Explaining Firms' Exchange Rate Exposure: the Role of Country Factors*

Georgios Gatopoulos† University of Geneva

Dušan Isakov‡ University of Fribourg

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Abstract

This paper provides new evidence on the measurement and determinants of exchange rate exposures of firms with an international orientation. We document the existence of significant foreign exchange rate exposures as well as substantial differences between firms originating from developed and emerging markets. We also propose new country-specific factors to explain the cross-sectional and time-series variation in exchange rate sensitivities. It appears that country specific factors account for about 30% of the variability of firms' exposure after controlling for firm and industry level determinants. Among such country factors, high use of foreign currency derivatives, deeper financial markets, as well as small and balanced current accounts significantly decrease firms' sensitivity with respect to exchange rate changes in both developed and emerging markets.

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†Email: ggatopoulos@gmail.com

‡Email: dusan.isakov@unifr.ch, URL: http://www.unifr.ch/cgf/equipe/isakov.php

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1 Introduction

In the post Bretton Woods era, high exchange rate volatilities have become a central element in international financial markets. In this setting, the ability to measure precisely the exchange rate exposure as well as to identify its determinants has become a critical issue for an increasing number of firms with internationally oriented activities. This paper contributes to the empirical literature and debate about the way to correctly measure and explain the cross-sectional variations of firms' exchange rate exposure by focusing on two specific areas of research. The first is the importance of country specific explanatory factors, and the second is the role of the type of the firm's home market, meaning whether it is a developed or an emerging economy. The main research questions studied are the following. How do firm sensitivities to exchange rates changes vary across time and type of markets? How do country factors, such as the degree of financial development or the aggregate use of foreign currency derivatives affect the firms' sensitivity to exchange rate movements?

We focus our analysis on firms with important international activities, since we consider firms whose equity is traded in more than one country. We compute two measures of a firm's sensitivity with respect to its country's effective exchange rate. The first is the firm's sensitivity with respect to exchange rate changes (first moment exchange rate exposure) and the second is the firm's sensitivity with respect to changes in exchange rate volatility (second moment exchange rate exposure). We find evidence that developed market firms are on average negatively affected by domestic effective ex-

change rate appreciations, whereas the opposite is true for emerging market firms. As far as explaining exposure is concerned, we find that the country's aggregate use of foreign currency instruments, such as currency derivatives, decreases the first moment exposure for all firms, and the impact on emerging markets is high. The depth of a country's local bond market also decreases the first moment exposure of firms in all types of markets, with higher economic significance in the developed world.

There is extensive literature on measuring, as well as explaining exchange rate exposure, on a firm level, on an industry level and more recently on a country level. Even though, theoretically, exchange rate exposure is well documented on all three levels, there is only partial empirical evidence supporting its economic importance. This divergence between theoretical predictions and empirical results, is often also referred to as the "exchange rate exposure puzzle".

From a theoretical point of view, exchange rate changes affect stock returns, either by varying the firm's expected cash flows, or through variation of the cost of capital used to discount these cash flows. Among seminal papers in this field, Adler and Dumas (1984), Jorion (1990, 1991) highlight the importance of a firm's foreign sales in its degree of exchange rate exposure. From an empirical point of view, evidence on the significance of exposure coefficients is often rather weak and several measurement issues have been raised. Such issues include the sensitivity of the exposure estimations on the length of the chosen time horizon, as in Chow et al. (1997), the choice of the exchange rate factor, or the choice of the market portfolio, as in Bodnar and Wong (2003).[1]

Apart from the debate on how to measure exposure, extensive literature has studied the question of how to explain it. Bodnar and Gentry (1993) em-

[1]For a complete survey with an overview of several measurement related issues, one may see Muller and Verschoor (2006).

phasize the importance of a firm's industry characteristics, Griffin and Stulz (2001) the role of the competition framework, Allayannis and Ihrig (2001) the link with potential markups, whereas Allayannis and Ofek (2001) the importance of financial hedging through foreign currency derivatives. A recent study by Bartram et al. (2009) assesses several firm specific factors that could explain the exchange rate exposure puzzle. By order of importance, these variables are the firm's use of foreign debt, its use of foreign currency derivatives, pass-through to prices and operational hedging. The importance of the use of currency derivatives and foreign debt on a firm level inspires this essay to examine the role of the same factors on a country level. We believe that the role of such country factors is crucial, especially when tested on a large cross-section of both emerging and developed markets.

Even though most research has focused on developed market firms exposure, there exist some studies on emerging market firms as well. They often find a negative exposure of emerging firms to local depreciation, as is the case for Thailand in the study by Dominguez and Tesar (2006). Parsley and Popper (2006) show that the existence of an exchange rate peg does not reduce a country's exchange rate exposure. Country factors that have been proposed as exposure determinants, among others, are trade balance, as in Entorf et al. (2007) and an economy's openness, as in Hutson and Stevenson (2009). On a large cross-sectional sample of countries, Bartram and Bodnar (2009) provide evidence of a significant conditional return premium per unit of exposure, which is more important among emerging markets. They also find that the exchange rate impact on stock returns is more due to a cash flow effect, than a discount rate effect.

Inspired by empirical evidence that stock correlations within country are higher for emerging than for developed markets, Chue and Cook (2008) emphasize the importance of measuring total exposure at the national level. They, also, distinguish between the direct effect of exchange rate changes

on firm stock returns and the effect of other macroeconomic shocks on both firm stock returns and exchange rates. Foreign debt on both firm and country levels, are among their most important explanatory factors. Nevertheless, they surprisingly find that their impact is not consistent across time, which could be due to non-controlling for other important country factors. Our study, hence, contributes on the debate, by proposing new country level factors that explain firms' total exposure. These include the relative degree of development of local bond markets and the aggregate use of foreign currency instruments in a country.

We use a large cross-section of firms from 37 countries, representing both emerging and developed economies. In the measurement stage of this study, we identify all firms' exposure and document several time varying and cross-sectional patterns. Among others, we find a reversal of sign in emerging market firms exposure before and after the turbulent year of 1998.[2] In the exposure determinants stage of this study, we test the significance of new country specific variables, while allowing for differences between emerging and developed markets. There is evidence that higher financial market development allows all firms to decrease both their first and second moment exposures.

The paper is structured as follows. In the next section, we present the data, and provide descriptive statistics on our sample firms, the country specific, as well as the firm specific factors we use. Section 3 presents the exchange rate exposure measurement, with an analysis of the estimated exposure coefficients and their variation across time and countries. Section 4 addresses the issue of identification of the main determinants of exchange rate exposure, while section 5 contains some concluding remarks

[2]This year corresponds to the aftermath of the Asian crisis and the turbulent period due to the Russian crisis.

2 Data

2.1 Selection of sample firms

In this study, we concentrate on firms that have an international orientation. By international orientation, one may think of multinational corporations, cross-listed companies, firms with high export ratios, firms with significant bond issues in foreign currency, or other parameters. The criterion we use in this study is to focus on firms which have an on-going American Depositary Receipt program.[3] Such firms are characterized by relatively easy access on international sources of financing (both debt and equity markets). They usually have presence in more countries than just their home market. Furthermore, their obligation to report their financial statements in compliance with the SEC, offers a high degree of comparability with respect to accounting variables needed in the second stage of the paper.

This sample of firms is of particular interest for the two focus points of this paper, namely the measurement as well as the determinants stage of exchange rate exposure. In the measurement aspect, on one hand, ADR firms' international presence is documented by a higher percentage of foreign sales with respect to their market average, thus probably higher exchange rate exposure than non-ADR firms. On the other hand, empirical work, such as Dominguez and Tesar (2006) find that firms which are more vulnerable to exposure tend to hedge more. Therefore an open question is which between the two offsetting effects prevails? And also whether the observed exposures are stable over time and among different countries.

The choice of firms with a depositary receipt program aligns as well with the second objective of the paper, which is analyzing new candidates as determinants of exposure, such as the use of foreign currency derivatives

[3] An American Depositary Receipt is a certificate traded in the US, which represents ownership in the ordinary shares of a non-US firm.

and foreign debt. ADR firms are known to be firms highly prone to use such financial instruments. This allows us to test the impact of the use of such tools on internationally oriented firms. We acknowledge that there is some US bias in the ADR firms' international orientation, but this does not reduce their exposure. There is also a selection bias issue, in the sense that our sample firms are not necessarily representative firms of each country's economy. For sure, our sample firms are among the biggest firms of each local market, but size could either have a positive effect on exposure (biggest firms are more internationally exposed) or a negative effect on exposure (biggest firms use more hedging instruments if there exist fixed costs in hedging). Therefore, the selection bias of our sample does not undermine the interest of examining our research objective of depicting the main determinants of exposure of such firms. On the contrary, it will give us more insight on the role of country factors on explaining exposure among highly comparable firms within a large cross-section of countries.

