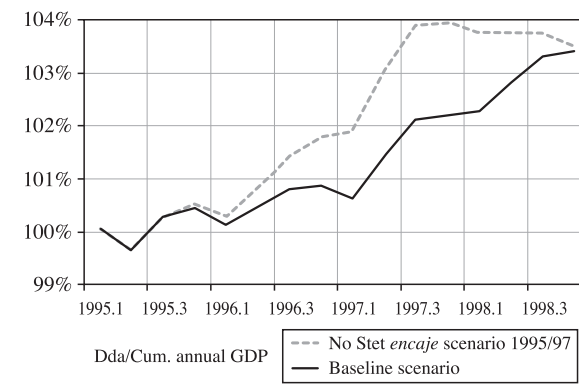


Source: Prepared by the authors.

FIGURE 3

Chile: Simulation of *encaje* elimination, 1995-1997

Aggregate demand



Source: Prepared by the authors.

macroeconomic effect; in the absence of the URR, the excess expenditure would have been either considerably larger, or else required the introduction of other compensatory measures, such as a much tighter fiscal policy, simply to keep aggregate expenditure at the original level.

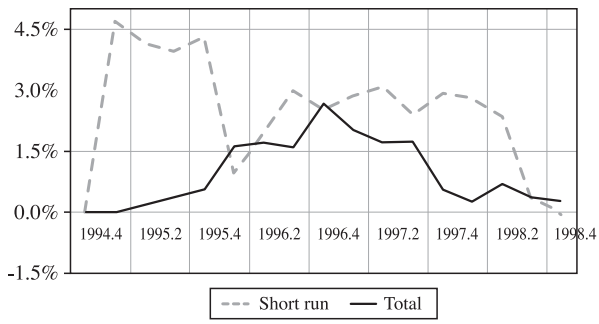
Figure 4 shows the deviations of total net capital flows and short-term flows from the baseline scenario in the no-*encaje* scenario. The simulation clearly shows that short-term flows respond more than twice as much as total flows to the elimination of the reserve requirement. Short-term capital flows increase by up to 4.5% of GDP, while total flows expand by 1.5% of

[33] That is the effect of the CFE on capital flows appears to be larger than that of the spread. It is important to have in mind that the underlying assumption in calculating the CFE is that all flows have a maturity of one year. For shorter maturities, the increase in the URR has a larger impact on the effective financial cost.

FIGURE 4

Chile: Simulation of *encaje* elimination, 1995-1997. Deviations of capital flows from baseline scenario

(Cumulative annual deviation, as a percentage of GDP)



Source: Prepared by the authors.

GDP, only. The counterpart of this difference would be a decrease in medium- and long-term flows in response to abolition of the *encaje*. This shows the strong effect of the URR on short-term flows and, consequently, its effectiveness in shifting the composition of external financing toward medium- and long-term flows.

Naturally, a different combination of policies than those actually applied if the *encaje* had been lifted completely can be envisaged, but that would have meant overcoming other problems. If, along with abolition of the URR the domestic interest rate had been lowered by an amount equivalent to the CFE reduction, the lower interest rate could have caused a narrowing of the *spread*, which would have at least partly averted the additional capital inflow stemming from the lower CFE. Still, for that to happen, it must be assumed that lowering the domestic interest rate would not have affected the exchange rate, and the expected real depreciation, otherwise the *spread* may have failed to fall in order to compensate the reduction in the CFE. But even in this favourable case, the lower cost of domestic financing associated with the lower real interest rate would have by itself boosted aggregate demand, thus aggravating the existing macroeconomic imbalance.

3. Macroeconomic adjustment scenarios

A second simulation exercise involves applying the results of the estimation to define policy actions that would have made it possible to curb spending growth in 1996 and 1997. A reduction in the level of aggregate demand equivalent to 1.5% of GDP in 1997 would have been sufficient to reduce the current account deficit to around 4% of GDP. Possible ways of achieving this include hikes in the URR rate and in the interest rates. In 1996 and 1997, the exchange rate remained close to the floor of its flotation band, so there was rigidity preventing the peso from appreciating in response to contractionary monetary policy. Consequently, an interest-rate hike in a situation of exchange-rate rigidity would have widened the expected spread of returns, and this would have stimulated additional capital inflows. Nonetheless, lacking an empirical relationship to explain the behaviour of the *spread*, for the purposes of the simulation exercise the CFE rate alone will be varied, with the *spread* and the domestic interest rate left unaltered. A 150 basis-point rise in the financial cost of the *encaje* —achieved, for example, by extending the term of the special deposit from 12 to 18 months— would have reduced total cumulative annual capital flows (FKNAY)[34] by 1.2% of GDP in 1996, and by 0.4% in 1997 (figure 5). With net capital flows declining in response to the higher CFE, aggregate expenditure would have shrunk, but only by 0.2% of GDP in 1996 and 0.75% of GDP in 1997. Therefore, a 150 basis-point increase in the CFE would not have been sufficient to generate the adjustment desired for aggregate demand, yet consideration of even larger increases raises problems of effectiveness. The existence of channels for capital flows that are not covered by the URR causes medium- and long-term loans to barely falter in response to increases in the CFE. Accordingly, once short-term flows converge to zero as a result of the rise in the financial cost of the reserve requirement, the marginal effectiveness of the URR in contracting total net flows and, hence, private expenditure, becomes exhausted. The reason for this is that while it is reasonable to expect the *encaje* to restrain capital inflows, it cannot be assumed to generate net short-term capital outflows. As shown in figure 6, in this scenario with a 150 basis-point rise in the CFE, net annual short-term capital inflows would have been negative for much of the 1995-1997 period. This points to the exhaustion of the *encaje* mechanism in terms of additional influence on total flows and private expenditure.[35]

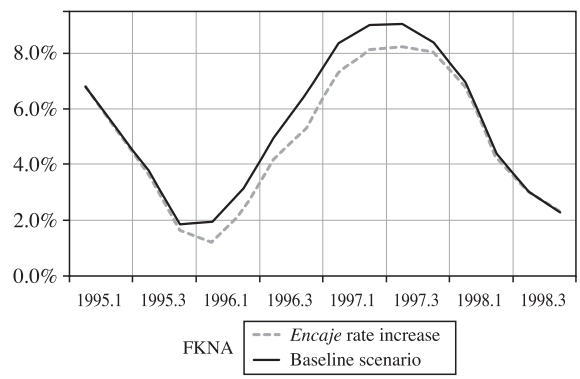
[34] Accumulated annually, such that the representative value for each year in the figure corresponds to the final quarter of that year.

[35] This argument is analogous to the effect of an increase in customs tariffs: no matter how high an import duty is set, it will never turn an import substitute into an exportable good.

FIGURE 5

Chile: Simulation of adjustment scenario for capital flows; 150 basis-point rise in the financial cost of the *encaje*, 1995-1997

(Cumulative annual net capital flows, as a percentage of GDP)

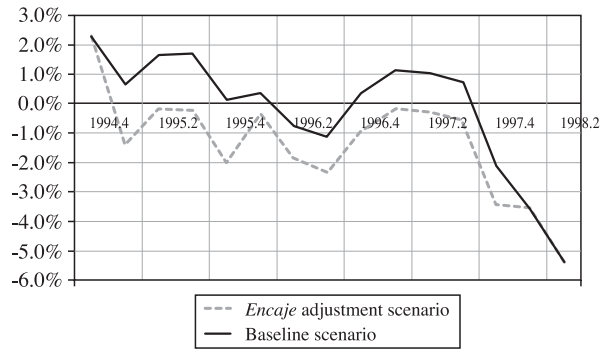


Source: Prepared by the authors.

