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JEL Classification
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Determinants of Corporate Exchange Rate Exposure and Implications for Investors: Evidence from Chilean Firms

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August 31, 2010

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This paper investigates the impact of exchange rate fluctuations on the value of non-financial firms in Chile. Using a detailed dataset on firms' foreign activities, the potential determinants of the identified exposure are examined. Foreign exchange exposure depends on the levels of foreign currency debt and foreign currency assets. Levels of tradeables (exports and imports) do not explain exposure. Chilean firms attempt real hedges through matching foreign assets and income with foreign debt. Also firms use debt and liquidity to reduce exposure in addition to any possible derivative usage. Other firm characteristics which proxy for corporate hedging are not significant. Further, using a portfolio approach, it is demonstrated that for an investor holding exposed firms, exchange rate variations yield economically significant returns during periods of currency depreciation and appreciation.

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1 Introduction

Much recent effort has been spent examining whether and how exchange rates affect the value of the firm. Theory dictates that exchange rates should have an impact on firm value and it is a widely held view that fluctuations in exchange rates have significant consequences for financial decision making and firm profitability. Yet empirical evidence suggests that non-financial firms face limited levels of exposure irrespective of their engagement in international business or the level of competition faced. This has given rise to what as become known as the exchange rate *exposure puzzle* (see Bartram and Bodnar, 2007).

Despite the existence of a large literature examining exchange rate exposure, much of the evidence is limited to developed economies, particularly the U.S. While greater levels of exposure are typically identified in small open economies, e.g., Nydahl (1999), there is limited evidence on emerging markets especially those in South America. For example, Muller and Verschoor (2008) report significant exchange rate exposure for U.S. multinationals to Latin America (Argentina, Brazil, Chile and Mexico). Dominguez and Tesar (2006) include Chile in their analysis reporting that the number of both firms and industries which face significant exchange rate exposure is estimated to be lower than most of the developed nations in their sample, including Germany, Japan and the U.K. However in examining the determinants of exposure, Domniguez and Tesar (2006) are restricted to data on firm characteristics and foreign sales. Chue and Cook (2006) analyse levels of exchange rate exposure in Brazil, Chile, Columbia and Venezuela reporting that significant negative exposure in Brazil and Chile but this is limited to the early part of their sample and their analysis is based on a very small sample of firms in each country. Further Doidge et al. (2006) report basic estimates of exposure for firms in Argentina, Brazil, Chile, Columbia, Peru and Venezuela but do not provide any analysis of this estimated exposure.

Using a rich dataset containing detailed information about firms' foreign activities, this paper offers further evidence on the exposure puzzle from a key South American developing economy. The data provide information at the firm level on the amount of debt outstanding in foreign markets (foreign currency debt), the accounting value of assets hold abroad (foreign currency assets), income from the sale of goods in foreign markets (exports) and the cost of purchases of goods abroad (imports). This allows for richer empirical analysis than in the prior literature and enables us to contribute to the literature addressing deficiencies in a number of key ways. First the paper establishes the extent of exchange rate exposure faced by a large sample of non-financial firms in Chile. Second the determinants of this exposure are investigated. While prior research such as Dominguez and Tesar (2006) has examined the impact of tradeables (exports and imports) we additionally focus on levels of foreign currency debt and assets – i.e., we incorporate both financial and real activities.[1] Finally, the economic significance of the exposure to an investor is investigated using a portfolio approach.

Several key reasons justify the study of the exposure to exchange rate fluctuations in developing economies: first, developing economies have been part of an increasing globalization

[1]Among the 15 studies surveyed by Bartram and Bodnar (2007), none include simultaneously proxies of foreign activities from both sides of the balance sheet. He and Ng (1998), Doidge et al. (2006), Dominguez and Tesar (2006), among others document a positive significant correlation between firm specific exposure and a measure of foreign income or foreign assets, but without controlling for foreign liabilities. Only, Chue and Cook (2008) provide evidence of the amount of debt issued in international markets as a determinant of exposure.

of trade flows and financial flows; second, it is a well established empirical fact that developing economies experience higher macroeconomic volatility than developed economies and, in particular, exchange rates are more volatile; third, over the recent past, several central banks in developing economies have modified their exchange rate policy, passing from some form of sticky exchange rate (e.g., fixed, crawling peg) to a freely floating exchange rate; fourth, at the macro level, liability dollarization has been identified as one of the determinants of the sudden stop of credit flows towards developing countries, (see Calvo et al., 2004); finally, financial markets in developing economies typically have less depth than their counterparts in developed economies. Thus, for instance, the amount of financial hedging instruments, as currency options and futures, available to firms, is minimal. Considering all these elements, firms in developing economies are typically more vulnerable to exchange rate fluctuations.

We focus on non-financial firms in Chile, a small open economy with a relatively under-developed derivatives markets. Over the period of analysis, 2000-2006, average GDP per capita was U.S.$11,364. This compares with the U.S. with average GDP per capita of U.S.$40,407, and the U.K. with average GDP per capita of U.S.$31,014. This disparity is also seen in terms of market capitalization, the value of the Chilean market is of similar size to the entire economy while the U.S. and U.K. markets are both around 40% larger than their respective economies. Chile is also more "open" than both the U.S. and U.K. in terms of foreign trade. Measuring "trade openness" as the sum of exports and imports of goods and services as a share of the GDP, the level of openness in Chile was, on average, 69% compared with 25% in the U.S. and 56% in the U.K.[2] Derivatives markets in Chile are relatively under-developed. Forward contracts in the Chilean peso - U.S. dollar have traded since 1992, though the contractual requirements (e.g., higher trading costs, legal regulations) of the OTC market mean the market is restricted mainly to large exporters and importers, pension funds and commercial and investment banks. Small and medium enterprizes do not ordinarily participate. In 2007 the average daily turnover of the OTC derivatives market was U.S.$2 billion mostly in foreign exchange contracts.[3]

In terms of the exchange rate regime, since September 1999 the Central Bank of Chile has operated a free float exchange rate policy. Hence, in principle, for the entire sample period of this study, the exchange rate fluctuates freely according to market conditions. However in common with some of Chile's South American neighbors, though in less dramatic circumstances, the Central Bank has intervened on two occasions, August 2001 and October 2002, to protect the currency. On the first occasion the Central Bank sold reserves and issued dollar-indexed bonds in the local market to the value of U.S.$ 2800 million. On the second, the bank issued dollar denominated debt worth U.S.$ 1500 million. These two events aside, our sample represents a period of relative economic stability.

