DIVERSITIES OF EXCHANGE RATE EXPOSURE IN EMERGING MARKETS[1]

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Abstract

This study is one of the few attempts to directly estimate the exposure of real sector firms from an emerging economy. The estimates based on a sample of Turkish manufacturing firms reveal a positive but lagged exposure to real exchange rate depreciation. The foreign sales ratio is found to be the most important positive determinant of exposure. However, foreign debt and other foreign non-financial liabilities make negative contribution to exposure. This indicates that measurable exposures are not easily hedged because of the missing derivative markets. Finally, the two groups of firms, exporters and competitive, are found to gain from real depreciation while the import competing and less competitive firms are found to lose from real depreciation.

Keywords: Exchange rate exposure, firm value, emerging markets, currency derivatives, industry structure

JEL Classification: F30, G30, L1

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1. Introduction

Exchange rate exposure is broadly defined as the sensitivity of firm value to exchange rate changes[2]. The exposure occurs as the unexpected exchange rate changes alter the firm's market value by changing the expected cash flows in its home currency. Changes in the expected cash flows can in turn be traced back to two basic sources: those from the value of net monetary assets held in foreign currency and those from the value of real assets located both in domestic economy and abroad. The former class includes not only the pure foreign monetary assets with fixed nominal returns (e.g., bonds, shares, etc.) but also nominal contracts fixed in foreign currency (e.g., receivables and payables)[3]. The exposures related to this class of assets are respectively referred to as translation and transaction exposures. The translation and transaction exposures may actively be managed through various covering instruments known as hedging. The latter class includes the real assets of all types of firms from purely local producers (e.g., utilities) to import competing and to sole exporting producers (e.g., multinationals). All types of firms are potentially exposed because their real assets are influenced by the resulting changes in fundamentals such as (domestic and foreign) demand, cost of imported inputs and market competition. The exposure related to the changes in these variables is referred to as economic exposure, and it may not be covered through hedging activities.

Firms from emerging economies face a potentially higher degree of exposure compared to those in advanced economies. This is due to fact that most of hedging instruments available in advanced financial markets are not available for firms of emerging markets. For instance, many of the formal foreign exchange derivatives even swaps are not operational in Turkey, whose currency is not traded and not a part of these hedging

[2] See, e.g., Adler and Dumas (1984), Booth and Rotenberg (1990), and Jorion (1990).

[3] Domestic currency counterparts of these items are not the subject of exchange rate exposure.

activities, except the few special contracts between the central bank and commercial banks and between large holdings and their banks[4]. Similarly, foreign currency debt that is generally considered to be a natural hedge may be value-reducing if short positions are considered to be unsustainable after a period of optimism that leads to over-borrowing, a frequent cycle in many emerging economies prone to foreign currency crises. Therefore, even transaction and translation exposures may not be easily hedged.

Another peculiarity of the exposure of firms in emerging economies derive from the fact that these firms are usually price-takers in international trade and have little power to pass through the changes in exchange rates to foreign buyers. That is, limited influence of these firms on international prices and limited pass-through capacity may amplify their exposure[5]. Firms facing a high foreign competition (and demand elasticity) in local markets are thus expected to have a high exposure. Price-taking position does not however mean that domestic currency prices of goods sold in domestic and foreign markets are the same. In contrast, a large differential between the two prices can arise depending on the direction of deviations from purchasing power parity (PPP) and intensity of competitions in foreign versus domestic markets. For instance, in times of real appreciations exporters can be more aggressive and eager for price cuts in foreign markets. Similarly, exporter can compensate revenues losses in foreign markets by increasing margins in domestic markets whereby competition is relatively softer (due to protection or market structure). More important, volatile real exchange rates (owing to volatile inflation and/or nominal exchange rates) in developing countries like Turkey may themselves impinge on exposure by changing the present and future cash flows in domestic currency.

[4] However, cross currency hedging (i.e., between two foreign currencies) is always possible via international markets but this provides no coverage for domestic visa viz foreign currencies.