FIGURE 6

Chile: Simulation of adjustment scenarios for short-run flows, 1995-1997; 150 basis-point rise in the financial cost of the *encaje*

(Cumulative annual flows, as a percentage of GDP)



Source: Prepared by the authors.

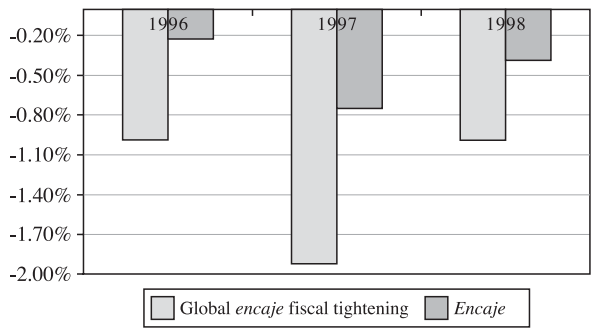
The marginal effectiveness of the *encaje* policy was seriously restricted by the selectiveness of its application. To prevent the circumvention that undermined its effectiveness, it would have been necessary to cover by the URR exempted flows, including direct commercial credit (from foreign suppliers or export buyers), and certain forms of portfolio investment. Nonetheless, the political feasibility of these type of extension was nil as it aroused strong resistance in the private sector and proposals along these lines found virtually no support in the public sector. The interesting point is that extending the reserve requirement to capital flows that were not covered not only would have increased its macroeconomic effectiveness but also would have reduced the microeconomic costs stemming mainly from differential financing costs between agents who could or could not avoid the URR.[36] Unfortunately, it is difficult to simulate how capital flows would have responded to an extension of the URR application. It is not enough to assume that a generalization of the mechanism would have caused medium- and long-term flows to behave like short-term flows. By design, the CFE that would have affected medium- and long-term flows brought within the coverage of the URR would have been much lower than the CFE affecting short-term flows. Absent the possibility of wider URR coverage, the most appropriate complement for an increase in the CFE to control the expansion of aggregate demand, would have been to consider the use of countercyclical fiscal policy. This type of policy would have consisted in accepting a higher fiscal balance, even surplus, in periods of rapid expansion of domestic activity and expenditure, and a lower balance, even deficit, in periods of slower or non-expansion of activity. As a result, the expansion of public expenditure would occur in line with the trend growth of public revenues rather than following its cyclical fluctuations.[37] For the purposes of simulating countercyclical fiscal policy, a scenario involving a real expansion of government spending of 5% per year in 1996-1997 is proposed, instead of the 7% average expenditure growth actually recorded during those two years. Complementing that fiscal adjustment with a higher financial cost of the *encaje*, it would have been possible to obtain a reduction in aggregate demand, compared to the baseline scenario, of 1.0% of GDP in 1996 and 1.8% in 1997 (figure 7). By virtue of this overall adjustment —*encaje* and fiscal—, the current account deficit could have been below 4% of GDP in 1997, thereby reducing the potential effects of a sudden stop of capital flows.

[36] Even direct investment was used as a channel for avoiding the *encaje*, by disguising flows that actually represented financial or portfolio investment. Le Fort and Sanhueza (1997) examine evasion channels and argue in favour of a generalization of the mechanism.

[37] See the analysis of countercyclical fiscal policy in Budnevich and Le Fort (1997).

FIGURE 7

Chile: Adjustment scenarios simulation. Increase in the financial cost of the *encaje*, and slower growth in government spending, 1996, 1997 and 1998



Source: Prepared by the authors.

It should be noted that there was another possible course of action available to moderate capital inflows, but, unlike the other alternatives, this required accepting a greater real currency appreciation. Allowing a larger real appreciation of the peso would have reduced the spread of returns by raising expectations of future real depreciation, thereby reducing capital inflows and private expenditure. Nonetheless, such a course of action entails risks that are hard to anticipate. The real appreciation might not have immediately resulted in expectations of future depreciation, as assumed regularly as well as in this model. Under especially uncertain conditions, a greater appreciation might encourage expectations of further appreciation, at least for a while; and this would have caused a profound misalignment of the exchange rate, with serious effects on resource allocation and macroeconomic stability. Apart from the expansionary or contractionary effect of the variable driving the real appreciation, there is some empirical evidence that such an appreciation is associated with an expansion of private spending. The first reason being that the Chilean private sector has a net liability position in foreign currency (Chile's external debt is held predominantly by the private sector), the real value of which falls with the real appreciation; and the second that the vast majority of consumers are wage-earners whose real income is essentially a non-tradable good whose relative price rises with a real appreciation.[38]

V

Conclusions

The foregoing analysis of the period of heavy capital inflows into Chile offers a set of lessons concerning the behaviour of capital flows and their relation to macroeconomic variables.

Firstly, Chile suffered from the effects of a massive capital flow surge from 1990 to 1997, and its subsequent sudden stop as from 1998. The capital inflow surge was concentrated in medium- and long-term flows, which was desirable given that these flows are less volatile and more persistent than short-term flows. But concentrating external financing in medium- and long-term flows was not sufficient protection, since it failed to prevent the sudden stop. This underscores the importance of total external financing in determining the likelihood of a reversal of capital inflows.

Secondly, the intensification of medium- and long-term flows had the characteristics of an exogenous supply shock rather than an endogenous arbitrage response to high domestic interest rates. The intensification is linked particularly to a reduction in the domestic interest rate and, hence, to a structural increase in the supply of foreign financing.

Thirdly, only short-term flows appear to be driven by returns arbitrage and attracted by higher domestic interest rates than those prevailing abroad. There are signs that the *encaje* helped to compensate for this effect, by allowing additional room for monetary-policy manoeuvre. In fact, the real domestic interest rate, and to some extent the actual spread appear to show a certain positive response to increases in the CFE, and a negative response to increases in the supply of foreign financing.

[38] It is also possible that the real appreciation would cause income to be redistributed towards groups with a higher marginal propensity to consume, thereby resulting in higher private expenditure, following the well known Diaz Alejandro effect. The real appreciation would boost real wages and reduce profits. If the marginal propensity to consume is greater among workers than among people who receive income from capital, then the real appreciation is expansionary for consumption.

Fourthly, the URR was effective in reducing total net capital flows and in altering their composition in favour of medium- and long-term flows. The cointegration and error-correction estimations reveal statistically significant responses by capital flows to the CFE when the supply of foreign financing is included as a determinant of capital flows. Elimination of the *encaje* during the surge of capital inflows would have produced non-negligible macroeconomic effects, including an increase in net capital flows of roughly 2% of GDP, and a serious worsening of the overexpansion of private spending that the Chilean economy was already suffering in the mid-1990s, involving an additional domestic-demand expansion of the order of 1.5% of GDP in 1997.

Fifthly, the marginal effectiveness of the *encaje* was limited, because there was little potential to continue reducing the short-term capital inflows on which the URR selectively acted. In contrast, there was no limit to greater circumvention through non-covered medium- and long-term flows, without extending the scope of URR application to close off exempt channels. A more effective strategy to control capital inflows and restrain domestic demand would have required additional strengthening of the *encaje*, not only raising its financial cost, but also expanding its application and supporting it with a countercyclical fiscal policy.