The criterion we use in this study is to focus on firms which have an on-going American Depositary Receipt program in the beginning of 2008. This may exclude US and Canadian firms, it provides us though with a sufficiently large cross-section of countries represented by firms with international orientation.[4] The population of all firms satisfying our criterion consists of 1'129 firms from 56 countries.[5] We apply a country filter in order to eliminate firms from countries that have less than 5 active DR programs and thus eliminate firms from 18 countries. Firms from Ukraine as well as some firms from other countries represented in our sample are eliminated due to unavailability of local market stock data from Thomson Financial. We thus end up with a sample of 870 firms from 37 countries as shown in table (3).

[4]The absence of US firms introduces a possibility to use US market macroeconomic variables as instruments for our robustness estimation tests via the GMM method.

[5]We include all types of ADR firms traded either over the counter, or in one of the following three markets: American Stock Exchange, NASDAQ, or New York Stock Exchange.

In the same table, one may see some summary statistics of the sample firms. For instance, it is confirmed that the average ADR firm is relatively big, with a high percentage of foreign sales, especially among developed countries. We use a time span of 15 years, from January 1994 until December 2008. The reason we begin in 1994 is due to the availability of crucial for the analysis country specific data, such as the trade-weighted exchange rates, from that year onwards.

All the country specific variables we use are presented in table (1). We hereafter explain their choice and what they proxy for, one by one.

2.2 Country specific variables

One important issue thoroughly examined in the exchange rate exposure literature is the choice of the exchange rate factor to be used in the estimations. Undoubtedly, an accurate measure used by Khoo (1994) would be to use a firm specific exchange rate that would weight each firm's proportion of foreign activities by currency, times the corresponding bilateral exchange rate.[6] Unfortunately, data disaggregated on this level was impossible to find for our sample firms. Another option would be to use for each firm's home market, the bilateral exchange rate of the country's main trading partner. Many studies use the US dollar bilateral exchange rate, since it is considered as a "global currency" and benchmark in such estimations. The disadvantage of this proxy is that it often neglects the exposure that firms face due to exchange rate changes of their local currency vis-a-vis non US dollar currencies. For an Argentinian firm for instance, which is a main importer from the USA, the Eurozone and Japan, its exposure would be correctly captured by this proxy, as long as at a given date, the peso devaluates with respect to

[6] The accuracy of this measure has been criticized by the fact that a firm is also exposed indirectly to currencies of zones where it may not be present, but either its competitors or its main inputs come from. Fraser and Pantzalis (2004) find evidence supporting this argument.

all three currencies, US dollar, euro and yen. Using the bilateral US dollar exchange rate as a proxy would distort though the Argentinian firm's exposure, in case the peso depreciates only with respect to the US dollar, but appreciates with respect to the euro and the yen.

In this study we use the effective exchange rate, meaning a country specific trade related weighted average of bilateral exchange rates. The weights are derived from manufacturing trade flows. BIS provides data of time-varying country specific trade weights comprising 58 economies (potential trading partners). We use these weights in order to compute the arithmetic weighted average of nominal weekly bilateral exchange rates.[7] We hence construct weekly effective exchange rates based on the time varying trade weights.[8] In the empirical estimations, we use continuous time changes of the effective exchange rates at date t, denoted by $ER_{m,t}$. The nominal effective exchange rate represents the weighted average value of a currency with respect to all currencies of its trade partners. By construction, an increase in our effective exchange rate corresponds to an appreciation of the domestic currency. The appreciation corresponds to higher domestic prices and relative cost, meaning a decrease in the country's international competitiveness.[9] Effective rates are used more generally in literature as measures of a country's competitiveness, or as components of financial condition indices.

In figure (1) we plot the effective exchange rates evolution among the 37

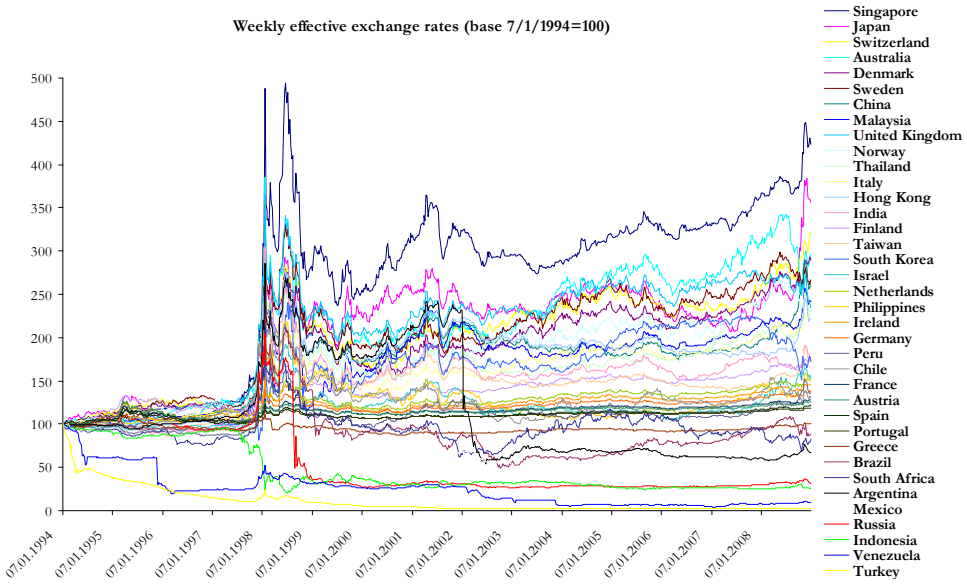
[7]Billateral nominal spot exchange rates of each currency with respect to the US dollar are provided by WM/Reuters and GTIS. We use them in order to compute the cross exchange rate of each country's currency with respect to all its trading partners. This latter, by construction, is defined in amounts of foreign currency per one unit of domestic currency.

[8]The time varying trade weights proposed by BIS are re-computed every three years. For a robustness test, we alternatively compute weekly effective exchange rates using exclusively the most recent weights published for 2005-2007. The correlation between the two types of exchange rate series is higher than 0.98 for all countries.

[9]Of course, such deterioration, as Turner and Van't Dack (1993) point out, would be a "symptom of success, not of failure", since appreciation was probably due to successful and innovative economic performance in the first place. Once the appreciation takes place though, the country becomes relatively more expensive internationally and hence less competitive.

countries represented through the sample. For the purposes of the graph, we set the first week of 1994 as a base date. We present all countries in our sample by order of higher to lower effective exchange rate on 2/1/2009 (end date). Countries like Singapore, Japan and Switzerland are countries whose currency has gained most in value (with respect to the broad basket of currencies of their trading partners) since 1994, whereas Turkey, Venezuela and Indonesia are countries whose currency has lost in value the most. Another interesting observation is that there seems to be periods of increased volatility in effective exchange rates, such as around the year 1998 and the Russian crisis. This is an indication that we should control for heteroscedasticity in our estimations. Furthermore, there is indication that it could be interesting to consider two proxies for exchange rate exposure. One concerning its first moment and another one related to its second moment. This is what we do in the subsequent empirical specifications.

Figure 1: Evolution of weekly effective exchange rates across countries



There are two clarifications to be made about our use of nominal effective exchange rates. First, Miller and Reuer (1998) point out that the use of a trade-weighted exchange rate factor leads to an underestimation of the true exchange rate exposure of a firm. The reason is that such indices tend to average out competitive effects resulting from bilateral exchange rate shocks. This bias would tend to undermine the significance of our results, meaning that our results are quite conservative and would be stronger without it.[10] The second issue to clarify is that the use of nominal, instead of real, exchange rates is common in this strand of literature, as suggested by Bodnar and Gentry (1993) for two reasons: first because financial markets do not observe inflation and therefore investors first incorporate the impact of nominal exchange rate changes on stock prices; second, inflation differentials vary very little with respect to exchange rate changes, therefore the use of real rates has a negligible effect on exposure estimates.

Among the most important country specific variables of this study are the variables proxying for the aggregate use of foreign exchange instruments in each country. The BIS coordinates a global central bank survey of foreign exchange and derivatives market activity every three years and the results are published in the Triennial Central Bank Survey. The objective of the survey is to provide "comprehensive and internationally consistent information" on turnover and amounts of contracts outstanding around several countries. We are able to collect such data from 1994 for our 20 developed markets and from 1996 for most of our emerging markets.[11] The inconvenience with this

[10] In a certain way, it also balances out the bias created by the sample firms selection, which tend to have high degree of international orientation and probably high degree of exposure with respect to their market average.

[11] There is no such data at all for Venezuela, whereas for Israel, Peru and Turkey such data is only available since 1999. We would like to thank Carlos Mallo from the BIS for providing us with the electronic data of the Triennial Surveys published in 1995, 1998, 2001, 2004 and 2007.