Several interesting results emerge from the analysis. First, at the firm level around 13% of the firms exhibit significant exchange rate exposure, whereas at the sector level this per-

[2]Hutson and Stevenson (2010) highlight the link between openness and exposure. Trade openness is the series 'openk' obtained from the Alan Heston, Robert Summers and Betina Aten, Penn World Tables version 6.3, Center for International Comparisons or Production, Income and Prices at the University of Pennsylvania. `http://pwt.econ.upenn.edu/php_site/pwt_index.php`.

[3]Fernandez (2006) provides greater detail and background on derivatives markets in Chile suggesting they lag behind those in Brazil and Argentina while Chan-Lau (2005) discusses the use of derivatives contracts in hedging foreign exchange risk in Chile. Further, Moguillansky (2002) examines the currency risk management practices of U.K. and Spanish multinationals operating in Chile, suggesting many multinationals struggle to hedge because of the weakness of the institutional framework, the levels of liquidity in turbulent periods and the lack of financial innovation in the derivative market for Latin American currencies.

centage increases to 30%. Most of the significant coefficients are negative, meaning that, on average, Chilean firms are seriously hurt by devaluations of the local currency. Second, foreign currency debt and foreign currency assets are the main determinants of a firm's exchange rate exposure. Exports and imports have no explanatory power and are not statistically significant. Thus, those firms holding foreign currency assets (debt) tend to experience an increase (decrease) in their market value after an exchange rate depreciation. This result is robust to control for the firm's liquidity, size and economic sector. The findings are consistent with suggestions that Chilean firms engage in currency matching to provide real hedges and that firms actively use foreign debt as a hedge (see Cowan et al., 2006; Kamil, 2009).

The portfolio analysis demonstrates that exchange rate variations have an economically significant. An investor holding a portfolio long in those firms with foreign currency assets or with income from exports activities, and short in those firms with neither foreign currency assets nor income from exports, will earn a positive statistically significant mean annual returns of around 3.6% during periods of exchange rate devaluations. Portfolios sorted on estimated exchange rate exposure also yield economically significant returns.

The remainder of the paper is organized as follows: in the next section, the dataset is described and descriptive statistics presented. Section 3 presents the analysis of firm-specific exchange rate exposure. The potential determinants of the estimated exposure are investigated in Section 4, examining whether variables that account for a firm's foreign activity, a firm's liquidity position, and other firm characteristics explain the observed levels of exposure. Section 5 presents the results of the portfolio approach to assess the economic significance of exchange rate exposure, and finally section 6 concludes.

2 Data and Descriptive Statistics

We obtain balance sheet and stock market data for a sample of 115 publicly traded non-financial firms over the period January 2000 to December 2006. These firms represent around 75% of the total market capitalization. The monthly closing stock price of each firm is obtained from the Economatica database. The macroeconomic data obtained from the Central Bank of Chile. The exchange rate is the nominal exchange rate between the US dollar and the Chilean peso, and the consumer price index (CPI) is used to deflate accounting variables.

The balance sheet data is obtained from the reports firms are required to submit to the government regulatory body, Super Intendencia de Valores y Seguros (SVS). Specifically each firm compiles a unified accounting sheet known as the Ficha Estadística de Clasificación Unica (FECU).[4] This provides detailed and standardized data on assets, liabilities and the income statement on a quarterly basis. The FECU does not provide detailed information about the currency composition of each item. Data on the amount of foreign debt and foreign assets held by firms are obtained from additional notes of the standard balance-sheet reports collected by the Central Bank of Chile. Data on the exports and imports of each firm are obtained from Prochile, a government entity in charge of registering any commercial transactions between local (foreign) sellers and foreign (local) buyers.

Table 1 reports descriptive statistics for the main variables used in the analysis of exposure in Section 3. 55.9% of firms in our sample hold foreign debt while 61.1% hold foreign assets.

[4]Unique Statistical Classification Sheet.

The average level of dollar-denominated assets held by firms in our sample is 9.9 percent of total assets, while the mean amount of dollar-denominated debt is slightly lower, 6.6 percent of total assets. In terms of tradeables, 43.2% of firms report export activity and 60.6% report import activity. Exports are on average 5.7 percent of total assets, while the level of imports is 4.7 percent of total assets. Naturally given many firms are not engaged in foreign trade the median values are close to zero. We adopt four variables to proxy for the firm's liquidity position: cash flow, the logarithm of the quick ratio, defined as short-term assets over short-term liabilities, coverage, defined as financial expenses over total profits, and the logarithm of current ratio, defined as the ratio between liquid assets and liquid liabilities. We also consider firm size and the market-to-book value.

3 Exchange Rate Exposure

To measure firm-specific exchange rate exposure we use the standard two factor model of Adler and Dumas (1984) and Jorion (1990). This augmented market model delivers a measure of conditional or residual exposure, i.e., it quantifies the firm-specifc exchange rate exposure after conditioning on the market return. In particular, the residual exposure will be the estimated coefficient, $\widehat{\beta}_2$, from the following regression

$$r_{it} = \alpha + \beta_1 r_{mt} + \beta_2 \Delta e_t + \varepsilon_{it} \tag{1}$$

where r_{it} is the stock return of firm i in period t, r_{mt} is the stock market return in period t, taken to be the return on the IPSA,[5] a value-weighted index commonly used in the Chilean stock market. Δe_t is the change in the nominal exchange rate between US dollar and Chilean peso in period t, and ε_{it} is a white noise error term.

