# MEASURING EFFICIENCY OF SOUTH AMERICAN FOREIGN EXCHANGE DERIVATIVES MARKET IN MINIMIZING CURRENCY RISK:

**RAAD MOZIB LALON**

Lecturer, Department of Banking & Insurance, University of Dhaka
Email:lalon.banking@gmail.com

## ABSTRACT

*This paper attempts to reveal whether the foreign exchange (FX) derivatives market effectively and efficiently reduces the volatility 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. 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. The study also found 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.*

## KEYWORDS

Volatility, FX Derivatives, NER, Openness, PPP, BIS, GDP

## 1. INTRODUCTION

A Foreign Exchange (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 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.

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, this research was able to access a unique daily and intraday database on the purchases and sales of most market participants.

### 1.1. Literature Review

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 Caballero, Cowan and Kearns (2004), among others, suggest that foreign exchange derivatives indeed tend to reduce currency exposure, but these valuable studies were conducted only at the firm level. Works such as 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 intraday data or extend the analysis to emerging market economies.Cornell (1981), by associating volatility with uncertainty, argues that volatility may lead to an increase in both hedging and speculative trading in derivatives contracts. 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, the future markets improve market depth and reduce volatility because the cost of informed traders of responding to mispricing is reduced. Models developed by Kyle (1985) and Ross (1989) 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 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. 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).

### 1.2. Objective of the Study

The major objective of this study is to analyze whether the use of currency derivatives is effective in reducing currency risk of foreign exchange market for a specific country or for a group of countries.

### 1.3. Methodology of the Study

The study has been divided into two parts where first part deals with the relationship between the Foreign exchange derivatives market and the volatility of spot exchange rate and the second part deals with measuring efficiency of using foreign exchange derivatives instruments to minimize currency risk causing exchange rate exposure in global financial market.

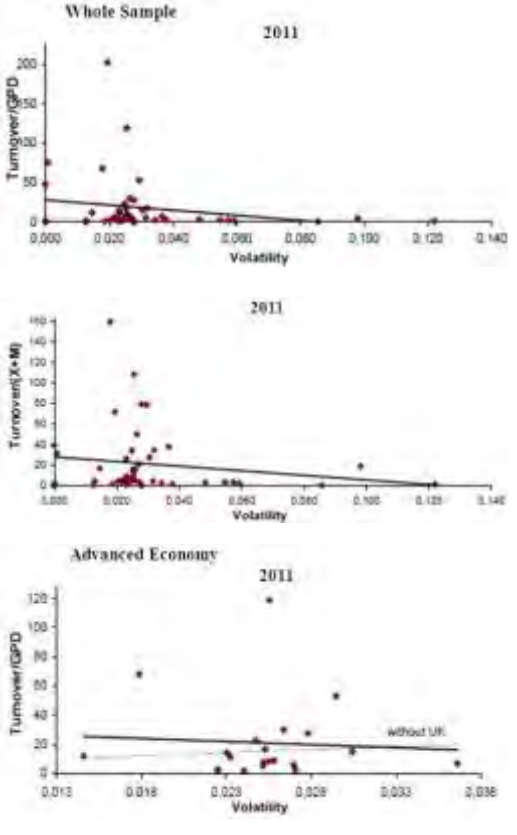
## 2. RELATIONSHIP BETWEEN THE FX DERIVATIVES MARKET AND THE VOLATILITY OF THE SPOT EXCHANGE RATE

