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Increasing Derivatives Market Activity in Emerging Markets and Exchange Rate Exposure

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Abstract

Using firm level data, we report a significant fall in the exchange rate exposure of emerging market firms over the past 10 years, and relate this to higher derivatives market participation. Our methodology follows a three stage approach. First, we measure and report foreign exchange exposures for each year using the popularized extension of the Adler-Dumas (1984) model. Next, we use an indirect approach to estimate the derivatives market participation at the firm level. Finally, we investigate the implications of the level of derivative market activity on a firm's foreign exchange exposure. Our results show that foreign exchange exposure is negatively related to derivatives usage, and support the hedging explanation of the exchange rate exposure puzzle.

Journal of Economic Literature Classification: G15; G32; F31

Keywords: Exchange rate exposure; derivatives; emerging markets

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I. Introduction

Following the Asian and Long Term Capital Management (LTCM) crises, emerging market economies experienced sharp decreases in economic activity. In contrast, during the recent credit market related financial turbulence these countries have shown more resiliency. Improved foreign exchange risk management in these financial markets has been argued to be a major determinant of the muted effect.[1] Another recent development in these economies, which we focus on in this paper, is the increase in derivatives market activity following the financial crises of the late 1990's.[2] The figures in Table 1 illustrate how dramatically the aggregate derivatives market volume (DMV) increased in emerging market economies and reveal that it has grown much faster when compared to advanced economies. For example, over the period 2004-2007, growth rates of daily derivative transaction averages in emerging markets were 115.6 percent but only 29.9 percent for advanced economies. The remarkable growth in DMV underscores the importance of identifying the role derivatives play in a firm's ability to manage risk. Furthermore, the rapid transition to more flexible exchange rate regimes in emerging markets and the growth of global financial integration highlights the importance of analyzing the effects of higher derivatives market activity on foreign exchange exposure in these economies. Unfortunately, data on firm level participation in derivatives market is not widely available in emerging market economies and therefore it is not possible to analyze the effects of derivatives market participation directly. Instead, we develop an indirect method of measuring participation

[1] See for example the April 2008 issues of IMF's GFSR and WEO.

[2] See for example: Financial Policy Forum, Special Policy Brief, 15 (2004); Futures Industry Association – Annual Survey (2003) and Bank of International Settlements (BIS) (2007). These reports indicate that some of the emerging market derivatives exchanges (Mexico's Merder, Brazillian BM&F, Korean Stock Exchange) are now ranked among the top 10 derivatives exchanges based on the number of contracts traded. See also studies such as Fratzscher (2006) and Basu (2006).

in derivative markets and use this to gauge whether growth in firms' derivatives market participation (DMP) lowers foreign exchange rate exposure in emerging markets.

Our methodology is composed of a three stage approach. First, we measure and report exchange rate exposures for each year using the popularized extension of the Adler-Dumas (AD) (1984) model. Next, and most importantly, we use an indirect approach to estimate derivatives market participation at the firm level. Finally, we investigate the implications of the level of derivatives market activity on a firm's exchange rate exposure.

The literature offers several explanations for why a firm would choose to use derivatives. Among these are the desire to reduce cash flow volatility, operational strategies to reduce the effect on firm value, underinvestment, financial distress, tax incentives and managerial incentives.[3] The objective of this paper is to assess the effects of using derivatives on exchange rate exposure, not to determine *why* a firm hedges.

The relationship between a firm's DMP and risk management has been studied for advanced economies. Allayannis and Ofek (2001) were the first to use notional, continuous derivatives data at the firm level to study the effects on exposure. [4] They find that firms in the United States use derivatives to hedge and not to speculate, and that the level of foreign sales and trade is an important determinant of the decision to hedge. They obtain these results using the two stage regression process of Cragg (1971). Others (Hagelin and Pramborg, 2004; Muller and Verschoor, 2006; Pantzalis, Simkins and Laux, 2001) also have used a similar approach to study other regions and different hedging procedures. Unfortunately, it is impossible to apply these methods to emerging market economies since firm level data on DMP is not available. The key

[3] See Bartram, Brown, and Fehle (2007) for a discussion of the underinvestment, financial distress, tax incentive and managerial incentive theories of derivative usage.
[4] Prior to Allayannis and Ofek (2001), most studies used either binary data to indicate whether firms use derivatives or gathered this information from surveys as in Simkins and Laux (1997).

innovation of our paper is our utilization of a method to indirectly measure the effect of DMP on foreign exchange exposure that can be used when derivatives data at the firm level is missing.

Few papers in the literature on foreign exchange exposure analyze emerging markets.[5] This is most likely a result of the limited data availability for these countries. For this paper, we constructed a data set comprised of firm-level observations spanning the years 1995-2005 for six large emerging market economies and add to the scarce body of work related to exchange rate exposure in emerging market economies.

Our results show that foreign exchange exposure is negatively related to a firm's DMP. This decline is especially salient in sectors with more foreign trade, for bigger firms, and over longer time periods. Results are robust to using different exchange rates, using non-linear and GARCH-SVAR models to measure exchange rate exposure, to employing overlapping observations, and to differing return horizons.

The main advantage of a developed foreign exchange derivatives market is the ability of both foreign investors and domestic businesses to hedge currency risk. The main drawbacks are potential increase in speculative positions in the absence of strict regulations, and vulnerability to higher volatility and counter party risks. One implication of our main result is that in general, the positive effects of using foreign exchange derivatives outweigh the negative effects. We find that as emerging economy derivatives markets develop, foreign exchange exposure coefficients decrease and converge to the low levels observed in advanced economies. This is interesting in the context of the exchange rate exposure puzzle as we view the decline in exposure in response to an increase in a firm's DMP as giving dynamic support for the hedging explanation.[6]

[5] See Chue and Cook (2008); Dominguez and Tesar (2001); Kho and Stulz (2000); Parsley and Popper (2008).
[6] Bartram and Bodnar (2007) state that the failure to find exposure, despite the effect of unanticipated exchange rate changes on the value of corporations (exchange rate exposure puzzle) is due to hedging, and not empirical methodology or sample selection related shortcomings.

The remainder of the paper is organized as follows: We discuss the data set in Section II. In Section III, we posit a model and report results regarding the evolution of foreign currency exposure over the 1995-2005 period. In Section IV, we present our indirect method of estimating a firm's DMP then we estimate the relationship between exchange rate exposure and DMP in Section V. We perform sensitivity analysis and check the robustness of our results in Section VI and then conclude with Section VII.

II. Data

We compiled our data from the Datastream database. Our data set includes firms listed in the stock exchanges of Brazil, Chile, Israel, Korea, Mexico, Turkey, and consists of daily observations spanning the period 1995-2005.[7] The number of firms for each country, the breakdown by sector and the stock exchanges are reported in Table 2. The data set consists of stock prices, sector affiliation, and total assets at the firm level, a composite stock market index, and risk free interest rates for different maturities. Data availability was the main driver of our choice of countries.

A majority of the literature using advanced economy data gauges the significance of openness on exposure by including the foreign sales variable in regressions. We were only able to find this data for a few firms in Chile and Israel. To consider all six countries, we classified the firms into three categories: high trade, low trade and financial. Manufacturing firms are classified into high trade and low trade groups using data from the United Nations Common database. Classification is based on the degree of trade openness at the sector level, and our proxy for this variable is exports divided by production.

[7] Data for Israel was available only at the weekly frequency.

We include the financial sector in our analysis. Although most of the literature does not include the financial sector due to its market-making property in derivatives and foreign exchange markets, we do so for three reasons. First, there is evidence that this sector has started using derivatives instruments to a greater extent for various reasons. Among these is the desire to hedge foreign currency exposure and to increase yield through higher leverage (while becoming more vulnerable to exchange rate volatility).[8] Table 3 reports the increase in domestic financial institutions' direct usage of foreign currency derivatives. Notice that the growth in derivatives market transactions for emerging market countries' financial sectors are significantly higher than country averages reported in Table 1. Second, the fragilities in emerging market bank balance sheets were argued to be one of the main determinants of the severity of the Asian and LTCM financial crises. Third, the recent financial turbulence in credit markets has shown that, despite the market-making property, off balance sheet exposures of banks can affect their balance sheets through their contingent credit lines to conduits. There is also evidence that foreign investors – not only the domestic financial sector - play a major market-maker role for structured products traded in emerging markets. [9] Therefore, it is important to determine the nature of the relationship between derivative usage and foreign exchange risk in the financial sector.

