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IS THE FX DERIVATIVES MARKET EFFECTIVE AND EFFICIENT IN REDUCING CURRENCY RISK?

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Resumen

En este trabajo exploramos si el mercado de derivados cambiarios reduce en forma efectiva y eficiente la vulnerabilidad de la economía a fluctuaciones en el tipo de cambio. Primero presentamos evidencia para un conjunto de países que sugiere que el desarrollo de este mercado no incrementa la volatilidad del tipo de cambio y, por otro lado, reduce la exposición agregada de la economía al riesgo cambiario. Luego examinamos datos diarios e intra-diarios del mercado cambiario chileno, encontrando que, con posterioridad a la adopción del régimen de flotación cambiaria, la actividad en el mercado forward de monedas no ha estado asociada a una mayor volatilidad del tipo de cambio. Asimismo, no encontramos evidencia de que las posiciones netas de los grandes participantes en el mercado cambiario, tanto forward como a contado, permitan predecir sistemáticamente las variaciones en el tipo de cambio. Nuestros hallazgos apoyan la visión de que el desarrollo del mercado de derivados cambiarios es una herramienta valiosa para reducir el riesgo agregado de la economía ante fluctuaciones del tipo de cambio.

Abstract

We explore whether the foreign exchange (FX) derivatives market effectively and efficiently reduces the vulnerability to foreign exchange rate fluctuations. Cross-country evidence suggests that development of the FX derivatives market does not boost up spot exchange rate volatility and reduces aggregate exposure to currency risk. Interday and intraday evidence for Chile shows that activity in the forward market has not been associated with higher volatility in the exchange rate following the adoption of a floating exchange rate regime. We also find no evidence that net positions of large participants in the FX derivatives market help to predict the exchange rate. These findings support the view that development of the FX derivatives market is valuable to reduce aggregate currency risk.

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I. Introduction

Floating foreign exchange rates have gained increased support as a preferred 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. They can also help amplify the stabilizing (or destabilizing) effects of agents' decisions on the foreign exchange rate. In the aggregate, the net effects of FX derivatives could well be to increase the volatility of the exchange rate or the overall exposure of the agents of the economy to fluctuations in the exchange rate. The end result could be more, rather than less, overall vulnerability to foreign currency risk.

In addition, even if a FX derivatives market may contribute to reduce currency risk, the efficiency with which it operates may be unsatisfactory. Two aspects of particular concern are market transparency and competition. No participants should systematically have superior information about exchange rate movements that would enable them to take more profitable positions when they foresee a convenient movement in the foreign currency, or have sufficient market power 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 in FX derivatives markets are likely to be accentuated in these economies, given their relatively thinner, less liquid, and less developed financial markets. Consequently, agents in these countries are debating the merits of foreign exchange derivatives as a mechanism for reducing currency risk, in particular in light of concerns stemming from the fairly recent adoption of floating exchange rate regimes.

Empirical evidence on whether and how the FX derivatives market reduces vulnerability to foreign exchange rate fluctuations is scant. While a few studies address the effects of derivatives on the volatility of other financial prices, we are not aware of previous attempts to empirically assess the effects of foreign exchange derivatives on foreign exchange rate volatility, for either advanced or emerging market economies. Allayannis and Ofek (2001) and Cowan, Hansen, and Herrera (2004), among others, suggest that foreign exchange derivatives indeed tend to reduce currency exposure, but these valuable studies are conducted only at the firm level. Works such as Wei and Kim (1997) and Klitgaard and Weir (2004) take on the issue of whether traders in foreign exchange derivatives markets possess price-relevant asymmetric information, based on weekly data for U.S. markets using; no studies to date use daily or intradaily data or extend the analysis to emerging market economies.

This paper provides empirical evidence on whether foreign exchange derivatives markets effectively and efficiently reduce currency risk, with a special focus on the Chilean economy. Among emerging market economies, Chile offers a particularly interesting case. The country adopted a floating exchange rate in September 1999, after a decade of enforcing an exchange rate band whose width and level were often revised. The new floating exchange rate regime is widely perceived as successful. In addition, while its foreign exchange derivatives market has grown into a reasonably active market given the size of the economy, the degree of market development is still far from the level in advanced economies, and the market's usefulness as a mechanism for reducing agents' currency risk has often been called into question. Finally, we were able to access a unique daily and intradaily database on the purchases and sales of most market participants.

The remainder of this paper is organized as follows. Section 1 of this paper presents the main recent tendencies and characteristics of the Chilean foreign exchange derivatives market. Sections 2 and 3 use cross-country analysis and time-series data for Chile to explore the contribution of foreign exchange derivatives to the effective reduction of currency risk, examining their relation with foreign exchange volatility and foreign exchange exposures, respectively. Section 4 explores the efficiency of the Chilean foreign exchange derivatives market, looking for evidence of asymmetric information that is price relevant. Section 5 provides concluding remarks.

II. Characteristics of the derivatives market in Chile

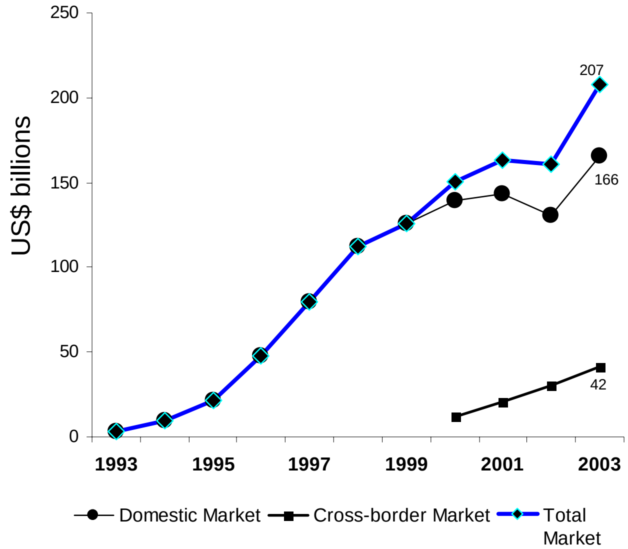
II.1. An Overview

In this section we briefly describe and analyze main trends and characteristics of the Chilean FX derivatives market. FX forwards were around 75 percent of total FX derivatives turnover in 2003. The remaining percentage is explained mainly by FX swaps and cross-currency swaps.