[5] It is a general conclusion that low pass-through is associated with high exposure and vise versa (Bodnar et al. (2000) and Marston (2001).

This paper is one of the few attempts to directly measure the exposure in an emerging market at the firm-level. The empirical analysis is based on a self-constructed data set that consists of 52 Turkish manufacturing firms from the three major industries of textile, machinery and food. Categorical differences based on criteria such as foreign market involvement and industry competition are also investigated. The data set is in quarterly (highest disclosure) frequency and covers the 1998-2001 periods only for which the relevant footnote information on foreign operations is available.

The exposure estimates based on a two-factor capital asset pricing model yields basically the followings. First, the exposure observed is not contemporaneous but lagged and positive in real depreciation. Second, the foreign sales ratio is the largest positive determinant and foreign currency debt is the largest negative determinant of exposure. Foreign non-financial liabilities ratio is the second largest negative determinant. The competitiveness and informal hedging make statistically marginal contribution to exposure.

2. A selective review

Shapiro (1975) presents the first formal analysis wherein foreign exchange exposure is determined as a function of three factors: the degrees of export sales, domestic competition and substitution between domestic and imported inputs. Recent research adds the type of competition (Marston (2001)) and operational and financial hedging activities (Allayannis and Ofek (2001), Allayannis et al. (2001)) as the determinants of the exposure. To stress role of the degrees of allocation of production and financial hedging the term 'net' exposure is adhered to (Williamson (2001)).

Most of the previous exposure models studying the effect of exchange rate shocks on firm value are based on the assumption of monopolistic competition. The basic implications in these models are that the net foreign revenue is the primary determinant of

the exposure and that the elasticity of the firm's product is irrelevant. The monopolistic firm is also expected to display a high ability to pass cost increases through to customers and thus a small and probably undetectable exposure. Moreover, given the export ratio, the exposure of monopolistic firm can easily be predicted and managed through financial instruments.

The exposure models that are based on a more competitive oligopolistic setting find the elasticity as a second important determinant of the exposure[6]. The elasticity in turn is determined by the substitution between the products by the domestic (exporting) firm and foreign (importing) firm. As a result, oligopolistic firms are expected to display low pass-through and thus greater exposure than monopolistic firms.

The exposure is expected to be a negative function of the costs denominated in foreign currency because the latter is a part of the net foreign currency revenue. The exposure of an exporting firm deceases with its ratio of foreign costs to revenue, given the standard assumption that foreign costs are smaller than foreign revenues.

A review of the theory thus identifies a set of real and financial operations as the potential determinants of exposure: foreign sales, competitive structure, distribution of costs and production, and foreign currency positions (both financial and non-financial) and hedging possibilities. Firms from every category, including large multinationals, small exporters and import competitors, can be exposed as their expected cash flows and therefore values are altered through any of the determining factors.

The present empirical analysis is based on a sample of firms with varying foreign market involvement measured by their foreign sales ratios, which ranges between 2 and 91

[6] A two-country and two-firm model wherein each firm produces a heterogeneous product and sells it in either of the countries is the underlying model. The exporter has to compete both in domestic and foreign markets, and thus the exposure becomes a function not only of its foreign revenues but also the two relevant elasticities, the elasticity of its own product (price elasticity of demand) and its competitor's product (cross elasticities of demand).

% on average. That is, the sample includes both primarily exporting firms with the foreign sales ratio close to hundred percent, primarily import competing firms with the foreign sales ratio close to zero, and firms in between. A categorization based on the foreign sales ratio is critical because it allows contrasting exposures across different categories. However, categorizing according to distribution of costs and productions is not possible because no useful information on domestic versus foreign currency expenses and on domestic versus foreign production is reported in balance sheets. This lack of data does not also allows us to calculate separate demand elasticities in domestic and foreign markets and thus to distinguish between the competitive structures in these two markets[7]. Only a common price elasticity of demand, calculated from the operational price-cost margin, is used to represent the overall competition.