Since there is no consensus in theory as to which exchange rate is suitable for countries, we first use Local Currency/US Dollar exchange rates and then examine Local Currency/other currency and trade-weighted exchange rates in our sensitivity analysis (Section VI).

Daily aggregate DMV data could only be gathered for Chile, Israel, Korea and Turkey. This data is available at monthly, quarterly, and annual frequencies for Brazil and Mexico.

[8] For evidence on using derivatives to increase leverage see IMF, Global Financial Stability Report, October, 2007.
[9] Table 3 shows that foreign investor share of derivatives market transactions is significantly above 70% and has been increasing over the past 6 years. Foreign participation in advanced economies is much higher partially reflecting financial openness.

However, the number of observations was insufficient in these two countries to apply our indirect approach to measuring a firm's DMP. Therefore, we show what happens to foreign exchange exposure in all 6 countries, but can only say how a firm's DMP affects exposure for 4 countries. The contents and the sources of the data set are shown in Table A.1 of Appendix A.

III. Evolution of Exchange Rate Exposure

In this section, we present two ways to measure foreign currency exposure. First we examine the relationship between the percent change in the exchange rate and a firm's stock return. Second, we examine the relationship between exchange rate volatility (proxied using the coefficient of variation) and a firm's stock return. In the next section, we present our method of indirectly estimating the level of a firm's DMP. Then we use our estimates of exchange rate exposure and estimates of a firm's DMP to analyze the effects of DMP on exchange rate exposure in Section V.

Exposure to Changes in Exchange Rates.

To measure foreign currency exposure, we follow the common practice in the literature and utilize the following extension of the AD model:

$$R_{it} - R_{ft} = \beta_{0i} + \beta_{1i}\left(R_{mt} - R_{ft}\right) + \beta_{2i}\Delta ER_t + e_t \quad (1)$$

where R_{it} is the rate of return on firm *i*'s common stock, R_{mt} is the return on the value weighted stock market index, ΔER_t is the percent change in the foreign exchange rate, and R_{ft} represents the risk free rate of return. The regression model measures the idiosyncratic effects of exchange rate volatility on a firm's stock return. The coefficient of interest is β_{2i}. If it is significant, we classify the firm as having a significant exchange rate exposure. The market index is included to account for the changes in economy specific factors that are common to every firm. This includes for example an expansionary monetary policy that would inflate stock prices and

depreciate the currency concurrently. The foreign exchange rate is measured in Local Currency/US Dollar. We also measure the exchange rate as Local Currency per the Japanese Yen, or British Pound, or Euro/DM or trade-weighted exchange rates in our sensitivity analysis. In contrast to some studies, we did not include exchange rates simultaneously due to the high degree of serial correlation we found among advanced economy currency-local currency exchange rates. When estimating equation (1), we use General Method of Moments (GMM).

Results are provided in Table 4. The numbers represent the percentage of firms with significant exchange rate coefficients ($\hat{\beta}_{2i}$'s) at the 5% level, measured using robust standard errors. The rows correspond to the different frequencies used to measure percent change in stock prices and exchange rates. Top panel of Table 4 shows the proportions of firms that had significant coefficients throughout the whole sample period. We can see that the proportions fall as frequency decreases, possibly due to the lower power associated with fewer observations.

In order to overcome the lack of power and make significance more comparable across different frequencies, we use overlapping observations similar to Dominguez and Tesar (2006) and Bodnar and Wong (2003). We calculate returns using daily, weekly, monthly, quarterly, semi-annual, and annual horizons. In doing so, we use daily overlapping observations for weekly return horizons, and weekly overlapping observations for monthly, quarterly, semi-annual and annual frequencies.[10] We correct for serial correlation stemming from the usage of overlapping observations by employing the Newey and West (1987) method, and use robust standard errors. Results are reported in the bottom panel of Table 4. Beyond the weekly horizon, our figures are

[10] For detailed discussion on the benefits of using overlapping observations see Richardson and Smith (1991). In addition to weekly frequency, we tried different horizons for overlapping observations and obtained similar results.

very large when compared to some studies that use advanced economy data.[11] Consistent with a majority of the research, we find that the proportion of firms that have significant exposure increases with the return horizon. [12]

To observe the evolution of exchange rate exposure, we repeat our experiment for each year in our sample and plot the proportion of firms with significant β_{2i} coefficients in Figures 1 and 2.[13] With the exception of daily returns, the pattern in the data indicates a declining proportion of exposure. This pattern is more evident in regressions with overlapping observations beyond the weekly frequency, and Chile, Mexico, and Israel seem to have the most uniform declines in the exposure proportions. Furthermore, the two-proportion z-test results shown in Table A.2 of Appendix A imply that the decline in exposure is significant.

Fraction of firms with significant exchange rate coefficients is not a good indicator of exposure if the magnitude of the coefficients is economically insignificant. Hence, we also measure and report the average absolute value of the exchange rate coefficients. The numbers reported in Table 5 reveal that the size of exposure has decreased parallel to the decline in the proportion of firms with significant exposure. Furthermore, although the magnitudes of the exchange rate coefficients were significantly higher than advanced economy coefficients at the start of the sample period, they converged to these levels towards the end.[14]

The decrease in exposure parallels the development of local bond markets in these economies following the crisis periods of the late 1990's and early 2000's. Since these financial

[11] Some of the exposure proportions in the literature for the US are: Jorion (1990), 5.2%; Walsh (1994), 5.6%; Prasad and Rajan (1995), 15.0%; Dukas, Fatemi and Tavakkol (1996), 5%-8.3%. For other countries: Prasad and Rajan (1995), 4% (JPN), 5.9% (GBR), 16.7 % (DEU); Doidge, Griffin and Williamson (2006), 8.2% (18 countries).
[12] See for example, Dominguez and Tesar (2001, 2006); Bodnar and Wong (2003); Chen and Chow (1998); Chow, Lee and Solt (1997); Jongen, Muller and Verschoor (2007).
[13] We omitted periods corresponding to exchange rate fluctuations exceeding 3 standard deviations in a given year. Including these periods generated negligible differences. Tables are available upon request.
[14] For the U.S., Jorion (1990)estimates maximum exposure to be 0.56 over the period 1971-1989. Dominguez and Tesar (2006) estimate it to be 0.17-0.56 over the period 1980-1999 in 6 non-US advanced economies. Hagelin and Pramborg (2002) estimate it to be 0.52 over the period 1997-2001 in Sweden.

instruments increase the availability of foreign currency hedges, the drop in foreign currency exposures can partially be attributed to greater degree of hedging. However, over the same period these countries have also reduced their foreign currency share of total debt, thereby eliminating some of their exposure to exchange rate fluctuations.[15] Therefore, it is important to identify the unique role that foreign exchange hedging (a firm increasing DMP) plays in decreasing foreign exchange exposure as we do in this paper.

Exposure to Exchange Rate Volatility

The evolution of foreign currency exposure estimated with equation (1) assumes that markets have information on firms' net foreign assets position as well as the maturity of their assets and liabilities. However, due to lags in data or uncertainty about off-balance sheet items, the direction of foreign currency exposure may not be available. Nevertheless, the stock of a firm with significant absolute exposure would be traded at a discount (premium) if exchange rate volatility increased (decreased). Furthermore, several studies have implied the possibility of a nonlinear relationship between exchange rates and stock returns. Stulz (2003) shows that if cash flows are a nonlinear function of exchange rates, exposures would also be nonlinear. Shifting of production activities to different locations in response to exchange rate movements is another source of convexity outlined in Kogut and Kulatilaka (1994) and Ware and Winter (1988). Other explanations include the absence of nonlinear hedging strategies by corporations as in Bodnar and Gebhart (1999) default risk as in Stulz (2003) and pricing to market as in Knetter (1994). There is also evidence that as emerging market countries allow their currencies to float, the resulting higher exchange rate volatility increases the demand for exchange rate hedging

[15] Source: IMF (2007). Foreign currency share of total debt has dropped approximately 16% in Brazil between 2002 and 2005, 33% in Indonesia between 1998 and 2005, 17% in Korea between 1997 and 2005, 29% in Mexico between 1998 and 2005, 24% in Thailand between 1997 and 2005, and 25% in Turkey between 2001 and 2005.

instruments as suggested by Turner (2002). Therefore, we feel that it is important to include nonlinearity in the model to gauge the effect of derivative usage on vulnerability to volatility.