3.1 Estimated Exposure

Table 2 presents the results obtained from the estimation of equation (1). The mean value of $\widehat{\beta}_2$ is negative, both at the firm level and the sector level.[6] At the firm level the average marginal exposure reaches a -0.154, while at the sector level it is higher, reaching a -0.223 in the equally-weighted portfolio, and -0.359 in the value-weighted portfolio. Median values are also of similar magnitude. However, the t-statistic shows that this relationship is, at least on average, statistically weak.

Consistent with the average exposure, most of the estimated marginal exposures are negatives. At the firm level, just 40 percent of the firms have a positive exposure, while at the sector level just 7 percent of the estimated sector exposures are positive. Thus, if any relationship exists between the exchange rate and the stock returns, it is negative in this sample of Chilean firms. A potential explanation for this phenomenon is that firms may hold a significant amount of unhedged foreign currency liabilities, that make them vulnerable in periods of local currency devaluation. We explore in detail the relationship between exposure and debt in foreign currency in Section 4.

[5] Indice de Precios Selectivo de Acciones. (Selective Stock Index Price)

[6] Details of the 14 sectors and the number of constituent firms are provided in an appendix.

The marginal exposure is significant in just 9.6 percent of the cases at the 5 percent level (11 firms), and 13.0 percent at the 10 percent (15 firms). At the sector level, 14.3% of the cases are significant at the 5 percent (2 sectors), and 21.4% percent at the 10 percent (3 sectors). Most of the firms or sectors with significant exposure have a negative coefficient. In particular, 50 percent of the firms with significant exposure have a negative exposure coefficient (4.7 percent of the firms in the sample), and all the sectors with significant exposure also have a negative exposure coefficient. These magnitudes are in line with other studies in developed countries. The survey by Bartram and Bodnar (2007) indicates that the majority of prior studies find significant exposures in just 10 to 25 percent of cases. Specifically, in the case of Chile, Doidge et al. (2006) report a significant exposure of 9.3 percent, with a mean positive coefficient, while Dominguez and Tesar (2006) report significant exposure in 14 percent of firms with around 43% positive coefficients (using the US$ exchange rate). Hence the magnitudes are quite similar, though both these two papers utilise data from the 1990s when a crawling peg exchange rate was in operation, suggesting that while there is no significant change in the level of observed exposure over time. Further the median firm-specific exposure is negative, consistent with Dominguez and Tesar (2006). This is contrary to Chue and Cook (2008) who suggest no evidence of exposure for their small sample post 2002. Finally, the inclusion of the exchange rate in the regression improves the fit of stock returns at the firm level (R^2 increases by 6.7 percent), and at the sector level (R^2 increases by 23 percent).

4 Determinants of Exchange Rate Exposure

In an attempt to try to explain exposure, we evaluate to what extent the firm specific exchange rate exposure is related to economic variables that account for foreign activity, the liquidity position and the economic sector of the firms. Previous empirical and theoretical studies have established a relatively consistent relationships between exchange rate exposure and proxies of these variables. Similarly we investigate which factors are potentially important determinants of either the direction or the magnitude of the exposure faced by Chilean non-financial firms, conducting both a univariate and a multivariate analysis.

The direction of exchange rate exposure, $\widehat{\beta}_2$, estimated in equation (1), or its magnitude, $\left|\widehat{\beta}_2\right|$, is regressed, in a cross-section fashion, over its potential determinants, X_i:

$$\widehat{\beta}_{2i} = \gamma + \delta X_i + \eta_i \quad (2)$$

$$\left|\widehat{\beta}_2\right| = \gamma + \delta X_i + \eta_i \quad (3)$$

where the right-hand side variables X_i are the mean values of the candidate explanatory variables over the sample period 2000-2006. The choice of determinants is driven by the prior literature, though as indicated in Section 2, the detailed data available provides for better proxies. Specifically we examine the role of foreign (dollar denominated) assets, foreign (dollar denominated) debt, exports, imports, whether the firm is from a tradeables sector, as well as a number of measures of the liquidity position of the firm, including cash flow, the quick ratio measured as short-term assets over short-term liabilities, the coverage ratio defined as

financial expenses over total profits and the current ratio defined as the ratio between liquid assets and liquid liabilities.

We also include three variables as proxies for corporate hedging. We include Leverage since more levered firms face a greater probability of financial distress and thus are more likely to engage in hedging to protect against this outcome. It follows that such hedging may also reduce the level of foreign exchange exposure faced by the firm. Size is included since evidence suggests that larger firms may be more likely to employ hedging policies which may reduce the levels of identified exposure, finally market-to-book, firms with higher levels of market-to book typically have more growth opportunities, hence may be expected to utilize hedging to a greater extent than other firms, consequently we might expect firms with higher market-to-book to have lower identified exposure due this hedging activity. Gezcy et al. (1997) and Allayannis and Ofek (2001) find that derivative use is positively related to size, leverage and market-to-book an negatively related to the quick ratio (liquidity). Bartram et al. (2009) confirm internationally that such firms are more likely to use derivatives.

4.1 Univariate Analysis

To provide comparison with previous studies (e.g. Dominguez and Tesar, 2006; Doidge et al., 2006) results of a univariate analysis are reported in Table 3. We consider as dependent variables both the direction and the magnitude of the estimated firm-specific exposure. From the univariate regressions there is no evidence that foreign activity explains the observed levels of exchange rate exposure. When the dependent variable is the direction of the exposure, only whether the firm belongs to a tradable goods sector has explanatory power, suggesting exposure is positive for these firms, and consequently firm value increases as the Chilean peso depreciates. This result seems intuitive considering that a large fraction of such firms, if not all of them, are exporters and so they should benefit from the competitive effect of devaluations. When sector dummies are also included, a measure of liquidity (cash flow) becomes significant.[7] Since firm liquidity operates as a hedge against adverse exchange rate movements it would be expected that greater liquidity would imply lower absolute exposure. It is less clear what it implies about the direction of the exposure, though given most firms face negative exposures again we would anticipate that low liquidity would imply higher negative exposure.