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] Some additional statistics and international comparisons are presented in Alarcón, Selaive and Villena (2004). The Chilean FX derivatives market also has been analyzed in Caballero, Cowan and Kearns (2004), Fernández (2001) and Velasco and Arellano (2003), although with a focus different than ours.

[1] Interbank trading is considered only once. Numbers do not include offshore operations.

Figure 1. FX Derivatives Turnover



Notes:

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

Figure 1 presents Chile's FX derivatives turnover from 1993 to 2003, broken down into domestic and cross-border subscriptions. Consistently with the increased flexibility in the exchange rate and a deepening of trade and financial integration of the Chilean economy with the rest of the world (Jadresic et al., 2003), turnover has shown rapid and persistent growth.

Table 1 shows that from the point of view of the operations of the banking sector, the non-financial and institutional sector increased its share in total turnover from 12 percent in 1998 to 23 percent in 2003 (the institutional sector gathers pension funds, mutual funds and insurance companies). This development is explained mainly by the internationalization of Pension Funds (AFPs).

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

Year	Non-Financial and Institutional 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: Alarcón, Selaive and Villena (2004)

In table 2 we look at turnover classified by counterparty involved in cross-border operations. The financial non-banking sector concentrated 65 percent of the total turnover. Thus, a large part of forward foreign exchange cross-border operations is not directly carried out by commercial banks.[2]

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

Year	Non-Financial and Institutional sectors	Domestic Banks	Financial Non-Banking Sector	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: Alarcón, Selaive and Villena (2004)

The average size of forward operations was around US$4.5 million in 2003, and cross-border contracts were much larger than the onshore contracts (see table 3). Of the cross-border contracts, the largest were taken out by the nonbank financial sector. The non-

[2] The number of counterparts in each sector is presented in Alarcón, Selaive and Villena (2004).

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.

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

Year	Domestic Banking				Cross-border operations				Total
	Non-Financial and Institucional Sectors	Interbank	Financial non-banking sector	Total	Non-Financial and Institucional Sectors	Banks	Financial non-banking sector	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: Alarcón, Selaive and Villena (2004)

Table 4 presents the maturity breakdown for onshore and cross-border forward operations. 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. Also, there has been a decreasing share in contracts of less than 7 days.

Table 4
Maturity breakdown

Year	Share in 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: Alarcón, Selaive and Villena (2004)

In table 5 we present activity indicators constructed from data of the Triennial survey of the Bank of International Settlements (BIS).[3] The ratios of derivatives over GDP and over trade

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

flows locate Chile below but close to the average of emerging market economies, although quite far from advanced economies.

Table 5
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 from their respective Central Banks.
Source: Authors´ calculations base on data from The World Bank, International Monetary Fund, Bank of International Settlements, Central Bank of Chile and Alarcón, Selaive and Villena (2004).

In table 6, we present average level and volatility of spreads for Chile and other selected economies, constructed from daily data available at Bloomberg for years 1998 and 2003.[4] Chile´s spread shows a persistent decrease over this period, with a level and volatility in the range of those observed in Australia, Brazil, Mexico and New Zealand.

In table 7 we present the correlation of daily spreads between January 1998 and December 2003 for the same economies. Remarkably, there is a quite low cross-correlation among countries (the simple average of all pairwise correlations yields 0.04). Chile´s spread commoves somewhat with Brazil´s, but not importantly with any of the other selected economies.

Table 6
Level 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
Brazil	-	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 98 - 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.

[4] Bloomberg reports spreads for a sample of reporting dealers who carried out cross-border and local operations.

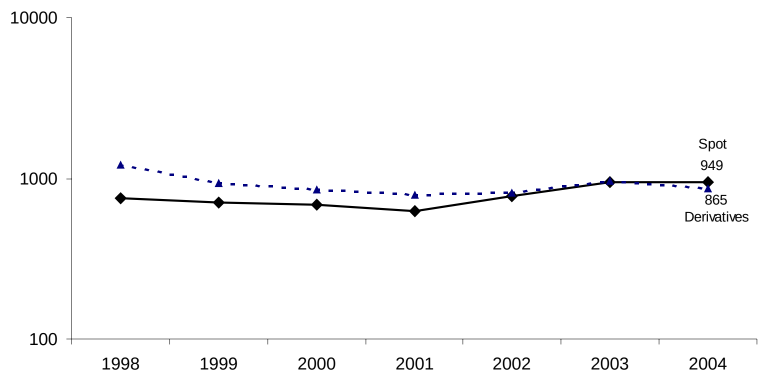
Table 7
Correlation of Daily Spreads Forwards 30 days.

	Australia	Brazil	Chile	New Zealand	Mexico
Australia	1	0.06	-0.08	0.20	0.05
Brazil	-	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

In 2003, nine banks concentrated approximately 80 percent of derivatives turnover. In figure 2, we present the Herfindahl-Hirshman Index (HHI) for both spot and derivatives contracts intermediated by banks. The index stands close but below 1000 points, indicating a low degree of concentration according to usual standards.[5]

Figure 2. HHI Index for turnover intermediated by banks.