To measure nonlinear exposure, we extend the AD model by including unconditional exchange rate volatility as an additional independent variable. We measure exchange rate volatility using the coefficient of variation which provides a unit free proxy for dispersion. More specifically, we divide the standard deviation of the exchange rate in a given period by the mean value of this variable and estimate the following regression model.

$$R_{it} - R_{ft} = \beta_{0i} + \beta_{1i}\left(R_{mt} - R_{ft}\right) + \beta_{2i}\Delta ER_t + \beta_{3i}\sigma_t^{er} + u_t \qquad (2)$$

where σ_t^{er} is the coefficient of variation and is our exchange rate volatility proxy. In this regression, we are interested in the coefficients on both the exchange rate measure (β_{2i}) and the exchange rate volatility measure (β_{3i}). To calculate returns we use weekly and monthly horizons with daily and weekly overlapping observations.

Results from estimating equation (2) are reported in Table 6 and show that our estimates of exposure increases significantly when exchange rate volatility is included in the model. The proportion of firms with significant coefficient estimates for the percent change in the exchange rate and the exchange rate volatility are reported in the first and second rows, respectively. Proportions of firms with at least one significant coefficient are reported in the third row. With the exception of Turkey, the decline in exposure was more gradual when we included exchange rate volatility. This pattern is evident when we compare Figures 2 and 3. Consistent with the majority of the literature we find that the sign of the exchange rate coefficient is evenly split between positive and negative. However, the sign of exchange rate volatility was negative in most of the cases (implying that in general an increase in exchange rate volatility has decreased share values).

Having found some evidence supporting a decreasing sensitivity to exchange rate movements both in terms of fraction of firms and magnitudes, we investigate if this is due to the developments in the derivatives markets.

IV. Measuring a Firm's DMP Indirectly

This section presents the procedure we use to indirectly measure a firm's DMP. In the absence of derivatives market activity at the firm level, it is not possible to measure the effect of derivatives usage on a firm's exchange rate exposure directly. Nevertheless, we can use a formulation similar to that employed in Section III to estimate the level of DMP at the firm level. More specifically, we replace the exchange rate variable in equation (1) with the aggregate DMV, and estimate the following:

$$R_{it} - R_{ft} = \gamma_{0i} + \gamma_{1i}\left(R_{mt} - R_{ft}\right) + \gamma_{2i} DMV_t + w_t \qquad (3)$$

where DMV_t is the derivatives market volume variable discussed in Section II and in Appendix Table A.1. This equation captures the idiosyncratic effects of derivatives market volume on a firm's stock return.[16] Hence, we use the coefficient $\hat{\gamma}_{2i}$ as a proxy for DMP. The intuition is as follows: On one hand, if a domestic firm takes advantage of the greater depth in the derivatives markets to lower its exchange rate associated risks, demand for its stock would increase, and $\hat{\gamma}_{2i}$ would be significant and negative. On the other hand, if a firm uses these instruments for higher leverage to increase return, $\hat{\gamma}_{2i}$ will be significant and positive. For either case, the absolute value of $\hat{\gamma}_{2i}$ would measure the sensitivity of stock returns to the availability of derivatives instruments and thereby indicate the degree of DMP.

[16] We excluded the market premium, $R_{mt} - R_{ft}$ from equation (3) to estimate the sensitivity to DMV_t and found results similar to those we report in this paper.

Our methodology is similar in essence to several approaches already taken in the literature. Sensitivity of stock returns to macroeconomic variables has been the subject of numerous studies, especially after Fama (1981) and Chen, Roll and Ross (1986). These studies find that macroeconomic variables such as industrial production, money supply, interest rates, inflation rates have explanatory power over stock returns.[17] Some of these studies also mention that local macroeconomic variables in emerging markets have higher explanatory power over stock returns compared to advanced economies since they are partially segmented from global capital markets. The macroeconomic variable we consider here is the derivatives market volume. Related to our analysis, there is a plethora of research that examines the relationship between financial development and stock returns. While most of these are at the country level, there are few studies that examine stock market returns (e.g. Dellas and Hess, 2005).

The unavailability of derivatives data at the firm level in our data set prevents us from testing the ability of $\hat{\gamma}_{2i}$ to proxy DMP. However, there is substantial firm level evidence as in Allayannis and Ofek (2001) and Muller and Verschoor (2005) linking the amount of foreign sales to the degree of derivatives usage. In light of this evidence, we test the performance of our model and measure the proportion of firms with significant $\hat{\gamma}_{2i}$ coefficients in 6 manufacturing sectors. The ordering of the sectors is determined by the average ratio of exports to production between 1995 and 2005 using United Nations Common Database such that sector 1 has the highest and sector 6 has the lowest exports to production ratios.[18] Subsectors were combined to generate 6 sectors so that there were at least 20 firms classified under each sector.

We report results from equation (3) in Table 7. Each cell in the table contains the percentage of firms within the corresponding sector in a country that have a significant $\hat{\gamma}_{2i}$

[17] See for example Schwert (1990); He and Ng (1994); Bilson, Brailsford and Hooper (2001); Ibrahim (1999).
[18] We have also used imports to production and exports plus imports to production ratios and found similar results.

coefficient when we estimate equation (3). The results are encouraging, and reveal that our proxy for DMP is not unreasonable. Notwithstanding a couple of exceptions, the proportion of firms with significant $\hat{\gamma}_{2i}$ coefficients increases as the level of openness increases. Nevertheless, we should point out that the experiment provides only a partial support that stock returns are sensitive to DMP and is far from perfect.[19]

V. Effects of DMP on Exchange Rate Exposure

To measure the effects of DMP on exchange rate exposure we follow three steps:

1. We collect the $\hat{\beta}_{2i}$ and $\hat{\beta}_{3i}$ coefficients estimated for each year in Section III using weekly overlapping observations and a monthly return horizon and retain only the significant coefficients.[20]
2. We collect our proxies for DMP, $\hat{\gamma}_{2i}$'s estimated for each year in Section IV using weekly overlapping observations and a monthly return horizon and retain only the significant coefficients.[21]
3. We construct our panel data set using the exposure and DMP coefficients measured for each year and firm for a specific country in steps 1 and 2. Next, we regress the exposure coefficients on the market participation proxy as follows:

$$\hat{\beta}_{2it} = \lambda_0 + \lambda_1 \hat{\gamma}_{2it} + \nu_t \tag{4}$$

We use the absolute values of $\hat{\beta}_{it}$ and $\hat{\gamma}_{it}$ in equation (4). A negative sign of $\hat{\lambda}_1$ indicates that foreign exchange exposure decreases when a firm participates more in the derivatives market. We also included the foreign sales/total sales ratio in equation (4) to control for the degree of foreign operations. Foreign sales data was only available for a few firms in Chile and Israel, and its inclusion did not change the results significantly for these countries.

Pagan (1984) proves that in models with generated regressors similar to that in equation (4), if the hypothesis to be tested is $\lambda_1 = 0$, the OLS estimator of the variance of $\hat{\lambda}_1$ is consistent,

[19] Due to the lack of firm level data, we were unable to include foreign sales as an explanatory variable.
[20] We have also estimated exposures using levels and volatility separately. Results were qualitatively similar.
[21] Using daily overlapping observations and a weekly return horizon yielded similar results.

and the asymptotic t-statistics are valid. Furthermore, some studies have used maximum likelihood estimation to deal with the generated regressor problem (e.g. McAleer and Mackenzie, 1991, 1994). Finally, Arrelano and Bover (1995) propose a GMM strategy for panel data that is superior to OLS when the dependent variable is not stationary, there are unobserved firm specific effects, and there is reverse causality (when a firms' stock return affects the return on the market index and/or the exchange rate). In our experiments we have used all three of the methods mentioned above. Since results were similar, we report the output from only the GMM estimation of equation (4) in Table 8.