Considering the magnitude or absolute exposure, although estimated with the expected sign, none of the foreign activity measures are significant. Consistent with Bartram (2004), there is evidence that liquidity has a significant impact on absolute levels of exposure. In fact, the coefficient is negative and significant at 1% suggesting increased levels of cash flows reduced the observed level of firm specific exposure. Initially the coverage ratio also has explanatory power, though this implies that when financing is a higher ratio of profits, firms typically face (slightly) higher exposure. However this is industry specific and the inclusion of dummies accounts for this effect.

In either case, direction or magnitude, we observe no explanatory role for the proxies for corporate hedging, leverage, size or market-to-book. Hence it appears, that for Chilean non-financial firms exposure is explained largely by the firm's liquidity position. However, clearly examining the role of determinants individually is inappropriate, since the regressions are

[7]For all sectors which consist 6 or more firms, the sector dummy is statistically significant.

misspecified and suffer omitted variable bias. To provide a more robust analysis we therefore consider a multivariate analysis.

4.2 Multivariate Analysis

The richness of the data available here enables the relationship between firm specific foreign exchange exposure and the foreign activities of a firm to be investigated in a multivariate setting. This has two key advantages: first, it deals with any potential omitted variable bias present, by definition, in the univariate analysis, second, and more importantly, the findings of the prior literature are enriched since foreign activities on both sides of the balance sheet are controlled for simultaneously. It is possible distinguish between "financial" foreign activities and "real" foreign activities and identify which has the greater explanatory power. While previous studies have documented this positive significant correlation between exposure and foreign income or foreign assets (see, e.g., He and Ng, 1998; Doidge et al., 2006) they do not control for foreign liabilities. Similarly though Chue and Cook (2008) incorporate debt as a determinant, showing that those firms holding foreign debt reduce their value after an exchange rate depreciation, they do not control foreign income or foreign assets. Again we investigate the impact on both the sign and size of exposure. Also, given the importance and significance of the inclusion of sector dummies in the univariate analysis, we employ these dummies throughout.

4.2.1 Main Results

The central hypothesis is that firms involved in foreign activity should be particularly affected by variations of the exchange rates. In particular, those firms that hold foreign assets or are exporters should be positively affected by devaluations (a competitive effect), whereas firms holding dollar denominated debt or net importers should be negatively affected (a balance-sheet effect). Hence if these determining factors explain the observed levels of exposure, they should have significant and correctly signed coefficients. Table 4 presents the results.

The regression results show that financial variables (dollar assets and dollar debt) are significantly correlated with firm specific foreign exchange rate exposure, whereas the real variables (exports and imports) are not. One explanation for this result is that financial variables react instantaneously to any kind of shock, in particular, to unexpected changes in the exchange rate, so their accounting value will change faster than the changes of exports and imports, what involves the change of real good. Further while the impact of exchange rate fluctuations on financial variables is typically direct the impact on exports and imports is affected by pass through and price mark-ups.

Consistent with expectations dollar denominated foreign assets (debt) has a positive (negative) sign. As suggested by Cowan et al. (2005) Chilean firms actively attempt to lower exchange rate exposure by engaging in matching, offsetting exposure to foreign income and assets with foreign debt. This implies that, controlling for dollar denominated debt, a devaluation of local currency increases firm value for those firms holding foreign dollar denominated assets. On the other hand, for those firms holding foreign dollar denominated debt, holding assets constant, a devaluation of the exchange rate reduces their market value. Interestingly,

the estimates suggest that when controlling for both assets and debt, the effect of foreign liabilities is stronger than the effect of foreign assets. Thus, for a firm with the same amount of dollar denominated debt as assets, an exchange rate devaluation will yield a negative net effect on its exposure and value, after considering the effects on both sides of the balance sheet. These results highlight the significance of the balance sheet channel for exposure and its impact on firm value. This finding is also consistent with the literature that stresses the negative impact of dollar debt on a firm's investment decisions (Céspedes, Chang and Velasco, 2004).

In stark contrast to the ability to explain the sign or direction of exposure, virtually none of the variables have significant explanatory power over the size or magnitude of the observed exchange rate exposure.

4.2.2 Liquidity and Size effects

Bartram (2004) documents that liquidity negatively affects the magnitude of the exchange rate exposure since firms that hold liquid assets or cash have a natural hedge against adverse exchange rate movements and potential financial distress. In addition, Doidge et al. (2006) and Dominguez and Tesar (2006) find that larger firms typically have lower levels of exposure. This is consistent with the evidence that larger firms make greater use of financial hedging, thereby reducing exposure. Considering this evidence, in this subsection we extend the multivariate analysis to explore the effect of liquidity and size on firm specific exchange rate exposure in Chilean non-financial firms.

Table 5 reports the results of extending the basic multivariate regressions reported in Table 4 to include all foreign activity variables, then adding different proxies for a firm's liquidity position, firm size and growth opportunities. The first result of note is that the key finding reported in Table 4, is robust to the inclusion of the additional variables. Dollar denominated foreign debt and dollar denominated foreign assets still remain as the main determinants of firm specific exchange rate exposure. The "real" foreign activity variables exports and imports, though estimated with the expected sign, are not statistically significant. Again, leverage has no significant impact on estimated exposure.

In terms of explaining signed exchange rate betas, both cash flow and the coverage ratio are significant at the 10% level and have positive coefficients. Given the majority of firms face negative exposure, this suggests that exposure is higher for firms with low liquidity. Conversely, those firms with greater liquidity have a natural short-term hedge and subsequently have lower estimated firm-specific exposure.