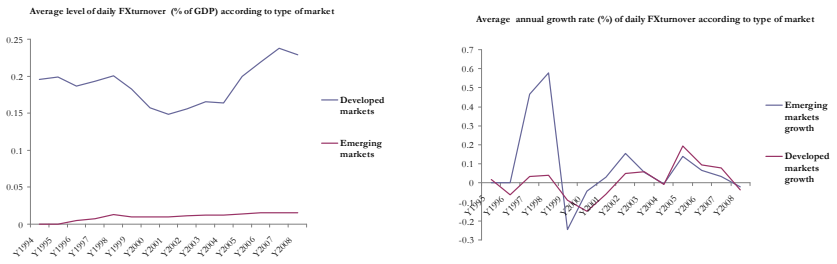
dataset is that it is only available in a three-annual frequency. We choose to interpolate linearly the missing yearly observations in order to complete our dataset.[12]

The four variables we obtain from the BIS global central bank survey for each country are i) the total foreign exchange turnover ii) the outright forward foreign exchange turnover iii) the foreign exchange swap turnover and iv) the spot foreign exchange turnover. All four variables are measured as daily averages in US dollars. For comparability purposes, we normalize the proxy for each country and divide it by the US dollar denominated Gross Domestic Product at PPP (Purchasing Power Parity) prices. This measure of GDP is available through Thomson Datastream. We thus denote our four variables by FXturnover, FXforward, FXswap and FXspot respectively.

In figure (2), one may notice the average evolution of FXturnover between 1994 and 2008, between developed and emerging market firms represented in our sample. It is noteworthy that the use of foreign currency instruments is on average significantly higher in developed markets. For instance the average FXturnover in all developed markets is around 18% in 2008, compared to a slight 1% in emerging markets. When we compute its annual growth rate, though, this is around 10% in emerging markets compared to an only 1% among developed markets over the same time span. This shows that the gap of use is diminishing between the two types of market. Finally, we notice that there is significant time series variation in the FXturnover variable, which differs from one country to the other. This shows that in the stage of explaining exposure, a panel data analysis could be more adequate than cross-sectional analyses used so far in literature examining the impact of other country variables.

[12] In order to feel more comfortable about the robustness of our intrapolation we collect annual foreign exchange derivatives (including a broader range of derivatives instruments) data from BIS available for 13 strong currencies. We compare them with our constructed indices for the same thirteen strong currencies and all correlations are significant and high.

Figure 2: Evolution of FXturnover variable across types of market



A general issue which may particularly influence exchange rate exposure is the degree of financial development of a market. The question to be examined is how does increasing financial development affect exposure? We hence need proxies for a country's financial development. Apart from foreign currency instruments presented above, we use two other variables for a more complete coverage of that research question. The Bank of International Settlements publishes in a quarterly frequency data on the outstanding amounts of domestic debt securities, as well as on the outstanding amounts of international bonds and notes. This data can be found disaggregated by the residence of the issuer. One expects that the more a financial market becomes sophisticated, the more its domestic bond market will be large relatively to its foreign debt alternatives. We thus compute the ratio IntDebt as the ratio between international over domestic bonds in a given country. The lower this ratio is, the higher the degree of the country's financial development should be. Another proxy we use is the total amount of domestic credit as provided by the IMF International Financial Statistics (in an annual frequency) divided by the GDP of each country. We denote this variable by DomCredit and the higher it is, the more a country's financial markets are mature.

It is the case that we do not have access to data for foreign debt on a firm level, we do account, though, for external debt on a country level. Chue and Cook (2008) emphasize the relevance of a country's external debt, even though its impact on exposure inverses sign in their two sub periods. In this work we test whether this is still the case in our sample, or if the fact that we also account for financial development and use of foreign currency derivatives alters the results. The proxy for net foreign debt as a percentage of GDP is available through Thomson Datastream (in an annual frequency) and is constructed by the Economist Intelligence Unit. We denote it by FXdebt.

We also include some variables related to the balance of payments of each country. The first such variable is the current account (CA) balance as a percentage of GDP. Other two variables are a country's total exports and imports of goods and services, as a percentage of GDP. All these variables are available through Thomson Datastream (in an annual frequency) and are constructed by the Economist Intelligence Unit. Hutson and Stevenson (2009) confirm that openness as measured by the sum of exports and imports as percentages of GDP are important determinants of exposure. As a result we define such a variable and denote it by Openness. Finally, we use a proxy for a government's ability to stabilize its currency, which is more relevant for emerging markets. We denote it by FXreserves and we define it as the foreign exchange reserves variable provided by Thomson Datastream, divided by the GDP at PPP.

2.3 Firm specific variables

All the firm specific variables we use are presented in table (2). Firm accounting variables are available through Worldscope and Thomson One Banker. Among the most relevant firm specific variables to be considered are foreign sales. In Worldscope's definition, a firm's foreign sales percentage corresponds to its sales by foreign affiliates divided by its total sales. We

denote this variable by Fsales. We also collect firm's leverage ratio, defined as the ratio of total debt over total assets. We collect data on each firm's market capitalization as a proxy for size, data on dividend yield as a proxy for profitability and also data on volume as a proxy for liquidity.

In order to take into account the type of industry in which a firm operates, we form six dummy variables according to the six types proposed in Worldscope's general industry classification code. These six types are industrials, utilities, transportation, banks, insurances and other financials. Even though the purpose of this study is to focus on the firm as well as the country factors explaining exchange rate exposure, extensive literature suggests that one needs to control for the firm's industry dimension as well. Finally, we use a dummy whether a firm's home country is an emerging market or a developed one. We follow the MSCI Barra classification as of 2008 and thus end up with 17 emerging markets and 20 developed ones.[13] This is of particular interest in our tests, since our large cross-section of countries allows us to reveal differences in the determinants of exposure between the two types of markets.

3 Measuring Exchange Rate Exposure

There are two approaches in measuring a firm's exchange rate exposure. The first is based on accounting variables and the second on studying the sensitivity of a firm's stock returns with respect to exchange rate changes. We focus on this second approach which unavoidably assumes a high degree of financial markets efficiency. In two seminal studies in this strand of literature, Adler and Dumas (1984) and Jorion (1990) define the concepts of a

[13]The classification we use is presented in table (3). There were three countries, Argentina, Israel and South Korea for which the classification was ambiguous. Since we do not consider any intermediate "frontier" type of market, after comparing with other sources' classifications and in order to split the bias, we decide to consider Argentina and Israel as emerging and South Korea as a developed market.

firm's total and marginal exchange rate exposure, respectively. They propose regressing the firm's stock return on exchange rate changes (total exposure), or regressing the firm's stock return on both exchange rate changes and the stock market return (marginal exposure after controlling for the market factor), respectively. Since then, there has been extensive literature proposing several refinements in these two estimation methods.[14]

In this study, the fact that sample firms come from very heterogeneous countries suggests that we opt for a measure of total exposure. Studies that focus on emerging markets as the one by Chue and Cook (2008), suggest that exposure estimates should reflect how firm returns are affected by exchange rate fluctuations, not just how they perform relative to their national market. This is particularly important here as well, where the research objective in the second part is to test the importance of country specific determinants of exposure. If we use a measure of marginal exposure, we would neutralize any country specific effects on our estimates. Furthermore, in order to compare the absolute magnitude of firm exposure for the 37 countries in our sample, it is better to obtain total exposure estimates.

On the other hand, using a total exposure model that just regresses firms' returns on exchange rate changes may lead to largely overestimated exposure estimates. The reason is that there often exist other macroeconomic variables that simultaneously covary with both exchange rates and stock returns. The need is to control at least for some market factor, without creating multicollinearity problems among the regressors. We thus follow Bris et al. (2004) two steps estimation of exchange rate exposure, while augmenting their model by adding a variable in the second stage in order to capture both first moment and second moment exposure. In the first step of the estimation, we regress the country's m stock market returns $R_{m,t}$ at date t, on the

[14] One may see Muller and Verschoor (2006) for a thorough literature review.

exchange rate changes $ER_{m,t}$ as follows:

$$R_{m,t} = \gamma_{0,m} + \gamma_{1,m} \cdot ER_{m,t} + \varepsilon_{m,t} \tag{1}$$

The coefficient $\gamma_{1,m}$ corresponds to the country's m overall exposure as a whole. For the stock market return we use an equally weighted market portfolio index, since Bodnar and Wong (2003) and Pritamani et al. (2004) suggest that value weighted portfolios overestimate exposure due to the overloading of large and more exposed firms. In the second step, we use the residuals of specification (1), in other words the component of a country's market return which is orthogonal to its effective exchange rate change and estimate the following model:

$$R_{i,t} = \beta_{0,i} + \beta_{1,i}\widehat{\varepsilon}_{m,t} + \beta_{2,i}ER_{m,t} + \beta_{3,i}\left|ER_{m,t}\right| + u_{i,t} \tag{2}$$

where the dependent variable $R_{i,t}$ is the firm's i stock return at date t. On the right hand side, $\widehat{\varepsilon}_{m,t}$ is the part of market returns of country m unexplained by exchange rate fluctuations from equation (1), $ER_{m,t}$ and $|ER_{m,t}|$ are the effective exchange rate changes of country m, and their absolute value, respectively. The coefficient $\beta_{2,i}$ corresponds to firm's i exchange rate exposure. A negative sign for $\beta_{2,i}$ means that as the effective exchange rate increases and thus (by construction) the country's local currency appreciates, then the firm's value decreases. This is typically the case for export oriented firms, among others. The coefficient $\beta_{3,i}$ is proposed by Griffin and Stulz (2001) and Koutmos and Martin (2003) and corresponds to the firm's i exposure with respect to a proxy for the volatility (second moment) of the exchange rate. A negative sign for $\beta_{3,i}$ means that the more volatile the exchange rate becomes, the less the firm is worth.