Reported coefficient values measure the percent change in exchange rate exposure in response to a one percent change in the sensitivity to derivatives market volume. We make three observations based on the results. First, all of the sectors with low levels of foreign trade (low exports/production ratios) have insignificant coefficients, and a majority of the high trade sector coefficients are significant and negative. Hence, foreign currency exposure of firms classified under sectors that trade heavily is more sensitive to DMP. The insignificance for low-trade firms can be partially explained by the fewer number of significant exchange rate and DMV coefficients in the first and second stage regressions that give us fewer observations in the third stage. This result is in line with the evidence indicating higher usage of derivatives by firms with more foreign sales in Allayanis and Ofek (2001), Nydahl (1999), Muller and Verschoor (2006).

Our second finding is that the financial sector participation coefficients are negative, higher than the high trade sector coefficients in absolute value, and more significant. This observation provides support for the numbers reported in Table 3. Conversely, the higher values of coefficients imply that financial firms were more efficient in reducing their foreign currency exposures by using derivatives compared to non-financial firms. Furthermore, the negative

coefficients imply that derivatives market transactions of these firms were predominantly due to hedging motives rather than speculation.

Finally, we find that the exposure to volatility is less sensitive to DMP. More specifically, Table 8 shows that significant exchange rate volatility exposure coefficients are fewer in number and smaller in size compared to the coefficients of exchange rate levels.

VI. Robustness

In this section, we test the robustness of our findings to considering different exchange rates, model specifications, period lengths and firm sizes. Results are displayed in Appendix B.

Using Different Exchange Rates -- EMAX

In this section, we replicated our simulations using a different measure of exchange rate constructed as follows: We ran separate regressions with the exchange rate measured as Local Currency per Japanese Yen, or British Pound, or Euro/DM, or US Dollar, or a trade-weighted exchange rate. Using the output of these regressions, for each firm we identified the currency that generates the maximum exposure and referred to this as EMAX. In our third stage regressions we used the $\hat{\beta}_{2i}$ and $\hat{\beta}_{3i}$ coefficients corresponding to EMAX. Our experiments using EMAX produced slightly higher sensitivity of exposure to the participation proxy for exchange rate levels compared to our main results in Table 8. However, the differences in exchange rate volatility coefficients estimated from regressions including USD and EMAX were negligible. The rest of Section VI discusses our sensitivity experiments using EMAX.

GARCH-SVAR

The analysis so far has the following caveat: Exchange rate fluctuations, the change in the exchange rate, and the market return are highly correlated. This in turn makes the coefficient estimates unreliable. Therefore, it is important to identify the shocks to volatility and to the

exchange rate that are independent of the shocks to other variables. In this respect, we follow a three step procedure similar to Jorda and Salyer (2003). First, we estimate a Vector Auto Regressive (VAR) model with the following ordering: $\left[R_m \;\; ER \;\; R_i \right]$ using weekly returns and lags up to two periods. We assume that individual stock returns do not affect macroeconomic variables. The other restriction we need in order to obtain the orthogonalized shocks is the independence of market returns from the change in exchange rates. To do this, we use the residuals from a regression of market returns on exchange rates, and consider the component of market returns that are not affected by exchange rates by construction. Next, we fit a GARCH(1,1) model to residuals from the exchange rate equation, and estimate the conditional variances, $\hat{\sigma}^{er}$. Finally we incorporate this conditional exchange rate volatility in a VAR model with the following ordering: $\left[\hat{\sigma}^{er} \;\; R_m \;\; ER \;\; R_i \right]$.

We are particularly interested in the effects of the exchange rate and exchange rate volatility on a firm's stock returns. It is straightforward to gauge this effect using decomposition of variance from our model. We measured the variance decompositions for forecast horizons 1 to 10 weeks ahead for each firm and constructed our two additional foreign exchange exposure proxies (SVAR proxies): percentage of variation in stock returns explained by exchange rates or by conditional exchange rate volatility. Despite slight differences, these two ratios were stable over different forecast horizons. Therefore, we used the results from 3 period ahead forecasts.

Using these proxies in our third stage regressions we find, similar to our main results in Table 8, that coefficients of the participation proxy are negative in general. The disparity between financial, high trade and low trade sectors, however become much more apparent with these alternative proxies. Furthermore, these coefficients were more significant compared to those obtained using the AD model proxies. This is partially due to the fact that every annual

observation for each firm is included in the third stage unlike in our main model. Hence, the larger number of observations causes a drop in the standard errors. We also find, consistent with our main results that the sensitivity of exposure to DMP is larger in Korea compared to others.

To eliminate the effect of power in this disparity, we followed two methods. First, we considered only annual data with variance ratios over certain values so as to equate the number of observations in SVAR and AD proxies. Second, we considered all the observations in the SVAR proxies. Results were similar. Overall, the negative effect of DMP on exchange rate exposure was robust to a more precise method of measuring the effect of exchange rate fluctuations on stock returns.

Different Period Lengths

So far we used exposures and derivative market participation coefficients measured annually in the third stage. Alternatively, we extend the time period to three years. This modification increases the number of observations and therefore the power of our estimation results in the first and second stage. However, the power of the results in the third stage decreases as we use lower frequencies. Our simulations produced a sharp increase in the size and significance of the coefficients. Furthermore, exchange rate volatility that was insignificant in regressions using annual data was more significant and larger in size when the period length was increased. These results are not surprising since the growth in the derivative market volume variable is much more apparent over a three year period.

Size Classification

A majority of the studies measuring exchange rate exposure for different size firms finds that larger firms are more exposed to exchange rate fluctuations than smaller firms.[22] Using data

[22].See Parsley and Popper (2002); Kho and Stulz (2000); Jorion (1990); Nance, Smith and Smithson (1993).

for Chile – the only country with size data – , we test how foreign exchange exposure sensitivity to DMV is related to a firm's size.

We divide the firms into three equal size groups, and implement our experiment for each of them using weekly overlapping observations and a monthly return horizon.[23] Our simulation results showed that larger firms participate more in the derivatives markets. This result is consistent with a number of studies that find evidence supporting the fixed start up costs in hedging theory.[24] Second, we found that large firms reduced their exposure to a greater extent over the sample period compared to smaller firms. Finally, the decline in exposure to exchange rate volatility was bigger for smaller firms. The last observation can possibly be interpreted as the ability of smaller firms to signal to the market that they are hedging some of their less transparent foreign exchange exposures. In contrast, bigger firms' direction of exposure was more transparent, and the decline in their foreign exchange exposure was more apparent when exchange rate changes were used.

VII. Conclusion

The rapid pace of financial integration and innovation in emerging markets has improved the efficiency of financial intermediation, and enabled firms to diversify risks. However, these developments have also introduced challenges to identify the underlying risks in these markets. The negative consequences of these risks were evident with the recent credit market related financial turmoil. Given the complex and less transparent nature of off-balance sheet transactions, it is essential to develop methods to gauge these risks.

[23] Share of a firm's total assets in the industry total is averaged for the 1995-2005 period to classify the firms.
[24] See Geczy, Minton and Schrand (1997); Froot, Scharfstein and Stein (1993); Allayannis and Ofek (2001); Minton, Stulz and Williamson (2008); Bartram, Brown and Fehle (2007).

In this paper, we identify a declining trend in emerging market firms' exchange rate exposure using various measures. Next, we investigate whether the growing scale of derivatives market activity in emerging market countries is partially responsible for this observation. Given the absence of derivatives data at the firm level, we propose and implement a method to indirectly measure firm level derivatives market participation, and measure the implications for exchange rate exposure.

Our focus on emerging markets is due to several reasons. First, these countries have recently been pursuing more active monetary policies and more flexible exchange rate regimes. Hence, understanding how firms cope with exchange rate uncertainties is important for assessing the risks to financial stability in these markets. Our finding that these economies are much more exposed to exchange rate fluctuations justifies our choice. Second, together with the low volatility in the world, these countries have experienced large capital inflows in the last five years. This flow of capital brought together with it demand for more complex financial instruments. In our opinion, it is critical to identify how domestic firms fare from this growth in financial innovation. Furthermore, higher capital integration among emerging and advanced economies, and emerging markets growing share of world output underscore the emphasis.

