Is the FX derivatives market effective and efficient in reducing currency risk? Some evidence, with focus on Chile*

Esteban Jadresic M.
&
Jorge Selaive C.

PRELIMINARY – ONLY FOR COMMENTS

Abstract

This paper explores whether the foreign exchange (FX) derivatives market effectively and efficiently reduces the vulnerability to foreign exchange rate fluctuations. Cross-country evidence suggests that derivatives indeed help to reduce firms´ FX exposure and do not boost up spot exchange rate volatility. A unique daily dataset for Chile following the adoption of a floating exchange rate shows that increased activity in the forward market has not been associated with larger volatility in the exchange rate. Also, it cast doubts about the view that large participants make profits out of using asymmetric information or have market power. Our findings support the view that development of the FX derivatives market is a valuable mechanism to reduce currency risk.

---

* Prepared for the conference *External Financial Vulnerability and Preventive Policies* organized by the Central Bank of Chile, Santiago, August 10-11, 2004. Jadresic: ejadresi@bcentral.cl, Selaive: jselaive@bcentral.cl. We thank Felipe Alarcón for research assistance. All errors are ours.

I. Introduction

Floating foreign exchange rates have gained increased support as a preferable system to reduce vulnerability of emerging markets to external shocks. The volatility of the exchange rate associated to floating exchange rates, however, exposes economic agents to the risk of changes in the valuation of the financial assets and liabilities in their balance sheet, as well as in their stream of current and expected cash flows. As derivatives provide agents with tools to insure against risks, it would seem that a key complement to a successful floating exchange rate system is the development of the foreign exchange (FX) derivatives markets.

A FX derivatives market, however, may not be effective in diminishing an economy's aggregate vulnerability to exchange rate fluctuations. FX derivatives reduce the cost of adjustment of foreign exchange positions both for participants in the market that want to hedge their initial positions, as for those that want to increase their exposure to foreign exchange risk. Similarly, they can help amplify the effects on the foreign exchange rate of the decisions of the agents that in any point in time may help to stabilize it, but also can amplify the effects of those agents whose decisions tend to destabilize it. In the aggregate, the net effects could well imply that FX derivatives increase the volatility of the exchange rate, increase the exposure to the foreign exchange rate of at least some agents, or both. The end result could be more rather than less overall vulnerability to foreign exchange rate fluctuations.

Moreover, even if a FX derivatives market contributes to reduce currency risk, the efficiency with which it operates may be unsatisfactory. Two aspects of particular concern are whether the market is transparent and competitive. This requires that there are no participants that systematically have superior information about the exchange rate movement that enables them to take more profitable positions when they foresee a convenient movement in the foreign currency, or that have sufficient market power so that their actions generate significant changes in the exchange rate. In short, there should be no asymmetric information among traders that may be price relevant.

The issue whether FX derivatives are effective and efficient in reducing currency risk is particularly relevant in the case of emerging market economies. Potential problems of FX derivatives markets are likely to be more accentuated in those economies, given their thinner, and less liquid and developed financial markets. In addition, for this reason, and perhaps also because the adoption of floating exchange rate regimes is more recent and memories of the old ways are more vivid in some agents, there is more concern and debate in them about the merits of FX derivatives as a mechanism to reduce currency risk.

This paper looks at empirical evidence on whether the FX derivatives market may effectively and efficiently reduce the vulnerability to foreign exchange rate fluctuations, with special focus on the current and potential situation of the Chilean market. Among emerging market economies, Chile offers a particularly interesting case. Having adopted a floating exchange rate in September 1999, after a decade old exchange rate band whose width and level was often revised, its floating exchange rate regime is widely perceived as a highly successful one. In addition, its FX derivatives market has grown to form a reasonably active market given the size of the economy, and a unique daily database reporting purchases and sales of most of the participants in the market is available. However, the development of this market still remains distant from the one in advanced economies, and its ability as a useful mechanism to reduce agents currency risk has often been put into question.

The literature that directly addresses the topics of interest for this paper is scant. Some work has been done in order to examine the effects of derivatives on foreign exchange exposure, particularly at the firm level, suggesting that foreign exchange derivatives indeed tend to reduce those exposures (for instance, Allayannis and Ofek, 2001). In contrast, we are not aware of previous attempts to assess empirically the effects of FX derivatives on foreign exchange volatility. On the issue whether traders in FX derivative markets may poses asymmetric information that is price relevant, there are some references with evidence on US markets (such as Wei and Kim, 1997; and Klitgaard and Weir, 2004) using weekly data, discussed further below. On the Chilean FX derivatives market, Alarcón, Selaive and Villena (2004) provide descriptive and comparative statistics, and Caballero, Cowan and

Kearns (2004), Fernández (2001) and Velasco and Arellano (2003) offer some analysis, but with focus different than ours. Finally, some useful related research is work done examining the functioning of markets for other financial derivatives, particularly equity derivatives. This literature is referred to below.

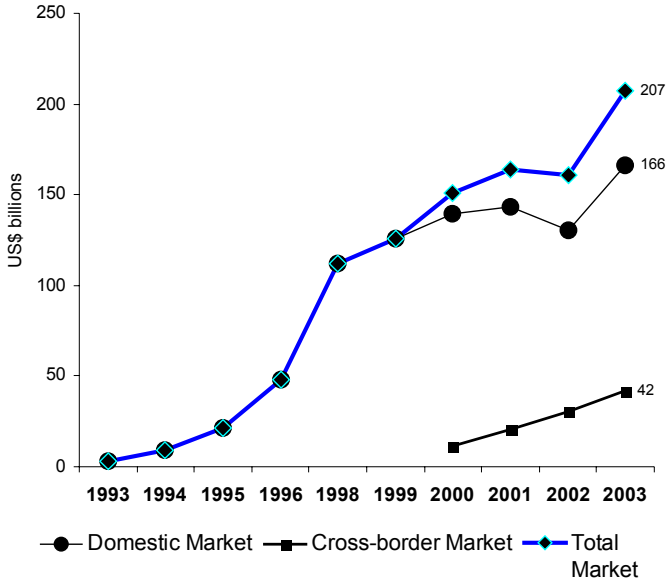
Given the meager literature on the topics of interest for this paper, the remainder of this paper explores various relevant topics and pieces of evidence we were able to investigate for this paper, instead of examining with strenuous detail a particular data set or issue. Its specific contents are the following. As the analysis has a focus on the current and potential situation of the Chilean FX derivatives market, Section II of this paper presents main recent tendencies and characteristics of this market. Sections III and IV use both cross-country evidence and time-series for Chile in order to explore the contribution of FX derivatives to effectively reduce the currency risk, examining their relationship with foreign exchange exposures, and foreign exchange volatility, respectively. Section V explores the efficiency of the Chilean FX derivatives market, studying whether there may be asymmetric information that is price relevant. Section VI provides concluding remarks.

II. Characteristics of the derivatives market in Chile

II.1. An Overview

In this section we briefly describe and analyze main trends and characteristics of the Chilean FX derivatives market. We use a unique dataset of foreign exchange derivatives compiled at the Central Bank, which covers all operations in which there is a domestic bank or a non-resident counterparty.[1] Part of this data with some additional statistics and international comparisons are presented in Alarcón et al. (2004).

Figure 1. Derivatives Turnover



Notes:

a. The amounts correspond to total turnover -purchases and sales- of currency derivatives

Figure 1 presents the evolution of Chile's derivatives turnover from 1993 to 2003, divided by domestic and cross-border subscriptions. A noteworthy feature of the derivatives market is its quite rapid and persistent growth, consistent with the increased flexibility in the exchange rate and a significant process of trade and financial integration of the Chilean

[1] Interbank trading is considered only once. Contracts in which there are no domestic banks nor non-resident involved belongs to the denominated informal FX market, or financial non-banking sector. According to non-official numbers, the informal FX market does not represent more than 30 percent of the total market. Numbers do not include offshore operations.

economy with the rest of the world (Jadresic et al., 2003). There is a slight decline during 2002 triggered by a drop in the domestic turnover. Even though, cross-border operations have increased steadily during the whole period.

Table 1 shows, from the point of view of the banking sector, that the non-financial and institutional sector represented 12 percent of the total turnover during 1998, and that this share increased, to 23 percent in 2003. This was mainly influenced by the rapid internationalization of Pension Funds (AFPs).[2]

Insert Table 1

Turnover by counteparty of the Banking Sector

On the other hand, in table 2 we look at turnover classified by counterparty involved in cross-border operations. The non-banking financial sector, basically investment banks that do not take deposits, concentrated 65 percent of the total turnover. Thus, a large part of forward foreign exchange cross-border operations is not directly carried out by banks.[3]

Insert Table 2

Turnover by counterparty of the Cross-Border Market

Even though the average size of forward operations was around US$ 4.5 millions in 2003, the cross-border contracts were much larger than the onshore ones (see table 3). Within the former contracts, the non-banking financial sector subscribed the largest contracts, which it may be associated to hedging strategies of domestic banks. On the other hand, the non-financial and institutional sectors have experienced a steady decrease in the size of contracts explained by a larger number of counterparties in the former sector.

Insert Table 3

Median Size of Operations: Domestic and Cross-Border Market

During 2003, 938 firms in the non-financial sector subscribed forwards contracts with either banks or foreign counterparties. Manufacturing firms had a share of approximately 20 percent of the turnover, while the financial sector, corresponding to investment banks, concentrated 24 percent of it (table 4).