It is important to note that the coefficient $\beta_{2,i}$ reflects both the direct and indirect exposure of firm i. The indirect effect is due to the interaction

between the market's exchange rate exposure $\gamma_{1,m}$ and the firm's sensitivity with respect to market movements that are due to exchange rate fluctuations. The regressor $\widehat{\varepsilon}_{m,t}$ does not include market movements that are related to exchange rate fluctuations and as a result, they are all captured in our firm exposure estimates. This is why this method provides us with total exposure estimates as needed by our research questions. The same holds for the second moment exchange rate exposure $\beta_{3,i}$.

One should see equation (2) neither as an asset pricing model, nor as a test of whether exchange rate risk is remunerated. We only need to isolate the relationship between exchange rates and firm value. By choosing an effective exchange rate $ER_{m,t}$, one may claim that the exposure estimate is broader than a strictly bilateral exchange rate sensitivity. One may think of such a measure, as an exposure with respect to a country's international competitiveness, which could be affected by several country specific variables to be tested in the second part.

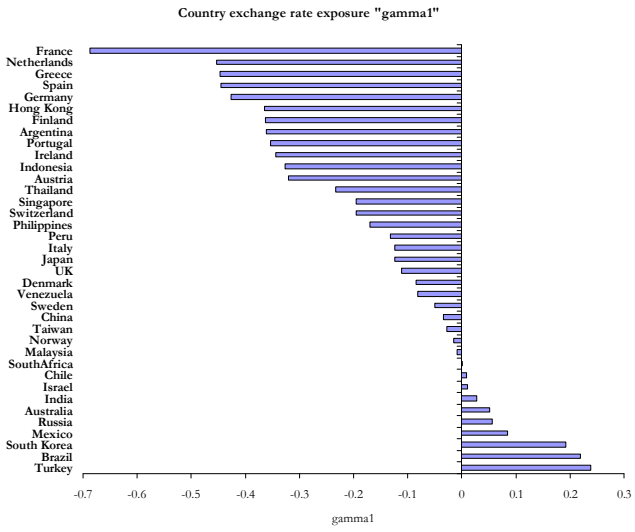
We use weekly frequency for our estimations. There is empirical evidence, as in Bartov and Bodnar (1994), Chow et al. (1997), or Dominguez and Tesar (2006), that exposure estimates are increasing in the return horizon used. By choosing weekly frequency, there is a possible under-estimation bias for our estimates, but this only makes the results appear more conservative. We do not use rolling windows in the estimations and thus do not have any serious serial correlation bias. We are suspicious of the presence of heteroscedasticity and thus use the White corrected covariance matrix.

The results of equation (1) estimation by country are presented in table (4). We notice that slightly more than half of the estimated country exposures $\widehat{\gamma}_{1,m}$ are significant.[15] A strong result is that among all the significant

[15]Studies using alternative specifications, where exposure is estimated in one step, as in Chue and Cook (2008), show that GMM estimation provides more robust estimates, since it takes out the effect of country-level macroeconomic shocks. In their case, ordinary least squares estimates overestimate exposure. Even though in our two-step estimation, we do account for non exchange rate related country level macroeconomic shocks through the

country exposures, about 90% are negative. This shows that there is a strong negative relationship on average between a country's currency value and its market returns. This is in line with the idea that following a currency appreciation, a country's economy becomes relatively less competitive. In terms of magnitude of exposure, figure (3) presents the values of estimated $\widehat{\gamma}_{1,m}$ (gamma1) by country, starting from the most negative (France) and ending with the most positive (Turkey).

Figure 3: Gamma1 estimations



In the second step, we estimate equation (2) and obtain the proxies for firm specific first moment and second moment exchange rate exposures, $\widehat{\beta}_{2,i}$

inclusion of the $\widehat{\varepsilon}_{m,t}$ variable, we perform GMM estimations as a robustness test for our country exposures $\gamma_{1,m}$. For this purpose we use global and US specific macro variables as instruments. These include the stock return of a worldwide market index, the effective exchange rate for US and the risk free rate in the US. By using Hansen's J-statistic, we reject the hypothesis of mis-specification and endogeneity of these instruments. The results are almost unchanged with a 54% of countries with significant $\widehat{\gamma}_{1,m}$ (compared to 57% with generalized least squares) and 80% of those significant that are negative (compared to 90% with generalized least squares). Since the relevance of global instruments can be criticized, we only present hereafter the results based on generalized least squares estimations.

and $\widehat{\beta}_{3,i}$ respectively. In order to get a better idea of the estimated betas, we present in table (5) the results of pooled estimations over all countries. Summarizing the main points, apart from the proxy for the market factor $\widehat{\beta}_{1,i}$ which is positive (as expected), the two exchange rate exposure betas are significantly negative on average across our whole sample. The firm's exposure $\widehat{\beta}_{1,i}$ with respect to the non-exchange rate related market variations is high, around 0.94. The sample representative firm's "traditional" first moment exchange rate exposure $\widehat{\beta}_{2,i}$ is about equal to -0.09. This means that on average, an appreciation of the effective exchange rate by 1% leads to a decrease in a firm's returns by 0.09%. The firm's second moment exposure $\widehat{\beta}_{3,i}$ is about equal to -0.2, meaning that, on average, an increase in the effective exchange rate volatility, decreases firms' returns. Pooling estimations from such a large sample may hide some aggregation bias, we hence try to refine the global picture of estimated betas by supplementary tests.

In an attempt to identify different trends between developed and emerging markets, we estimate equation (2) separately for developed and emerging market firms. We find indeed that over the whole sample the sign of exchange rate exposure $\widehat{\beta}_{2,i}$ is negative only for developed market firms, whereas it is significantly positive for emerging market firms. This means that internationally oriented emerging market firms benefit on average from appreciations of their local currency. In addition, second moment exposure appears significant only for developed market firms.

Inspired by the apparent more volatile effective exchange rates since 1998, as shown in figure (1), we perform the same estimations in two subsamples. The first subsample is between 1994 and 1997, whereas the second begins in 1998 and ends in 2008.[16] The first interesting result is that, when considering separately the exposure with respect to exchange rate volatility $\widehat{\beta}_{3,i}$ of de-

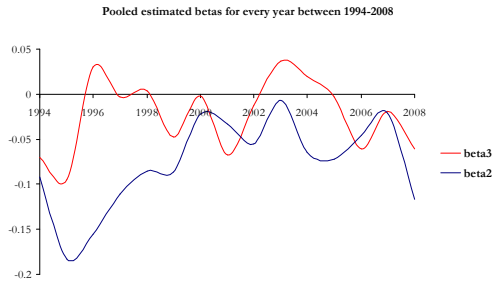
[16]We perform robustness tests running the same estimations on more than these two time sub-samples. The results are quite stable within these two sub-periods.

veloped or emerging market firms, none is significant until 1997. Since 1998, though, developed markets are significantly negatively affected by increases in such volatility. A second noteworthy result is that the exchange rate exposure $\widehat{\beta}_{2,i}$ of emerging market firms reverses sign in the two sub-periods. Until 1997, emerging market firms are negatively affected by exchange rate appreciations, whereas the prevailing result on our overall sample is valid only since 1998 onwards. This could be related to Chambet et al (2008) evidence that shocks may occur on emerging markets' degree of integration during financial crises.

In tables (6) and (7), we present some summary statistics by country, with respect to the estimated exposures $\widehat{\beta}_{2,i}$ and $\widehat{\beta}_{3,i}$, respectively. We notice that nearly half of the estimated firm first moment exposures are significant, which is a rather high percentage compared to previous literature. The percentage of negative $\widehat{\beta}_{2,i}$'s is higher among developed markets, while the same holds for negative $\widehat{\beta}_{3,i}$'s. The average levels of significance are higher for the $\widehat{\beta}_{2,i}$ (beta2) coefficients than for $\widehat{\beta}_{3,i}$ (beta3). This could be also due to the changes in these measures occurred from 1998 onwards.