Our paper finds evidence that the proportion of firms with exposure has decreased over time and that this decline is due to higher level of activity in derivatives markets. However, these findings do not imply that a sharp reversal of capital, especially in less liquid markets, will not lead to a financial crisis.

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Table 1. Derivatives Market Volume (Daily Averages, Millions, US Dollar)

	1998	2001	2004	2007
Brazil		1,881	1,238	685
Chile	466	635	942	1,967
Colombia		82	242	565
Czech Republic	2,998	1,245	1,429	3,631
Hungary	464	226	2,141	4,658
India	1,290	1,848	3,457	24,015
Indonesia	1,037	534	1,355	1,357
Israel		414	2,274	4,812
Korea	1,046	3,950	10,269	17,819
Malaysia	800	895	854	1,812
Mexico	2,397	4,186	4,543	10,795
Peru		36	45	214
Philippines	403	605	338	1,256
Poland	541	3,341	4,604	6,820
Russia	873	154	6,153	16,190
Slovakia		497	1,459	3,246
Slovenia		9	30	152
South Africa	5,206	7,858	8,032	10,568
Taiwan	1,524	1,669	4,636	6,725
Thailand	2,228	1,315	1,979	4,931
Turkey		678	2,232	3,311
Emerging Countries Average	1,520	1,527	2,774	5,978
Industrialized Countries Average	50,640	42,757	62,995	81,831
Emerging Countries Total	23,271	32,967	55,750	120,717
Industrialized Countries Total	1,337,907	1,186,071	1,757,614	1,800,271

Source: BIS Triannual Survey (2007). OTC outright forward, swap, options and other foreign currency derivatives.
Note: Datastream, the source of the data used to conduct the analysis in this paper, does not contain daily information at the firm-level from all of the countries listed above for the period considered in this paper. Sufficient data was available only for: Brazil, Chile, South Korea, Mexico, and Turkey.

Table 2. Number of Firms by Sector

	Brazil	Chile	Israel	Korea	Mexico	Turkey
	Sao Paulo Stock Exchange (BOVESPA)	Santiago Stock Exchange (SSE)	Tel Aviv Stock Exchange (TASE)	Korea Stock Exchange (KSE)	Bolsa Mexicana de Valores (BMV)	Istanbul Stock Exchange (ISE)
Aluminum	12	1	12	6	0	1
Auto Parts	33	1	13	28	10	7
Automobiles	22	0	12	26	0	2
Banks	76	20	19	45	26	15
Brewers	13	4	12	19	6	5
Building Mat.& Fix.	45	10	23	32	13	29
Business Support Svs.	15	25	22	22	21	11
Comm. Vehicles,Trucks	16	1	12	35	6	5
Commodity Chemicals	33	11	17	56	12	19
Containers & Package	28	2	7	34	1	6
Electrical Equipment	29	3	13	23	11	8
Electricity	43	22	12	29	0	4
Exploration & Prod.	35	0	23	28	0	0
Farming & Fishing	11	4	13	22	1	1
Fixed Line Telecom.	32	5	14	8	4	0
Food Products	108	15	19	23	22	23
Food Retail,Wholesale	20	7	20	32	20	9
Footwear	20	3	18	73	14	40
Forestry	7	1	0	7	0	0
Gas Distribution	12	1	10	8	0	1
Heavy Construction	18	0	22	27	10	2
Industrial Machinery	7	7	18	34	11	24
Investment Services	11	3	32	77	1	7
Paper	45	1	10	13	3	2
Pharmaceuticals	8	4	44	84	6	6
Pipelines	10	0	32	12	0	0
Real Estate Hold, Dev	19	12	12	22	2	3
Specialty Chemicals	11	8	8	48	2	6
Specialty Finance	14	29	24	54	51	25
Steel	26	3	12	22	7	0
Tobacco	18	0	17	25	0	0
Unclassified	12	32	41	51	67	12
Total	**809**	**235**	**558**	**1025**	**327**	**273**

Source: Authors' computation using firm-level data from 1995-2005, compiled from Datastream.

Table 3. Financial Sector's and Foreign Investor's Derivative Usage

	2001	2004		2007	
	% Foreign	Domestic Financial	% Foreign	Domestic Financial	% Foreign
Emerging	62.1	89.8	65.7	236.3	72.0
Advanced	88.5	58.7	91.3	183.8	89.3

Percent Foreign represents the Percent Non-local institutions' and dealers' share of OTC outright forward and swap transactions. Domestic Financial Columns show the percentage increase in outright forward and swap transactions of the domestic financial sector over the past three years.
Source BIS.

Table 4. Percentage of Firms with Significant Exchange Rate Exposure (1995-2005)

	Brazil	Chile	Israel	Korea	Mexico	Turkey
Daily	4.7	5.5		16.9	10.6	28.2
Weekly	3.4	4.7	6.5	14.0	4.7	15.4
Monthly	3.0	6.8	6.8	15.7	9.5	12.1
Quarterly	6.8	6.0	5.0	12.7	7.5	7.3
Overlapping Observations						
Daily	4.7	5.5		16.9	10.6	28.2
Weekly	12.9	14.5	6.5	31.6	16.5	38.1
Monthly	18.9	34.0	12.0	47.1	24.4	44.3
Quarterly	27.4	47.2	28.5	52.1	29.5	42.5
Semi Annual	32.4	55.7	41.0	56.0	36.6	51.6
Annual	35.7	60.9	53.6	66.1	37.8	54.2

The numbers represent the percentage of firms that have a significant β_2 coefficient at the 5% level in the following regression: $R_{it} - R_{ft} = \beta_{0i} + \beta_{1i}\left(R_{mt} - R_{ft}\right) + \beta_{2i}\Delta ER_t + e_t$. Rows correspond to the different horizons used. Local Currency/US Dollar exchange rate is used in the estimation. In regressions using overlapping observations, daily overlapping observations are used for the weekly return horizons and weekly overlapping observations are used for monthly, quarterly, semi-annual, and annual return horizons.

Table 5. Average Exchange Rate Coefficients

	Brazil	Chile	Israel	Korea	Mexico	Turkey
1995	0.86	0.66	1.36	0.62	1.47	1.87
1996	1.72	0.82	1.03	0.37	0.94	1.41
1997	1.67	0.71	0.72	0.38	0.71	2.13
1998	1.70	0.67	0.69	0.56	0.80	1.93
1999	0.50	0.61	0.77	0.64	0.79	2.15
2000	0.95	0.70	0.65	0.53	0.66	1.92
2001	0.53	0.39	0.54	0.40	0.60	0.41
2002	0.31	0.44	0.54	0.18	0.58	0.35
2003	0.27	0.38	0.52	0.29	0.54	0.45
2004	0.29	0.35	0.43	0.42	0.42	0.49
2005	0.17	0.35	0.45	0.21	0.41	0.38

Figures represent the simple average of the absolute value of $\hat{\beta}_{2i}$ coefficients estimated from the following regression: $R_{it} - R_{ft} = \beta_{0i} + \beta_{1i}\left(R_{mt} - R_{ft}\right) + \beta_{2i}\Delta ER_t + e_t$. The coefficients represent the percent change in stock returns in response to a one percent change in exchange rates. Weekly return horizons are used in estimation.