Two additional determinants of exposure, which are peculiar to emerging market firm, are considered. These are the net foreign currency payables (net transaction position) and an informal instrument for foreign currency hedging. Short transaction positions in foreign currency, though easily predictable, may not be fully covered because formal foreign currency derivatives are not available in Turkey as in many emerging markets[8]. This fact leaves no choice but find informal instruments of hedging. Potential informal instruments are the foreign currency holdings, foreign currency debt and other indirect (domestic currency) instruments such governments bonds and papers[9]. Indirect instruments provide coverage for foreign currency risks through the risk-free real interest rate returns that can be easily converted into foreign currency (Kaufold and Smirlock (1986)).

[7] This amounts to assuming a unique profit margin in domestic and foreign markets.

[8] More precisely, most of these instruments are formally available but the markets are not functioning because the Lira is not accepted as an international currency, that is, the Lira side of the market is missing.

[9] Only recently, limited amount of government bonds denominated in foreign currency (foreign currency indexed bonds) are available but these are mostly held by banks rather than the nonfinancial sector.

Investments in government papers (for short-term hedging) and government bonds (for longer-term hedging) are the indirect instruments considered.

Foreign currency debt is generally considered as a natural hedge and firms are expected to use this financing parallel with their foreign market involvement and thus to reduce the currency risk (Goswami and Shrikhande (2001)). However, owing to frequent cycles of overvaluations and currency crises whereby foreign financing is initially motivated, foreign debt may be increasing the foreign exchange risk rather than serving as a natural hedge in emerging markets. Apriori, exchange rate exposure is expected to be positively related to the foreign sale ratio and available hedging instruments, negatively related to the elasticity and transaction position, but ambiguously related to foreign currency debt.

Some notable findings from previous empirical research, which exclusively focus on advanced countries[10], are as follows. First, the lagged exposure can be stronger than the contemporaneous exposure (Jorion (1990) and Bartov and Bodnar (1994)) and exposure is more detectable in the longer-run data (Chow et al. (1997) and Dominguez and Tesar (2001b). Second, the foreign sales ratio is a common determinant of exposure when it is found to be significant (Bodnar and Gentry (1993)) but firms with no material foreign assets, revenues or debt may well be exposed (Booth and Rotenberg (1990)). Third, intra-industry competition is an important determinant (Williamson (2001), Allayannis and Ihrih (2000) and Griffin and Stulz (2001)) and financial and operational hedging reduces exposure (Allayannis and Ofek (2001) and Gao (2000)).

[10] One exceptional paper on emerging economies we encountered is Chiao and Hung (2000) on Taiwanese exporting firms. The paper considers only exports and (long-term) foreign debt among the above theoretically articulated determinants of exposure. It finds a significantly positive effect of the export ratio but no significant effect of foreign debt ratio. A second relevant paper is Allayannis et al. (2001), which focus on the management of exchange rate risk in a group of East Asian countries.

3. Statistical analysis

3.1. Construction of data set

The data set is self-constructed and consists of 52 publicly traded Turkish manufacturing firms from the three major industries of textile, machinery and food[11]. A prior decision for the firms to be included is about the industries. We have chosen three different but representative industries, namely, the textile (21 firms), machinery (19 firms), and food (12 firms) as an adequate mix of exporting and import competing industries. This will also enable us to distinguish the exposure across industries. The number of firms and the time period is dictated by the availability of relevant footnotes information on especially the foreign currency debt and foreign currency receivables/payables. These footnote information are available only after 1998 for 52 firms from the three industries.