[2] The institutional sector gathers pension funds, mutual funds and insurance companies.
[3] The number of counterparts in each sector is presented in Alarcón, Selaive and Villena (2004).

Insert Table 4

Sectoral Distribution of Turnover: Non Financial Sector

To assess how the derivatives market has evolved in terms of the maturity of forward contracts, table 5 presents the maturity breakdown for onshore and cross-border operations. There is a clear pattern showing a decreasing share in contracts of less than 7 days. It is worthnoting that these contracts are mostly associated to banking liquidity shortage in foreign currency. During 2003, 2.6 percent of total turnover was associated to contracts of over 1 year, quite close to the world average of 3 percent. Thus, currency derivatives markets are, in general, short-term concentrated and Chile is not an outlier.

Insert Table 5

Maturity breakdown

In table 6 we present activity indicators constructed from data of the Triennial survey of the Bank of International Settlements (BIS).[4] The ratios of derivatives over GDP and over trade flows locate Chile below but close to the average of emerging market economies, although quite far from advanced economies.

Insert Table 6

Derivatives Activity Indicators

In table 7, we present average level and volatility of spreads, constructed from daily data available at Bloomberg for years 1998 and 2003.[5] Australia presents the lowest spread among the selected economies, while Chile shows a persistent decrease over the same period, and the second lowest volatility.

For an investor in different currencies, it is also important to assess the heterogeneity in spread movements to achieve the appropriate degree of portfolio diversification. In table 8 we present the correlation of daily spreads between January 1998 and December 2003. Remarkably, there is a quite low cross-correlation among countries. While Australia and New Zealand present the highest pairwise correlation, Chile does commove mainly with Brazil, but not importantly with any of the other selected economies. Moreover, the simple

[4] Classification of the economies is in appendix A.

average of all pairwise correlations yields 0.04. This finding suggest that common sources of variations are not important in the forward market, and on the other hand, idiosyncratic shocks may be the main factors of variations.[6] Given financial integration and the rise of "crossover investors", this result seems surprising.

Insert Table 7 & Table 8

Level, Volatility and Correlations of Spreads 1998-2003.

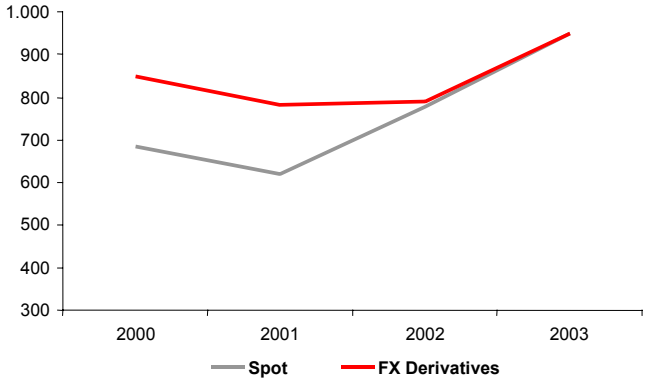
Cross-country transmission of shocks: Cross-country correlation matrix of spreads

The concentration degree in the intermediation of the FX Market can be evaluated by calculating market shares of local market-makers. In 2003, the number of banks that concentrated approximately 80 percent of spot and derivatives turnover were 10 and 9, respectively.

Insert Table 9
Banking Concentration in the Derivatives Market

Another more elaborated approach to the issue of concentration is shown in figure 2, where we present the Herfindahl index for both spot and derivatives contracts intermediated by banks. Interestingly, the index locates always below 1000 points indicating a low degree of concentration according to usual standards.

Figure 2. Banking Concentration: *Herfindahl Index*.



Notes: Based on banks´ market shares in the total turnover of FX derivatives
a. Between 0 and 1000 the concentration is considered low; between 1000 and 1800 moderate; and above 1800 the market is considered concentrated (Tirole, 2000)

[5] Bloomberg reports spreads for a sample of reporting dealers who carried out cross-border and local operations.
[6] A factor analysis for a large sample of economies, in the spirit of Litterman and Scheinkman (1991), may be worth to pursue to further explore this finding.

II.2. Current challenges to develop the market

In general, we observe that the derivatives market has developed substantially in the last few years. Even though, we have not assessed quantitatively the level of development, there are some avenues to follow by authorities and private sector to boost the derivatives market.

Currency options were approximately 10 percent of total turnover according to the BIS Survey 2001, and they were traded in more than 80 percent of the reporting countries. In Chile, banks are not allowed to issue these kinds of instruments.

Most trading in the FX markets occurs in decentralized dealer markets, and at the same time, the trading is carried out by fax and telephone. The degree of transparency of the market could be improved with on-line information about exchange rates.

To eliminate the settlement risk is also a priority for FX participants. A common practice in developing countries is that the counterparty in the stronger bargaining position gets paid first (Canales-Kriljenko, 2003). CLS Bank International has been able to fully eliminate settlement risk in the cross-border trading of the mayor currency pairs since 2002.

Finally, participants in the Chilean FX market take positions mostly by non-deliverable forwards that imply compensation at the expiration date. The availability of a spot on-line exchange rate may be relevant to allow for the development of deliverable forwards.

III. Does the FX derivatives market reduce exposure to FX fluctuations?

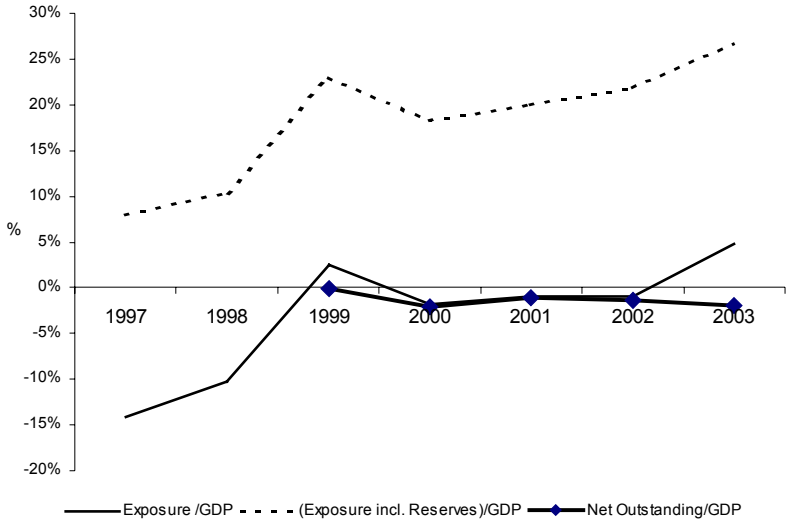
In table 10 and figure 3 we present a measure of aggregate currency mismatch in the Chilean economy, based on a simplified version of the methodology developed by the Australian Bureau of Statistics (2001). Total foreign currency exposure (FCE) is calculated as foreign currency debt assets plus foreign equity assets and net position of foreign

currency derivatives minus foreign currency debt liabilities.[7] Thus, a negative value indicates a short foreign currency position.

Without considering international reserves, we observe that Chile has gradually increased its exposure, ending up 2003 with a long position of around 5 percent of the current GDP. The notional value of the net outstanding foreign currency exchange is negative, which means that Chile is in a net sold –short- position with respect to non-residents, although numbers are quite small as a percentage of the GDP.[8] This last feature is mainly explained by foreign investors that hedge their direct and portfolio investments in the local market, which more that surpasses the hedging (long) positions taken by domestic agents (pension funds, mutual funds and the non-financial sector).

Insert Table 10
Chilean FCE from 1997 to 2003

Figure 3. Derivatives and foreign currency exposure



[7] Instruments indexed to the US dollar issued by the Central Bank do not alter the exposure at the aggregated level since most of them are held by residents.

[8] Although these aggregate numbers give a reassuring picture of Chilean´s foreign currency exposure, it is possible that they could disguise substantial imbalances within sectors of the economy. Thus, a sectoral distribution of exposure and intensity of derivatives usage is an important extension, but out of the scope of this paper.

In table 11 we calculate -for a group of selected economies- a quite standard measure of currency mismatch (Goldstein and Turner, 2004). [9] This measure does not incorporate the net outstanding position because of the lack of reliable data at a cross-country basis. Interestingly, there appears to be a positive association between currency mismatch and derivatives: the pairwise correlation between derivatives usage and net debt over GDP is 0.44 for the sample of countries.

This result suggests that economies with a more developed derivatives market tend to have also more room to borrow in foreign currency. Implicitly, behind this assessment is the assumption that a more developed derivatives market brings together a larger net bought position. So, for instance, Australia looks with a larger currency mismatch with respect to Chile, although the net positive position in currency derivatives allow this country to afford this larger indebtedness. Unfortunately, this says nothing about the association between the depth of the FX derivatives market and net foreign exchange exposures.

In the absence of direct data to measure currency mismatches across countries, we examine the association between a complementary measure of currency exposure derived from a regression analysis and the turnover in the currency derivatives market (table 12). Under this measure of exchange rate exposure, a sector/firm exhibits exchange rate exposure if its share value is influenced by changes in currency values after controlling for the market return. We used the Morgan Stanley Capital Indices available at Bloomberg at monthly frequency from January 1995 to June 2004. The stock market return and nominal exchange rates were also obtained from Bloomberg. We consider eight sectors: Consumer discretionary, consumer staples, financials, health care, industrial, material, telecommunications and utilities.[10]

[9] As Caballero et al. (2004) point it out, foreign debt do not completely summarize currency mismatch since they ignore the currency composition of debt and the response of income to exchange rate fluctuations.
[10] The model specification is $R_{i,t} = a_0 + a_1 Market\ Return_t + a_2 \Delta NER_t + error_t$. The table presents coefficient estimates from a panel OLS with fixed effects and individual sectoral estimates for each country.