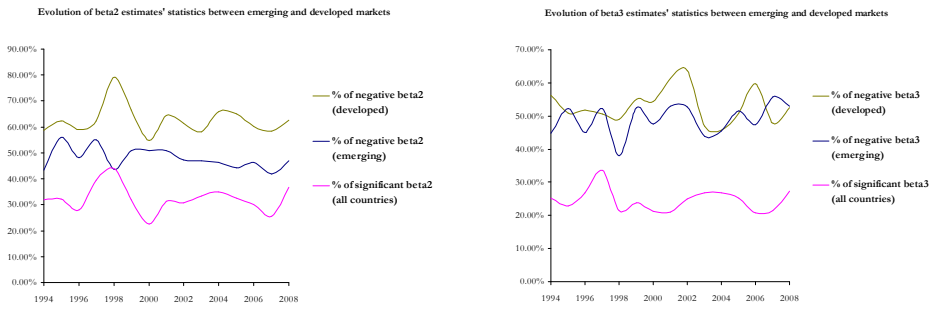
Due to the observed significant cross-sectional, as well as time series variation of our estimates, we perform separate pooling estimations over each calendar year (52 weekly observations) and obtain firm specific beta coefficients per year. We thus obtain, between 1994 and 2008, 15 yearly beta estimated coefficients for each firm. Figure (4) illustrates the evolution of our pooled yearly $\widehat{\beta}_{2,i}$ and $\widehat{\beta}_{3,i}$ coefficients. We observe that our first moment exchange rate exposure remains negative during all 15 years and does not oscillate outside the range of -0.2 and 0.

Figure 4: Evolution of pooled beta estimates across time



Additionally, we present some time varying statistics on the evolution of the number of firms with negative exposure estimates. Figure (5) shows that the number of negative first moment exposures remains higher in developed than emerging markets, during the whole time span. The two types of markets exhibit a similar percentage of negative second moment exposure across time, however its significant ratio is much lower. The time varying as well as cross-sectional characteristics of our beta estimates leads us to use panel data estimations in the subsequent part of the estimation, where the goal is to identify their main determinants.

Figure 5: Evolution of beta2 and beta3 estimates statistics across time



4 Explaining Exchange Rate Exposure

In this part of our study, we explain the estimated levels of exchange rate exposure of equation (2) through firm specific and country specific variables, after controlling for the industry level of each firm as well. The relevance of firm specific accounting variables is straightforward, since they are related to the definition and the origins of exposure. The relevance of industry specific variables is emphasized by extensive literature, though it is not of central interest in this study.

The relevance of country specific variables is explained as follows. Let's focus on the impact of using the residuals of equation (1) in order to control for a market factor that influences firm returns in equation (2). Can it make country factors seem independent with respect to exchange rate exposure $\beta_{2,i}$ or $\beta_{3,i}$? This is not true for the following reason. The regressor $\widehat{\varepsilon}_{m,t}$ only includes market fluctuations that are orthogonal to exchange rate fluctuations. Hence, it does not include market movements that are related to exchange rate fluctuations. These latter are thus all captured in our $\beta_{2,i}$ and $\beta_{3,i}$. The use of a broad effective exchange rate, which measures a country's international competitiveness and is often used as a component of financial condition indices, exhibits a non zero correlation with most of the country variables considered hereafter. In such a way, our estimates of firms' total exposure could as well be explained by country specific variables.

Country factors could impact firms' total exposure either through a direct channel or through an indirect one. The indirect channel refers to the interaction between the market's exchange rate exposure $\gamma_{1,m}$ and the firm's sensitivity with respect to market movements related to exchange rate fluctuations. The direct channel refers to the direct impact of exchange rate fluctuations on firm value. This could be significant in our case, because of the particular nature of the sample firms which exhibit high international

orientation with respect to their market average.

4.1 Explaining first moment exposure

In order to identify the impact of several factors on firms' i first moment exchange rate exposure, we estimate the following model:

$$\widehat{\beta}_{2,i,t} = \alpha_{0,j} + \alpha_1 X_{i,t} + \alpha_2 \Psi_{m,t} + \eta_{i,t} \tag{3}$$

where $\widehat{\beta}_{2,i,t}$ is the estimated annual firm specific first moment exchange rate exposure. On the right hand side, $X_{i,t}$ represents a vector of firm i specific variables, $\Psi_{m,t}$ is a vector of country specific variables and the constant $\alpha_{0,j}$ is industry j specific. Our panel data consists of 870 cross-sectional firm observations across 15 years, between 1994 and 2008. We use annual data for our pooled generalized least squares estimations, correcting for heteroscedasticity, and the firm is used as the cross-sectional identity. There is an issue with a bias introduced in the standard errors due to the use of an estimated variable as the dependent variable. As a test of robustness, we weight each observation with the inverse of the standard error of the estimated $\widehat{\beta}_2$ coefficient from equation (2). Alternative specifications that we test for robustness include using only the significant $\widehat{\beta}_2$ coefficients from equation (2), or using the t-stats of $\widehat{\beta}_2$ from equation (2), instead of the coefficients themselves. In these alternative specifications, the sign and magnitude of the impact of the main determinants remain the same, thus such results are not presented in the tables.

The main results concerning the determinants of first moment exchange rate exposure are presented in table (8). Panel I presents some results on all the raw first moment exposures $\widehat{\beta}_2$. These results though are often hard to interpret without, either examining the impact of factors on the magnitude of exposure $\left|\widehat{\beta}_2\right|$, as in panel II, or separating firms with positive and negative

betas, as in panel III.

Consequently, apart from the impact of several variables on the sign of exposure, panel II examines the impact of such variables on the magnitude of exposure. For this reason, we test the determinants of a measure of the absolute value of exchange rate exposure $\left|\widehat{\beta}_2\right|$ in columns D, E and F of table (8). In reality, as in Dominguez and Tesar (2006) and Hutson and Stevenson (2009), we use as the dependent variable the square root of the absolute value of the $\widehat{\beta}_2$ exposure coefficient. The reason for this is that by simply taking the absolute value, we create a bias since the error term is not normal. We thus correct for that, by using a monotonic transformation of the absolute value of $\widehat{\beta}_2$, without altering our determinants' impact direction.

Columns G and H of table (8) estimate equation (3) on two separate subsamples. The first one includes firm observations with negative exposure estimates $\widehat{\beta}_2$, while the second includes firm observations with positive exposures. Due to our definition of the exchange rate, negative exposures can be a feature, among others, of a firm's export orientation, whereas negative exposure, that of a firm's import orientation. Similar specifications have been used in previous literature, as by He and Ng (1998) and Pritamani et al. (2004), in order to interpret easier the sign of the impact of different determinants. Due to the fact that most of our emerging market firms exhibit positive exposures, over-identification problems prevent us from estimating disaggregated columns G and H for emerging and developed markets.

As far as firm specific variables are concerned, we notice that firms with higher foreign sales are more likely to have a low, or even negative exposure $\widehat{\beta}_2$. This means that they tend to be negatively affected by their domestic currency's appreciation. In terms of magnitude of exposure, foreign sales significantly increase exposure only among developed market firms. This means that for developed market firms, foreign sales are not the result of an operational hedging strategy. Panel III goes one step further and shows

that foreign sales make firms with inherently negative exposure to be more sensitive to exchange rate changes in both developed and emerging market firms. The same holds for developed market firms that have an inherent positive exposure $\widehat{\beta}_2$. The only case where foreign sales appear to play a hedging role and decrease exposure is among emerging market firms with an inherent positive exposure $\widehat{\beta}_2 > 0$.

In relation to firms' size, big firms tend to be negatively affected by their domestic currency's appreciation in developed markets (column B), whereas the same effect is positive for big firms in emerging markets (column C). On the other hand, big size appears to increase exposure in absolute terms in all types of market (columns D,E and F). This rejects the hypothesis that there are important fixed costs in hedging that allow only to large firms to use relevant hedging tools. When we consider separate estimations according to the sign of the dependent variable $\widehat{\beta}_2$, we confirm that exposure becomes more negative for already negatively exposed firms, whereas exposure becomes more positive for inherently positively exposed firms. One may note that the overall positive effect of size in column C is related to the fact that, as we showed in the measurement section, the majority of emerging market firms have positive first moment exposures.

Total leverage is another firm level variable that is tested in table (8) and shows a similar pattern with the impact of size. In the case of developed markets, more indebted firms appear to be negatively affected by domestic currency appreciations, whereas this is the case for less indebted firms in emerging markets. The fact that high leveraged firms in emerging markets are negatively affected by domestic currency depreciations, is probably due to the significant use of foreign debt, as documented in previous studies. On absolute terms, leverage seems to increase exposure, in a significant way in emerging markets. This indicates that total leverage is positively correlated with foreign debt use among emerging market firms. The increasing impact

on inherent exposure is confirmed by columns G and H, where negatively exposed firms are negatively affected and positively exposed firms are positively affected.

In terms of profitability, as measured by the dividend yield proxy, we find evidence that more profitable firms tend to be more positively affected by domestic currency appreciations. On average, this results on a decrease in the magnitude of exposure, particularly for developed market firms, which exhibit in their majority negative exposures. As a matter of fact, the decreasing impact on inherent exposure is confirmed in columns G and H, for both export oriented (with $\widehat{\beta}_2 < 0$ that becomes less negative) and import oriented firms (with $\widehat{\beta}_2 > 0$ that becomes less positive).