Sixthly, the effectiveness of the URR in restraining net capital flows stems from the compensation response to an intensification of capital inflows arising from an increase in the supply of foreign financing. If the latter is not recognized and foreign financing supply variables are excluded from the specification of the net capital flow equation, then the *encaje* has no statistically significant effect on capital flows. As the capacity of the model to explain capital flows also deteriorates sharply, exclusion of the *encaje* and foreign financing-supply variables is rejected by the data.

Lastly, the effect of monetary policy on domestic expenditure could be weakened by capital inflows if the exchange rate is unable to fluctuate freely in response to changes in the interest rate. If the currency cannot appreciate to offset the potential effects of higher domestic interest rates on the rates spread, additional capital inflows weaken the effect of contractionary monetary policy on domestic spending and complicate efforts to stabilize the exchange rate. Exchange-rate flotation restores the effectiveness of monetary policy; nonetheless, in the face of intensifying capital inflows, as occurred in 1996-1997, allowing the currency to float could generate a significant risk of exchange-rate overshooting, with potentially very harmful repercussions on resource allocation and external stability.

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APPENDIX A

Glossary of variables

Spread of expected returns between domestic and foreign assets

This variable represents the difference between the expected returns on assets denominated in pesos and those denominated in dollars. It is calculated using the following equation:

$$Spread = r - (i^* - \pi^* + ss) - E\hat{T}CR$$

where

r : Real 90-365 day lending rate
i^* : Libor in dollars
π^* : Wholesale price index of the United States, projected rate of change
ss : Country-risk or Chile's sovereign spread
$E\hat{T}CR$: Expected real depreciation, calculated as the difference between the effective exchange rate and the equilibrium rate, according to Soto and Valdés (1998).

Effective spread of returns between domestic and foreign assets (spread_2)

Same as the previous variable, except that the differential here corresponds to the effective return on peso- and dollar-denominated assets. It is calculated using the effective forward change of the real exchange rate

$$Spread\_2 = r - (i^* - \pi^* + ss) - T\hat{C}R$$

$T\hat{C}R$: Real effective forward or expected devaluation, under perfect foresight.

Financial cost of the encaje (CFE)

This variable is calculated assuming a loan with the same maturity as the required deposit, one year, and using the following equation:

$$\text{CFE} = \frac{\varepsilon\,(i^* + s)}{(1-\varepsilon)\,(1-t)}$$

where

ε : *Encaje* rate for the period (30%)
i^* : One-year Libor
s : Average spread on short-term foreign credits to the Chilean private sector.
t : Tax on foreign interest payments (4%).

Given that from the date of initial application of the *encaje* until December 1994 it was possible to make the special deposit in the operation's currency of origin, for that period the minimum CFE was obtained from those resulting by calculating the Libor in dollars, deutschmarks and yen, weighting them according to the weights in the currency basket used to define the central parity exchange rate (*acuerdo*). Regulations in force since 1995 have required the *encaje* to be established in dollars; so, from that year onward, the CFE calculated with the Libor in dollars was used (Source: Le Fort and Sanhueza, 1997).

Domestic interest rate on loans (rc90)

Average interest rate of the banking system for loans denominated in "Unidades de Fomento" (UF), at 90-365 days. Source: Central Bank

Nominal external interest rate (libo90 = i)*

Libor in dollars at 90 days. Source: Central Bank

Real external interest rate (rext): rext = $i^* - \pi^* + ss$

Real exchange rate, in logarithm form (LTCR= log TCR) Source: Central Bank

Dummy variable for reversal of capital flows (DUM98)

Takes the value 0 until the final quarter of 1997, and 1 as from the first quarter of 1998.

Index of the supply of foreign capital, in log form (LOFCA= log OFCA)

OFCA was constructed as the sum of capital flows destined for Argentina, Brazil, Mexico (according to IFS capital account figures) weighted by the respective sovereign spread relative to the spread on Chilean bonds. Prepared by the authors using data from J.P. Morgan.

Net flow of short-term capital (FKNCP) including errors and omissions, credit lines, short-term loans and change in external assets; *Net flow of medium- and long-term capital (FKNMYLP),* including direct and portfolio investment and medium and long-term loans; and *Total Net capital flow (FKN+FKNCP).* Source: Balance of Payments, Central Bank.

Cumulative annual net capital flow as a percentage of GDP (FKNAY)

Source: Prepared by the authors using cumulative annual FKN data expressed as a percentage of GDP.

Output gap (Gaphpy)

Source: Variable constructed by applying the Hodrick-Prescott filter to real quarterly GDP, cumulative for the last four quarters, and expressed in log form. The gap is defined as filtered GDP minus actual GDP. Quarterly GDP Source, National Accounts, Central Bank

Depth of the financial system in log form (LFIN)

Trend of stock market capitalization in Chile as a percentage of GDP.

Source: Lehmann (1998).

Euromoney risk index for Chile (IRE)

Index constructed by Euromoney in the range 0-100. Economic and sociopolitical factors are weighted to determine the country-risk rating for each economy. The higher the index, the less risky the country. Source: Euromoney.

Gross domestic product, in log form (LPIB = log PIB)

Source: Central Bank

Domestic aggregate demand in log form (LDDA = log DDA)

Source: Central Bank

Gross fixed capital formation, in log form (LFBKF = log FBKF)

Source: Central Bank

Remainder of domestic aggregate demand, in log form (LRESTD=log RESTD)

RESTD includes domestic aggregate demand other than gross capital formation, consumption and inventory accumulation. RESTD = DDA-FBKF

Source: Central Bank

Index of the terms of trade, in log form (LTI = log TI)

Source: Central Bank.

Government spending, in log form (LGOB=log GOB)

Source: Ministry of Finance

Government expenditure on capital formation (GOBFBK)

Source: Ministry of Finance

Other government expenditure (GOBRST)

Source: Ministry of Finance

Private gross fixed capital formation, in log form (LFBKPR)

FBKPR = FBKF - GOBFBK.

Remainder of private-sector domestic aggregate demand, in log form (LRSTPR)

RSTPR = RESTD - GOBRST.

Tax revenue, in log form (LTRIB)

Source: Ministry of Finance

Worldwide GDP growth (g_{World}) and United States GDP growth (g_{USA})