The data frequency is an important point of concern in exposure estimation. The tendency is to use lower frequency data in which exposure is believed to be more detectable. The reason is the noise in high frequency observations in especially exchange rates relative to the persistence of low frequency movements[12]. Moreover, exposure is expected to be independent of the time horizon in theoretical models that assume market efficiency and complete information. That is, in all horizons, the impact of (observed and expected) exchange rate changes on the current and future cash flows are incorporated in the current stock prices (see, among others, Dominguez and Tezar (2001a) and Bodnar and Wong (2000)). In parallel with the current trend, we constructed the data set at quarterly horizon that is believed to be sufficient if not optimal. It covers the 1998.1-2001.3 period and has therefore a panel dimension of 52x15.

[11] The data set, constructed from the scratch since databases such as the Compustat in the USA or Exstat in the UK are unavailable, includes both the market and balance sheets variables.

[12] This is however contrary to the common practice of using monthly data, which was inherited from the original empirical asset pricing literature.

Another compelling reason that motivated the construction of the data set at quarterly frequency has to do with the estimation methodology adopted. As will be explained, there are two alternative procedures to ultimately estimate the determinants of exposures. These are the one-step (direct) and two-step (indirect) procedures that have quite different statistical properties. Although widely adopted, the two-step procedure, which runs a regression of exposures betas from the first stage estimation on a set of determinants, is usually problematic because of the potential correlations across betas and thus across the error terms. The alternative direct procedure does not involve this statistical problem because it directly incorporates the set of determinants as interaction terms in the first stage of estimation. This of course requires a data set that has sufficient observations and a unique frequency. To implement this second procedure we have chosen the quarterly return horizon that is the highest disclosure frequency for balance sheets.

The choice of the proxy for market return in empirical tests is another concern. Previous empirical works overwhelmingly use country specific market returns although a global portfolio return might be more appropriate in a world of highly integrated capital markets. Another concern is the weighting of the specific proxy chosen for market return, be it value-weighted or equal-weighted. The value-weighting might underestimate the exposure coefficient as it removes the negative cash flow effects of larger firms that dominate the market portfolio (Bodnar and Wong (2000)). Smaller local or import-competing firms might easily avoid the negative cash flows. However, Dominguez and Tesar (2001a, 2001b) present evidence based on an international data set that conditioning on the value-weight versus the equally-weighted market portfolio has no discernable effect on exposure coefficient. We principally use the largest published market index, namely, the capitalization-weighted national 100 firms index.

A final point of discussion relates to the choice of the exchange rate index. A variety of indexes from the end of month bilateral to the average trade-weighted indexes are used in empirical exposure studies. We do not embark on these methodological discussions, but take a practical approach in deciding on the type of indexes to be used. We prefer to basically use the published capitalization-weighted share prices and end of month bilateral (US dollar) exchange rate indexes. This preference is based on the cross-country evidence by Dominguez and Tesar that the exposure estimates are not seriously affected by the weighting of market portfolio and that the trade-weighted exchange rate index leads to underestimation. More important, as emphasized by Griffen and Stulz (2001), the bilateral exchange rate index helps to better uncover the competitive effect of industry. However, we will also experiment with the equal-weighted share prices and trade-weighted exchange rate indexes to see if the results are sensitive to choice of alternative indexes.

We now present some relevant statistics for each industry and for the manufacturing panel. The textile industry has the highest foreign sales and foreign debt ratios, followed by the food and machinery industries. Similarly, the ratios of the contract in foreign currencies (receivables and payables) are the highest in the textile industry, but now followed by the machinery and food industries. Moreover, the textile industry is the most suffered one from the drastic decline in the real stock returns. The real returns on the exchange rate stayed positive and much more stable (with the standard deviations of 6 % versus 32 %) over the sample period. The final observation from Table 1 is about the preliminary exposure statistics. Parallel with the other figures of foreign involvements, the textile industry has again the highest coefficient.