Table 6. Percentage of Firms with Significant Exposure (1995-2005)

		Brazil	Chile	Israel	Korea	Mexico	Turkey
Weekly	ER	12.1	14.0		31.0	15.7	37.7
	ER_Vol	7.9	9.8		23.5	5.9	23.4
	Either Coeff	14.1	19.6		43.7	17.7	47.6
Monthly	ER	18.9	34.0	9.7	47.4	24.0	45.1
	ER_Vol	15.6	35.7	12.4	42.0	21.7	32.6
	Either Coeff	24.6	45.1	20.1	59.5	29.9	50.2
	% of Neg ER	48.8	51.6	53.2	50.4	46.2	54.7
	% of Neg ERVol	67.2	60.9	87.0	85.1	53.3	68.8

Exchange rate volatility is proxied by the standard deviation of the US Dollar exchange rate divided by its mean value in the respective period. Weekly horizons with daily overlapping observations and monthly horizons with weekly overlapping observations are used to calculate the returns. Coefficient rows report the % of firms with a significant β_2 and/or β_3 coefficients (at 5%) estimated from: $R_{it} - R_{ft} = \beta_{0i} + \beta_{1i}\left(R_{mt} - R_{ft}\right) + \beta_{2i}\Delta ER_t + \beta_{3i}\sigma_t^{er} + e_t$

Table 7. Derivatives Market Participation and Trade Openness

	Chile	Israel	Korea	Turkey
sector 1	54.0	46.5	41.7	42.1
sector 2	41.6	31.6	37.0	34.0
sector 3	27.8	33.2	33.9	33.3
sector 4	23.3	14.8	15.8	32.5
sector 5	11.5	7.2	18.4	16.1
sector 6	6.3	2.6	9.8	13.2

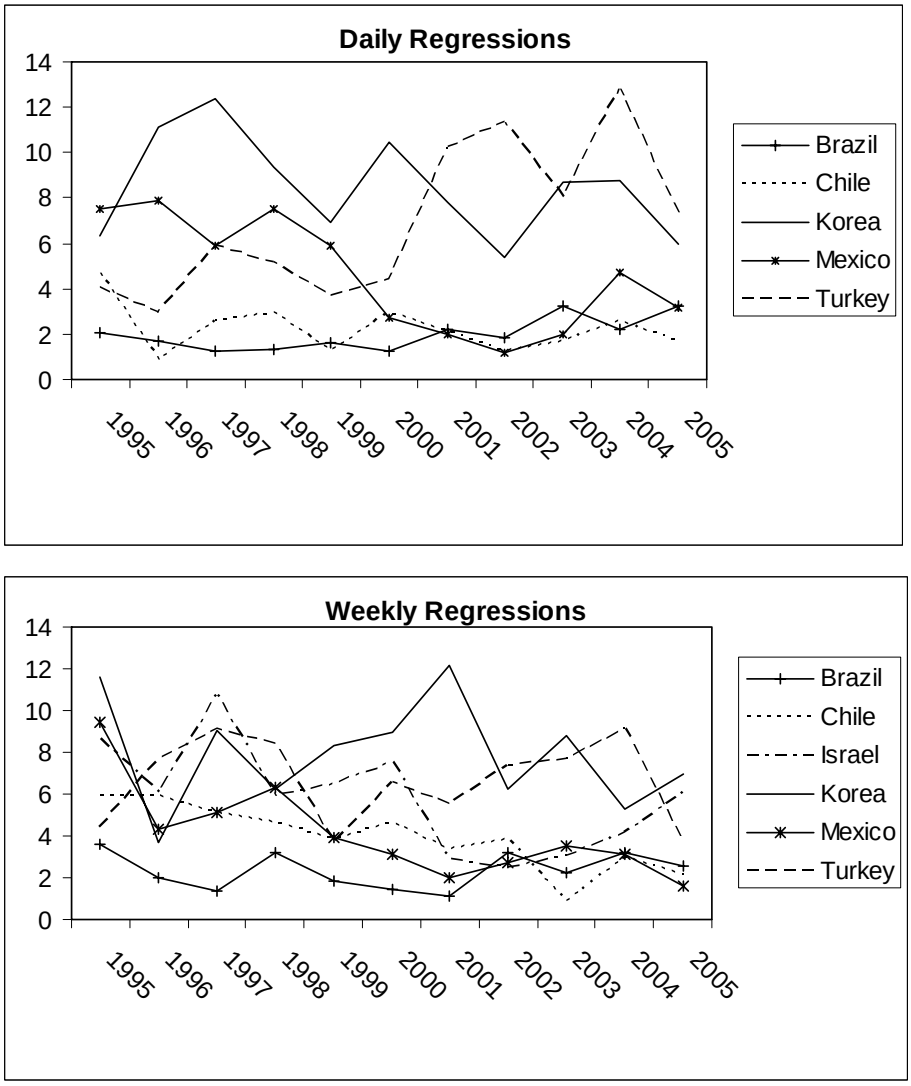
This table shows the percentage of firms within a sector that have a significant $\hat{\gamma}_{2i}$ coefficient in the following regression: $R_{it} - R_{ft} = \gamma_{0i} + \gamma_{1i}\left(R_{mt} - R_{ft}\right) + \gamma_{2i} DMV_t + e_t$. The ordering of the sectors is determined by the average ratio of exports to production between 1995 and 2005 using United Nations Common Database such that sector 1 has the highest and sector 6 has the lowest exports to production ratios. Subsectors were combined to generate 6 sectors so that there were at least 20 firms classified under each sector.

Table 8. Third Stage Regressions (US Dollar)

	Chile	Israel	Korea	Turkey
ER: USD	**-0.36**	**-0.51**	**-8.28**	-2.47
	(0.12)	(0.11)	(2.61)	(1.49)
Low Trade	0.06		-0.68	-1.77
	(0.55)		(0.47)	(1.86)
High Trade	1.85		**-2.12**	**-2.91**
	(1.43)		(0.37)	(1.31)
Financial	**-4.75**		**-7.02**	**-6.10**
	(1.77)		(3.02)	(1.17)
ER_Vol: USD	**-0.55**	**-0.38**	0.37	-0.13
	(0.26)	(0.08)	(0.24)	(0.52)
Low Trade	0.00		0.00	0.37
	(1.00)		(0.01)	(0.35)
High Trade	-2.00		0.04	-0.48
	(3.03)		(0.14)	(0.44)
Financial	**-2.11**		**-0.10**	**-0.64**
	(0.44)		(0.01)	(0.26)

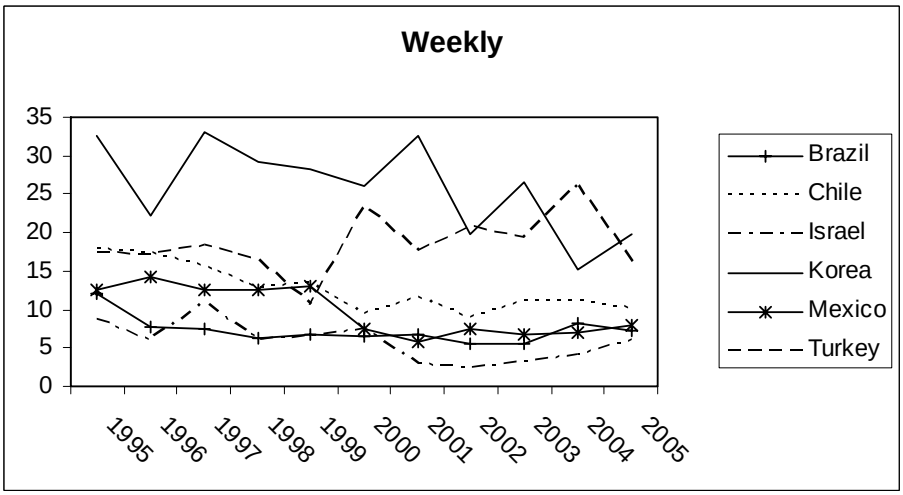
The table reports the slope coefficients and their standard errors estimated from the following regressions: $\hat{\beta}_{2it} = \lambda_0 + \lambda_1 \hat{\gamma}_{2it} + \nu_t$, $\hat{\beta}_{3it} = \lambda_0 + \lambda_1 \hat{\gamma}_{2it} + \nu_t$ where $\hat{\beta}_{2i}, \hat{\beta}_{3i}$ and $\hat{\gamma}_{2i}$ are estimated using equations (2) and (3) for each year. Coefficients that are significant at the 5 percent level are in bold font. US Dollar is used as the exchange rate. Sector classification is determined based on the exports/production ratios gathered from the United Nations Common database. Sector classification for Israel is not included due to insufficient data.