Notes:
a. Based on banks´ market shares in total turnover. Axis *y* in logarithmic scale.
Source: Authors´ calculations base on data provided by the Central Bank ok Chile

[5] Markets in which the index is between 1000 and 1800 points are considered to be moderately concentrated, and those in which the HHI is in excess of 1800 points are considered to be concentrated (U.S. Department of Justice and the Federal Trade Commission *Merger Guidelines § 1.5.1 (1997)). Available at*
http://www.usdoj.gov/atr/public/guidelines/horiz_book/toc.html*)*

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

III.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.

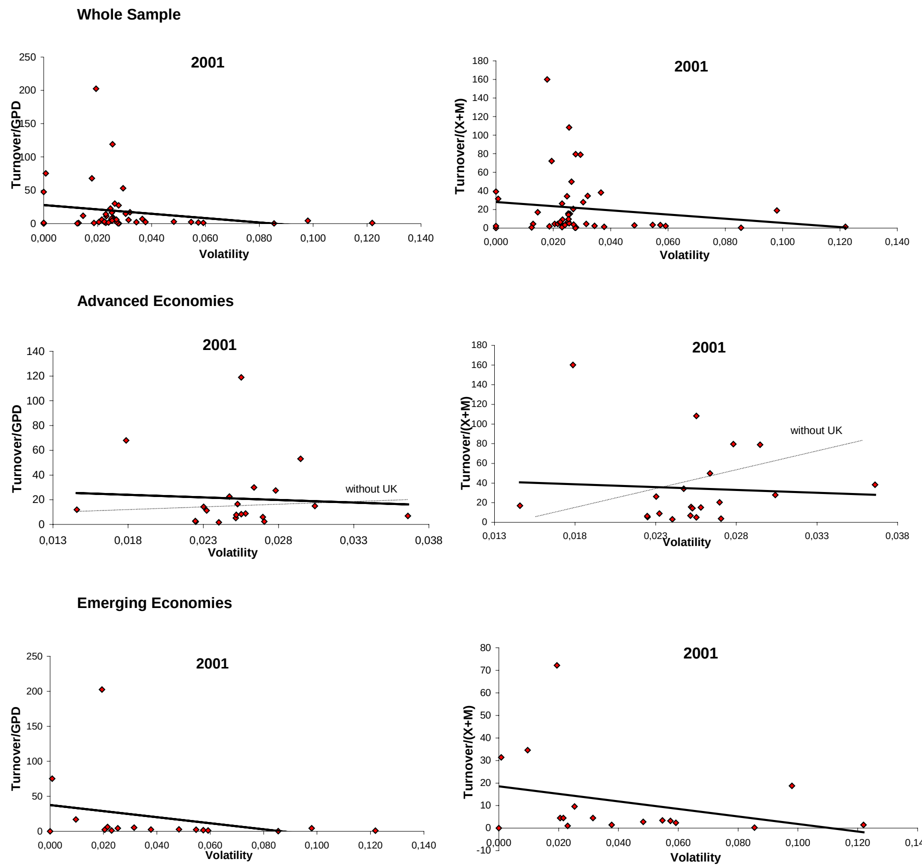
Stein (1987) develops a model in which prices are determined by the interaction between hedgers and informed speculators. In this model; (1). The derivatives market improves risk sharing and therefore reduces price volatility, and (2). If the speculators observe a noisy but informative signal, the hedgers 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 3). 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.[6] In the next subsection we further explore this finding.

[6] Classification of economies in Appendix A.

Figure 3. Derivative usage and exchange rate volatility



Notes:

a. Volatility constructed as the standard deviation of the change in the monthly (log) exchange rate for the period 1994 - 1999. 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*.

III.2. Volatility and derivatives: A cross-country approach

We explore the following empirical specification for exchange rate volatility across countries:

$$Vol_i = \beta_0 + \beta_1 Openness_i + \beta_2 Fin.Develop._i + \beta_3 Size_i + \beta_4 GDPpc_i + \beta_5 Derivatives_i + \mu_i$$

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.[7] The benefit of a floating nominal exchange rate is inversely related to the level of trade with the rest of the wold.[8] *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 be 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 8 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 correlation

[7] We list the countries in appendix B.

[8] Devereux and Lane (2002) and Hau (2002) among others find empirical evidence of a negative relationship between volatility and openness.

between openness and volatility is -0.07, which may indicate that a time series analysis may yield the expected negative sign.[9]

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 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.

[9] In our case, a time series analysis is restricted by the unavailability of derivatives statistics.

Table 8

Volatility Regression: OLS Estimation

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

	Full Sample (1)	(2)	**Non-OECD countries** (3)	(4)
Openness	0.003	0.007	0.003	0.009
	(0.004)	(0.004)	(0.005)	(0.007)
Financial Development	-0.011***	-0.007***	-0.010***	-0.009**
	(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 per capita		-0.004*		-0.005*
		(0.002)		(0.003)
Derivatives Usage	-0.011	-0.0007	-0.001	-0.001
	(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

III.3. Volatility and derivatives: Daily approaches 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, open 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 regularly applied in the analysis of stock markets.

First, we estimate a EGARCH(1,1)-M augmented by activity measures following closely Bessembinder and Seguin (1992).[10] We use as activity measures: *turnover,* which corresponds to the volume of purchase and sales in all FX derivatives and; notional *outstanding* amounts, which correspond to the notional values of all deals concluded and not yet settled at a given date.[11] We calculate volatility based on a real exchange rate obtained by deflating the nominal one by daily inflation.[12] The sample period covers from January 1st 1995 to June 30th 2004. We report the results in table 9 (specification (A)).[13] It is important to mention that the daily and intraday 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 may depend upon the time frame used for analysis.