Insert Table 11

Net Debt for Selected countries

Insert Table 12

Exposure by regression analysis for selected countries

As can be seen in Table 12, the results suggest that countries with the lowest ratios of derivatives usage are also the ones with more exposure. This is confirmed either when we consider the panel estimates or the number of sector with significant exposure.

In a nutshell, it seems that countries with a more develop derivatives market tend to increased its share of net foreign currency debt, but at the same time, present lower degrees of exposure to fluctuations in the foreign exchange rate.

IV. What is the relationship between the FX derivatives market and the volatility of the spot exchange rate?

IV.1. Links between volatility and activity in the derivatives market.

Previous research has been oriented to analyze the relationship between volatility and activity mainly in stock markets. Models predict different relations between price and volume that depend on the rate of information flow to the market, how the information is disseminated, the extent to which market prices convey information and the size of the market. Price variability affects the volume of trade in forwards. The time to delivery of a forward or futures contract affects the volume of trading, and through this effect, possibly also the variability of price. The price-volume relation can also indicate the importance of private versus public information in determining investors´ demands (Karpoff, 1987).

Cornell (1981), by associating volatility with uncertainty, argues that volatility may lead to an increase in both hedging and speculative trading in derivatives contracts. First, uncertainty may induce risk-averse agents to transfer risk to those better able to bear it. Uncertainty is also supposed to lead to asymmetric information, thus greater uncertainty provides a speculative motive for trading. Among the links between volatility of price and

activity, the hedging would create a positive relationship. On the other hand, the speculative transactions create a link between price variability and volume that will finally depend upon the public (or private) nature of the information. This fact takes us to distinguish macro announcement that will tend to increase volume and variability with respect to information-based trading that may not be necessarily associated with a positive relation between both variables.

Stein (1987) develops a model in which prices are determined by the interaction between hedgers and informed speculators. In this model; (1). The derivatives market improves risk sharing and therefore reduces price volatility, and (2). If the speculators observe a noisy but informative signal, the hedgers react to the noise in the speculative trades, producing an increase in volatility. In contrast, Danthine (1978) argues that futures markets improve market depth and reduce volatility because the cost of informed traders of responding to mispricing is reduced. Models developed by Kyle (1985), Ross (1989) and Froot and Perold (1991), among many others, associate the volatility of the asset to the rate of information flow. Their models imply that the volatility of the asset price will increase as the rate of information flow increases. Thus, if forward operations increase the flow of information, the volatility of the spot price must change accordingly.

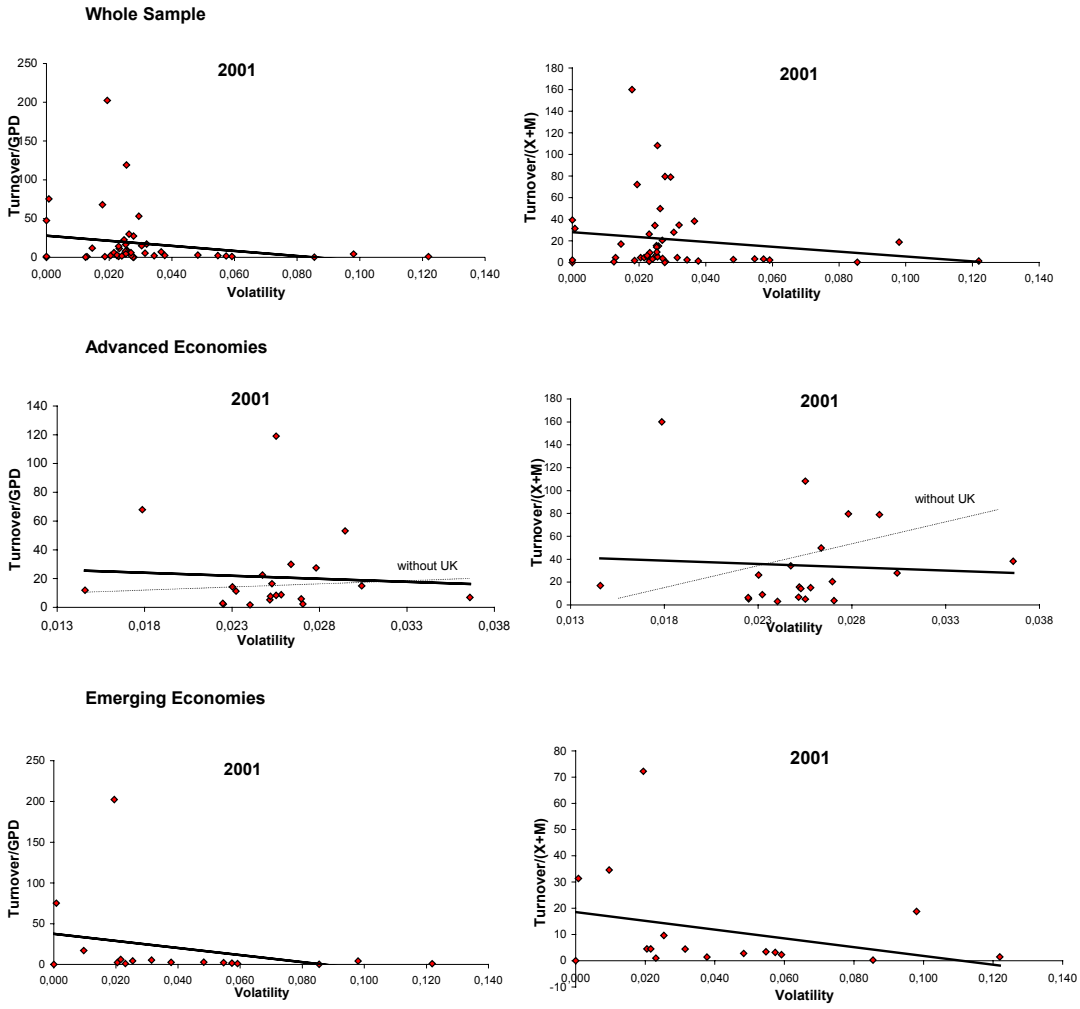
In a nutshell, although all these motives may seem intuitively appealing, the precise interaction can only be established empirically.

Building on the above literature, we make a simple cross-country association between volatility and development of the derivatives market based on data from the BIS (2002) (Figure 4). Although the number of observations is not enough to set a convincing stylized fact, there seems to be a negative association between exchange rate volatility and derivatives. We also split the sample between advanced and emerging economies, and the negative association subsists, although it weakens for the former group because of the inclusion of United Kingdom.[11] These preliminary findings suggest that the derivatives

[11] United Kingdom is a financial european centre.

market may be indeed a good tool to reduce adverse external effects on the exchange rate. In the next subsection we further explore this finding.

Figure 4. Derivative usage and exchange rate volatility



Notes:

a. Volatility constructed as the standard deviation of the change in the monthly (log) exchange rate. Turnover corresponds to subscriptions of forwards, fx swaps, options and futures.

Source: Authors´ calculations based on data from BIS (2002) and IMF *International Financial Statistics*.

IV.2. Volatility and derivatives: A cross-country econometric approach

Our empirical specification is to model exchange rate volatility by

$$\text{Vol}_i = \beta_0 + \beta_1 \text{Openness}_i + \beta_2 \text{Fin.Develop.}_i + \beta_3 \text{Size}_i + \beta_4 \text{GDPpc}_i + \beta_5 \text{Derivatives}_i + \mu_i$$

where Vol_i is the level of nominal exchange rate volatility constructed using monthly data over 1994.1 to 1999.4, drawn for the IMF *International Financial Statistics*. *Openness* is the ratio of the sum of exports and imports over GDP.[12] The benefit of a floating nominal exchange rate is inversely related to the level of trade with the rest of the wold.[13] *Size* is the log of the average real GDP adjusted by PPP of years 1999 to 2001 obtained from the World Bank *Development Indicators*. This variable is intended to proxy for microeconomics benefits of exchange rate stability: smaller countries should be more reluctant to tolerate fluctuations in the nominal exchange rate. *Financial development* is measured as the ratio of private lending to GDP 2001. More financially sophisticated countries should also able to tolerate a higher level of exchange rate volatility. Although the sign may also be negative if domestic financial development helps to stabilize the exchange rate. Finally, *Derivatives Usage* corresponds to currency derivatives reported at the BIS (2002) over current GDP.

We include *GDP per capita* (in PPP units), following Devereux and Lane (2002), as an extra control variable. This is intended as a general check for potential omitted variable bias, and the expected sign is negative: richer countries may have more stable exchange rates.

In Table 13 we present a cross-country estimation. For the full sample of countries, columns (1)-(2), standard variables work reasonably well. Only *openness* does not have the expected sign, although the parameters are not significant either. The simple pairwise

[12] We list the countries in appendix B.
[13] Devereux and Lane (2002), Hau (2002), among others, find empirical evidence of a negative relationship between volatility and openness.

correlation between openness and volatility is -0.07, which may indicate that a time series analysis may yield the expected negative sign.[14]

For the full sample and also for non-OECD countries, *Financial development* enters with a significantly negative coefficient. This suggests that domestic financial development helps to stabilize the exchange rate movements, for instance by facilitating intertemporal smoothing by households and firms or adding liquidity to financial markets (Devereux and Lane, 2002). Finally, *Derivatives Usage* is consistently negative but not significant for all cross section estimates.