As far as country specific variables are concerned, we first notice the significant impact of the aggregate use of currency derivatives, such as forwards and currency swaps, measured by "FXtools". The higher aggregate use of foreign exchange instruments in a country leads to a reduction of exposure in absolute terms for all types of market. The results of columns D, E and F reveal that exposure decreases in all markets, with particular economic significance among emerging market firms. Results are robust in columns G and H showing that exposure becomes less negative for already negatively exposed firms, whereas exposure becomes less positive for inherently positively exposed firms. In addition, raw results of columns A, B and C are in allignment with the fact that developed market firms have in majority negative exposure, and emerging firms positive exposure. A side result not reported in the table is that when we replace these derivatives level of use proxies by their annual growth rate, there is evidence that an increase in their growth rate reduces emerging market firms exposure $\widehat{\beta}_2$. These results actually show that derivatives markets help internationally oriented firms to decrease their exposure, particularly for emerging markets, where the results are of high economic importance. In this case, our sample firms mostly use

foreign exchange instrument markets for hedging purposes and not for speculation. The impact of these markets on decreasing firm exposure is high among all firms.

A similar result holds with respect to a market's financial development as measured by the inverse of "IntDebt". The more domestic financial markets develop, the less the exchange rate exposure $\widehat{\beta}_2$ becomes in absolute terms, for all firms. The result is less economically significant, though, for emerging market firms. This finding shows that financial development and more specifically the development of domestic bond markets has a more pronounced negative impact on the magnitude of developed market firms' exposure than emerging market firms' exposure. This could be due to the fact that local bond market are still relatively shallow in emerging markets and thus affect less exposure. Results are robust in columns G and H showing that in shallow financial markets exposure becomes more negative for already negatively exposed firms, and more positive for inherently positively exposed firms.

Finally, table (8) finds evidence of significant negative impact of a country's current account on the firm's raw exposure $\widehat{\beta}_2$. This means that the more a country's trade balance improves or net income from abroad increases, the more its firms will tend to be negatively affected by their domestic currency's appreciation. This is intuitive, since current account in this case captures a country's net export orientation or net flow of foreign income. The impact of current surpluses is robust in column G, whereas the positive sign of column H is only due to the developed market firms with inherent positive exposure. In order to test the impact on the magnitude of exposure in columns D, E and F, we consider the absolute value of a country's current account, representing thus its size or imbalance. We find that current account absolute size (either deficit or surplus) increases firms' absolute exposure.

In all estimations presented in table (8), we include an industry specific constant, due to the need to control for a firm's nature of activities. They are

all significant, but we do not observe a significant difference or pattern among industries. In order to assess the relative importance of firm, industry and country level determinants of exposure, we compute the average distribution of R^2 by level of variables. Firm specific variables remain on average the most important ones, accounting for about 55% of the adjusted R^2. Industry level variables account for about 15%, whereas country level variables are responsible for about 30% of our adjusted R^2. For this reason, we claim that country specific variables are important in explaining firms' exchange rate exposure.

4.2 Explaining second moment exposure

Apart from the traditional exchange rate exposure coefficient $\widehat{\beta}_2$, we explain the estimated levels of the firm's exposure with respect to the volatility of the exchange rate $\widehat{\beta}_3$ of equation (2) through firm specific and country specific variables.

$$\widehat{\beta}_{3,i,t} = \delta_{0,j} + \delta_1 X_{i,t} + \delta_2 \Psi_{m,t} + \theta_{i,t} \tag{4}$$

where $\widehat{\beta}_{3,i,t}$ is the estimated annual firm specific second moment exchange rate exposure. On the right hand side, $X_{i,t}$ represents a vector of firm i specific variables, $\Psi_{m,t}$ is a vector of country specific variables and the constant $\alpha_{0,j}$ is industry j specific. We thus test the same explanatory variables as when explaining $\widehat{\beta}_2$.

One may see the main results concerning the determinants of second moment exchange rate exposure in table (9). Panel I presents some results on all the raw first moment exposures $\widehat{\beta}_3$. As in the previous subsection, panel II examines the impact of factors on the magnitude of exposure $\left|\widehat{\beta}_3\right|$. Panel III separates firms on two separate subsamples. The first one includes firm observations with negative volatility exposure estimates $\widehat{\beta}_3$, while the

second includes firm observations with positive exposures.

As far as firm specific variables are concerned, we notice that developed firms with higher foreign sales are more likely to have a low, or even negative exposure $\widehat{\beta}_3$. This means that they tend to be negatively affected by an increase in their domestic currency's volatility. The opposite holds for emerging market firms. In terms of magnitude of exposure, foreign sales significantly increase second moment exposure among all firms, as it was the case for first moment exposure. This means that for developed market firms, foreign sales are not the result of an operational hedging strategy. The result is confirmed as well in columns G and H, where foreign sales have a negative impact on already negative second moment exposures and a positive impact on already positive exposures.

Similar to the case of first moment exposure, firm's size seems to increase absolute second moment exposure for firms in all types of market (columns D, E and F), for firms with negative volatility exposure (column G), as well as for firms with positive volatility exposure (column H). We also find that leverage may not significantly increase absolute second moment exposure of firms in emerging markets, however it increases exposure for firms with positive and negative volatility exposure. This indicates again that total leverage is probably highly correlated with foreign debt use, which in turn increases volatility exposure. On the other hand, more profitable firms manage to reduce second moment exposure, with the exception of firms with negative volatility exposure (column G).

Among the country specific variables of table (9), it is noteworthy that the aggregate use of foreign exchange instruments (forwards and currency swaps) significantly decreases second moment exposure among both developed and emerging market firms. The decrease in exposure is particularly economic significant among emerging market firms. Results are robust in columns G and H, showing that in countries with high use of forwards and currency

swaps, exposure becomes less negative for negatively exposed firms, whereas exposure becomes less positive for inherently positively exposed firms. As a matter of fact, this shows that firms use currency derivatives markets to hedge not only against specific directional moves of the exchange rate, but also hedge against exchange rate volatility. These results actually show that derivatives markets are mostly used as a hedge for exchange rate volatility in both developed and emerging markets. When we replace the "FXtools" by "FXturnover" which comprises all spot transaction volume, the impact on volatility exposure becomes positive. This means that spot transactions tend to increase exposure, in contrast to currency derivatives linked transactions. Another side result not reported in the table is that when we replace the level of derivatives use proxies by their annual growth rate, there is evidence that an increase in their growth rate reduces emerging market firms exposure $\widehat{\beta}_3$.

The results on financial development (as proxied by the inverse of "Int-Debt") are also in the same direction. The more domestic financial markets develop, the less the volatility exposure $\widehat{\beta}_3$ becomes in absolute terms, for all firms. The result is less economically significant, though, for emerging market firms. This reveals that the development of domestic bond markets has a more pronounced negative impact on the magnitude of developed market firms' exposure than emerging market firms' exposure. This could be due once again to the fact that local bond markets are still relatively shallow in emerging markets and thus affect less exposure. Results are robust in columns G and H, showing that in shallow financial markets, volatility exposure becomes more negative for already negatively exposed firms, and more positive for inherently positively exposed firms.

As far as a country's current account is concerned, it has a clearly positive impact on the firm's volatility exposure $\widehat{\beta}_3$. This means that the more a country's trade balance or net income from abroad increases, the more its firms will tend to positively affected by their domestic currency's increase in

volatility. In addition, the more a country's current account is balanced, the less its firms are affected by their domestic currency's volatility fluctuations.

In relation to both first and second moment exposures, we perform several robustness tests, not presented in the tables. For instance, we control for other variables that either appear less economically significant, or are highly correlated with some of our regressors and are thus excluded to avoid multicollinearity. An example includes a firm specific measure of liquidity, which appears to slightly increase first moment exposure, but without any significant impact. Some country variables that are tested include a country's "Openness", which significantly increases absolute exposure, but is highly correlated with "FXtools" and is thus excluded. The role of a country's external debt through "FXdebt" appears to significantly increase both first and second order exposure. We do not include it in the estimations due to multicollinearity issues that arise when we combine it with the other three country variables used.

We finally perform a robustness test where we use country wide portfolios and test the equations (3) and (4), while using the country as the cross-sectional identity. We construct such portfolios by computing the equally weighted beta2 and beta3 estimates for every country per year. For each firm specific accounting variable, we compute the equally weighted averages of all firms from the same country in a given year. We thus end up with a panel data with 37 cross sections (countries) and 15 yearly observations. The results are not reported here, since the importance and sign of the impact of country variables remain the same as the ones presented above.

5 Conclusions

This study sheds light on two axes related to the exchange rate exposure of internationally oriented firms. On the first axis, by using a large panel

data of firms, we measure and document significant variations in firms' first and second moment exchange rate exposure across time, as well as among countries. Developed market firms are on average negatively affected by domestic effective exchange rate appreciations. Emerging market firms' exposure reverses sign during our time span and such firms now exhibit on average positive returns when their country's currency appreciate.

On the second axis, we find new country specific factors that serve as channels of the observed exposures, after accounting for what literature proposes as firm and industry level determinants. We quantify the importance of these new country factors as powerful to explain about 30% of observed first and second moment exposure variability. The country's aggregate use of foreign currency instruments, such as currency derivatives, decreases the first moment exposure for all firms, and the impact on emerging markets is particularly important. The degree of a country's domestic corporate bond market development also decreases both first and second moment exposures of firms in all types of markets, with higher economic significance in the developed world.