Source: Bloomberg

APPENDIX B

Graphs of the main variables

Figure B1: Spread

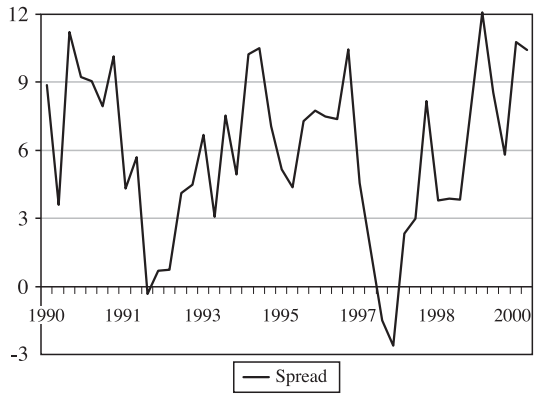


Figure B2: Spread_2

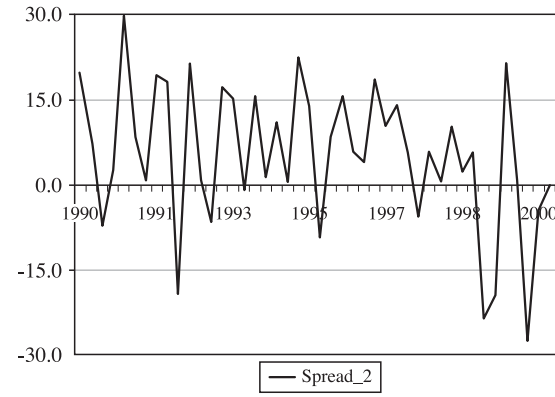


Figure B3: Financial cost of the *encaje*

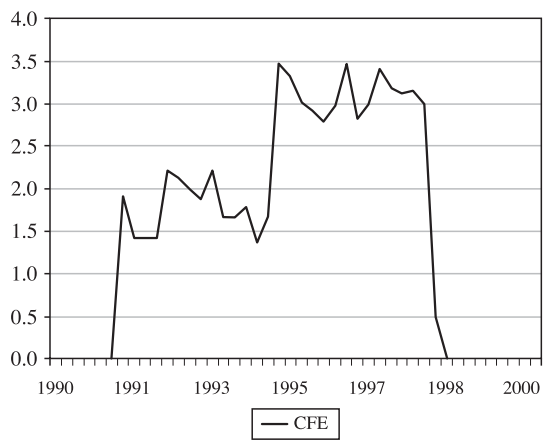


Figure B4: rc90

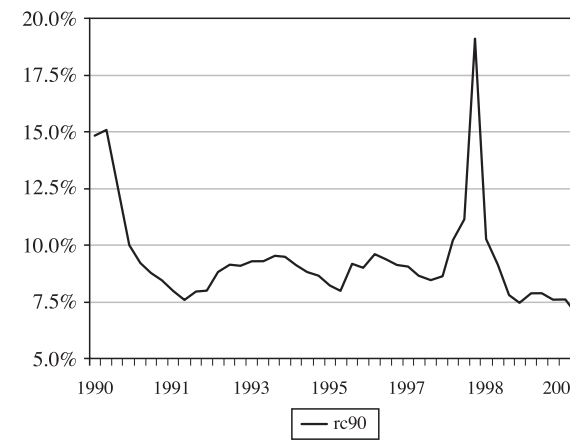


Figure B5: Libo90

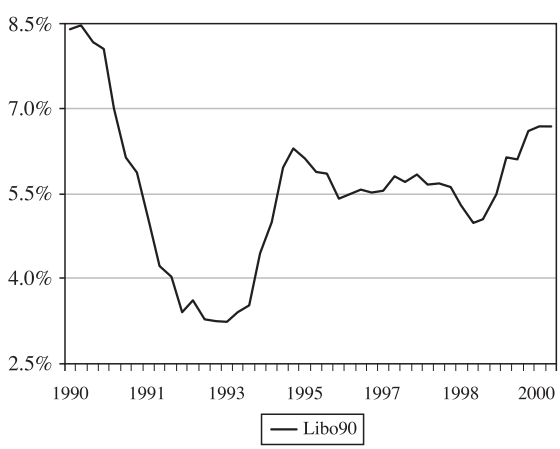


Figure B6: REXT

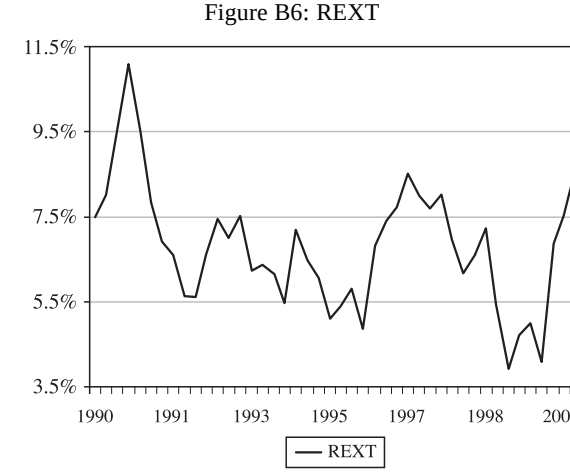


Figure B7: LTCR

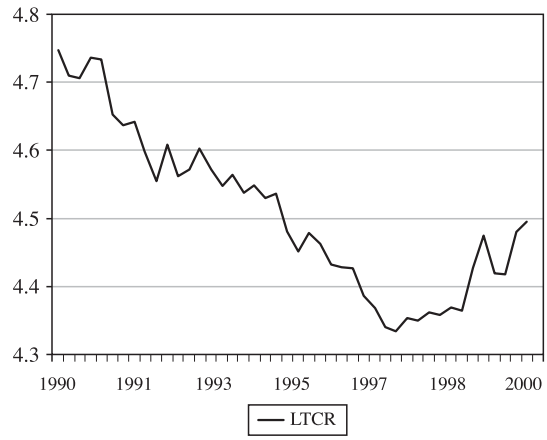


Figure B8: Dum98

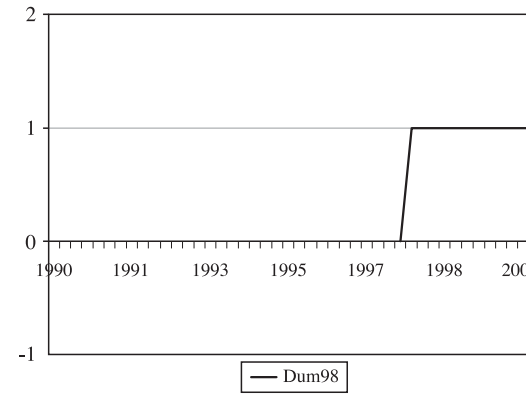


Figure B9: LOFCA

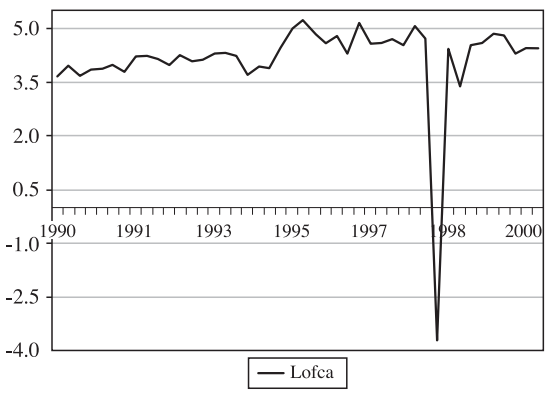


Figure B10: FKN

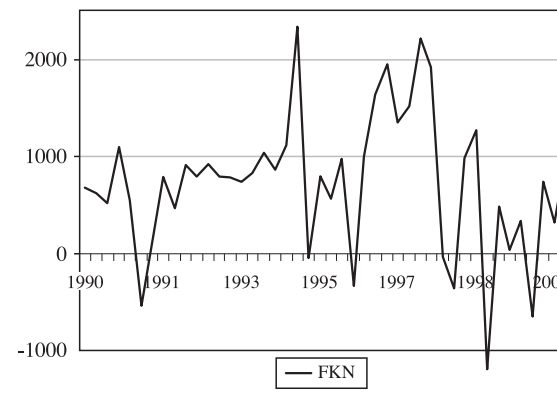


Figure B11: FKNCP

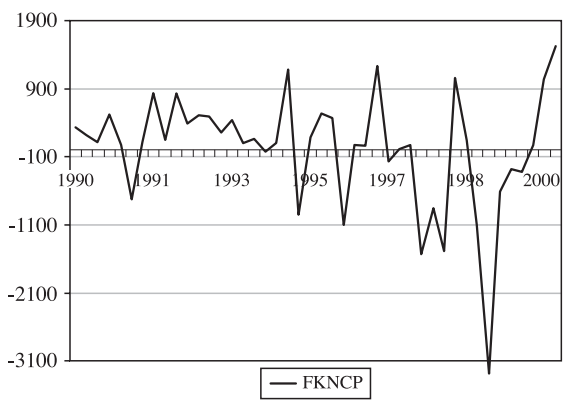


Figure B12: FKNMYLP

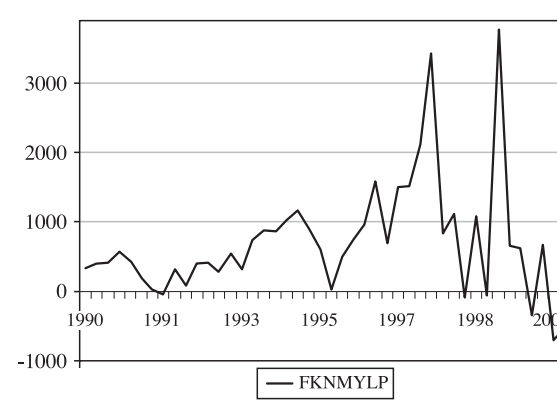


Figure B13: FKNAY

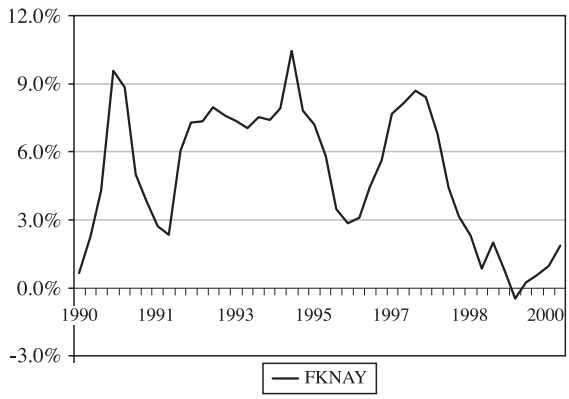


Figure B14: LFBKF

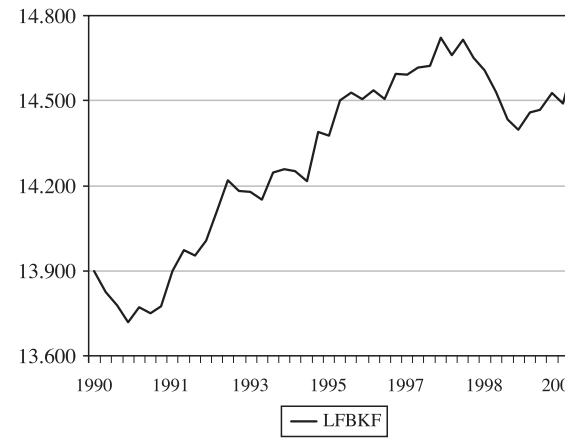


Figure B15: LDDA

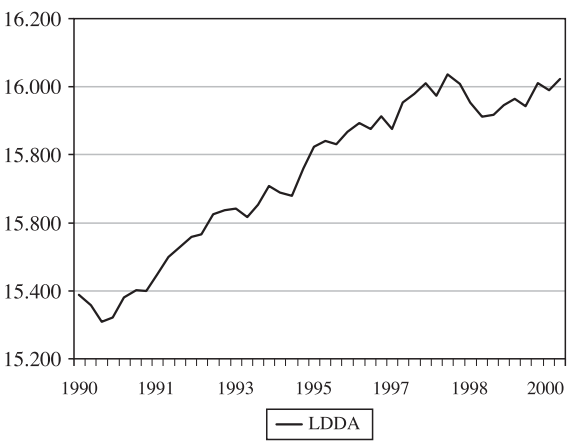


Figure B16: LPIB

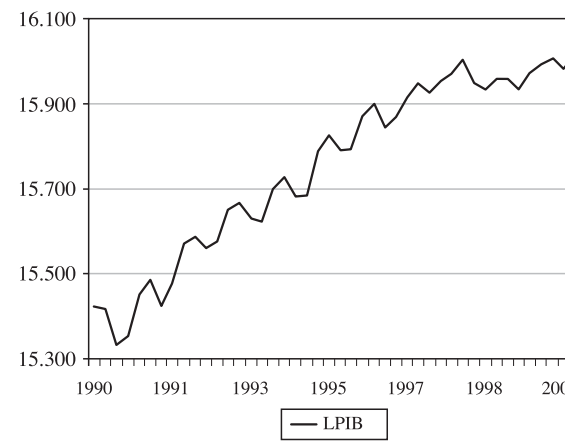


Figure B17: GAPHPY

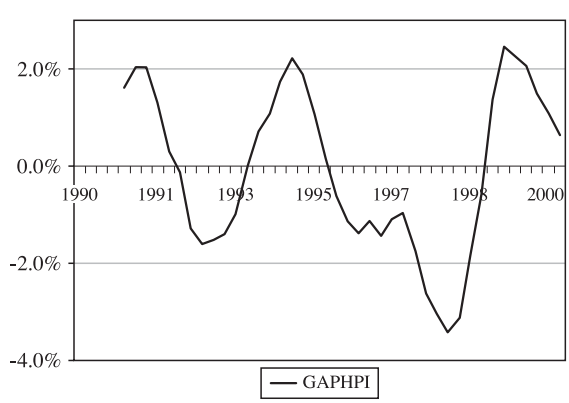


Figure B18: LFIN

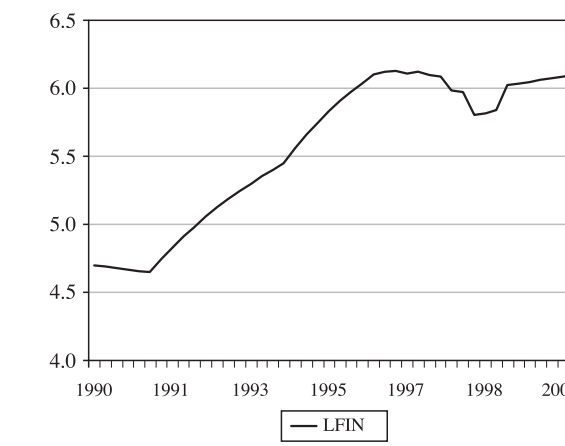


Figure B19: LGOB

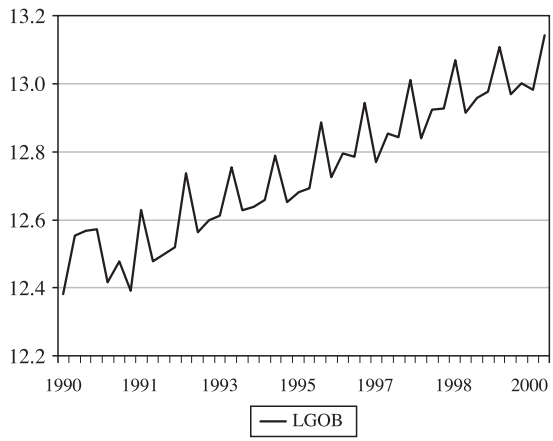


Figure B20: LTRIB

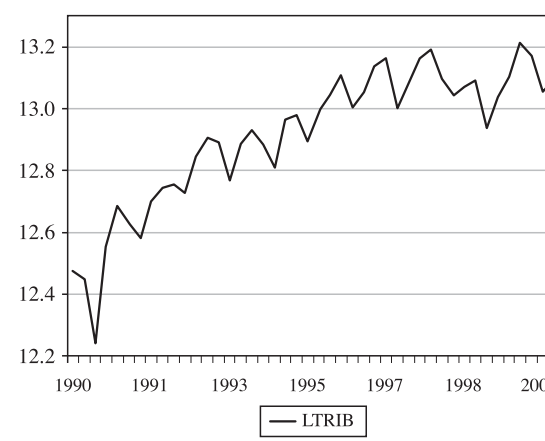


Figure B21: LRSTPR

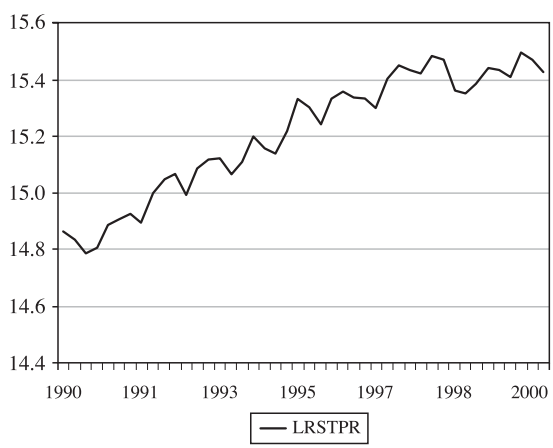
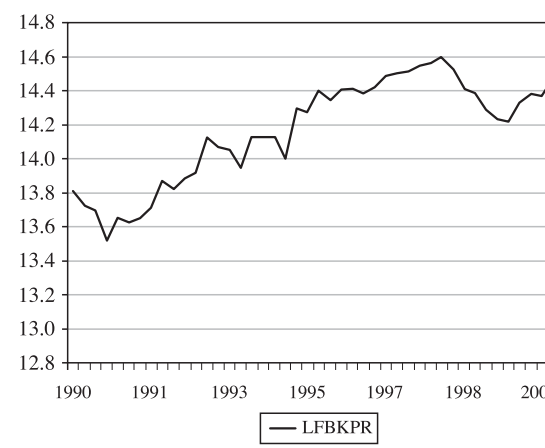


Figure B22: LFBKPR



Source: This set of graphs was prepared by the authors.

APPENDIX C

Private expenditure estimated equations

TABLE C1

Chile: Cointegration for private gross fixed capital formation (LFBKPR) and for other private aggregate demand (LRSTPR) [a/ b/]

Method: Two-stage least squares (1990.1 Stet - 2000.4)

Variable explained	LFBKPR	LRSTPR
Explanatory variables		
Constant	10.0561 (0.000)	12.2253 (0,000)
LTI	0.4369 (0.039)	– (–)