The OLS results may not be fully reliable if some of the regressors are endogenously determined by the exchange rate volatility. We consider three variables to be potentially affected by this problem*: Openness, Financial Development and Derivative Usage*. There are two reasons to believe that exploring a IV estimation procedure may not be appealing: (1) find good instruments will not be an easy job, in particular, for *derivatives usage*; (2) evidence with respect to bilateral exchange rate volatility presented by Devereux and Lane (2002) suggest that the IV procedure may not change substantially the results.

While tentative in that they do not account for endogeneity of the right-hand side variables, the results suggest that the exchange rate volatility may be better explained by adding to standard variables, other financial determinants. After controlling for other macro determinants, it seems that a more developed derivatives market does not increase the exchange rate volatility. Finally, further extensions incorporating other financial linkages across-countries, in particular currency-hedging variables, may be promising to better assess the robustness of our findings.

[14] In our case, a time series analysis is restricted by the unavailability of derivatives statistics for a large set of countries.

Table 13

Volatility Regression: OLS Estimation

Dependent Variable : STDEV[d(log(NER$_i$)]

	Full Sample		***Non-OECD countries***	
	(1)	*(2)*	*(3)*	*(4)*
Openness	0.003	0.007	0.003	0.009
	(0.004)	(0.004)	(0.005)	(0.007)
Financial	-0.011***	-0.007***	-0.010***	-0.009**
Development	(0.003)	(0.003)	(0.003)	(0.004)
Size	0.003***	0.004***	0.004**	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
GDP		-0.004*		-0.005*
per capita		(0.002)		(0.003)
Derivatives	-0.011	-0.0007	-0.001	-0.001
Usage	(0.001)	(0.001)	(0.001)	(0.001)
R^2	0.11	0.13	0.10	0.13
#Obs.	124	124	102	102

Notes:
a. White Heteroskedasticity-Consistent Standard Errors & Covariance. Standard Errors in parenthesis. ***, **, * denote 1%, 5% and 10% levels of significance

IV.3. Volatility and derivatives: daily approach for Chile

An alternative approach to gauge the relationship between FX derivatives and exchange rate volatility is to examine the behavior of high-frequency time series on market turnover, positions, and volatility. In recent years there have been a number of empirical studies of the effects of index futures on the volatility of the underlying index. Some of them strongly support the view that index futures do not increase the long-run volatility of the spot price (Yu, 2001). They also conclude that stock market volatility is not related to either the existence of, or the level of activity in the futures market. Although other studies reach the

exact opposite conclusion claiming that futures increase the volatility of the spot price (see Brorsen, 1991, among others).

Empirical research thus far has not produced any conclusive evidence as to the general impact of futures trading on the spot market volatility. Therefore, it is of particular interest to examine the case of the FX markets. In the case of these markets, the references are nonexistent, so we follow approaches commonly used in the finance literature to assess whether there is an increase in volatility when forwards volume is high in the derivatives FX market.[15]

First, we follow closely Bessembinder and Seguin (1992), but instead of these authors that estimated a GARCH augmented by activity measures, we estimate a EGARCH(1,1)-M.[16] As a measured of Activity we use *turnover*, which corresponds to the volume of purchase and sales in all FX derivatives, and *open interest*, which corresponds to the volume of contracts that have not yet been offset by an opposite transaction at the end of the day.[17] We calculate volatility based on the real exchange rate obtained by deflating the nominal one by daily inflation.[18] The sample period covers from January 1995 to June 2004. We report the results for daily estimations in table 14 (specification (A)).[19] It is important to mention that the daily and intra-day approaches are the most commonly used since, in general, it is more difficult to find reasonable explanations that justify a weekly or monthly association between volatility and activity. Although there is agreement that uncovering the relationship between these two markets depend upon the time frame used for analysis.

[15] An alternative approach may assess whether the introduction of forwards generated a change in the level of volatility.
[16] Morandé and Tapia (2002) also use a GARCH-M for the Chilean exchange rate. The ARCH-M models are often used in financial applications where the expected return on an asset is related to the expected asset risk. Therefore, we introduce the conditional "variance" in the conditional mean equation. The EGARCH model implies that the leverage effect is exponential and that forecasts of the conditional variance are guaranteed to be nonnegative.
[17] It is worth noting that *open interest* is not available in a cross-country basis. Interbank trading considered only once.
[18] We also performed all estimations using the nominal exchange rate (not shown to save space).
[19] To use implied volatility derived from at-the-money options traded offshore may be an alternative measure of volatility. The advantage of this option-based approach over GARCH is that it uses current market-determined prices that reflect the market´s true volatility forecast, rather than a series model that is based on an assumed relationship between future volatility and past exchange rate movements.

Insert Table 14
Volatility –Activity Relationship: Specification (A)

For the full sample period –columns (1) to (6), we do not observe a significant link between activity and volatility for the forward and spot market variables tested. For the period after the exchange rate band (free floating-columns (1) to (6)), we observe the same pattern with all coefficients negative and non-significant.

As an alternative approach to properly assess the previous findings, we also follow Jeanneau and Micu (2003). The authors perform an instrumental variable approach that we adapt to test whether more activity in the derivatives market has been accompanied by a more volatile exchange rate. To do so, we will employ the conditional volatility obtained from a GARCH model.[20] The results are in table 15 (specification (B)).

Insert Table 15
Volatility –Activity Relationship: Specification (B)

Under this approach we observe a weak "negative" link between volatility and activity in the derivatives market for the crawling band period (columns (1) and (2)). Similarly, for this period we observe a positive link between activity in the spot FX market and volatility.[21] Although there is no link during the free floating period for any of the variables tested.

The previous results suggest that, at least at a daily frequency, the link between spot exchange rate volatility and activity is quite weak or non-existent.

V. Do large participants benefit from superior information and/or market power?

An important question in the foreign exchange market is whether there exists asymmetric information among traders that may be price relevant. Empirical work on the effect of currency positions on the exchange rate movement is lacking, in part, because of unavailability of data. In this matter, we want to test the abilities to forecast the level or first moment of the exchange rate by large participants of the Chilean exchange. To do so, we

[20] We performed estimations using different ARCH models, and results were uniformly unaltered.

evaluate the forecasting abilities of net currency positions taken in the derivatives and spot markets by these large players. [22]

It is important to point out that the testing involves two observationally equivalent hypotheses. Either large participant have superior information about the exchange rate movement so they take positions when they foresee a convenient movement in the foreign currency or, these participants have sufficient market power so that their actions generate significant changes in the exchange rate. Thus, if we fail to find evidence of a forecasting ability of large participants, neither hypothesis can be true.

The analysis of the relationship between position-taking by large participants and the exchange rate movement is also important because it could help us to understand the forces behind the movement of the exchange rate (Evans and Lyons, 2004).[23] For instance, this approach to understanding exchange rate movements may be of interest to policymakers, who want to understand what drives the changes over relatively short periods. They may draw upon this evidence about the types of flows that are driving the exchange rates. Little else can be said to explain robustly large changes in the short-term.

Wei and Kim (1997) and Klitgaard and Weir (2004) perform a similar exercise for the U.S FX market with weekly data. Both papers find that players trade on noise rather than on asymmetric information, although they report a strong contemporaneous connection between net positions and exchange rates. We are not aware of any study analyzing this question with daily data.

An important characteristic of the dataset employed in this section is the level of disaggregated FX trade flows. The dataset covers nearly nine years of daily data (from

[21] Bessembinder and Seguin (1992) also find a positive association between spot volume and volatility.
[22] A natural extension may be to test the relevance of integrated variables that gather spot and forward net positions .
[23] Although the cited authors did not extend the analysis to the derivatives market, Sarno and Taylor (2002) suggest this as a natural extension. To assess –from a microstructure approach - the quantitative effect of foreign exchange interventions may also be another avenue of research.

January 1995 to June 2004), or 2870 observations for the largest Chilean FX market players.

For the derivatives market, we employ trading (forward) flows in US dollars categorized by the institution type of each dealer´s trading partners, where trade flows correspond to net purchases of outright forward trades (net forward position). Thus, the trade flow at day *t* for a group of participants is constructed as:

$$\text{Trade Flow}^{D}_{t} = \sum \left(\text{Purchases}_{it} - \text{Sales}_{it} - (\text{Non - outstanding Purchases}_{it} - \text{Non - Outstanding Sales}_{it} \right)$$

where *i* represents a given participant within the group. In addition to trade flows, the analysis utilizes FX rate returns for the CL$/US$ exchange rate defined as the log difference of the nominal exchange rate (*dólar observado*).

Our measure of trade flow is a proxy -for the derivatives market- of the order flow employed by Evan and Lyons (2002). While trade flows are defined in this paper as the difference between purchases and sales among dealers and their various clients at the end of the day, order flows are the difference between buyer- and seller-initiated orders within the interdealer market. Dealers' (banks) trading is disaggregated by trade with pension funds, financial non-banking agents and cross-border clients. We also distinguish the trading that occurs between all residents (banks, firms, pension funds and financial non-banking sector) with foreign clients.[24]

The measure of order flow used in the analysis -trade flow- assumes that the public is always initiating the trade as dealers are considered to be the passive side of customer order flow. Lyons (2001) and Evans and Lyons (2002), among other, provide empirical results that show that order flow in the spot FX market covaries positively with the exchange rate over horizons of days and weeks, and may be a good complement for macro fundamentals explaining/forecasting the nominal exchange rate.