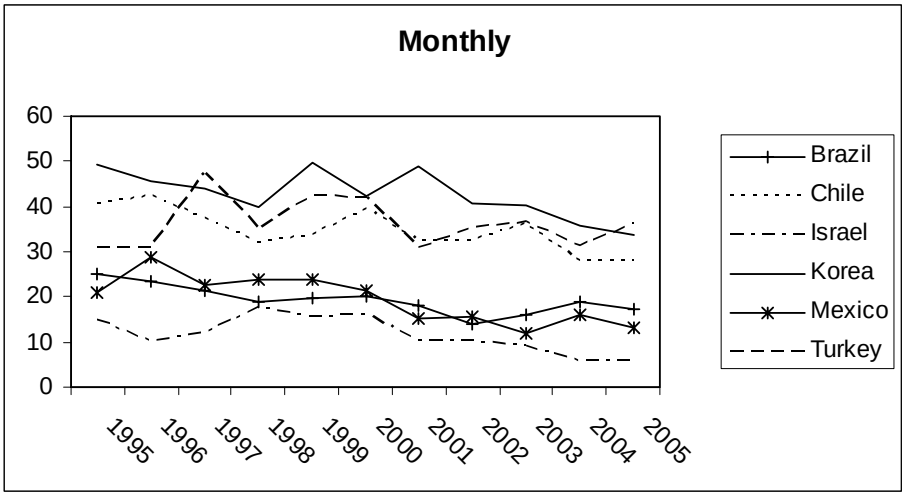
Figure 1. Percentage of Firms with Significant Exposure by year

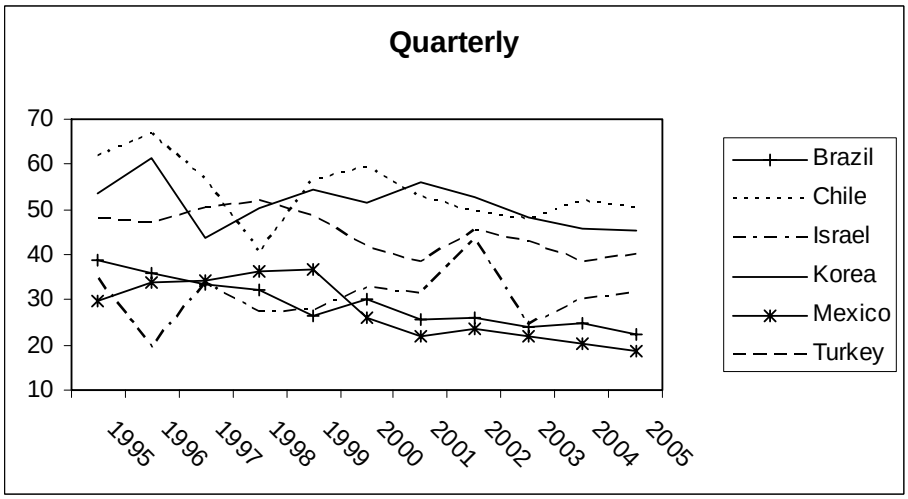


Source: Data compiled by authors from Datastream.

Figure 2. Percentage of Firms with Significant Exposure, Overlapping Observations



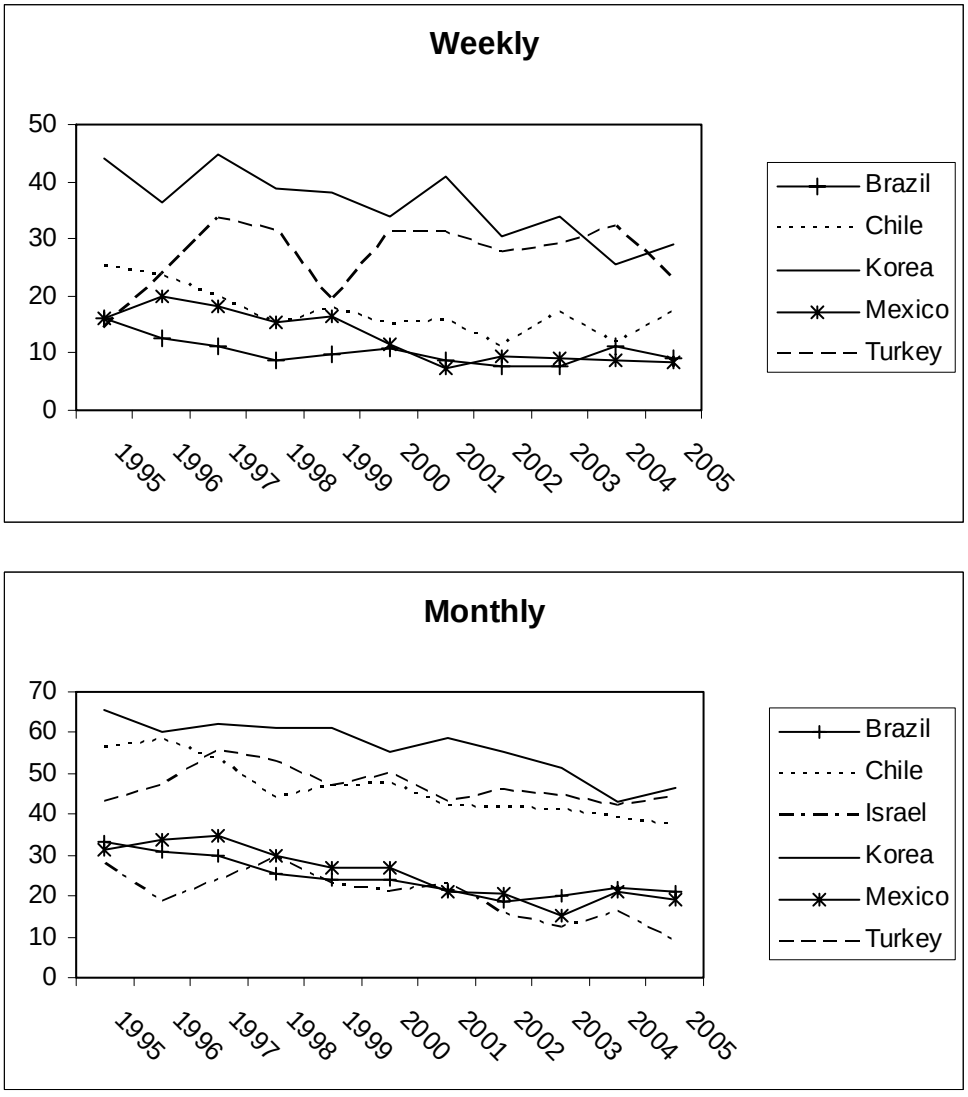




Weekly, monthly and quarterly return horizons are used with daily, weekly, and monthly overlapping observations respectively to estimate β_{2i}.

Source: Data compiled by authors from Datastream.

Figure 3: Including Exchange Rate Volatility, Overlapping Observations



Weekly return horizon with daily overlapping observations and monthly return horizons with weekly overlapping observations are used to estimate β_{2i} and β_{3i}.

Source: Data compiled by authors from Datastream.

Appendix A:

Table A.1. Contents of Derivatives Market Volume Data

	Range (Daily)	Source	Content
Chile	01/2002-07/2007	Central Bank (Banco Central de Chile): Statistical Database	Forward Operations Amount (peso/dollar). >42 days, 31-42 days, <7 days. Millions of US Dollars
Israel	06/2000-06/2006	Central Bank (BOI): Trade turnover in the NIS Foreign Currency Market	Buy + Sell. Foreign financial institutions, other customers, domestic interbank swap contracts. Millions of USD.
Korea	01/2004-10/2007	Korea Exchange (KRX): Futures and Options	USD, JPY, EURO call + put options and futures trading volume
Turkey	10/2002-10/2006	Central Bank (TCMB): Volume of Foreign Exchange Transactions of Banks Against Turkish Lira.	Total volume of swap and forward foreign exchange transactions with domestic dustomers, offices and branches abroad, corporations and customers abroad, within the domestic interbank market. Millions of USD