FKNAY*(1-DUM98)	1.4031 (0.034)	– (–)
FKNAY*DUM98	2.7691 (0.030)	– (–)
GAPHPY [c/]	-4.4007 (0.000)	-1.1039 (0.006)
LFIN [d/]	0.3348 (0.000)	0.3099 (0.000)
Time	0.0071 (0.040)	30.39 (0.133)
LPIB-LTRIB	– (–)	0.4679 (0.000)
rc90*(1-DUM98)	– (–)	-0.8976 (0.000)
Adjusted R^2	0.954	0.961
Durbin-Watson statistic	2.184	1.693
F-statistic	135.381	243.106

Source: Prepared by the authors.

[a/] Figures in parentheses correspond to P-values.

[b/] Instruments: CFE, LFIN(-1), LOFCA, FKN(-1), GAPHPY(-1), LFBKF (-1,) LPIB(-1), LTI, TIEMPO, DUM98, RC90(-1), LIBO90, SPREAD (-1), LRSTD(-1), LGOB, FKNAY(-1), LTRIB(-1), LTCR(-1), REXT, EDTCR(-1), LRSTD(-1), LGOB2, LGOBRST, LGOBFBK .

[c/] Defined as the difference between potential GDP represented by a Hodrick-Prescott filter applied to cumulative annual GDP, and actual cumulative annual GDP.

[d/] See Lehmann (1998).

Fixed capital formation of the private sector (LFBKPR) is explained by variables relating to the return of investment projects, such as the terms of trade (LTI) that affect profitability of export-oriented projects, and the output gap (GAPHPY), that affect the profitability of projects oriented to domestic demand. In addition, variables representing the effect of financing conditions on investment were also included, such as cumulative annual net capital flow (FKNAY) and stock market capitalization (LFIN). The availability of foreign credit (FKNAY) has a positive effect on capital formation, and this effect becomes more intensive during the period of weakening capital inflows (DUM98=1), which also coincides with the period of least exchange-rate intervention and thus more direct association between foreign credit and domestic spending.