We implement a straightforward procedure that resembles Meese and Rogoff (1983), Mark (1995), Wei and Kim (1997) and Evans and Lyons (2002), in testing the relevance of macro fundamentals and/or variables from the microstructure of the foreign exchange market predicting the nominal exchange rate. In a regression equation, trade flows (x_t) are included as a regressor.[25] We rely on both in-sample and out-of-sample evidence to assess the degree of predictability of net positions. It is well known that fitting a model in-sample is one thing, but forecasting out-of-sample is quite another. The advantage of out-of-sample evaluation procedures is that they implicitly test the stability of the estimated coefficients and therefore provide a more stringent and realistic hurdle for models/variables to overcome. The evaluation criterion in this paper uses the root-mean-squared-error comparing the forecasting performance of trade flow with respect to a simple random walk. Numerous econometric studies have found that the random walk model provides more accurate forecasts than other models of the exchange rate. Thus, the random walk is a natural benchmark in judging forecast performance. Therefore, the regression analysis reduces to:

$$\Delta\log(NER)_{t+k} = \alpha_k + \alpha_k x_t + \varepsilon_{t+k} \qquad k = 1, 7, 14, 21$$

will improve forecast accuracy relative to the random walk forecast:

$$\Delta\log(NER)_{t+k} = \alpha_k + \varepsilon_{t+k} \qquad k = 1, 7, 14, 21$$

Sample periods were defined based on the availability and reliability of the individual series, and when it was possible, we also split the testing for the crawling band and free floating periods. We perform this comparison for the following six (non-exhaustive) trade flows at daily frequency. The results are presented in table 16:[26]

(a) Banks with pension funds.

---

[24] We are not able to capture the trade flows among firms (non-financial sector) and firms with the financial non-banking sector. It is worth to mention that net interdealer (banks) trading cross is zero in our database.

[25] All of these works suffer from simultaneous equation bias since explanatory variables are all endogenous (determined within the economic system). Even though, it is unclear why biased coefficients would be a problem for a forecasting exercise. If the covariance matrix of the structural errors is homoskedastic and stable over time, forecast from biased coefficients would be superior to those from structural parameters (Neely and Sarno, 2002). A more serious problem emerges -for an out-of-sample forecasting exercise- from the persistence of the variables, which makes inconsistent the coefficient estimates.

[26] We also tested the trade flows of banks with local clients and banks with local and foreign clients (not shown to save space). Although for theses trade flows it is difficult to have a reasonable assumption about who initiated the operation.

(b) Banks with foreign clients.

(c) & (d) Banks with the financial non-banking sector.

(e) & (f) Banks with the non-financial sector.

(g) Domestic participants (including banks) with foreign clients.

(h) Non-financial sector with foreign clients.

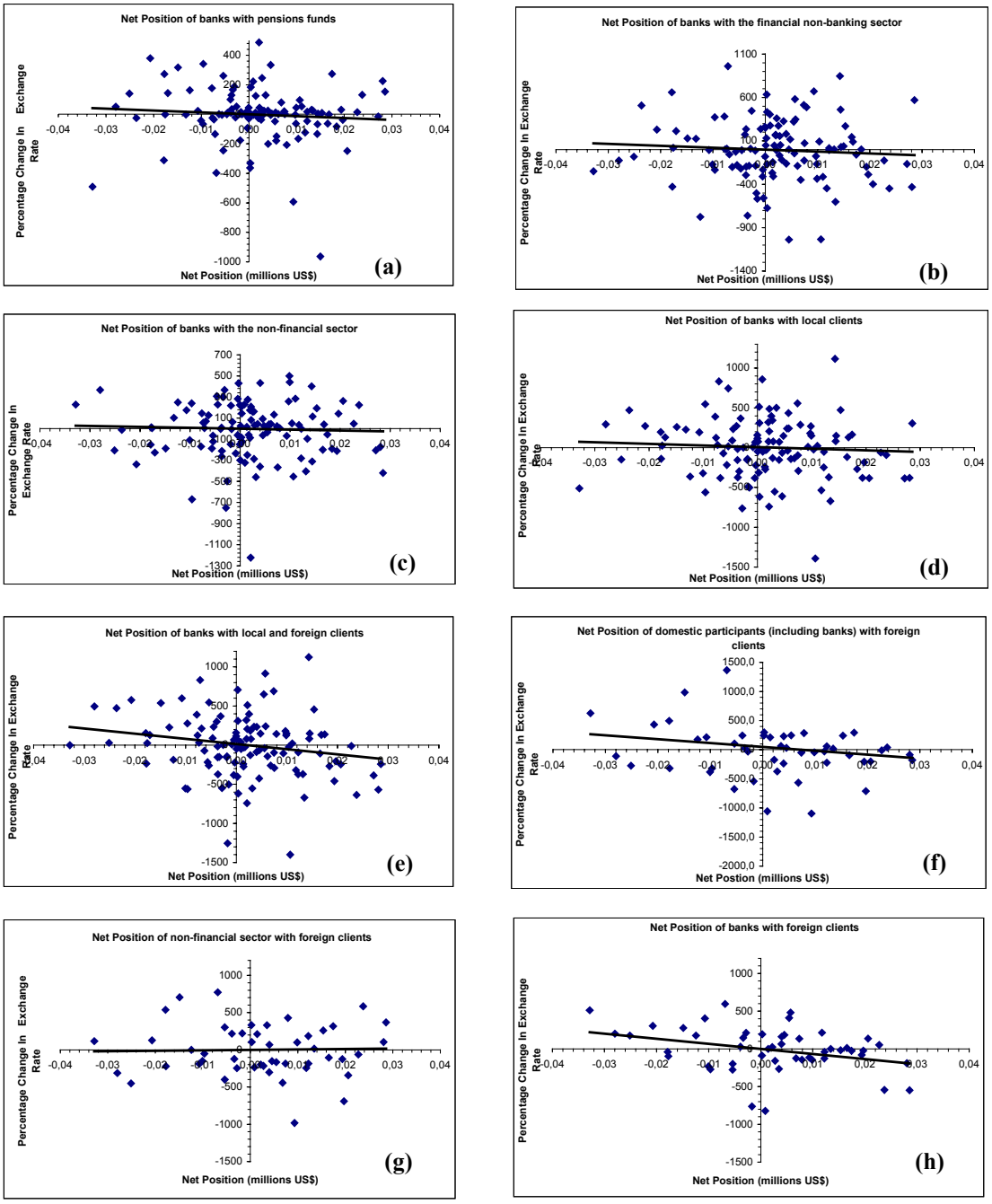
The in-sample estimations fit quite well for the first periods, but the out-of-sample results are less convincing and do not show evidence of forecasting ability of the trade flows variables tested. The previous findings suggest that main participants in the derivatives market do not have significant market power or asymmetric information.

To complement and give more intuition to the previous results, we also graph the contemporaneous relationship between exchange rate and net forward position. In figure 5 we present monthly nominal exchange rate movements and changes in the net positions currency derivatives held by some participants from January 1995 to June 2004.[27] We observe a tenuous –negative- relationship between the change in the net position and the contemporaneous movement of the exchange rate with the exception of the net position between banks and financial non-banking sector. To interpret the chart, note that an observation in the upper-left quadrant of each panel represents a month when participants, as a group, increased their holdings of short contracts in the foreign currency relative to long contracts, and the peso depreciated relative to the dollar in the same month. The conclusion of this simple graphic analysis confirms that the main participants in the derivatives market are not consistently taking positions in a manner that allow them to make some *extra-pesos*, but in general, to hedge long or short positions in underling investments.

Insert Table 16
Forecast performance - Derivatives Market

[27] We also graphed 1-month-ahead changes in nominal exchange rate and results were unaltered (not shown to save space). Similarly, we also tested and graphed aggregated net positions and results do not change.

Figure 5. Net Forward Positions and Exchange Rate Movement
Monthly Changes from Jan. 1995 - Jun. 2004



Notes:

a. Graphs (f), (g) and (h) include data only for the period May 2000-June 2004.

Source: Authors´ calculations based on information provided by the Central Bank of Chile

For the spot market, we follow the same path, and construct the following trade flow variable:

$$\text{Trade Flow}^{S}_{t} = \sum \left(\text{Purchases}_{it} - \text{Sales}_{it} \right)$$

In this case, we tested three trade flows. Results are presented in table 17:[28]

(a) Banks with pension funds.
(b) Banks with the financial non-banking sector.
(c) Banks with the non-financial sector.

Insert Table 17
Forecast performance - Spot Market

From table 17 we observe that any of the net spot positions have a significant forecasting ability out-of-sample. Even though, in-sample fitting support the view that to look at regularly these series may be relevant to understand current movements in the nominal exchange rate.[29]

Overall, our previous findings support the view that large players in both spot and forward FX markets do not trade based on private information, or if they do, they do not make consistently profits out of it. Furthermore, they indicate that to follow disaggregated series of net positions taken by some participants in the FX market may help to better understand short-run movements and tendencies of the nominal exchange rate.

III. Conclusions and further research

To be written

[28] Note that total spot turnover (purchases plus sales) is available since 1995, but disaggregated data by participant is only available since January 1998. We perform the forecasting analysis for pension funds from October 1998 because spot trading was scarce during the previous months.
[29] In-sample results for the net positions taken by pension funds during the free floating period show significant *t-statistics* at 10 percent (available upon request).