Insert Table 9
Volatility –Activity Relationship

[10] 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.

[11] It is worth noting that *outstanding* positions are not available in a cross-country basis.

[12] We also performed all estimations using the nominal exchange rate and results were unaltered (not shown to save space).

[13] 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.

For the full sample period –columns (1) to (6) in Table 9, 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 (columns labeled (1) to (6)), we observe the same pattern with all coefficients negative and non-significant.

To further test the reliability of the results, we perform an instrumental variable estimation. To do so, we employ the conditional volatility obtained from a GARCH model.[14] The results are in table 10.

Insert Table 10
Volatility –Activity Relationship

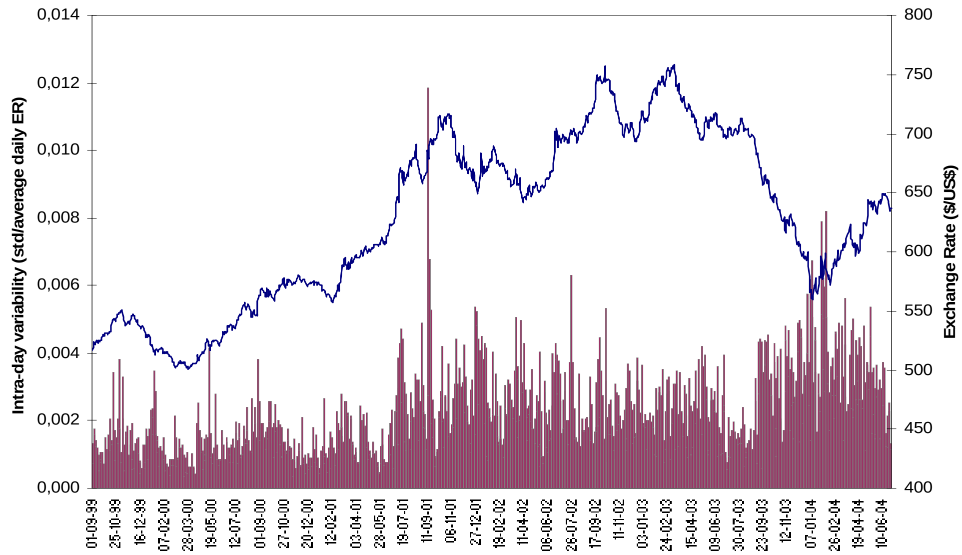
Under this approach we observe a weak "negative" link between volatility and activity in the derivatives market for the crawling band period (columns (1) and (2)). Similarly, we observe a positive link between activity in the spot FX market and volatility.[15] Even thought, there is no link during the free floating period for any of the variables tested.

Our last exercise works with a measure of volatility based on *intraday* prices and we focus our attention to the free floating period. Figure 4 presents the level of the nominal exchange rate and a measure of intraday variability constructed with all interbank transactions excluding derivatives contracts expiring within a given day. Our proxy of variability is the intraday standard deviation over the daily weighted average nominal exchange rate.[16] From a simple graphical perspective, it seems that nominal exchange rate volatility has increased after the elimination of the crawling band.

[14] We performed estimations using different ARCH models, and results were uniformly unaltered. Jeanneau and Micu (2003) perform a similar IVestimation with monthly data.
[15] Bessembinder and Seguin (1992) also find a positive association between spot volume and volatility.

Figure 4. Intraday variability

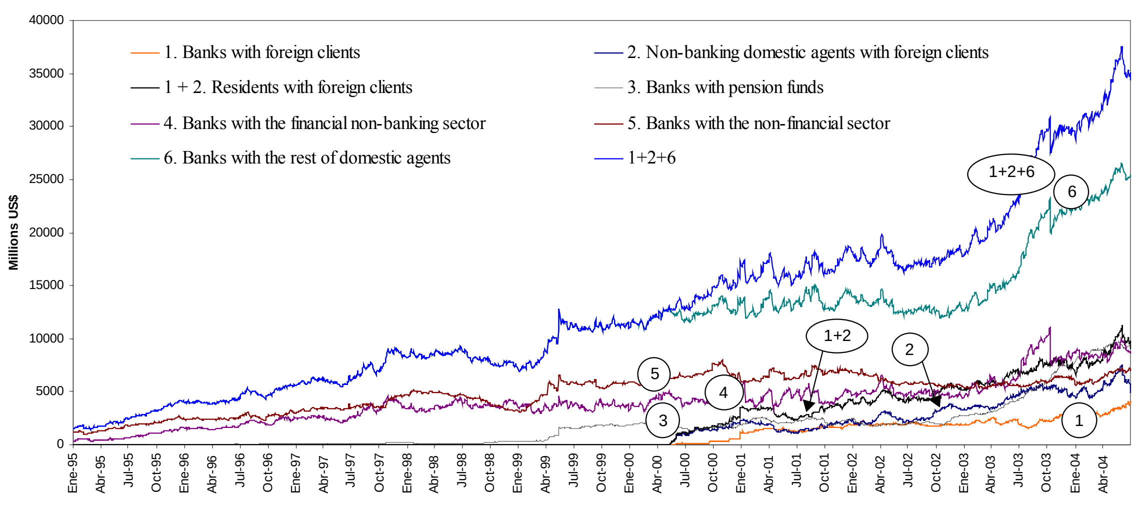
September 1999-June 2004



We restrict our activity variables to outstanding positions held by large participants in the derivatives market (Figure 5). Such disaggregated information provides an opportunity to investigate the impact on volatility of individual trader groups.