The rest of the private-sector aggregate demand encompasses consumption and changes in inventories. The explanatory variables for this equation include a version of private-sector disposable income (LPIB-LTRIB) and stock market depth (LFIN), the output gap (GAPHPY) and the real interest rate, which affects the rest of private demand only in the period of high availability of external financing (DUM98=0). Estimation of the error-correction model for private demand is shown in table C2. The variables considered, including variations in the interest rate, terms of trade and output gap, all have the expected signs and are significantly different from zero.

TABLE C2

Chile: Error-correction estimations for fixed capital formation and the rest of private-sector domestic demand [a/]

Method: Ordinary least squares (1991.2 - 2000.4)

Variable explained =>	DFBKPR	DRSTPR
Explanatory variables		
C	–	0.01399 (0.014)
DTI(-1)+ DTI(-2)	0.44155 (0.000)	–
DTI(-5)+ DTI(-6)	0,15923 (0,055)	–
Drc90(-1) + Drc90(-4)	-0.76841 (0.000)	–
Drc90(-3) + Drc90(-4)	–	-0.56164 (0.019)
Drc90(-6) + Drc90(-7) + (Drc90(-8)	-0.9811 (0,000)	–
Drc90(-6) + Drc90(-7)	–	-0.37952 (0.054)
Drc90(-5)	-1.8633 (0.000)	–
DDFKNAY(-1)+ DDFKNAY(-2)	0.72855 (0.000)	–
DFKNAY(-5)	–	0.71187 (0.018)
DDGAPHPY(-1)	-6.7357 (0.000)	–
DGAPHPY(-1) + DGAPHPY(-7)	-1.3635 (0.114)	–
DPIB(-1)	–	1.10349 (0.000)
DPIB(-2)	–	0.85115 (0.001)
DTRIB(-2)	–	-0.22269 (0.020)
DDy(-3)	-0.35612 (0.000)	–
Dy(-1) + Dy(-3)	0.29376 (0.000)	–
Dy(-5) + Dy(-6)	–	-0.31973 (0.003)
Dy(-6) + Dy(-8)	0.07005 (0.096)	(0.056)
Dy(-4)	–	0.3204
Dy(-1)+Dy(-2)	–	-0.48674 (0.001)
RESID(-1)	-0.72414 (0.000)	-0.63242 (0.000)
Adjusted R^2	0.928	0.781
Durbin-Watson statistic	1.968	2.249

Source: Prepared by the authors.

[a/] Figures in parentheses are P-values. RESID(-1) represents the residuals of the corresponding cointegration equation, with a one-period lag. D represents the first difference of the variable and DD the second difference. Dy (-i) is the explained variable with *i* lags.