The findings for absolute exchange rate betas are consistent with Bartram (2004). Cash flow liquidity is negatively signed and is highly significant. The sizeable coefficient suggests firms with large amounts of cash face much lower levels of exposure. The current ratio is also found to have significant (at 10%) explanatory power however the coefficient is positive suggesting,

In terms of the size variable we estimate a negative effect consistent with theory and previous research (e.g., Dominguez and Tesar, 2006) suggesting larger firms face smaller exposures (since those firms are more likely to be undertaking financial hedging) but the coefficient is not statistically significant. Similarly we find the coefficient on the market-to-book variable is correctly signed but is insignificant.

5 Evaluation based on a Portfolio Approach

To this point, we have demonstrated the extent of and investigated the determinants of corporate foreign exchange exposure. It appears that there exists some degree of exposure in Chile and that this is related to the financial activities of the firm. However is this of any significance for a portfolio manager? In other words, aside from statistical significance is there any economic importance to the identified exposures? To examine this, we follow the portfolio approach proposed by Doidge et al. (2006), to characterize the impact of exchange rates on firm value.

5.1 Basic Idea and Portfolio Construction

The portfolio approach is based on the idea that what really matters from a diversified investor's point of view, is not how a particular firm reacts to exchange rate variations, but how a group (or portfolio) of them reacts. Thus, an investor evaluates this relationship based on the returns she would obtain from an investment strategy that goes long in firms that, *a priori*, benefit from an exchange rate depreciation or appreciation, and goes short in those firms that are expected to suffer.

We perform the portfolio construction for each sorting variable in the following manner. In December of the previous year, firms are sorted according to a particular variable, for example, the amount of dollar assets held. Two portfolios are then formed. Those firms in the upper 20 percentile and those firms reporting zero for that particular sorting variable (i.e. no dollar denominated assets). In the case of sorts on the identified "marginal" firm specific exposure, the upper and the lower 20 percentile of firms are used to build the portfolios. We construct both equally weighted and value weighted sorted portfolios.

To examine the performance of the long-short strategy two holding period returns are calculated. The current return corresponds to the return yielded during the last month, i.e. a one-month holding period, and the one-year ahead return that assumes that the investor will be patient, and hold her strategy for a further eleven months.

In addition, two exchange rate regimes are defined in order to evaluate the investment strategy. In the first regime, a depreciation (appreciation) period occurs when the exchange rate depreciates (appreciates) more than one standard deviation.[8] In the second regime, a depreciation (appreciation) period occurs whenever the exchange rate depreciate (appreciate) irrespective of the magnitude of the change.

5.2 Results

5.2.1 Dollar assets, dollar debt, exports and imports sorted portfolios

Table 6 presents the calculated returns for different portfolio sorts. The columns headed Dollar Assets show the mean returns of both an equally weighted portfolio and a value weighted portfolio that goes long in the upper 20 percentile of firms sorted according to their

[8]The standard deviation is the unconditional standard deviation of the exchange rate over the entire sample period.

holding of dollar denominated assets, and short in those firms without dollar assets. The following columns show the same calculations for portfolios sorted on firm's holding of dollar debt, exports and imports activities. For the dollar assets sorted and export sorted portfolios, a positive return is expected during periods of a depreciation and a negative return during an appreciation. The opposite is expected for the dollar debt sorted and import sorted portfolios. In addition to presenting the average returns of the long-short strategy for both depreciation and appreciation periods, the results from a one-side mean difference test are reported. The mean difference test quantifies whether there is any statistical difference between the reported depreciation and appreciation returns. In the case of assets and exports (debt and imports) we test a null hypothesis that the difference is zero against the alternative that the difference in mean returns is positive (negative).

For many of the sorted portfolios there are sizeable differences in the returns earned during depreciations and appreciations. However only in a few cases the returns are of the expected sign and the difference between returns is significantly different from zero. When the regime is defined by a depreciation or appreciation at least one standard deviation in magnitude, for current one-period returns, one only portfolio, the equally weighted high dollar debt minus no dollar debt portfolio, generates a significant return of the expected sign between depreciations and appreciations. During a depreciation of the local currency, investors holding this portfolio obtain a negative monthly return of 0.5% whereas during periods of appreciation the portfolio earns a positive 1.5% return. An equally weighted portfolio built on firms with a high value of dollar denominated assets against those with no dollar denominated assets yields a 12 month ahead return of 3.6% during periods when the exchange rate depreciates by more than one standard deviation. During large currency appreciations this portfolio gives a return of -9.3%. For a value weighted portfolio the returns are 3.7% and -3.6% respectively. In both cases the one-sided mean difference test is significant at 10%, suggesting the difference in return between appreciations and depreciations is significantly positive for either portfolio. None of the other portfolio sorts yield significant results for year ahead returns, further the returns for these portfolios are not of the expected sign.

When the regime is simply classified by all depreciations and appreciations, there are some minor changes to the observed results. For portfolios formed on dollar denominated assets there is evidence of a significant difference in the mean returns for both current and year ahead returns. There is now also a significant difference (of the correct sign) in the mean depreciation and appreciation 12 month returns for a portfolio (whether equally or value weighted) formed on exports. The value weighted high dollar debt minus no dollar debt portfolio also yields a significant difference between the two returns however it is not of the expected sign.[9]

There is therefore clear evidence that portfolios formed on the various determinants of exchange rate exposure yield economically significant phenomenon, in the sense that an investor who cares about a group of firms, instead of a particular firm, may obtain significant returns following an investment strategy that goes long in firms that a priori should benefit, and go short in firms that should suffer, in a particular exchange rate regime.

[9] A two-sided means difference test clearly rejects the null hypothesis that the difference is zero.

5.2.2 Portfolios formed on exchange rate betas

Finally, having investigated the extent to which portfolios formed on the determinants of exposure yield economic significant returns, we turn our attention to portfolio sorted on the basis of the estimated firm-specific exchange rate exposure. Doidge et al. (2006) argue that the adoption of the estimated exchange rate exposure is potentially more valuable since it has a more direct link with theory than the determinants used in section 5.2.1 which act as proxies for international activity.