Figure 5. Outstanding positions by participant

September 1999-June 2004



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16 The calculations implied to work with approximately 780.000 operations. We also used the difference between the max and min price within the day, and results were unaltered.

We first present the Pearson correlation coefficients between our intraday volatility measure and the contemporaneous and lagged temporary component of outstanding positions held by each participant. We extract temporary components by the standard HP filter (table 11).

Table 11

Cross-correlation coefficients: volatility measure vs. temporary component of outstanding position series.

Outstanding	*Correlation*	*Causality*	*Outstanding*	*Correlation*	*Causality*
Banks with foreign clients			*Banks with the financial non banking sector*		
$Temporary_t$	0.000	no	$Temporary_t$	-0.004	no
$Temporary_{t-1}$	0.052	no	$Temporary_{t-1}$	-0.004	no
Non banking domestic agents with foreign clients			*Banks with the non-financial sector*		
$Temporary_t$	-0.049	no	$Temporary_t$	0.097	no
$Temporary_{t-1}$	-0.129	no	$Temporary_{t-1}$	0.016	no
Banks with pension funds			*Banks with the rest of domestic agents*		
$Temporary_t$	0.160	yes	$Temporary_t$	0.096	no
$Temporary_{t-1}$	0.211	yes	$Temporary_{t-1}$	0.068	no

Notes:

a. Series filtered by the Hodrick-Prescott filter setting $\lambda=(250^2)x100$.

b. Granger causality test for 36 lags and 5 percent probability. Volatility never caused temporary outstanding series.

From table 11, we see that temporary changes in activity associated to the unexpected component of the series have a feeble positive relationship with the intraday volatility of the nominal exchange rate. In fact, the trading volumes of the financial non-banking sector and non-banking domestic agents with foreign clients are negatively related to volatility.

We also perform a bivariate autoregression to test for granger-causality between volatility and temporary activity in the derivatives market (Lee and Rui, 2002). Granger causality tests indicate that series do not cause volatility with the exception of temporary activity of pension funds.

Finally, among the many alternatives, we chose to evaluate the contemporaneous relationship between trading volumes and volatility estimating the following two simultaneous equation model:

$$(1) \qquad Vol_t = \alpha_0 + \alpha_1 Temporary^i t + \alpha_2 Vol_{t-1} + \varepsilon_t$$

$$(2) \qquad Temporaty^i t = \beta_0 + \beta_1 Vol_t + \beta_2 Temporary^i t-1 + \xi_t$$

where *Temporary*^{i} corresponds to the temporary component of outstanding position of participant *i*, and *Vol* corresponds to the intraday variability measure presented in Figure 4.

To avoid problems of simultaneous bias we estimate the system (1) and (2) using the Generalized Method of Moments (GMM) and a 3SLS procedure. Results are in table 12. Remarkably, none of the outstanding position series has a significant link with the intraday volatility measure during the free floating period.

Table 12

Contemporaneous relationship between volume and volatility

Estimation Method	**GMM**		**3SLS**	
Temporary component of Outstanding	α_1	β_1	α_1	β_1
Banks with foreign clients	-2.3×10^{-7} (2.2×10^{-7})	3813.4 (3879.9)	-2.2×10^{-7} (2.5×10^{-7})	2958.5 (3800.9)
Non banking domestic agents with foreign clients	-9.8×10^{-8} (1.2×10^{-7})	-3225.1 (7942.9)	-9.5×10^{-8} (1.3×10^{-7})	-2490.7 (7774.9)
Banks with pension funds	2.5×10^{-7} (2.5×10^{-7})	510.79 (2683.66)	2.8×10^{-7} (1.9×10^{-7})	404.84 (2266.73)
Banks with the financial non banking sector	3.5×10^{-9} (6.9×10^{-8})	-2788.7 (9557.4)	1.6×10^{-9} (7.0×10^{-8})	-6510.2 (9137.9)
Banks with the non-financial sector	1.4×10^{-8} (1.4×10^{-7})	5951.9 (3901.8)	2.3×10^{-8} (1.3×10^{-7})	5349.3 (4160.1)
Banks with the rest of domestic agents	3.5×10^{-8} (7.4×10^{-8})	7822.9 (10164.0)	3.7×10^{-8} (6.7×10^{-8})	7822.9 (10164.0)

Notes:

a. Daily observations since September 1999 to June 2004. White Heteroskedasticity-Consistent Standard Errors & Covariance. Instruments are lags of endogenous variables. Standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% levels of significance.

The previous results suggest that the link between nominal exchange rate volatility and activity in the derivatives market has been quite weak or non-existent during the free floating period.

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

The notional value of the net outstanding FX forward positions indicates that, in recent years, Chilean residents have been in a net short position with respect to non-residents. This reflects the fact that the hedging by foreign investors of their direct and portfolio investments in the local market, and by resident firms of their external liabilities, has more than surpassed the hedging positions taken by domestic agents (pension funds, mutual funds and the non-financial sector) that invest abroad. Perhaps most important, the net short position also has been quite small as a percentage of the GDP (-1% in 2002 and -2% during 2003). Thus, it seems unlikely that the Chilean FX derivatives market is currently modifying substantially the overall gap between assets and liabilities denominated in foreign currency.[17]

As Chile´s FX derivatives market is less developed than those of advanced economies, it is interesting to explore whether economies with more developed FX derivatives markets present more or less aggregate exposure to currency risk.