APPENDIX D

Chile: Augmented Dickey-Fuller (ADF) unit root test

Variable	ADF / EGR	Constant	Trend	Constant and trend
FKN	-5.0 [a/]	Yes	No	-5.0 [a/]
dFKN	-3.3 [b/]	Yes	No	-7.2 [a/]
LTI	-2.1	Yes	No	-2.8
dTI	-8.8 [a/]	Yes	No	-8.7 [a/]
Spread	-2.5	Yes	No	-2.3
d*Spread*	-4.5 [a/]	Yes	No	-4.6 [a/]
*Spread_*2	-6.9 [a/]	Yes	No	-7.4 [a/]
d*Spread_*2	-5.7 [a/]	Yes	No	-5.8 [a/]
CFE	-1.6	Yes	No	-1.6
dCFE	-5.3 [a/]	Yes	No	-5.2 [a/]
LTCR	-2.1	Yes	No	-0.7
dLTCR	-6.6 [a/]	Yes	No	-7.1 [a/]
RC90	-3.3	Yes	No	-3.2
DRC90	-5.4 [a/]	Yes	No	-4.2 [a/]
LIBO90	-2.1	Yes	No	-2.9
dLIBO90	-2.5 [b/]	No	No	-2.5
REXT	-2.3	Yes	No	-2.2
dREXT	-5.8 [a/]	No	No	-5.8 [a/]
EdTCR	-2.7	Yes	No	-2.7
dEdTCR	-7.8 [a/]	No	No	-7.7 [a/]
LFIN	-2.0	Yes	No	-1.1
dFIN	-3.0 [b/]	No	No	-3.5 [a/]
LOFCA	-6.5 [a/]	Yes	No	-6.4 [a/]
dLOFCA	-11.5 [a/]	No	No	-11.4 [a/]
LPIB	-2.7	Yes	No	-2.1
dPIB [a/]	-1.9	Yes	No	-2.9
LDDA	-0.9	Yes	No	-1.5
dDDA	-6.5 [a/]	Yes	No	-6.6 [a/]
LFBKPR	-1.1	Yes	No	-2.7
dFBKPR	-8.0 [a/]	Yes	No	-7.9 [a/]
LRSTPR	-2.0	Yes	No	-1.9
dRSTPR	-8.5 [a/]	Yes	No	-4.9 [a/]
FKNCP	-4.6 [a/]	Yes	No	-4.6 [a/]
dFKNCP	-6.6 [a/]	Yes	No	-6.6 [a/]
FKNMYLP	-4.8 [a/]	Yes	No	-4.8 [a/]
dFKNMYLP	-12.5 [a/]	Yes	No	-12.4 [a/]
FKNAY	-1.9	Yes	No	-2.2
dFKNAY	-4.9 [a/]	Yes	No	-5.0 [a/]
GAPHPY	-4.4 [a/]	Yes	No	-4.2 [a/]
dGaphpy	-4.5 [a/]	Yes	No	-4.4 [a/]
LTRIB	-3.5 [b/]	Yes	No	-1.9
dTrib	-3.3 [b/]	Yes	No	-4.0 [a/]

Source: Prepared by the authors.

[a/] Rejected at 1%. [b/] Rejected at 5%.

[a/] Using the Phillips-Perron test, the unit root hypothesis is rejected at the 1% significance level, whether including a constant and trend, or a constant alone.

APPENDIX E

Engle-Granger unit root test for residuals (EGR) [a/]
(Without constant or trend)

Variable	EGR
RESIDFKN	-7.0 [a/]
RESIDFKNCP	-4.2 [a/]
RESIDFKNMYLP	-5.5 [a/]
RESIDFKBPR	-6.4 [a/]
RESIDRSTD	-5.6 [a/]
RESID*Spread* 2	-7.4 [a/]
RESIDrc90	-4.7 [a/]
RESIDLTCR	-2.0

Source: Prepared by the authors.

[a/] Rejected at 1%. Critical value of EGR: at 1%, -3.73; at 5%, -2.91.
[b/] See Enders (1995), p. 383.

APPENDIX F

Chile: Variables characterization matrix [a/]
(1990.1 - 1997.4)

	World growth	Supply of capital	Capital inflows	Price of copper	Terms of trade	Trend current a/c
World growth	2.15/0.91	0.26	0.23	0.5	0.52	0.057
Supply of capital	0	68.62/70.7	0.02	-0.03	0.24	-0.35
Net flows	2 ==> 1	0	0.24/0.05	0.25	0.16	-0.345
Price of copper	0	0	0	106.21/22.76	0.85	-0.014
Terms of trade	0	1 ==> 2	0	2 ==> 1	125.27/11.48	-0.089
Trend current a/c	0	0	2 ==> 1	0	0	0.76/0.88

Source: Prepared by the authors.

[a/] The diagonal contains the mean and standard deviation of each variable. The cells above the diagonal show the correlation coefficient between the variables. The cells below the diagonal indicate the result of the Granger causality test. Identifier numeral "1" refers to the variable that appears in the corresponding row, and "2" to the variable in the column.

The results show that world growth causes net capital flows to Chile; the terms of trade cause the supply of capital; and capital inflows cause the trend current account (or expenditure). The supply of capital responds positively to the terms of trade, but not to the copper price.

APPENDIX G

TABLE G1

Chile: Cointegration of total net capital flows [a/ b/]
(Alternative specifications)
Method: Two-stage least squares (1991.1 - 2000.4)

Variable explained	FKN (1)	FKN (2)	FKN (3)	FKN (4)	FKN (5)
Explanatory variables					
Constant	13104.97 (0.101)	9336.26 (0.161)	13616.61 (0.107)	8263.05 (0.384)	7795.05 (0.377)
LTI	-2671.56 (0.139)	-1819.65 (0.220)	-3102.50 (0.108)	-1554.11 (0.489)	-1433.58 (0.464)
LDDA-LPIB	16503.11 (0.000)	13788.89 (0.001)	16457.78 (0.001)	17725.94 (0.001)	18099.08 (0.000)
Spread	2920.02 (0.443)	– (–)	3233.07 (0.419)	4285.85 (0.355)	3987.97 (0.333)
Spread_2	– (–)	-360.21 (0.720)	– (–)	– (–)	– (–)
CFE	-26282.12 (0.054)	-26811.84 (0.024)	-26927.32 (0.067)	2011.64 (0.881)	– (–)
DUM98	-1887.17 (0.000)	-1932.33 (0.000)	– (–)	– (–)	– (–)
LOFCA (1-DUM98)	– (–)	– (–)	378.53 (0.002)	– (–)	– (–)
Time	33.45 (0.085)	35.58 (0.060)	22.71 (0.225)	-24.05 (0.103)	-25.31 (0.034)
Adjusted R^2	0.419	0.486	0.358	0.135	0.159
Durbin-Watson statistic	2.200	2.269	2.072	1.699	1.681
F-statistic	7.238	7.389	6.232	3.789	4.866

Source: Prepared by the authors.

[a/] Figures in parentheses are P-variables.
[b/] Instruments: CFE, LFIN(-1), LOFCA, FKN(-1), GAPHPY(-1), LFBKF(-1), LPIB(-1), LTI, TIME, DUM98, RC90(-1), LIBO90, SPREAD(-1), LRSTD(-1), LGOB, FKNAY(-1), LTRIB(-1), LTCR(-1), REXT, EDTCR(-1).

Each of the five specifications reports a negative and statistically significant effect for the CFE on total net capital flows. The only exception is when variables representing the supply of foreign financing are excluded from the specification.

In addition to the five alternative specifications, we present the results of the coefficient restriction test. In the first case the effect of the spread is restricted to be equal to that of the CFE, but with opposite sign. The test is applied to specification (1), which is an unrestricted version of the cointegration equation for the FKNs used in this paper; the restriction is not rejected by the data at the 10% significance level. The test of CFE exclusion applied to specification (1) is also rejected by the data, this time at the 5% significance level, along with the test for exclusion of CFE and DUM98, which is rejected at the 1% level.