In summary, the country factors used in this study are important in explaining the variations of observed first and second moment exchange rate exposures at the firm level. Firms seem to use currency derivatives markets and benefit from the country's level of financial sophistication in order to decrease both their first and second moment exposures. In addition, firms in countries with large current accounts tend to be more sensitive to exchange rate changes. These results, apart from their relevance on a firm's exposure identification and explanation level, can help induce some references about the impact of derivatives markets on different groups of firms and types of market. This latter could also be of some interest for policy makers and financial market regulators.

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Tables

Table 1: Country specific variable definitions and sources

Variable	Definition	Unit	Data source
R	Stock return	%	Thomson Datastream
ER	Effective exchange rate change	%	Bank of International Settlements
GDP_{PPP}	Gross Domestic Product at PPP (billions USD)	USD	Thomson Datastream - Economist Intelligence Unit
FXturnover*	Total foreign exchange turnover / GDP_{PPP}	%	Bank of International Settlements
FXfor*	Outright forward foreign exchange turnover / GDP_{PPP}	%	Bank of International Settlements
FXspot*	Spot foreign exchange turnover / GDP_{PPP}	%	Bank of International Settlements
FXswap*	Foreign exchange swap turnover / GDP_{PPP}	%	Bank of International Settlements
FXtools*	FXfor+FXswap	%	Thomson Datastream - Economist Intelligence Unit
IntDebt	$\frac{\text{International bonds notional amounts outstanding (billions USD)}}{\text{Domestic debt notional amounts outstanding (billions USD)}}$	%	Bank of International Settlements
CA	Current account balance (% of GDP)	%	Thomson Datastream - Economist Intelligence Unit
Export	Exports of goods and services (% of GDP)	%	Thomson Datastream - Economist Intelligence Unit
Import	Imports of goods and services (% of GDP)	%	Thomson Datastream - Economist Intelligence Unit
Openness	Export+Import	%	
FXdebt	Net foreign debt (% of GDP)	%	Thomson Datastream - Economist Intelligence Unit

* The turnover provided by the BIS is a daily average in billions USD

Table 2: Firm specific variable definitions and sources

Variable	Definition	Unit	Data source
R	Stock return	%	Thomson Datastream
FSales	Sales from operations in foreign countries / Total sales	%	Worldscope (field 08731)
Leverage	Total Debt / Total Assets	%	Worldscope (field 08236)
Market Cap	ln(Year end market capitalization in USD)	USD	Worldscope (field 07210)
Dividend	Dividend yield close	%	Worldscope (field 09404)
Industry	Dummy following the General Industry Classification Code		Worldscope (field 06010)
Emerging	Dummy=1 if firm's home market is emerging		computed based on MSCI Barra
β_2	Exchange rate exposure with respect to levels of ER		Estimated
β_3	Exchange rate exposure with respect to volatility of ER		Estimated

Table 3: Summary descriptive statistics of sample firms.

The table shows all sample firms' distribution by country, type of market and industry. Countries are followed by (D) if they are classified as developed and by (E) if they are classified as emerging. The table also presents the arithmetic mean of major accounting variables across firms as of 2008.

Number of firms by country									
Argentina (E)	17	France (D)	34	Italy (D)	13	Portugal (D)	3	Taiwan (E)	7
Australia (D)	78	Germany (D)	38	Japan (D)	57	Russia (E)	31	Thailand (E)	10
Austria (D)	12	Greece (D)	5	Malaysia (E)	10	Singapore (D)	17	Turkey (E)	7
Brazil (E)	51	Hong Kong (D)	107	Mexico (E)	42	South Africa (E)	33	U.K. (D)	95
Chile (E)	16	India (E)	12	Netherlands (D)	28	South Korea (D)	16	Venezuela (E)	10
China (E)	28	Indonesia (E)	2	Norway (D)	8	Spain (D)	8		
Denmark (D)	4	Ireland (D)	17	Peru (E)	7	Sweden (D)	11		
Finland (D)	5	Israel (E)	9	Philippines (E)	7	Switzerland (D)	15	Total	870
Number of firms by type of market									
Emerging	299	Developed	571						
Number of firms by industry									
Industrial	614	Utilities	123	Transportation	28	Banks, insurances & other financial firms			111
Descriptive statistics of sample firms (as of 2008)									
All sample firms									
Market Capitalization (millions USD)	10'846			FSales	49.37%		Leverage	25.75%	Dividend yield 3.21%
Developed market firms									
Market Capitalization (millions USD)	13'355			FSales	56.57%		Leverage	26.58%	Dividend yield 2.91%
Emerging market firms									
Market Capitalization (millions USD)	6'026			FSales	25.41%		Leverage	24.06%	Dividend yield 3.88%

Table 4: Pooled generalized least squares estimates of country overall exchange rate exposure (gamma1)
Country exposure is estimated from equation (1) using data for the entire time span in weekly frequency. The estimates are obtained by separate generalized least squares estimation in each country, with 783 time observations. We use White's heteroscedasticity consistent standard errors and covariance matrix. Adjusted R^2 oscillate between 1% and 2%.

*Estimated country exposure $\widehat{\gamma}_{1,m}$ (** denotes significance at the 95% level)*

Argentina	-0.36**	France	-0.69**	Italy	-0.12**	Portugal	-0.35**	Taiwan	-0.03
Australia	0.05**	Germany	-0.43**	Japan	-0.12**	Russia	0.06	Thailand	-0.23
Austria	-0.32**	Greece	-0.45	Malaysia	-0.01	Singapore	-0.20	Turkey	0.24
Brazil	0.22**	Hong Kong	-0.36**	Mexico	0.08	South Africa	0.01	United Kingdom	-0.11**
Chile	0.01	India	0.03	Netherlands	-0.45**	South Korea	0.19	Venezuela	-0.08**
China	-0.03	Indonesia	-0.33	Norway	-0.01	Spain	-0.45**		
Denmark	-0.08**	Ireland	-0.34**	Peru	-0.13**	Sweden	-0.05		
Finland	-0.36**	Israel	0.01	Philippines	-0.17**	Switzerland	-0.19**	All countries	-0.07**

Table 5: Pooled generalized least squares estimates of firm market exposure (beta1), first moment exchange rate exposure (beta2) and second moment exchange rate exposure (beta3)

Firm exposure coefficients are estimated from equation (2) using data in weekly frequency. The estimates are obtained by pooled generalized least squares estimation, with 541'575 panel observations for the whole sample between 1994 and 2008. We use White's heteroscedasticity consistent standard errors and covariance matrix. Adjusted R^2 oscillate between 26% and 32%. Coefficients' significance at 99%, 95% and 90% confidence level is noted by ***, **, * respectively.

Pooled estimation of equation (2) for groups of countries

Coefficients	$\widehat{\beta}_{1,i}$	$\widehat{\beta}_{2,i}$	$\widehat{\beta}_{3,i}$
All countries 1994-2008	0.943***	-0.088***	-0.019***
Developed countries 1994-2008	0.926***	-0.134***	-0.013***
Emerging countries 1994-2008	0.972***	0.022***	0.009
Developed countries 1994-1997	0.939***	-0.164***	-0.007
Emerging countries 1994-1997	0.971***	-0.032***	0.005
Developed countries 1998-2008	0.925***	-0.131***	-0.010***
Emerging countries 1998-2008	0.975***	0.040***	0.014*

Table 6: Pooled generalized least squares estimates of firm first moment exchange rate exposure (beta2)

Firm exposure coefficients are estimated from equation (2) using data in weekly frequency. Summary statistics by country and type of market below show i) %Neg refers to the percentage of firms with negative first moment exposure estimate ii) % Sig refers to the percentage of firms with significant (at the 95% level) first moment exposure estimate and iii) %Neg/Sig refers to the percentage of firms with negative first moment exposure, given that the latter is statistically significant.