Appendix A

Classification of Economies

1998	Category	2001	Category
Argentina	Emerging	Argentina	Emerging
Australia	Emerging	Australia	Advanced
Austria	Advanced	Austria	Advanced
Belgium	Advanced	Belgium	Advanced
Brazil	Emerging	Brazil	Emerging
Canada	Advanced	Canada	Advanced
Chile	Emerging	Chile	Emerging
Czech Republic	Emerging	Colombia	Emerging
Denmark	Advanced	Czech Republic	Emerging
Finland	Advanced	Denmark	Advanced
France	Advanced	Finland	Advanced
Germany	Advanced	France	Advanced
Greece	Advanced	Germany	Advanced
Hong Kong	Emerging	Greece	Advanced
Hungary	Emerging	Hong Kong	Emerging
India	Emerging	Hungary	Emerging
Indonesia	Emerging	India	Emerging
Ireland	Advanced	Indonesia	Emerging
Italy	Advanced	Ireland	Advanced
Japan	Advanced	Israel	Emerging
Malaysia	Emerging	Italy	Advanced
Mexico	Emerging	Japan	Advanced
Netherland	Advanced	Malaysia	Emerging
New Zeland	Advanced	Mexico	Emerging
Norway	Advanced	Netherland	Advanced
Poland	Emerging	New Zeland	Advanced
Portugal	Advanced	Norway	Advanced
Russia	Emerging	Poland	Emerging
South Africa	Emerging	Portugal	Advanced
South Korea	Emerging	Russia	Emerging
Spain	Advanced	Slovak Republic	Emerging
Sweden	Advanced	Slovenia	Emerging
Switzeland	Advanced	South Africa	Emerging
Thailand	Emerging	South Korea	Emerging
United Kingdom	Advanced	Spain	Advanced
		Sweden	Advanced
		Switzeland	Advanced
		Thailand	Emerging
		Turkey	Emerging
		United Kingdom	Advanced

Notes:

a. Emerging Economies are the ones in the JP Morgan EMBI Global index

Appendix B

Full Sample

Albania	El Salvador	Madagascar	Spain
Algeria	Estonia	Malawi	Sri Lanka
Argentina	Ethiopia	Malaysia	St. Lucia
Armenia	Fiji	Maldives	St. Vincent & Grens.
Australia	Finland	Mali	Sudan
Austria	France	Malta	Suriname
Azerbaijan	Gabon	Mexico	Sweden
Bahamas, The	Gambia, The	Moldova	Switzerland
Bahrain, Kingdom of	Georgia	Mongolia	Syrian Arab Republic
Bangladesh	Germany	Morocco	Tajikistan
Barbados	Greece	Mozambique	Tanzania
Belgium	Guatemala	Namibia	Thailand
Belize	Guinea-Bissau	Nepal	Togo
Benin	Guyana	Netherlands	Tonga
Bhutan	Haiti	New Zealand	Trinidad and Tobago
Bolivia	Honduras	Nigeria	Tunisia
Brazil	Hong Kong	Norway	Turkey
Burkina Faso	Hungary	Oman	Uganda
Burundi	Iceland	Pakistan	United Kingdom
Cameroon	India	Panama	Uruguay
Canada	Indonesia	Papua New Guinea	Vanuatu
Cape Verde	Iran, I.R. of	Paraguay	Venezuela, Rep. Bol.
Central African Rep.	Ireland	Peru	Zimbabwe
Chad	Israel	Philippines	
Chile	Italy	Poland	
China,P.R.: Mainland	Jamaica	Portugal	
Colombia	Japan	Romania	
Congo, Republic of	Jordan	Russia	
Costa Rica	Kazakhstan	Rwanda	
Côte d'Ivoire	Kenya	Samoa	
Croatia	Korea	Saudi Arabia	
Cyprus	Kuwait	Senegal	
Czech Republic	Lao People's Dem.Re	Seychelles	
Denmark	Latvia	Sierra Leone	
Dominica	Lebanon	Singapore	
Dominican Republic	Lithuania	Slovak Republic	
Ecuador	Luxembourg	Slovenia	
Egypt	Macedonia, FYR	South Africa	

References

Australian Bureau of Statistics (2001) "Measuring Australian´s Foreign Currency Exposure", Balance of Payments and International Investment Position, Australia, ABS Cat No 5302.0. Also available at the Reserve Bank of Australia Bulletin, August 2002.

Alarcón, F., J. Selaive and J.M. Villena (2004) "El Mercado de Derivados Cambiarios", *Forthcoming* in Serie de Estudios Económicos, Banco Central de Chile.

Allayannis, G. and E. Ofek (2001) "Exchange Rate Exposure, Hedging and the Use of Foreign Currency Derivatives," *Journal of International Money and Finance* 20, pp. 273-296.

Bessembinder, H. and P. Seguin (1992) "Futures-Trading Activity and Stock Price Volatility", *Journal of Finance* 5, pp. 2015-2034

Brorsen, B.W. (1991) "Futures Trading, Transactions costs and stock market Volatility", *Journal of Futures Mark*ets 11, pp, 153-163.

Caballero, R., K. Cowan and J. Kearns (2004) "Fear of Sudden Stops Lessons from Australia & Chile", MIT WP 04-23.

Canales-Kriljenko, J. (2003) "Foreign Exchange Market Organization in Selected Developing and Transition Economies: Evidence from a Survey", IMF Working Paper/04/4

Cornell, B. (1981) "The relationship between volume and price variability in futures markets", *Journal of Futures Markets* 1, pp. 303-316.

Danthine, J. (1978) "Information, Futures Prices, and Stabilizing Speculation*" Journal of Economic Theory* 17, pp. 79-98.

Devereux M. and P. Lane (2002) "Understanding Bilateral Exchange Rate Volatility", Discussion Paper # 3518, Centre for Economic Policy and Research.

Domiguez, K. and L. Tesar (2001) "A Re-examination of Exchange Rate Exposure", *American Economic Review: Papers and Proceeding* 9, pp. 396-399.

Evans, M. y R. Lyons (2002) "Order Flow and Exchange Rate Dynamics*", Journal of Political Economy* 110, pp. 170-180.

_____ (2004) "A New Micro Model of Exchange Rate Dynamics". NBER WP # 10379.

Fernandez, V. (2001) "The Derivatives Market in Latin America with Emphasis on Chile" WP, Departamento de Ingeniería Industrial, Universidad de Chile.

Froot, K and A.F. Perold (1991) "New Trading practices and Short-Run Market Efficiency", WP MIT.

Goldstein, M. and P. Turner (2004) "Controlling Currency Mismatches in Emerging Markets", Institute for International Economics, Washington, DC.

Hau, H. (2002) "Real Exchange Rate Volatility and Economic Openness: Theory and Evidence", *Journal of Money, Credit & Banking* 34, pp. 611-630.

Jeanneau, S. and M. Micu (2003) "Volatility and Derivatives Turnover: A Tenuous Relationship", *BIS Quarterly Review*, pp. 57-65.

Karpoff, JM (1987) "The Relation Between Price Changes and Trading Volume: A Survey", *Journal of Financial and Quantitative Analysis* 22, pp. 109-126.

Klitgaard, T. and L. Weir (2004) "Exchange Rate Changes and Net Positions of Speculators in the Futures Market", FRBNY Economic Policy Review, pp. 17-28.

Kyle, A.S. (1985) "Continuos Auctions and Insider Trading", *Econometrica* 53, pp. 1315-1335.

Litterman, R. and J. Scheinkman (1991) "Common Factors Affecting Bond Returns, *Journal of Fixed Income* 1, pp. 62-74.

Lyons, R. (2001) "The Microstructure Approach to Exchange Rates", MIT Press

Meese, R. and K. Rogoff (1983) "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?" *Journal of International Economics* 14, pp. 3-24.

Mark, N (1995) "Exchange Rates and Fundamentals: Evidence on Long-Horizon Predictability" *American Economic Review* 85, pp. 201-218.

Morandé, F. and M. Tapia (2003) "Exchange Rate Policy in Chile: From the Band from Floating and Beyond", Working Paper #152, Central Bank of Chile

Neely, C. and L. Sarno (2002) "How Well do Monetary Fundamental Forecast Exchange Rates", Working Paper 2002-007, Federal Reserve Bank of St. Louis.

Ross, S.A. (1989) "Information and volatility: The no-arbitrage martingale approach to timing and resolution irrelevance", *Journal of Finance* 44, pp. 1-17

Sarno, L. and M. Taylor (2002). "The Economics of Exchange Rates", Cambridge Press.

Stein, J.C. (1987) "Informational Externalities and Welfare-Reducing Speculation", *Journal of Political Economy* 95, pp. 1123-1145.

Tirole, J. (2000) "The Theory of Industrial Organization" MIT Press.

Velasco, A. and P. Arellano (2003) "Internacionalizar el Peso: Justificaciones, Lecciones Internacionales y Tareas Pendientes", Manuscript, Ministerio de Hacienda, Gobierno de Chile.

Wei, S-J. and J. Kim (1997) "The Big players in the Foreign Exchange Market: Do They Trade on Information Noise?", NBER WP #6256

Yu, S-W (2001) "Index Futures Trading and Spot Price Volatility", *Applied Economic Letters* 8, pp. 183-186.