Table A.2. Proportion Tests

		Non-Overlapping		Overlapping			Overlapping with ER Vol.	
		Daily	Weekly	Weekly	Monthly	Quarterly	Weekly	Monthly
Brazil	(95-96)-(97-98)	-1.4	-0.9	**-3.1**	**-2.8**	**-2.8**	**-3.6**	**-2.8**
	(97-98)-(99-00)	0.3	-1.3	-0.3	-0.3	**-2.8**	0.1	**-2.3**
	(99-00)-(01-02)	1.3	1.0	-0.6	**-2.9**	-1.5	-1.9	**-2.8**
	(01-02)-(03-05)	1.6	1.0	1.1	1.2	-1.4	1.2	0.8
Chile	(95-96)-(97-98)	0.0	-0.7	-1.4	**-2.2**	**-4.9**	**-2.6**	**-2.7**
	(97-98)-(99-00)	-0.6	-0.5	-1.3	0.6	***2.9***	-0.4	-0.3
	(99-00)-(01-02)	-0.5	-0.5	-0.6	-1.4	**-2.1**	-1.3	-1.7
	(01-02)-(03-05)	0.3	-1.5	0.3	-0.5	-0.3	0.8	-0.8
Israel	(95-96)-(97-98)		0.9	0.9	1.5	1.7		1.8
	(97-98)-(99-00)		-1.2	-1.2	0.7	0.0		**-2.6**
	(99-00)-(01-02)		**-4.8**	**-4.8**	**-3.9**	***3.5***		-1.5
	(01-02)-(03-05)		***2.2***	***2.2***	**-3.0**	**-4.4**		**-4.6**
Korea	(95-96)-(97-98)	***2.3***	0.0	***2.6***	**-3.7**	**-6.9**	1.0	-0.8
	(97-98)-(99-00)	**-2.4**	1.1	**-2.8**	***2.7***	***4.0***	**-3.8**	**-2.2**
	(99-00)-(01-02)	**-2.5**	0.7	-0.7	-0.9	0.8	-0.2	-0.9
	(01-02)-(03-05)	1.5	**-2.6**	**-4.2**	**-5.3**	**-5.2**	**-4.3**	**-6.4**
Mexico	(95-96)-(97-98)	-0.6	-0.8	-0.4	-0.6	1.1	-0.6	-0.1
	(97-98)-(99-00)	-1.7	-1.6	-1.2	-0.2	-1.3	-1.2	-1.9
	(99-00)-(01-02)	**-2.6**	-1.1	**-2.0**	**-2.9**	**-3.1**	**-2.8**	**-2.4**
	(01-02)-(03-05)	1.8	0.4	0.3	-0.9	-1.0	0.1	-0.9
Turkey	(95-96)-(97-98)	1.6	1.7	0.1	***3.6***	1.3	***5.2***	***3.1***
	(97-98)-(99-00)	-1.1	**-2.4**	-0.2	0.3	-1.9	**-2.7**	-1.9
	(99-00)-(01-02)	***4.3***	0.9	0.9	**-3.1**	-1.1	1.6	-1.2
	(01-02)-(03-05)	-0.8	0.3	0.5	0.6	-0.5	-0.4	-0.3

This table shows the t-statistics form the two-proportion z-tests with unequal variances. Our intention is to tests the significance of the negative trends in Figures 1,2 and 3. Proportions are calculated as the percentage of firms with significant exposure in a two year window. Numbers in bold italic font are positive and significant at the 5 percent level. Numbers in bold font are negative and significant at the 5 percent level.

Source: Data compiled by authors from Datastream.

Appendix B. Sensitivity Analysis

Using the US Dollar, JPY, Euro, GBP, Trade Weighted Exchange Rates

	Chile	Israel	Korea	Turkey
ER: EMAX	**-0.71**	**-1.30**	**-8.85**	**-7.20**
	(0.33)	(0.29)	(3.63)	(1.16)
Low Trade	0.00		0.00	0.00
	(0.64)		(0.24)	(0.27)
High Trade	**-1.35**		**-2.10**	**-0.60**
	(.37)		(0.18)	(0.24)
Financial	**-1.60**		**-12.30**	**-10.00**
	(0.13)		(0.38)	(0.28)
ER_Vol: EMAX	-0.32	**-0.67**	**-0.39**	**-0.27**
	(0.43)	(0.03)	(0.16)	(0.12)
Low Trade	0.00		0.00	0.00
	(0.12)		(0.01)	(0.14)
High Trade	-0.47		0.00	0.00
	(0.27)		(0.01)	(0.09)
Financial	**-0.41**		**-0.68**	**-0.40**
	(0.16)		(0.07)	(0.07)

The table reports the slope coefficients and their standard errors estimated from the following regressions:: $\hat{\beta}_{2it} = \lambda_0 + \lambda_1 \hat{\gamma}_{2it} + \nu_t$ where $\hat{\beta}_{2i}, \hat{\beta}_{3i}$,and $\hat{\gamma}_{2i}$ are estimated using equations (2) and (3) for each year. Coefficients that are significant at the 5 percent level are in bold font. For each firm a exchange rate that produces the largest exposure coefficient is used in the calculations for that firm (EMAX). Sector classification is determined based on the exports/production ratios gathered from the United Nations Common database. Sector classification for Israel is not included due to lack of data.

Using SVAR-GARCH to proxy exposure

	Chile	Korea	Turkey
ER: EMAX	**-0.45**	**-7.18**	**-0.36**
	(0.02)	(0.15)	(0.05)
Low Trade	**0.49**	0.01	0.01
	(0.02)	(0.11)	(0.04)
High Trade	**-19.31**	**-43.87**	0.02
	(0.01)	(0.20)	(0.03)
Financial	**-25.35**	**-127.23**	**-25.78**
	(0.01)	(0.22)	(0.05)
ER_Vol: EMAX	**-0.87**	**-3.41**	**-1.14**
	(0.04)	(0.37)	(0.05)
Low Trade	**-0.06**	0.00	0.09
	(0.02)	(0.13)	(0.02)
High Trade	**-1.00**	**-2.18**	**-15.34**
	(0.03)	(0.21)	(0.03)
Financial	**-22.46**	**-61.89**	**-16.08**
	(0.02)	(0.41)	(0.03)

The table reports the slope coefficients and their standard errors estimated from the following regressions:: $\hat{\beta}_{2it} = \lambda_0 + \lambda_1 \hat{\gamma}_{2it} + \nu_t$. $\hat{\gamma}_{2i}$ is estimated using equation (3). $\hat{\beta}_{2i}, \hat{\beta}_{3i}$ are estimated using variance decompositions from the SVAR model with the following casual ordering $\left[\hat{\sigma}^{er} \; R_m \; ER \; R_i\right]$ for each year. Coefficients that are significant at the 5 percent level are in bold font. For each firm a exchange rate that produces the largest exposure coefficient is used in the calculations for that firm (EMAX).

3-Year Intervals

	Chile	Korea	Turkey
ER: EMAX	**-2.77**	**-17.77**	**-5.33**
	(0.02)	(0.64)	(1.12)
ER_Vol: EMAX	**-0.57**	**-2.47**	**-0.58**
	(0.07)	(0.74)	(0.17)

The table reports the slope coefficients and their standard errors estimated from the following regressions:: $\hat{\beta}_{2it} = \lambda_0 + \lambda_1 \hat{\gamma}_{2it} + \nu_t$ where $\hat{\beta}_{2i}, \hat{\beta}_{3i}$, and $\hat{\gamma}_{2i}$ are estimated using equations (2) and (3), and three year intervals. Coefficients that are significant at the 5 percent level are in bold font. For each firm a exchange rate that produces the largest exposure coefficient is used in the calculations for that firm (EMAX).

Including Size (Chile)

	% of Signicant Betas	% of Signicant Gammas	Effect of DMVt
ER: EMAX			
Small	19.56	24.37	-0.08
			(0.23)
Medium	37.39	44.56	**-0.51**
			(0.13)
Large	45.05	55.24	**-0.90**
			(0.24)
ER_Vol: EMAX			
Small	19.85		**-2.32**
			(0.67)
Medium	39.39		-0.67
			(0.39)
Large	47.86		-0.01
			(0.55)

The table reports the slope coefficients and their standard errors estimated from the following regressions:: $\hat{\beta}_{2it} = \lambda_0 + \lambda_1 \hat{\gamma}_{2it} + \nu_t$ where $\hat{\beta}_{2i}, \hat{\beta}_{3i}$ and $\hat{\gamma}_{2i}$ are estimated using equations (2) and (3) for each year. Coefficients that are significant at the 5 percent level are in bold font. For each firm a exchange rate that produces the largest exposure coefficient is used in the calculations for that firm (EMAX). Size data from Chile was employed in estimation. Firms are classified into three equal groups based on their total assets.