TABLE G2

Variable restriction and exclusion tests in the cointegration of total net capital flows

Wald test:
Equation EQFKN

Statistical test	Value	df	Probability
F-statistic	2.406231	(1, 33)	0.1304
Chi-squared	2.406231	1	0.1209

Summary of null hypothesis:

Normalized restriction (= 0)	Value	Standard error
C(4) + C(5)	-23362.10	15060.63

Redundant variables: CFE

F-statistic	4.160857	Probability	0.049440

Dependent variable: FKN
Method: Two-stage least squares
Sample: 1991.1 2000.4
Number of observations: 40

Variable	Coefficient	Standard error	t-statistic	Probability
C	15881.50	8179.707	1.941573	0.0605
LDDA-LPIB	13412.14	4091.269	3.278235	0.0024
LTI	-3426.204	1837.548	-1.864552	0.0709
SPREAD	5919.967	3844.308	1.539931	0.1328
DUM98	-1350.852	425.1714	-3.177193	0.0032
TIME	28.58302	19.70826	1.450306	0.1561

R^2	0.436849	Mean of dependent variable	724.1099
Adjusted R^2	0.354033	Standard deviation of dependent variable	758.3639
Standard error of the regression	609.5127	Sum of the squares of the residuals	12.631.195
F-statistic	6.935445	Durbin-Watson statistic	2.109922
Probability (F-Statistic)	0.000147		

Redundant variables: CFE, DUM98

F-statistic	7.782162	Probability	0.001703

Variable	Coefficient	Standard error	t-statistic	Probability
C	7609.241	8822.429	0.862488	0.3943
LDDA-LPIB	17984.64	4357.349	4.127427	0.0002
LTI	-1391.464	1959.591	-0.710079	0.4824
SPREAD	3807.827	4307.973	0.883902	0.3828
TIME	-25.22153	11.47011	-2.198891	0.0346

R^2	0.249573	Mean of dependent variable	724.1099
Adjusted R^2	0.163810	Standard deviation of dependent variable	758.3639
Standard error of the regression	693.4739	Sum of the squares of the residuals	16.831.710
F-statistic	4.747603	Durbin-Watson statistic	1.681684
Probability (F-statistic)	0.003633		

APPENDIX H

Error-correction model: Total net capital flows

TABLE H1

Chile: Alternative specifications
Method: Ordinary least squares (1991.2 - 2000.4)

Variable explained	DFKN (1)	DFKN (2)	DFKN (3)
Explanatory variables			
DCFE(-4)	-20628.87 (0.114)	-20547.31 (0.016)	-21714.33 (0.007)
DREXT(-4)	-20796.53 (0.014)	-20547.31 (0.016)	-21714.33 (0.007)
D*SPREAD*(-3)	4311.87 (0.011)	– (–)	6891.60 (0.007)
DTI(-3)+DTI(-4)	-2837.73 (0.024)	-2714.69 (0.054)	-4226.93 (0.003)
DLOFCA(-2)+DLOFCA(-4)	51.44 (0.100)	72.39 (0.037)	71.69 (0.026)
DDDA(-4)-DPIB(-4)	9674.33 (0.0003)	9556.90 (0.002)	11302.25 (0.000)
DFKN(-4)	0.35347 (0.0015)	0.289513 (0.008)	0.37741 (0.000)
RESIDY(-1)	-0.80899 (0.000)	-0.77950 (0.000)	-0.63882 (0.000)
Adjusted R^2	0.788	0.718	0.751
Durbin-Watson statistic	2.081	2.186	2.246

Source: Prepared by the authors.

[a/] Figures in parentheses are P-values. RESIDY(-1) represents the residuals from the corresponding cointegration equation, with a one-period lag.

Specification (1) presents an alternative version of the error-correction model associated with the cointegration relation for selected FKNs. The second column presents an error-correction model based on alternative specification (4) for FKN cointegration, using the observed spread (*Spread _2*) instead of the expected spread. The third is based on the cointegration specification for FKN (5) which uses LOFCA instead of DUM98 to represent the supply of capital.

The first restriction consists of excluding all arbitrage-related variables from the selected error-correction model. This restriction is rejected at the 1% significance level, according to F-tests and the likelihood ratio. The second restriction excludes only variables associated with the *encaje*; in this case the restriction is also rejected at the 1% level, according to the F-test and the likelihood ratio.

TABLE H2

Test of restrictions in the error-correction model for FKN

Redundant variables: DCFE(-4), DCFE(-7), DREXT(-5)

F-statistic	12.55910	Probability	0.000046
Logikelihood ratio	34.92271	Probability	0.000000

Dependent variable: DFKN
Method: Least squares
Sample: 1992.2 2001.1

Variable	Coefficient	Standard error	t-statistic	Probability
C	-14.07508	64.33351	-0.218783	0.8285
DTI(-3)+DTI(-4)	-1372.601	1104.481	-1.242757	0.2250
DTI(-6)	-5480.374	1309.262	-4.185850	0.0003
DTI(-7)+DTI(-8)	3100.855	1130.278	2.743444	0.0109
DLOFCA(-2)+DLOFCA(-4)	64.93306	26.13234	2.484778	0.0197
DLOFCA(-8)	71.60060	39.47195	1.813961	0.0812
DDDA(-4)-DPIB(-4)	10852.28	2684.125	4.043136	0.0004
DFKN(-4)	0.304481	0.083557	3.643988	0.0012
DFKN(-7)+DFKN(-8)	-0.156841	0.097817	-1.603423	0.1209
RESIDFKN(-1)	-0.828273	0.146451	-5.655622	0.0000

R^2	0.885404	Mean of dependent variable	-15.16610
Adjusted R^2	0.845736	Standard deviation of dependent variable	972.2218
Standard error of the regression	381.8540	Akaike information criterion	14.95809
Sum of the squares of the residuals	3.791.125	Schwarz criterion	15.39795
Log likelihood	-259.2456	F-statistic	22.32045
Durbin-Watson statistic	1.912767	Probability (F-statistic)	0.000000

Redundant variables: DCFE(-4), DCFE(-7)

F-statistic	8.064264	Probability	0.002219
Logikelihood ratio	19.12887	Probability	0.000070

Dependent variable: DFKN
Method: Least squares
Sample: 1992.2 2001.1

Variable	Coefficient	Standard error	t-statistic	Probability
C	-52.82989	53.71039	-0.983606	0.3347
DREXT(-5)	-23913.63	6444.825	-3.710517	0.0010
DTI(-3)+DTI(-4)	-1482.778	904.9873	-1.638451	0.1139
DTI(-6)	-5957.520	1079.886	-5.516802	0.0000
DTI(-7)+DTI(-8)	2302.837	950.2834	2.423316	0.0230
DLOFCA(-2)+DLOFCA(-4)	51.37420	21.71047	2.366334	0.0260
DLOFCA(-8)	88.04781	32.62752	2.698575	0.0123
DDDA(-4)-DPIB(-4)	10517.75	2199.977	4.780848	0.0001
DFKN(-4)	0.287082	0.068588	4.185573	0.0003
DFKN(-7)+DFKN(-8)	-0.202594	0.081049	-2.499642	0.0194
RESIDFKN(-1)	-0.927187	0.122861	-7.546624	0.0000

R^2	0.926101	Mean of dependent variable	-15.16610
Adjusted R^2	0.896542	Standard deviation of dependent variable	972.2218
Standard error of the regression	312.7143	Akaike information criterion	14.57492
Sum of the squares of the residuals	2444755	Schwarz criterion	15.05878
Log likelihood	-251.3486	F-statistic	31.33011
Durbin-Watson statistic	2.156734	Probability (F-statistic)	0.000000