ANNEX

Table 1
Turnover by Domestic Counterparty of the Domestic Banking Sector
(US$ Millions)

Year	Non-Financial and Institucional sectors	Interbank	Financial Non-Banking Sector	Total
1998	13.259	35.647	63.244	112.150
1999	21.412	45.218	58.864	125.494
2000	21.536	51.840	65.852	139.228
2001	29.864	49.928	63.399	143.192
2002	25.538	42.403	62.745	130.686
2003	38.188	62.662	64.985	165.835

Source: Authors´ calculations based on information provided by the Central Bank of Chile

Table 2
Turnover by Domestic Counterparty of the Foreign Market
(US$ Millions)

Year	Non-Financial and Institutional sectors	Domestic Banks	Financial sector (no banks	Total
1998	-	-	-	-
1999	-	-	20	20
2000	503	1.300	9.843	11.646
2001	255	6.218	13.835	20.308
2002	132	9.681	20.602	30.414
2003	352	14.091	27.148	41.592

Source: Authors´ calculations based on information provided by the Central Bank of Chile

Table 3
Median Size of Operations: Domestic and Cross-Border Market
(US$ Millions)

Year	Domestic Banking				Cross-border NDF				Total
	Non-Financial and Institucional Sectors	Interbank	Financial Sector (non-banks)	Total	Non-Financial and Institucional Sectors	Banks	Financial Sector (non-banks)	Total	
1998	3,8	2,0	7,4	3,7	-	-	-	-	3,7
1999	4,6	2,5	7,3	4,0	-	-	1,6	1,6	4,0
2000	3,7	2,8	6,9	4,1	19,3	11,4	4,8	5,3	4,2
2001	2,9	4,2	10,1	5,1	8,5	6,9	5,7	6,1	5,2
2002	2,0	5,3	9,5	4,6	3,0	5,8	5,1	5,3	4,7
2003	1,8	5,5	10,8	4,3	1,8	6,5	5,3	5,6	4,5

Source: Authors´ calculations based on information provided by the Central Bank of Chile

Table 4
Sectoral Distribution of Turnover: Non-Financial Sector
Year 2003

Sector	Firms with FX derivatives	
	Number of Firms	Share
Agriculture, Mining and Fishing	28	3,5%
Manufacturing	266	20,3%
Electricity, Gas y Water	23	13,7%
Construction	21	5,8%
Retail, Restaurants and Hotels	371	20,9%
Transportation and Communications	33	9,0%
Financial Services	167	24,1%
Others (Public Administration, personal services)	28	2,6%
Total	**938**	**17 billions USD**

Notes:
a. Firms with both domestic and cross-border operations are included
b. Firms classified by the "*Clasificador de Actividad Económica de Cuentas Nacionales*" provided by the Central Bank of Chile

Source: Authors´ calculations based on information provided by the Central Bank of Chile

Table 5
Maturity breakdown

Year	Percentage Share of Total Turnover		
	Until 7 days	8 days to 1 year	More than 1 year
1998	36,6	62,5	0,9
1999	23,4	75,1	1,6
2000	18,0	79,9	2,1
2001	20,9	75,8	3,3
2002	19,9	77,4	2,7
2003	15,5	82,0	2,6
World Average 2001	33,5	63,5	3,0

Notes:
a. Local and Cross-border operations peso and UF are included
Source: Authors´ calculations based on information provided by the Central Bank of Chile

Table 6
Activity Indicators

Country	D/GDP		D/(X+M)	
	1998	2001	1998	2001
Argentina	0	0	1	0
Australia	19	27	60	80
Austria	8	5	12	7
Bahrain	37	48	24	39
Belgium	20	8	30	5
Brazil	3	4	22	19
Canada	11	12	16	17
Chile	**2**	**2**	**4**	**5**
Colombia	-	0	-	1
Czech Republic	13	5	14	4
Denmark	31	30	57	50
Finland	6	2	11	4
France	10	8	23	16
Germany	7	9	14	15
Greece	8	6	25	20
Hong Kong	74	75	34	31
Hungary	2	1	3	1
India	1	1	4	4
Indonesia	3	1	3	1
Ireland	16	11	11	9
Israel	-	1	-	2
Italy	4	3	9	6
Japan	6	7	33	38
Korea, Rep	1	2	1	3
Luxemburg	198	119	183	108
Malasya	3	3	2	1
Mexico	1	2	2	3
Netherland	17	16	17	14
New Zealand	23	15	51	28
Norway	10	14	19	26
Perú	0	0	0	1
Philipins	2	2	2	2
Poland	1	5	2	10
Portugal	6	2	10	3
Russia	1	0	2	0
Saudia Arabia	2	1	3	2
Singapore	261	202	103	72
Slovak Republic	-	6	-	5
Slovenia	-	0	-	0
South Africa	10	17	23	35
Spain	6	2	25	5
Sweden	12	23	18	34
Switzeland	55	53	90	79
Thailand	5	3	6	3
Turkey	-	1	-	2
United Kingdom	82	68	197	160
United States	7	4	36	22
World Average	**23**	**18**	**29**	**21**
Advance Economies	**17**	**16**	**38**	**32**
Emerging Economies without HK and Singapur	**4**	**4**	**6**	**6**

Notes:

a. Turnover for Brazil and Perú were obtained for the CBB and CBRP, respectively.

Source: World Bank, International Monetary Fund, Bank of International Settlements, Central Bank of Chile and Alarcón et al (2004)

Table 7

Liquidity and Volatility of Spreads

	Quoted Spread Forwards 30 days							
	1998	1999	2000	2001	2002	2003	Forward Spread Volatility [a]	Period
Australia	0,09%	0,08%	0,09%	0,10%	0,09%	0,07%	0,07%	1998-2003
Brasil	-	0,45%	0,40%	0,19%	0,20%	0,16%	0,26%	Oct. 99 - 2003
Chile	0,21%	0,23%	0,13%	0,10%	0,10%	0,11%	0,13%	April 99 - 2003
New Zealand	0,13%	0,13%	0,15%	0,15%	0,15%	0,12%	0,07%	1998-2003
Mexico	0,21%	0,15%	0,13%	0,11%	0,10%	0,11%	0,18%	1998-2003

Notes:

a. Volatility measured by the standard deviation of the spread first difference

b. Volatility measured as the change in the first difference of the log forward exchange rate (last trade)

Source: Authors´ calculations based on data from Bloomberg.

Table 8

Correlation of Daily Spreads Forwards 30 days.

	Australia	Brasil	Chile	New Zealand	Mexico
Australia	1	0,06	-0,08	0,20	0,05
Brasil	-	1	0,15	0,00	0,09
Chile	-	-	1	-0,05	0,01
New Zealand	-	-	-	1	-0,05

Notes:

a. Spreads based on bid-ask quotes for the period: 01/01/1998 - 31/12/2003

Source: Authors´ calculations based on data from Bloomberg

Table 9

Banking concentration in the spot and derivatives markets

Year	Spot FX Market		Derivatives Market	
	# of Banks with a cumulative Market Share of 80%	Total of Banks	# of Banks with a cumulative Market Share of 80%	Total of Banks
2000	13	30	9	28
2001	14	28	11	27
2002	12	27	11	27
2003	10	26	9	25

Notes:

a. Market shares are calculated based on derivatives turnover of each commercial bank.

Source: Authors´ calculations based on information provided by the Central Bank of Chile

Table 10

Aggregate Net Foreign-currency Exposure: 1997-2003

Year	Net Outstanding/GDP	Exposure /GDP	(Exposure incl. Reserves)/GDP
1997	-	-14%	8%
1998	-	-10%	10%
1999	0%	2%	23%
2000	-2%	-2%	18%
2001	-1%	-1%	20%
2002	-1%	-1%	22%
2003	-2%	5%	27%

Notes:
a. Exposure calculated following ABS (2001)
Source: Authors´ calculations based on information provided by the Central Bank of Chile

Table 11

Net debt for selected countries

Year 2002

	Without Reserves		Including Reserves		
Country	***Net debt/GDP***	***Net debt/(X+M)***	***Net debt/GDP***	***Net debt/(X+M)***	***Derivatives ´01/GDP***
Australia	48	304	43	273	27
Brazil	44	326	35	264	4
Canada	41	112	37	99	12
Chile	29	100	5	21	2
Colombia	29	188	15	101	0
Czech Republic	-2	-5	-36	-66	5
Hungary	35	66	19	36	1
New Zealand	65	261	56	232	15
Peru	45	330	28	208	0,1
Poland	27	111	12	49	5

Notes:
a. Net debt =[Debt Securities (liabilities)+other investment (liabilities)]-[debt securities (assets)+other investment (assets)].
b. For Brazil and Perú, derivatives were obtained directly from the corresponding central banks

Source: Authors´ calculations based on the Balance of Payments Statistics Yearbook 2003, BIS (2002) and IMF International Financial Statistics

Table 12

Exposure by regression analysis for selected countries

Country	Exposure from a panel OLS	# of sectors with exposure	***Derivatives/GDP 2001***
Australia	non significant	1 out of 8	27
Brazil	0.6%	7 out of 7	4
Chile	1.08%	8 out of 8	2
Czech Republic	0.25%	1 out of 6	5
France	non significant	0 out of 8	8
Germany	non significant	0 out of 8	9
Hungary	-0.35%	2 out of 7	1
Indonesia	0.07%	6 out of 7	1
Italy	non significant	1 out of 7	3
Japan	non significant	1 out of 8	7
Malasya	-0.28%	3 out of 7	3
Mexico	-0.22%	4 out of 6	2
New Zealand	non significant	1 out of 7	15
Poland	0.22%	1 out of 7	5
Russia	2.11%	5 out of 5	0.1
Singapore	1.02%	2 out of 6	202
Thailand	-0.37%	2 out of 7	3

Notes:

a. Estimation based on end-of-month changes in MSCI, nominal exchange rate and stock market return (IPSA). Period covers January 1995 to June 2004 (114 Observations).

b. Derivatives obtained from the BIS (2002).