Table 1: Descriptive statistics on exposure in the Turkish manufacturing*				
	Individual industry			Total manufacturing
	Textile	Machinery	Food	
Foreign/total sales ratio	0.51	0.24	0.40	0.39
Foreign payables/total sales ratio	0.21	0.16	0.08	0.16
Foreign receivables/total sales ratio	0.23	0.17	0.11	0.18
Foreign currency debt/total assets ratio	0.33	0.22	0.30	0.29
Foreign currency assets/total assets ratio	0.02	0.05	0.03	0.03
Lerner index[a]	4.02	3.96	5.45	4.33
Real stock return	-0.20	-0.16	-0.12	-0.16
Real exchange rate return	0.01	0.02	0.03	0.02
Real market return[b]	-0.10	-0.10	-0.10	-0.10
Exposure beta[c]	0.10	0.07	0.08	0.09

*Figures are based on a sample of 52 firms; 21 from the textile, 19 from the machinery, and 12 from the food industries over 1998-2001. Note that the returns in this quarterly data set are not annualized.

[a]Lerner index is calculated as the reciprocal of the operational price cost margin, (sales-costs)/sales.

[b]Based on the broadest domestic market (value-weighted) index of 100 traded firms.

[c]The correlation coefficient between the real stock return and real exchange rate return.

3.2. Estimation

A prior decision is whether the variables should be expressed in nominal or real terms. In the high inflationary environment of Turkey, the inflation is volatile and it needs to be treated as random. This requires using the real returns on exchange rates and asset prices in regressions, and thus measuring the exposure in real terms. The wholesale price index is used to convert the nominal returns into real returns.

The basic estimating equation is a two-factor CAPM written as

$$R_{it} = \beta_{0i} + \beta_{1i} R_{mt} + \beta_{2i} R_{st} + \varepsilon_{it}, \qquad (1)$$

where R_i, R_m and R_s are respectively the real returns on stock i, market portfolio and the exchange rate. A positive value for R_i indicates a real depreciation (of the Lira) since the exchange rate is measured as the Lira price of the foreign currency. Firms and/or industry characteristics are not considered because our aim is not to model the dynamics of exposure but rather to estimate the average exposure. Basically, fixed-effects panel and GLS estimation methods are adopted. Prior Hausman tests were performed to justify fixed-versus random-effects methods[13]. The tests, assessing the efficiencies of estimators by comparing the resulting variances, favor the use of fixed-effects method[14]. The GLS method is based on cross-sectional weights. The estimators are heteroskedasticity consistent as the covariance matrix is corrected for within cross-section heteroskedasticity. In addition, for some dynamic versions of the model (those on the lagged exposure, to be explained below) a GMM estimation method based on the orthogonality condition is tried to detect potential estimation biases.

Three different coefficients of exposure from equation (1) are obtained by including different specifications of the exchange rate variable. First, in line with the literature, contemporaneous and lagged exposure coefficients are separately estimated. Second, an average exposure coefficient based on a weighted average of exchange rate variable is

[13] The random-effects approach, subjecting the residuals from the fixed-effects to a randomness check through some arbitrary weighting, may sometimes be very restrictive and therefore not preferred. See, e.g., Hsiao (1986).

[14] The tests, not presented but can be obtained upon request, are based on the statistic,

$$(\beta_{fe} - \beta_{re})' \left[Var(\beta_{fe}) - Var(\beta_{re})\right]^{-1} (\beta_{fe} - \beta_{re}),$$

where β_{fe} and β_{fe} are the vectors of respectively the fixed and random-effects parameters. The null is the random-effects model. Under the null hypothesis, both the random-effects and fixed-effects estimators are consistent and random-effects model is efficient. Therefore, a large Wald measure with χ^2distribution weighs against the null (random-effects) in favor of the alternative (fixed-effects) model. We calculated the Hausman test statistics for the complete samples in the first and second stage estimations (option D in Table 2 and the all-firms category in Table 3).

estimated. The average exposure coefficient, besides some statistical advantages over alternative dynamic specifications as explained below, combines both the contemporaneous and lagged effects and gives a net measure of exposure. Moreover, each of the three coefficients of exposure is obtained for four different categories of samples. The distinguishing criteria are foreign sales, competition, industry classification, which are widely discussed in the theoretical and empirical literature. Table 2 presents the estimates of three different parameters of exposure under four categories of samples from A to D, as well as the numbers of significantly exposed firms in each categories.