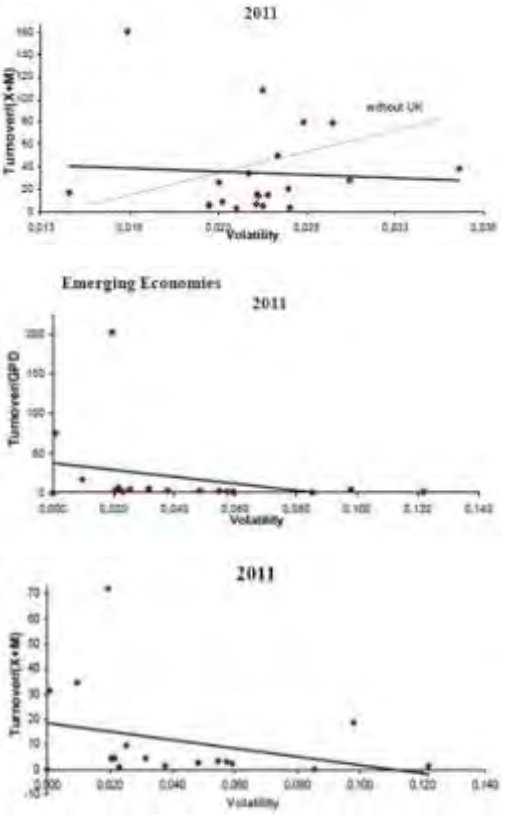
### 2.1. Nexus between Volatility and Activity in the derivatives Market

Earlier 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.

We make a simple cross-country association between volatility and development of the derivatives market based on data from the BIS (2011) (Figure 1). 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. In the next subsection we further explore this finding.




Notes: a. Volatility constructed as the standard deviation of the change in the monthly (log) exchange rate for the period 2004 - 2009. Turnover corresponds to subscriptions of forwards, fx swaps, options and futures.

Source: Authors´ calculations based on data from BIS (2011) and IMF International Financial Statistics.

### 2.2. 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 Voli is the level of nominal exchange rate volatility constructed using monthly data over 2004.1 to 2009.4, drawn for the IMF International Financial Statistics. Openness is the ratio of the sum of exports and imports over GDP. The benefit of a floating nominal exchange

rate is inversely related to the level of trade with the rest of the world. Size is the log of the average real GDP adjusted by PPP of years 2009 to 2011 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 2009. 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 (2011) 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 following Table, the study presents 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 pair wise correlation between openness and volatility is -0.07, which may indicate that a time series analysis may yield the expected negative sign.

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.

**Table 01.** Volatility Regressions (OLS Estimations)

| *Dependent Variable: STDEV [d(log(NER$_i$)]* | | | | |
|---|---|---|---|---|
| | ***Full Sample*** | | ***Non-OECD countries*** | |
| *Openness* | *(1)* | *(2)* | *(3)* | *(4)* |
| | 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 respectively

## 2.3 Volatility and Derivatives: Daily Approaches for Chile

Empirical research so 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 this

study follows approaches regularly applied in the analysis of stock markets.

At First, the paper estimates a EGARCH(1,1)-M augmented by activity measures following closely Bessembinder and Seguin (1992). It uses 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. The study calculates volatility based on a real exchange rate obtained by deflating the nominal one by daily inflation. The sample period covers from January 1st 2002 to June 30th 2011. The study reports the results in Table No.03 (Referred to Appendix section: specification (A)).

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.

Referred to Table 03 (Appendix Section)
**Volatility –Activity Relationship**

For the full sample period –columns (1) to (6) in Table 03, the study does 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)), it observes the same pattern with all coefficients negative and non-significant. To further test the reliability of the results, it performs an instrumental variable estimation. To do so, study employ the conditional volatility obtained from a GARCH model. The results are in table 04.

Referred to Table No. 04 (Appendix Section)
**Volatility –Activity Relationship**

Under this approach this study observes a weak "negative" link between volatility and activity in the derivatives market for the crawling band period (columns (1) and (2)). Similarly, it observes a positive link between activity in the spot FX market and volatility. Though, 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 it focus its attention to the free floating period. The following figure 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. From a simple graphical perspective, it seems that nominal exchange rate volatility has increased after the elimination of the crawling band.