A measure of aggregate currency mismatches that has often been used is net foreign debt (see Caballero et al., 2004 and Goldstein and Turner, 2004).[18] This is shown in table 13 for a group of selected economies. This measure does not incorporate the net outstanding position in the FX derivatives market because of the lack of reliable data at a cross-country basis. Also, foreign debt does not completely summarize currency mismatch since it ignores the currency composition of debt, the value of other assets and liabilities and the response of income to exchange rate fluctuations. Nonetheless, it is interesting that there is

[17] Of course, the FX derivatives market could still be making a substantial contribution to resolving currency imbalances within sectors of the economy.

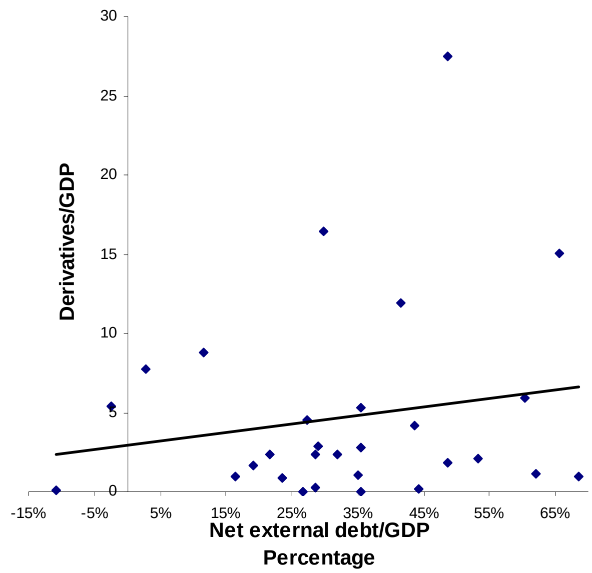
[18] As Caballero et al. (2004) point it out, foreign debt do not completely summarize currency mismatch since they ignore the currency composition of debt and the response of income to exchange rate fluctuations.

a tenuous but positive association between net external debt and derivatives usage with a pairwise correlation of 0.17 for the sample of countries. This is confirmed in the figure next to table 13.

Table 13

Net foreign debt and derivatives usage for selected economies
Year 2002

Country	*Net foreign debt/GDP*	*Net foreign debt/(X+M)*	*Derivatives ´01/GDP*
Argentina	35%	106%	0,003
Australia	49%	147%	27
Austria	35%	50%	5
Brazil	44%	183%	4
Canada	41%	60%	12
Chile	29%	54%	2
Colombia	29%	95%	0,2
Czech Republic	-2%	-2%	5
Finland	22%	37%	2
France	3%	6%	8
Germany	12%	21%	9
Greece	60%	195%	6
Hungary	35%	32%	1
India	16%	71%	1
Indonesia	69%	125%	1
Israel	23%	41%	1
Italy	36%	86%	3
Mexico	19%	37%	2
Netherlands	30%	32%	16
New Zealand	66%	135%	15
Peru	44%	166%	0,1
Philippines	53%	61%	2
Poland	27%	51%	5
Portugal	49%	89%	2
Russia	-11%	-22%	0,1
Slovenia	27%	28%	0,001
Spain	32%	72%	2
Thailand	29%	30%	3
Turkey	62%	129%	1



Notes:

a. Net external 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 data from the Balance of Payments Statistics Yearbook 2003, BIS (2002) and IMF International Financial Statistics.

One interpretation of this result is that economies with a more developed derivatives market also have 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. Unfortunately, however, 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 aggregate 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.

$$R_{i,t} = a_0 + a_1 MR_t + a_2 \Delta NER_t + e_t,$$

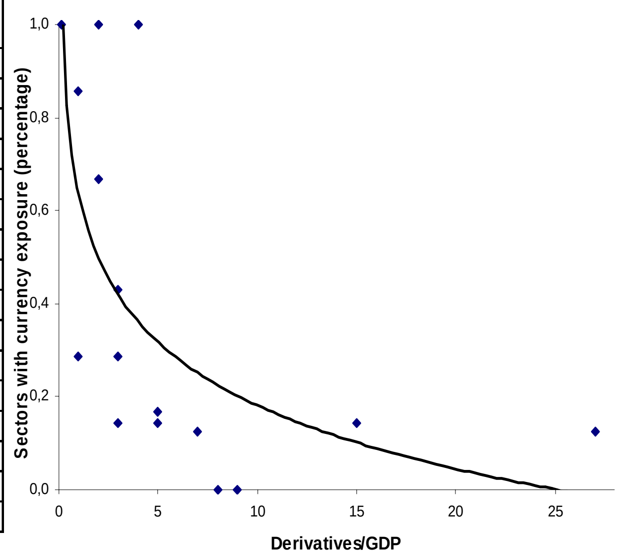
where R_i represents the monthly return of sector i, MR represents the monthly return of the market, and ΔNER the monthly change in the log of the nominal exchange rate with respect to the dollar.[19]

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.

[19] The table presents coefficient estimates from a panel OLS with fixed effects and the number of significant individual sectoral estimates for each country.

Table 14
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
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 returns. 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.

As can be seen in Table 14, the results suggest that countries with the lowest ratios of derivatives usage are also the ones with more currency exposure. This is confirmed either when we consider the panel estimates or the number of sector with significant exposure. Similar findings using data at the firm level are presented by Cowan et al (2004) and Allayannis and Ofek (2001).

In a nutshell, the evidence examined in this section suggests that, while countries with a more develop derivatives market may increase its share of net foreign currency debt, they present lower degrees of exposure to fluctuations in the foreign exchange rate.