Clearly it would be inappropriate to examine the performance of the long-short investment strategy with portfolios formed using the full sample exposure estimates reported in section 3. Therefore, the exchange rate betas are estimated using data up to the December 2003 and the investment strategy returns are computed over the period 2004-2006. Similar the process for the determinants of exposure, firms are sorted according to their firm-specific exchange rate betas. An investment strategy is then defined which goes long in the upper 20^{th} percentile and short in the lowest 20^{th} percentile with the expectation that during an exchange rate depreciation, those firms with a positive beta increase their value, and those with a negative beta reduce their value. Thus, the long-short strategy should yield a positive return during depreciations, and a negative one during appreciations.

The final two columns of Table 6 report the results for the portfolio formed on exchange rate betas. Independent of the definition of regime, the mean current (one-period) returns are consistent with our prior expectations. The portfolio earns a positive 2.4% (equally weighted) or 2.9% (value weighted) return during one standard deviation exchange rate depreciations, and earns 2.0% and 2.7% respectively for all depreciations. Following appreciations the portfolio provides a negative 2.9% (equally weighted) or -2.0% (value weighted) return during one standard deviation exchange rate depreciations, and yields -1.9% and -1.0% respectively for all appreciations. In each case the difference between these mean returns is not only economically significant but also statistically significant.

All portfolios earn positive mean 12 month returns though, *a priori*, we would expect the return during an appreciation to be much lower than that during a depreciation. Indeed this is the case for the regime capturing all appreciations. During periods of an appreciating exchange rate the portfolio earns an average 12 month return of 3.3% (equally weighted) or 7.3% (value weighted). Similarly during a depreciation the portfolio yields returns of 12.5% and 20% respectively, producing a significant difference in the returns between depreciations and appreciations.

6 Conclusions

Though the exchange rate *exposure puzzle* is well documented, to date, there has been little evidence based on the economies of Latin America. The study of such developing economies is relevant considering that these economies are typically more exposed to macroeconomic volatility, and their financial markets exhibit less depth than their counterparts in developed economies, reducing the potential hedges that firms may take to cover their exposed positions. This paper addresses this shortfall and examines the impact of changes in exchange rates on the value of firms, using a sample of 115 Chilean publicly-listed non-financial firms. We document that a considerable number of firms face statistically significant levels of exposure,

13% of firms and 21% of sectors. Further, most of the estimated exposures are negative, meaning that on average, Chilean firms suffer during devaluations of the local currency. This is comparable with the findings reported by Dominguez and Tesar (2006) but in contrast to Doidge et al. (2006) who report largely positive exposure and the lack of exposure documented by Chue and Cook (2008). Yet the key contribution is to provide a detailed analysis of the determinants of this firm-specific exposure.

Using detailed firm level data providing information on the amount of firms' foreign currency assets, foreign currency debts, foreign income (exports) and expenses in goods bought abroad (imports) a comprehensive analysis of the estimated exposure is undertaken. Both financial and real foreign activity are investigated simultaneously with both sides of the balance sheet accounted for, something hitherto neglected in the literature. The results establish both dollar denominated debt and dollar denominated assets as the main determinants of exposure. Neither foreign income from export activity nor the value of goods imported by firms are statistically significant. The findings suggest that not only do Chilean firms use foreign debt to hedge exposure rather than use derivatives, employing matching strategies to provide real long term hedges, but that in many cases debt acts as a complement to the use of forwards contracts and not as a substitute. Further, firms with greater liquidity face lower levels of exposure, again suggesting firms have a natural hedge. There is no evidence that other firm characteristics linked to corporate hedging and derivatives usage have any explanatory power.

Finally, the evidence of firm-specific exposure is not only statistically significant, it is also economically significant. An investor holding a portfolio long in those firms with dollar denominated assets on the balance sheet or receiving income from export activity earns a significant positive return during periods of exchange rate devaluations. Further portfolios formed on the estimated firm-specific exchange rate exposure beta, yield significantly different returns during periods of appreciation and depreciation. The results suggest firms with high levels of exposure outperform (underperform) firms with low levels of exposure during periods of local currency depreciation (appreciation) by around 2-3% per month.

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Appendix

Sector	No. of Firms
Food, Beverage, Tobacco	25
Electricity	16
Commerce (wholesale retail , manufacturing, etc.)	13
Construction	12
Ocean Transport	11
Mining	10
Recreation Services and Education Services	7
Forestry	6
Telecommunications	6
Gas and Sanitary Services	3
Others	2
Railway and Highway Transport	1
Energy	1
Health	1
Conglomerates	1
Total	115

Table 1 : Descriptive Statistics

	Obs.	Mean	Median	Sd. Dev.	Min.	Max.
Dollar Asset	114	0.099	0.024	0.199	0.000	1.038
Dollar Debt	112	0.066	0.029	0.095	0.000	0.434
Exports	101	0.057	0.000	0.122	0.000	0.825
Imports	115	0.047	0.002	0.111	0.000	0.618
Total Debt (leverage)	115	0.315	0.336	0.195	0.000	0.847
Cash Flow	115	0.06	0.04	0.08	-0.03	0.31
ln (Quick Ratio)	115	-0.05	-0.01	1.42	-6.88	3.74
Coverage	113	-2.44	0.03	17.39	-171.00	22.87
ln(current)	115	0.46	0.40	1.22	-5.18	4.83
ln(Size)	107	13.68	13.50	1.68	9.48	17.43
ln (market-to-book)	107	0.25	0.19	0.82	-1.52	4.57

Note: Table reports descriptive statistics for the determinants of exchange rate exposure over the sample period 2000 -2006. Obs. is the number of firm observations for each variable.