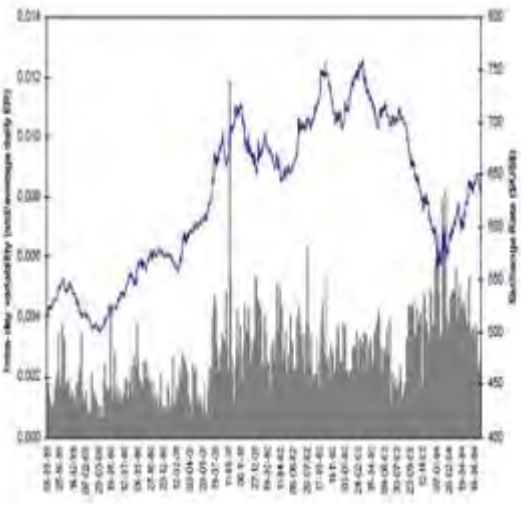


***Figure 01.*** *Intraday Volatility*

The study first presents the Pearson correlation coefficients between our intraday volatility measure and the contemporaneous and lagged temporary component of outstanding positions held by each participant. This research extracts temporary components by the standard HP filter (table 05).

**Table 05.** 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 λ=(2502)x100. b. Granger causality test for 36 lags and 5 percent probability. Volatility never caused temporary outstanding series.

From table 05, 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. The study also performs a bivariate auto regression to test for granger-causality between volatility and temporary activity in the derivatives market. Granger causality tests indicate that series do not cause volatility with the exception of temporary activity of pension funds. Finally, among the many alternatives, it chose to evaluate the contemporaneous relationship between trading volumes and volatility estimating the following two simultaneous equation models:

One model is

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

And another model is:

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

where Temporaryi 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 it estimates the system (1) and (2) using the Generalized Method of Moments (GMM) and a 3SLS procedure. Results are in table 06. Remarkably, none of the outstanding position series has a significant link with the intraday volatility measure during the free floating period.

**Table 06.** Contemporaneous relationship between volume and volatility

| Estimation Method | GMM | | 3SLS | |
|---|---|---|---|---|
| Temporary component of Outstanding | $\alpha_1$ | $\beta_1$ | $\alpha_1$ | $\beta_1$ |
| *Banks with foreign clients* | -2.5x10$^{-7}$ (2.2x10$^{-7}$) | 3813.4 (3879.9) | -2.2x10$^{-7}$ (2.5x10$^{-7}$) | 2958.5 (3800.9) |
| *Non Banking domestic agents with foreign clients* | -9.8x10$^{-8}$ (1.2x10$^{-7}$) | -3225.1 (7942.9) | -9.5x10$^{-8}$ (1.3x10$^{-7}$) | -2490.7 (7774.9) |
| *Banks with pension funds* | 2.5x10$^{-7}$ (2.5x10$^{-7}$) | 510.79 (2683.66) | 2.8x10$^{-7}$ (1.9x10$^{-7}$) | 804.84 (2266.73) |
| *Banks with the financial non banking sector* | 3.5x10$^{-8}$ (6.9x10$^{-8}$) | -2788.7 (9357.4) | 1.6x10$^{-8}$ (7.0x10$^{-8}$) | -6510.2 (9357.9) |
| *Banks with the non-financial sector* | 1.4x10$^{-8}$ (1.4x10$^{-7}$) | 5951.9 (3601.8) | 2.3x10$^{-8}$ (1.5x10$^{-7}$) | 5349.3 (4360.1) |
| *Banks with the rest of domestic agents* | 3.5x10$^{-8}$ (7.4x10$^{-8}$) | 7822.9 (10164.0) | 3.7x10$^{-8}$ (8.7x10$^{-8}$) | 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.

### 2.5. 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 2009 and -2% during 2010). 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.

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). This is shown in table 07 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 a tenuous but positive association between net external debt and derivatives usage with a pair wise correlation of 0.17 for the sample of countries. This is confirmed in the figure next to table 07.