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 deficient, in part, because of the 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 FX market. To do so, we evaluate the forecasting abilities of net currency positions taken in the derivatives and spot markets by these large players. [20]

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. 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 help us to understand the forces behind the movement of the exchange rate (Evans and Lyons, 2004). For instance, this approach to understanding exchange rate movements may be of interest to policymakers, who want to understand what drives the changes in the nominal exchange rate over relatively short periods. They may draw upon this evidence about participants or 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 using daily data.

The dataset covers nearly nine years of daily data (from January 1995 to June 2004), or 2870 observations for the largest Chilean FX market players, although to implement the testing we focus on the free floating period since September 1999.

[20] A natural extension may be to test the relevance of integrated variables that gather spot and forward net

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 net position for group or participant *j* at day *t* adds agents´ net positions within the group, and is constructed as:

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

Our measure of net position is a proxy -for the derivatives market- of the order flow employed by Evan and Lyons (2002). While net positions 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. Lyons (2001) and Evans and Lyons (2002), among other, provide empirical evidence that shows 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. Dealers' (banks) trading is disaggregated by trade with pension funds, non-banking financial agents and cross-border clients. We also distinguish the trading that occurs between residents (banks, firms, pension funds and financial non banking sector) and foreign clients.[21]

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, net positions (x_t) are included as a regressor.[22] 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

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positions.

[21] We are not able to capture the net position of firms with firms neither firms with the non-banking financial sector. It is worth to mention that net interdealer (banks) trading is zero in our database.

[22] 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.

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:

$$\Delta\log(NER)_{t+1} = \alpha_1 + \beta_1 x_t + \varepsilon_{t+1}$$

will improve forecast accuracy relative to the random walk forecast:

$$\Delta\log(NER)_{t+1} = \alpha_1 + \varepsilon_{t+1}$$

We utilize FX rate returns for the CL$/US$ exchange rate defined as the log difference of the nominal exchange rate (*dólar observado*).

Sample periods were defined based on the availability and reliability of the individual series. We perform this comparison for the following net positions: banks with foreign clients (*line 1* in figure 5); non-banking domestic agents with foreign clients (*line 2* in figure 5); banks with pension funds (*line 3* in figure 5); banks with the financial non-banking sector (*line 4* in figure 5); banks with the non-financial sector (line 5 in figure 5); residents with foreign clients (*line 1+2* in figure 5); banks with rest of domestic agents (*line 6* in figure 5) and aggregate net position (*line 1+2+6* in figure 5). Results are in table 15. We report the value of the t-statistic of parameter β and the U-theil statistics for the out of sample performance. For the derivatives market, we also report the forecast performance for changes 35-days ahead in the nominal exchange rate: [23]

[23] Alarcón, Selaive and Villena (2004) report an average duration of 5 weeks in forward contract.

Table 15
Forecast performance - Derivatives Market

Net position of	Sample Period	Forecasting ability			
		In Sample		Out of Sample	
		$\Delta\log(NER)_{t+1}$	$\Delta\log(NER)_{t+35}$	$\Delta\log(NER)_{t+1}$	$\Delta\log(NER)_{t+35}$
		| t-statistic |	| t-statistic |	U-theil	U-theil
Banks with foreing clients	December 2000 - June 2004	**2.36**	0.60	1.003	0.999
Non banking domestic agents with foreign clients	December 2000 - June 2004	1.41	0.51	1.002	1.041
Banks with pension funds	September 1999 - June 2004	1.45	**2.39**	1.001	1.001
Banks with the financial non banking sector	September 1999 - June 2004	0.47	0.62	1.001	1.001
Residents with foreign clients	December 2000 - June 2004	**2.34**	0.69	1.000	1.035
Banks with the non-financial sector	September 1999 - June 2004	**2.14**	0.01	0.999	1.001
Banks with the rest of domestic agents	September 1999 - June 2004	0.15	**1.91**	1.001	1.001
Aggregate net position	September 1999 - June 2004	0.89	**2.18**	1.000	1.001

Notes:
a. U-Theil less than one indicates better forecast with respect to random walk. Out of Sample rolling forecasts start at the middle of the corresponding sample period.
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

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. We also performed forecasting exercises for weekly net positions, and results point to the same direction.