Table 2 : Firm and Sector Level Exchange Rate Exposure

	Firms	Sectors	
		equally-weighted	value-weighted
Mean Value	-0.154	-0.223	-0.359
Median Value	-0.141	-0.184	-0.373
Mean Absolute Value	0.597	0.283	0.380
t-statistic	-0.205	-0.663	-1.035
Positive	41.7%	21.4%	7.1%
Significant at 5%	9.6%	0.0%	14.3%
Significant at 10%	13.0%	7.1%	21.4%
Significant at 5% & Positive	4.4%	0.0%	0.0%
Significant at 10% & Positive	4.4%	0.0%	0.0%
Δ% Average Adj. R^2	6.7%	-11.9%	23.0%
No. of Firms / Sectors	115	14	14

Note: Table reports results of the estimation of exchange rate exposure, β_2 in the equation $r_{it} = \alpha + \beta_1 r_{mt} + \beta_2 \Delta e_t + \varepsilon_{it}$ for the sample of 115 non-financial firms and 14 industry sectors over the period 2000 to 2006.

Table 3 : Univariate Analysis of Exchange Rate Exposure

Dependent Variable	Direction		Magnitude	
Dollar Assets	0.769	0.593	0.403	0.468
	[0.532]	[0.500]	[0.321]	[0.299]
Dollar Debt	-0.310	-0.705	-0.538	0.193
	[0.680]	[0.476]	[0.573]	[0.385]
Exports	0.949	0.758	0.106	0.156
	[0.779]	[0.764]	[0.424]	[0.388]
Imports	0.519	0.214	-0.383	-0.138
	[0.484]	[0.575]	[0.365]	[0.415]
Tradeable	0.458	0.492	-0.028	0.089
	[0.188]**	[0.283]*	[0.160]	[0.211]
Liquidity (Cash Flow)	1.508	1.828	-2.525	-1.738
	[1.095]	[0.913]**	[0.910]***	[0.637]***
Liquidity (Quick Ratio)	0.136	0.069	-0.057	-0.055
	[0.093]	[0.069]	[0.082]	[0.057]
Liquidity (Coverage Ratio)	0.002	0.004	0.002	0.001
	[0.002]	[0.003]	[0.001]**	[0.002]
Liquidity (Current Ratio)	0.104	-0.026	0.111	0.13
	[0.103]	[0.120]	[0.087]	[0.103]
Leverage	-0.123	-0.036	-0.112	0.145
	[0.335]	[0.422]	[0.235]	[0.276]
ln(Size)	0.023	-0.039	-0.076	-0.043
	[0.071]	[0.045]	[0.062]	[0.036]
ln(Market-to-Book)	-0.118	-0.062	0.039	0.026
	[0.135]	[0.131]	[0.122]	[0.119]
Sector Dummies	No	Yes	No	Yes

Note: Table reports results of the determinants of exchange rate exposure, $\hat{\beta}_2$ (direction) or $|\hat{\beta}_2|$ (magnitude) in the equation $\hat{\beta}_{2i} = \gamma + \delta X_i + \eta_i$ or $|\hat{\beta}_{2i}| = \gamma + \delta X_i + \eta_i$ where X_i is one of the candidate explanatory variables for the sample of 115 non-financial firms over the period 2000 to 2006. Heteroscedasticity robust standard errors are reported in brackets. * significant at 10%, ** significant at 5% and *** significant at 1%.

Table 4 : Multivariate Analysis of Exchange Rate Exposure

Dependent Variable	***Direction***						***Magnitude***					
Dollar Assets	1.258		0.467		0.904	0.976	0.303		0.804		0.443	0.48
	[0.378]***		[0.625]		[0.371]**	[0.422]**	[0.332]		[0.248]***		[0.307]	[0.339]
Dollar Debt	-1.220			-0.791	-1.704	-1.964	0.062			0.200	0.164	0.031
	[0.516]**			[0.468]*	[0.695]**	[0.809]**	[0.395]			[0.385]	[0.479]	[0.588]
Exports		0.798	0.645		1.064	1.01		0.23	-0.008		0.087	0.059
		[0.791]	[0.787]		[0.703]	[0.686]		[0.392]	[0.405]		[0.424]	[0.415]
Imports		-0.199		0.561	0.219	0.206		-0.372		-0.047	-0.149	-0.155
		[0.697]		[0.529]	[0.613]	[0.620]		[0.493]		[0.394]	[0.438]	[0.438]
Leverage						0.327						0.168
						[0.486]						[0.369]
Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N° Obs.	111	101	100	112	98	98	111	101	100	112	98	98
R^2	0.23	0.22	0.22	0.21	0.25	0.26	0.23	0.23	0.25	0.23	0.24	0.24

Note : Table reports results of the determinants of exchange rate exposure, $\hat{\beta}_2$ (direction) or $|\hat{\beta}_2|$ (magnitude) in the equation $\hat{\beta}_{2i} = \gamma + \delta_j X_{ij} + \eta_i$ or $|\hat{\beta}_{2i}| = \gamma + \delta_j X_{ij} + \eta_i$ where X_{ij} are the competing explanatory variables for the sample of 115 non-financial firms over the period 2000 to 2006. Heteroscedasticity robust standard errors are reported in brackets. * significant at 10%, ** significant at 5% and *** significant at 1%.