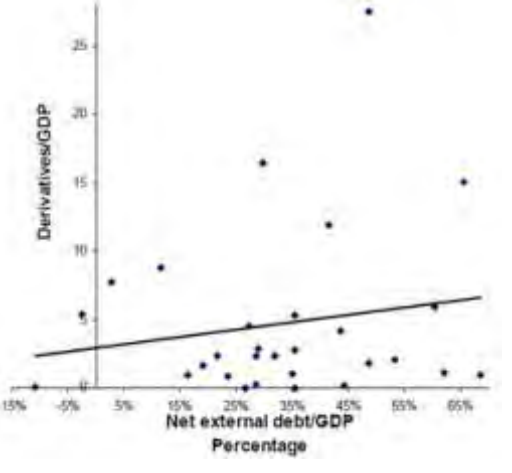
**Table 07.** Net foreign debt and derivatives usage for selected economies in 2011

| Country | Net foreign debt/GDP | Net foreign debt (X+M) | Derivatives '11/GDP |
|---|---|---|---|
| Australia | 49% | 147% | 27 |
| Argentina | 35% | 106% | .003 |
| 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 | 55 | 61 | 2 |
| Poland | 27 | 51% | 5 |
| Portugal | 49 | 89 | 2 |
| Russia | -11 | -22 | 0.1 |
| 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: Author's calculations based on data from the Balance of Payments Statistics Yearbook 2011, BIS (2010) and IMF International Financial Statistics.

Graphical Representation:



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.

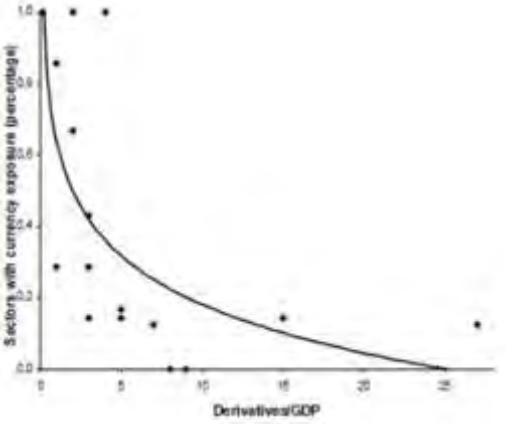
In the absence of direct data to measure aggregate currency mismatches across countries, this paper examines the association between a complementary measure of currency exposure derived from a regression analysis and the turnover in the currency derivatives market.

Where Ri 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. 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. The paper used the Morgan Stanley Capital Indices available at Bloomberg at monthly frequency from January 2002 to June 2011. The stock market return and nominal exchange rates were also obtained from Bloomberg. It considered eight sectors: Consumer discretionary, consumer staples, financials, health care, industrial, material, telecommunications and utilities.

***Table 08.*** *Exposure by regression analysis for selected countries*

| Country | Exposure from a panel OLS | Number of sectors with exposure | *Derivatives/GDP 2010* |
|---|---|---|---|
| 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 |
| Malaysia | -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 | 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 2002 to June 2011 (114 observations). b. Derivatives obtained from the BIS (2011).




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

As can be seen in Table 08, 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.

In Brief, 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.

## 3. CONCLUDING REMARKS

In case of effectiveness, the 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, this paper has 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, the study was not able to find a significant relationship between activity and volatility. 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. As a corollary, the evidence in this paper supports the view that development of the FX derivatives market is valuable to reduce aggregate currency risk.

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**Appendix:**

Table 03

**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) | | 0.059 (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) | | 0.293 (0.253) | 0.249 (0.277) | | 0.333 (0.127) | 0.178 (0.466) | | 0.164 (0.286) | 0.081 (0.412) | | -0.076 (0.167) | -.007 (0.195) | | 0.019 (0.193) | -.007 (0.199) |
| Turnover Spot | | | | -0.035 (0.112) | 0.017 (0.100) | 0.043 (0.101) | | | | 0.210 (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 |

Table 04

**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* | *0.63* | *0.99* | *0.29* | *0.28* | *0.99* | *0.44* |