Table 2: Core exposure model; testing for degree of exposure					
Sub-category	Exposure coefficient			No of significant at 5 %[c]	
	Current	Lagged[a]	Average[b]	+ /Sample	- /Sample
A. Foreign sale					
High foreign sales firms	0.25****	1.50*	3.78*	10/30	1/30
Low foreign sales firms	-0.20****	1.85*	0.54****	3/22	3/22
B. Competitiveness					
More competitive firms[d]	-0.02****	1.50*	2.23*	11/31	4/31
Less competitive firms[e]	0.04****	1.96*	2.15*	4/21	1/21
C. Industry type					
Textile industry firms	-0.12****	2.25*	3.36*	6/21	1/21
Machinery industry firms	0.05****	1.78*	1.78*	5/19	1/19
Food industry firms	0.02****	0.96***	1.49***	3/12	2/12
D. All firms	-0.001****	1.69*	2.20*	15/52	5/52

Explanations: The estimating equation is (1), and dependent variable is the real return on individual stocks and independent variables are the real return on market portfolio and real exchange rate (a positive values mean real depreciations of the Lira).

[a]The most significant lagged coefficient.

[b]The coefficient on the arithmetically weighted (from period t to t-3) series of the real exchange rate change.

[c]Based on the arithmetically weighted average series as defined in the previous footnote.

[d]Includes the firms with profit margin between 0.07 and 0.29 (or elasticity between 3.44 and 14.3).

[e]Includes the firms with profit margin between 0.30 and 0.43 (or elasticity between 2.32 and 3.33).

* Denotes the significance at 1 % level, ** at 5 %, *** at 10 %, and **** denotes insignificance.

A major result from the estimations of the two-factor model in Table 2 is the insignificant coefficients on the current exchange rate under all categories. This is a strong evidence against the Efficient Market Hypothesis (EMH) and an evidence for mispricing or a form of market inefficiency. The market inefficiency is double checked by the strong coefficients on the lagged exchange rate under all categories. All lagged exposure

coefficients are significant (mostly at 1 % level) and have positive sign[15], a positive but lagged exposure. That is, the exchange rate risk is priced (requiring a positive premium) with some delay in stock prices.

The lagged exposure coefficients in all categories except the food industry are greater than one[16]. In most cases, the third lag produced especially the most significant and the largest coefficients and therefore was chosen as the proper lag (see the detailed estimations in the appendix). However, in few cases, other lags also tend to produce significant coefficients when included together with the third lag. However, we detected some multicollinearity between these lags and decided not to include them together. We instead constructed a single weighted exchange rate series from period t to t-3 to get an average exposure measure that avoids the multi-co linearity problem[17]. A striking result from the average exposure estimates is the insignificant coefficient for firms of the low foreign sales category and marginally significant coefficient for firms of the food industry[18]. That is, firms of the low foreign sales category are not exposed when the current and lagged effects are combined while firms of the food industry are at the margin.

Two categories of firms, those of the textile and high foreign sales firms, have the largest exposure based on the lagged or average coefficients, while those of the low foreign sales and food industry categories have the smallest exposure coefficients. Moreover, the largest cross-category divergences are according to the foreign sale and industry division. That is, the most divergent exposure is between the high and low foreign sales categories,

[15] That is, a real depreciation leads to a higher asset return.

[16] It is interesting to note that the lagged exposure coefficient, as well as the average exposure coefficient, is at the margin of significance in the food industry whereby more than the half of the firms have low foreign sales ratio.

[17] The results are qualitatively the same if the constructed series is extended from period t to t-4 or if the weights are altered.