Source: Authors´ calculations based on Morgan Stanley Capital Indices available at Bloomberg.

Table 14

Volatility –Activity Relationship: Specification (A)

EGARCH-M augmented by activity measures

Period	**Full**						**Crawling Band**						**Free Floating**					
Coeff. Estimate for Activity	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Turnover Derivatives	0.067 (0.050)		0.039 (0.059)	0.082 (0.050)		0.057 (0.059)	0.161** (0.073)		0.142 (0.109)	0.111 (0.091)		0.105 (0.125)	-0.045 (0.059)		-.044 (0.069)	0.021 (0.073)		0.022 (0.072
Open Interest		0.280 (0.230)	0.241 (0.275)		0.291 (0.235)	0.249 (0.277)		0.331 (0.327)	0.178 (0.466)		0.164 (0.286)	0.081 (0.412)		-0.076 (0.167)	-.007 (0.195)		0.016 (0.195)	-.007 (0.190)
Turnover Spot				-0.035 (0.112)	-0.017 (0.100)	0.045 (0.101)				0.216 (0.174)	0.251** (0.127)	0.205 (0.156				-.129 (0.108)	-.117 (0.098)	-.129 (0.108)
# Obs.	2366	2366	2366	2366	2366	2366	1164	1164	1164	1164	1164	1164	1201	1201	1201	1201	1201	1201

Notes:

a. Following Bessembinder and Seguin (1992) activity series were first detrended by the Hodrick-Prescott algorithm setting $\lambda=(250^2)x100$.

b. Robust *t-statistics* were calculated using Bollerslev and Woolrigde procedure. Standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% levels of significance.

c. Full period: Jan. ´95 – June ´04. Crawling Band: Jan. ´95 – Sept. ´98. Free Floating: Sept. ´99 – June´ 04.

Table 15

Volatility –Activity Relationship: Specification (B)

$$Activity_t = \alpha + \beta Activity_{t-1} + \gamma\ Volatility_t + \delta Trend + e_t$$

Period	**Full**			**Crawling Band**			**Free Floating**		
Coeff. Estimate for Volatility	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Turnover Derivatives	-1428*** (427)			-695.6 (670.2)			-27.1 (484.6)		
Open Interest		-31.0*** (11.49)			-50.1*** (18.8)			-22.9 (15.9)	
Turnover Spot			632.7*** (243.3)			964.4*** (283.9)			472.4 (311.3)
# Obs.	2366	2366	2366	1164	1164	1164	1201	1201	1201
Adj.R^2	*0.70*	*0.99*	*0.59*	*0.65*	*0.99*	*0.29*	*0.28*	*0.99*	*0.44*

Notes:
a. Volatility was first estimated from a GARCH(1,1) model. Robust *t-statistics* were calculated using Bollerslev and Woolrigde procedure.
b. Standard errors in parenthesis. Newey-West HAC Standard Errors & Covariance. ***, **, * denote 1%, 5% and 10% levels of significance
c. Full period: Jan. ´95 – June ´04. Crawling Band: Jan. ´95-Sept. ´98. Free Floating: Sept. ´99 – June´ 04

Table 16

Forecasting performance of participants´ net positions in the derivatives market

(a) ***Period: January 1999 - June 2004***

	Banks - Pension Funds			
	In Sample statistics		Out-of-Sample Statistics	
Days	**| t-statistic |**	**R2**	**U-Theil**	**Diebold Mariano**
1	1,8391	0.0036	1,0018	-0.4387
7	0.5883	0.0003	1,0010	-1,6296
14	0.7492	0.0006	1,0006	-0.3484
21	1,4108	0.0023	0.9996	0.2533

Notes: Out of Sample forecast begins in October 2, 2001.

(b) ***Period: February 2001 - June2004***

	Banks - Foreign Clients			
	In Sample statistics		Out-of-Sample Statistics	
Days	**| t-statistic |**	**R2**	**U-Theil**	**Diebold Mariano**
1	2,4790	0.0058	0.9976	0.5746
7	2,2249	0.0054	0.9975	0.7942
14	1,8867	0.0043	0.9980	0.7964
21	0.4613	0.0002	1,0012	-1,2529

Notes: Out of Sample forecast begins in October 22, 2002.

(c) ***Period: January 1995 - June 2004***

	Banks - Financial non-banking sector			
	In Sample statistics		Out-of-Sample Statistics	
Days	**| t-statistic |**	**R2**	**U-Theil**	**Diebold Mariano**
1	0.6848	0.0002	1,0014	-1,3036
7	1,0124	0.0003	1,0001	-0.5599
14	1,0228	0.0003	1,0003	-0.7603
21	0.1358	0.0000	1,0003	-1,6971

Notes: Out of Sample forecast begins in September 28, 1999.

(d) ***Period: September 1999 - June 2004***

	Banks - Financial non-banking sector			
	In Sample statistics		Out-of-Sample Statistics	
Days	**| t-statistic |**	**R2**	**U-Theil**	**Diebold Mariano**
1	0.4887	0.0002	1,0004	-1,2141
7	0.6268	0.0002	1,0002	-1,1443
14	0.2080	0.0000	1,0004	-2,0577
21	0.5726	0.0001	1,0004	-1,1749

Notes: Out of Sample forecast begins in January 23, 2002.

(e) ***Period: January 1995 - June 2004***

	Banks - Non-Financial Sector			
	In Sample statistics		Out-of-Sample Statistics	
Days	**| t-statistic |**	**R2**	**U-Theil**	**Diebold Mariano**
1	1,9851	0.0015	0.9992	1,1379
7	0.2412	0.0000	1,0002	-1,5599
14	1,0326	0.0005	1,0000	0.1364
21	0.0001	0.0000	1,0002	-1,0839

Notes: Out of Sample forecast begins in September 28, 1999.

(f) ***Period: September 1999 - June 2004***

	Banks - Non-Financial Sector			
	In Sample statistics		Out-of-Sample Statistics	
Days	**| t-statistic |**	**R2**	**U-Theil**	**Diebold Mariano**
1	2,0396	0.0027	0.9989	0.6818
7	0.1684	0.0000	1,0010	-2,5631
14	0.7575	0.0005	1,0006	-1,2526
21	0.0548	0.0000	1,0006	-1,8849

Notes: Out of Sample forecast begins in January 23, 2002.

(g) ***Period: May 2000 - June 2004***

	Domestic participants (including banks) with foreign clients			
	In Sample statistics		Out-of-Sample Statistics	
Days	**| t-statistic |**	**R2**	**U-Theil**	**Diebold Mariano**
1	2,3432	0.0050	1,0009	-0.2071
7	1,0622	0.0008	1,0003	-0.1776
14	1,3935	0.0015	1,0003	-0.1346
21	0.1397	0.0000	1,0030	-2,4651

Notes: Out of Sample forecast begins in June 12, 2002.

(h) ***Period: May 2000 - June 2004***

	Non Financial Sector - Foreign Clients			
	In Sample statistics		Out-of-Sample Statistics	
Days	**| t-statistic |**	**R2**	**U-Theil**	**Diebold Mariano**
1	1,4186	0.0020	1,0028	-0.8134
7	0.0036	0.0000	1,0012	-1,0279
14	0.6573	0.0003	1,0014	-0.8103
21	0.1324	0.0001	1,0026	-1,454

Notes: Out of Sample forecast begins in June 12, 2002.

a. U-Theil less than one indicates better forecast with respect to random walk

b. Newey-West HAC Standard Errors & Covariance under Andrews (1991)´s method automatic lag truncation

Source: Authors´ calculations based on information provided by the Central Bank of Chile

Table 17

Forecasting performance of participants´ net positions in the spot market

(a) ***Period: October 1998 - June 2004***

	Banks - Pension Funds			
	In Sample statistics		Out-of-Sample Statistics	
Days	**| t-statistic |**	**R2**	**U-Theil**	**Diebold Mariano**
1	0,7130	0,0013	0,9993	0,6308
7	0,0628	0,0001	1,0007	-1,4971
14	0,7014	0,0007	1,0000	-0,0034
21	1,0908	0,0020	0,9993	0,8617

Notes: Out of Sample forecast begins in August 13, 2001.

(b) ***Period: January 1998 - June2004***

	Banks - financial non-banking sector			
	In Sample statistics		Out-of-Sample Statistics	
Days	**| t-statistic |**	**R2**	**U-Theil**	**Diebold Mariano**
1	3,3056	0,0070	0,9955	3,1996
7	2,0097	0,0017	0,9992	0,7091
14	1,5659	0,0017	1,0000	0,0142
21	1,2571	0,0013	1,0009	-0,7621

Notes: Out of Sample forecast begins in March 23, 2001.

(c) ***Period: January 1998 - June 2004***

	Banks - financial non-banking sector			
	In Sample statistics		Out-of-Sample Statistics	
Days	**| t-statistic |**	**R2**	**U-Theil**	**Diebold Mariano**
1	2,1012	0,0029	0,9983	2,4072
7	0,0131	0,0001	1,0003	-1,2874
14	1,1065	0,0007	0,9999	0,414
21	0,1048	0,0001	1,0007	-1,3729

Notes: Out of Sample forecast begins in March 23, 2001.

a. U-Theil less than one indicates better forecast with respect to random walk
b. Newey-West HAC Standard Errors & Covariance under Andrews (1991)´s method automatic lag truncation

Source: Authors´ calculations based on information provided by the Central Bank of Chile