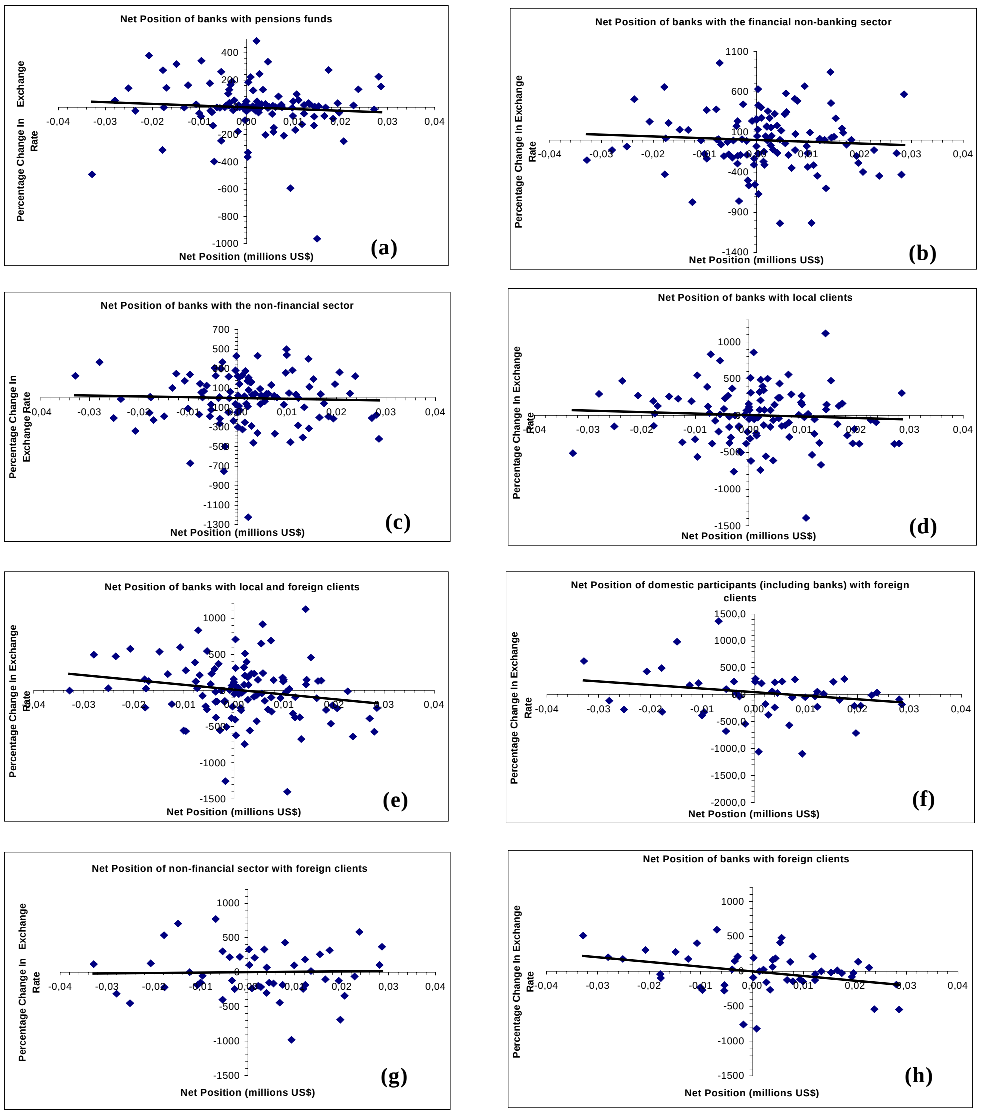
To give intuition to the previous results, we graph the contemporaneous relationship between exchange rate and net forward position. We present monthly nominal exchange rate movements and changes in the net positions currency derivatives held by some participants from January 1995 to June 2004 in figure 6.[24] 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. After fitting a straight line by OLS we observe a tenuous –negative- relationship between the change in the net position and the contemporaneous movement of the exchange rate. From this simple graphic analysis we confirm that the main participants in the derivatives

[24] We also graphed 1-month-ahead changes in nominal exchange rate and results were unaltered (not shown to save space).

market are not consistently taking positions in a manner that allow them to make some *extra-pesos*, but probably to hedge positions in underling investments or sales.

Figure 6. 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 Dec. 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 spot net position variable as:

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

Results are presented in table 16 for the following net positions: banks with pension funds; banks with the non-banking financial sector; bank with the non-financial sector; banks with the rest of domestic agents and aggregate net position.

Table 16
Forecast performance - Spot Market

Net position of	Sample Period	Forecasting ability In Sample	Forecasting ability Out of Sample
		| t-statistic |	U-theil
Banks with pension funds	September 1999 - June 2004	**2.70**	0.997
Banks with the financial non banking sector	September 1999 - June 2004	**3.55**	0.995
Banks with the non-financial sector	September 1999 - June 2004	**2.73**	0.997
Banks with the rest of domestic agents	September 1999 - June 2004	**1.85**	0.999
Aggregate net position	September 1999 - June 2004	**1.99**	1.002

Notes:
a. U-Theil less than one indicates better forecast with respect to random walk. Out of Sample rolling forecasts start at the middle of the corresponding sample period.
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

From table 16 we observe that none 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 worth to pursue to improve our understanding of current movements in the nominal exchange rate. Available upon request, we also performed forecasting exercises for weekly net positions, and results point to the same direction.

Overall, these findings support the view that main players in FX markets do not forecast accurately the nominal exchange rate, casting doubts about the view that participants have superior information and/or significant market power that allow them to make profits consistently out of it.

VI. Concluding remarks

The evidence in this paper supports the view that development of the FX derivatives market is valuable to reduce aggregate currency risk.

On the issue of effectiveness, our cross-country evidence suggests that development of the FX derivatives market helps a country to decrease its degrees of exposure to fluctuations in the foreign exchange rate, and that it does not increase the volatility of its foreign exchange rate. To further explore the issue of volatility, we used a unique database containing detailed statistics of foreign exchange market operations of private agents in Chile, and tested a pool of models to evaluate whether derivatives exacerbated the volatility of exchange rate after the implementation of the free float. Consistently, we were not able to find a significant relationship between activity and volatility.

On efficiency of the FX derivatives market, we also have examined evidence on the ability of large participants in this market to forecast or affect the level or first moment of the nominal exchange rate during the free floating period. Our results on the relationship between their net positions in the spot and derivatives markets, and the foreign exchange rate, cast doubt on the hypothesis of asymmetric information and/or market power in the FX spot and derivatives markets.

This paper constitutes a novel attempt to explore empirically the overall effects of the FX derivatives market on aggregate currency risk. This issue merits further research, given the increased adoption of floating exchange rate regimes by many developing and emerging market economies, together with general concerns about the risks associated with derivatives, currency mismatches, and exchange rate volatility. Empirical evidence based on panel and time series models for both advanced and emerging market economies would prove insightful, although in principle such studies are limited by the availability of data.

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	

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ANNEX

Table 9

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
Outstanding		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 10

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 <u>Volatility</u>	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Turnover Derivatives	-1428*** (427)			-695.6 (670.2)			-27.1 (484.6)		
Outstanding		-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

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