Table 5 : Multivariate Analysis of Exchange Rate Exposure

Dependent Variable	*Direction*						*Magnitude*					
Dollar Assets	1.108	0.819	0.980	1.025	0.822	0.870	0.334	0.477	0.479	0.206	0.359	0.286
	[0.471]**	[0.383]**	[0.420]**	[0.450]**	[0.350]**	[0.370]**	[0.305]	[0.352]	[0.342]	[0.354]	[0.286]	[0.305]
Dollar Debt	-1.757	-1.983	-2.204	-1.987	-2.008	-2.257	-0.196	0.030	0.073	0.160	0.927	0.745
	[0.810]**	[0.852]**	[0.791]***	[0.797]**	[0.792]**	[0.731]***	[0.606]	[0.592]	[0.576]	[0.548]	[0.579]	[0.576]
Exports	0.683	1.037	1.028	1.034	0.767	0.779	0.417	0.059	0.055	-0.073	-0.418	-0.120
	[0.652]	[0.684]	[0.654]	[0.709]	[0.710]	[0.681]	[0.476]	[0.425]	[0.418]	[0.407]	[0.519]	[0.400]
Imports	-0.246	0.122	0.217	0.251	0.093	0.163	0.341	-0.156	-0.157	-0.407	-0.344	-0.266
	[0.696]	[0.628]	[0.611]	[0.637]	[0.600]	[0.689]	[0.506]	[0.443]	[0.440]	[0.428]	[0.391]	[0.509]
Leverage	0.184	0.676	0.290	0.201	0.544	0.748	0.325	0.173	0.175	0.870	-0.022	-0.336
	[0.501]	[0.576]	[0.484]	[0.750]	[0.424]	[0.465]	[0.380]	[0.437]	[0.374]	[0.603]	[0.299]	[0.352]
Liquidity	2.178						-2.394					
(Cash Flow)	[1.100]*						[0.861]***					
Liquidity		0.139						0.002				
(Quick Ratio)		[0.127]						[0.103]				
Liquidity			0.020						-0.003			
(Coverage Ratio)			[0.011]*						[0.009]			
Liquidity				-0.054						0.300		
(Current Ratio)				[0.188]						[0.156]*		
ln(Size)					-0.003						-0.069	
					[0.064]						[0.053]	
ln(Market-to-Book)						-0.182						0.189
						[0.256]						[0.240]
Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N° Obs.	98	98	98	98	91	91	98	98	98	98	91	91
R^2	0.27	0.27	0.27	0.26	0.19	0.20	0.27	0.24	0.24	0.34	0.15	0.16

Note : Table reports results of the determinants of exchange rate exposure, $\hat{\beta}_2$ (direction) or $|\hat{\beta}_2|$ (magnitude) in the equation $\hat{\beta}_{2i} = \gamma + \delta_j X_{ij} + \eta_i$ or $|\hat{\beta}_{2i}| = \gamma + \delta_j X_{ij} + \eta_i$ where X_{ij} are the competing explanatory variables for the sample of 115 non-financial firms over the period 2000 to 2006. Heteroscedasticity robust standard errors are reported in brackets. * significant at 10%, ** significant at 5% and *** significant at 1%.

Table 6 : Portfolio Analysis based on a Long-Short Strategy

FX Regime 1		***Portfolio built on:***									
		Dollar Asset		***Dollar Debt***		***Exports***		***Imports***		***FX Beta***	
		Equal	Value	Equal	Value	Equal	Value	Equal	Value	Equal	Value
Stock Return											
Current	Depreciation	-0.00693	0.0005	**-0.00503**	0.0134	0.00315	0.01153	0.00295	-0.0039	**0.0235**	**0.0291**
	Appreciation	0.00363	-0.0154	**0.01995**	-0.0018	0.00581	-0.00596	-0.0014	-0.0048	**-0.0286**	**-0.0202**
	P-value	0.49	0.15	**0.06**	0.85	0.56	0.17	0.62	0.52	**0.00**	**0.01**
Year Ahead	Depreciation	**0.03619**	**0.03666**	-0.04156	-0.0157	0.0410	0.01647	-0.0154	-0.0001	0.10776	0.1998
	Appreciation	**-0.09344**	**-0.03639**	-0.07256	0.0026	0.0165	0.0147	-0.1324	-0.0566	0.2256	0.1728
	P-value	**0.02**	**0.07**	0.70	0.32	0.40	0.49	0.91	0.83	0.83	0.39

FX Regime 2		***Portfolio built on:***									
		Dollar Asset		***Dollar Debt***		***Exports***		***Imports***		***FX Beta***	
		Equal	Value	Equal	Value	Equal	Value	Equal	Value	Equal	Value
Stock Return											
Current	Depreciation	0.00004	**0.0061**	0.00183	0.01127	0.0057	0.0039	0.0000	-0.0051	**0.02032**	**0.02698**
	Appreciation	-0.00473	**-0.0125**	0.0014	-0.01193	0.0001	-0.0030	-0.0118	-0.0041	**-0.01883**	**-0.0098**
	P-value	0.28	**0.03**	0.51	0.99	0.24	0.23	0.94	0.45	**0.00**	**0.00**
Year Ahead	Depreciation	**-0.01178**	-0.0012	-0.0459	-0.0003	**0.0597**	**0.0309**	-0.0576	-0.0129	**0.12549**	**0.1997**
	Appreciation	**-0.06443**	-0.04518	-0.0357	0.0173	**-0.0201**	**-0.0434**	-0.1141	-0.0375	**0.0334**	**0.0729**
	P-value	**0.05**	0.14	0.37	0.21	**0.05**	**0.07**	0.88	0.76	**0.06**	**0.00**

Note : In FX Regime 1, a depreciation (appreciation) is a period where the exchange rate depreciates (appreciates) more than 1 standard deviation. In FX Regime 2, a depreciation (appreciation) occurs when the exchange rate depreciates (appreciates) during that month. Stocks returns are calculated from an investment strategy that goes long in those firms in the upper 20th percentile according to a particular sorting variable, and short in those firms in the lower 20th percentile. The current return is the return between period t and t-1, and the year-ahead return is the return between t+11 and t-1. Equal (Value) refers to the fact the portfolio is an equally (value)-weighted portfolio. P-value is the p-value of a one-side mean difference test with unequal variances. FX Beta is the estimated exchange rate exposure, β_2, in the equation $r_{it} = \alpha + \beta_1 r_{mt} + \beta_2 \Delta e_t + \varepsilon_{it}$. Values in bold type are statistically significant at at least 10%.