Estimated first moment firm exposure $\widehat{\beta}_{2,i}$ by country or groups of countries

	% Neg	% Sig	%Neg/Sig		% Neg	% Sig	%Neg/Sig		% Neg	% Sig	%Neg/Sig
Argentina	100%	62.5%	100%	Indonesia	50%	50%	0	Singapore	94.1%	82.3%	100%
Australia	23.1%	19.2%	6.7%	Ireland	93.7%	25%	100%	South Africa	48.5%	45.4%	40%
Austria	91.7%	50%	100%	Israel	44.4%	44.4%	75%	South Korea	31.2%	68.4%	97.4%
Brazil	19.6%	52.9%	0%	Italy	84.6%	46.1%	100%	Spain	87.5%	87.5%	100%
Chile	25%	18.7%	66.7%	Japan	98.2%	68.4%	97.4%	Sweden	45.4%	36.4%	100%
China	82.1%	53.6%	100%	Malaysia	33.3%	55.6%	60%	Switzerland	100%	92.8%	100%
Denmark	100%	50%	100%	Mexico	20.5%	41%	6.2%	Taiwan	42.9%	0%	-
Finland	80%	40%	100%	Netherlands	96.4%	71.4%	100%	Thailand	90%	50%	100%
France	80%	76.7%	95.6%	Norway	62.5%	75%	66.7%	Turkey	0%	100%	0%
Germany	84.2%	52.6%	100%	Peru	71.4%	28.6%	50%	United Kingdom	75.6%	41.1%	91.9%
Greece	80%	60%	100%	Philippines	100%	42.8%	100%	Venezuela	77.8%	33.3%	100%
Hong Kong	96.2%	61.9%	100%	Portugal	100%	66.7%	100%	All developed	77.3%	52.1%	91.1%
India	75%	0%	-	Russia	40%	16.7%	80%	All emerging	47.1%	41.2%	46.7%
								All countries	67%	48.4%	78.3%

Table 7: Pooled generalized least squares estimates of firm second moment exchange rate exposure (beta3)
Firm exposure coefficients are estimated from equation (2) using data in weekly frequency. Summary statistics by country and type of market below show i) %Neg refers to the percentage of firms with negative second moment exposure estimate ii) % Sig refers to the percentage of firms with significant (at the 95% level) second moment exposure estimate and iii) %Neg/Sig refers to the percentage of firms with negative second moment exposure, given that the latter is statistically significant.

Estimated second moment firm exposure $\widehat{\beta}_{3,i}$ *by country or groups of countries*

	% Neg	% Sig	%Neg/Sig		% Neg	% Sig	%Neg/Sig		% Neg	% Sig	%Neg/Sig
Argentina	62.5%	18.7%	66.7%	Indonesia	0%	0%	-	Singapore	64.7%	5.9%	100%
Australia	61.5%	11.5%	22.2%	Ireland	62.5%	6.2%	0%	South Africa	54.5%	18.2%	33.3%
Austria	25%	41.7%	0%	Israel	44.4%	11.1%	0%	South Korea	62.5%	12.5%	100%
Brazil	41.1%	9.8%	40%	Italy	61.5%	30.8%	50%	Spain	87.5%	87.5%	100%
Chile	18.7%	25%	0%	Japan	64.9%	15.8%	77.8%	Sweden	45.4%	36.4%	100%
China	42.8%	7.1%	100%	Malaysia	55.6%	11.1%	100%	Switzerland	42.8%	14.3%	0%
Denmark	50%	75%	33.3%	Mexico	61.5%	28.2%	45.4%	Taiwan	28.6%	28.6%	0%
Finland	80%	40%	50%	Netherlands	64.3%	7.1%	0%	Thailand	30%	0%	-
France	46.7%	23.3%	28.6%	Norway	37.5%	25%	0%	Turkey	16.7%	33.3%	0%
Germany	60.5%	18.4%	14.3%	Peru	28.6%	0%	-	United Kingdom	57.8%	12.2%	36.4%
Greece	40%	40%	50%	Philippines	71.4%	28.6%	50%	Venezuela	55.6%	11.1%	0%
Hong Kong	81%	15.2%	87.5%	Portugal	100%	33.3%	100%	All developed	62.8%	15.4%	44.8%
India	50%	16.7%	0%	Russia	50%	13.3%	25%	All emerging	46.7%	15.8%	34.8%
								All countries	57.3%	15.6%	41.3%

Table 8: Estimates from regressions with beta2 as the dependent variable

The table presents different estimation specifications of equation (3) using data in annual frequency from 1994 till 2008. The estimates are obtained by pooled generalized least squares, with White's heteroscedasticity consistent standard errors and covariance matrix. Panel I considers all raw betas as the dependent variable. Panel II uses absolute betas as the dependent variable. Panel III considers either only positive betas or only negative betas as the dependent variable. Coefficients' significance at 99%, 95% and 90% confidence level is noted by ***, **, * respectively.

		Panel I : Raw estimations on all betas			Panel II : Estimations on absolute betas		
		all markets	developed	emerging	all markets	developed	emerging
Variables	Proxying	A: $\widehat{\beta}_{2,i,t}$	B: $\widehat{\beta}_{2,i,t}$	C: $\widehat{\beta}_{2,i,t}$	D: $\left\|\widehat{\beta}_{2,i,t}\right\|$	E: $\left\|\widehat{\beta}_{2,i,t}\right\|$	F: $\left\|\widehat{\beta}_{2,i,t}\right\|$
FSales	firm foreign activities	-0.144***	-0.079***	-0.164***	0.154***	0.168***	0.013
Market Cap	firm size	-0.009***	-0.011***	0.023***	0.027***	0.029***	0.043***
Leverage	firm leverage	-0.009***	-0.011***	0.101***	0.027	0.016	0.269***
Dividend	firm profitability	0.008***	0.007***	0.004***	-0.001	-0.004***	-0.001
FXtools	use of FX instruments	-0.007***	0.185***	-6.100**	-0.204***	-0.273***	-1.795***
IntDebt	1/financial development	-0.016**	-0.065***	0.044***	0.077***	0.106***	0.029***
CA	current account	-1.705***	-2.449***	-0.763***			
|CA|	absolute current account				2.120***	2.724***	0.950***
Adjusted R^2	(6'413 observations)	7.06%	34.21%	34.21%	27.35%	34.75%	34.75%

Panel III : Separate estimations on firm observations with $\widehat{\beta}_{2,i,t} < 0$ or firm observations with $\widehat{\beta}_{2,i,t} > 0$							
Variables	Proxying	G: $\widehat{\beta}_{2,i,t} < 0$			H: $\widehat{\beta}_{2,i,t} > 0$		
FSales	firm foreign activities	-0.096***	-0.028***	-0.626***	0.111***	0.133***	-0.178***
Market Cap	firm size	-0.065***			0.082***		
Leverage	firm leverage	-0.032***			0.274***		
Dividend	firm profitability	0.001***			-0.003***		
FXtools	use of FX instruments	0.089***			-0.412***		
IntDebt	1/financial development	-0.120***			0.003***		
CA	current account	-1.389***			0.888***		
Panel observations		3'162			2'340		
Adjusted R^2		64.96%			72.18%		

Table 9: Estimates from regressions with beta3 as the dependent variable

The table presents different estimation specifications of equation (4) using data in annual frequency from 1994 till 2008. The estimates are obtained by pooled generalized least squares, with White's heteroscedasticity consistent standard errors and covariance matrix. Panel I considers all raw betas as the dependent variable. Panel II uses absolute betas as the dependent variable. Panel III considers either only positive betas or only negative betas as the dependent variable. Coefficients' significance at 99%, 95% and 90% confidence level is noted by ***, **, * respectively.

		Panel I : Raw estimations on all betas			Panel II : Estimations on absolute betas		
		all markets	developed	emerging	all markets	developed	emerging
Variables	Proxying	A: $\widehat{\beta}_{3,i,t}$	B: $\widehat{\beta}_{3,i,t}$	C: $\widehat{\beta}_{3,i,t}$	D: $\left\|\widehat{\beta}_{3,i,t}\right\|$	E: $\left\|\widehat{\beta}_{3,i,t}\right\|$	F: $\left\|\widehat{\beta}_{3,i,t}\right\|$
FSales	firm foreign activities	-0.066***	-0.036***	0.091***	0.075***	0.057***	0.048**
Market Cap	firm size	0.012***	0.012***	0.013***	0.044***	0.044***	0.041***
Leverage	firm leverage	-0.053***	-0.066***	-0.141***	0.012	0.013	-0.181
Dividend	firm profitability	-0.005***	-0.003***	-0.004***	-0.009***	-0.015***	-0.002**
FXtools	use of FX instruments	-0.092***	0.003	-0.643**	-0.239***	-0.334***	-3.996***
IntDebt	1/financial development	0.015***	-0.004	0.037***	0.075***	0.097***	0.018***
CA	relative current account	0.457***	0.255***	0.452***			
|CA|	absolute current account				0.909***	1.121***	0.638***
Adjusted R^2	(6'412 observations)	1.51%	1.66%	1.66%	58.10%	21.20%	21.20%

Panel III : Separate estimations on firm observations with $\widehat{\beta}_{3,i,t} < 0$ or firm observations with $\widehat{\beta}_{3,i,t} > 0$							
Variables	Proxying	G: $\widehat{\beta}_{3,i,t} < 0$			H: $\widehat{\beta}_{3,i,t} > 0$		
FSales	firm foreign activities	-0.085***	-0.075***	-0.087***	0.042***	0.030***	0.175***
Market Cap	firm size	-0.071***			0.047***		
Leverage	firm leverage	-0.004***			0.247***		
Dividend	firm profitability	-0.001***			-0.001		
FXtools	use of FX instruments	0.415***			-0.140***		
IntDebt	1/financial development	-0.024***			0.036***		
|CA|	absolute current account	-1.608***			1.390***		
Panel observations		2'896			2'605		
Adjusted R^2		38.84%			71.02%		