[18] As noted before, an insignificant average coefficient, against a significant individual (third) lag, is to be explained by the presence of other significant but offsetting lags that dominates the former.

followed by the one between the textile and food industries. A division according to the competitiveness does not lead to a notable divergence in exposure coefficients. This may be an indication that domestic industry setup of these internationally price-taking firms has a limited influence on their exposures.

Finally, parallel with the signs of panel coefficients, the significant individual exposure coefficients are predominantly positive and account about one third of the total, compared to the individually significant negative coefficients that account only one tenth of the total. These results are invariant to the estimation method adopted since an alternative GMM estimation yields almost identical estimates. The GMM estimation is performed by orthogonalizing the exchange rate return on the stock return[19].

We now focus on the determinants of exposure as revealed by the (first stage) estimates from the two-factor model in Table 2. We need to directly incorporate those potential determinants that were only categorically considered in the first stage. This means extending the basic two-factor arbitrage-pricing model to obtain parameters of these determinants. We distinguish five main determinants of exposure that are thought to be the most relevant in the particular case of Turkey[20]. These, ordered from the most to least common, are: the level of foreign sales, net foreign currency debt, industry competition, net foreign non-financial liabilities (foreign currency payables minus receivables), and finally domestic risk free assets as a means of informal hedging. The key question here is whether these factors amplify or dampen the exchange rate exposure. The effects of some of these determinants (e.g., foreign currency debt) might however be drastically different for firms of an emerging economy that lacks the formal instruments of foreign currency hedging.

[19] The average correlation coefficient between the exchange rate and stock returns is only 0.07.

[20] Some other potential determinants such as foreign operations, domestic versus foreign currency production and costs are not considered because of the data restriction.

The second stage estimations for the determinants of exposure are based on the following extended model that involves interactions,

$$R_{it} = \beta_{0i} + \beta_{1i} R_{mt} + (1 + {}^{j}X_{it})\beta_{2ji} R_{st} + \varepsilon_{it}, \qquad (2)$$

where ${}^{j}X_{it}$ the jth determinant fir firm i, and $j = 1, \ ,5$ and $i = 1, \ ,52$.

R_m and R_s are respectively the real rate of returns on the market portfolio and the exchange rate.

Given parameters exposure estimated in the first stage from equation (1), we are now interested only in the parameters of interaction terms $R_{st}{}^{j}X_{it}$. The relevant multi-factor model to be estimated is therefore[21],

$$R_{it} = \beta_{0i} + \beta_{1i} R_{mt} + ({}^{j}X_{it} R_{st})\beta_{2ji} + \varepsilon_{it}, \qquad (3)$$

where β_{2ji} is the coefficient on the jth determinant (${}^{j}X_i$) interacted with the exchange rate for firm i.

The explicit forms of these five interactive terms are as follows:

for $j = 1$, the interaction term is $S_f * R_s$, where S_f is the ratio of foreign to total sales;

for $j = 2$, the interaction term is $(-1/OPCM) * R_s$, where $OPCM$ is the operational price-cost margin;

for $j = 3$, the interaction term is $D_f * R_s$, where D_f is the ratio net foreign currency debt to total assets;

for $f = 4$, the interaction term is $L_f * R_s$, where L_f is the ratio of net foreign non-financial liabilities (payables minus receivables) to total sales;

for $j = 5$, the interaction term is $R_{rf} * R_s$, where R_{rf} is the real return on repos and reverse repos in government papers up to two weeks of maturity.

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[21] As discussed before, we prefer the direct estimation method for parameterization of determinants. The connection with the alternative two-stage method is easily be established through the relation $\hat{\beta}_{2jt} = \gamma_0 + \gamma_{1j}{}^{j}X_{it} + \upsilon_{it}$. See, e.g., Jorion (1990) for further discussion.

As in the first stage estimations, equation (3) is estimated through the fixed-effects GLS method based on the cross-sectional weights. The estimation results, whose details are relegated to Appendix 2, are given in Table 3. Eight alternative parameters for each interaction term are estimated based on the eight categorical division of the sample, a critical issue in the exposure literature. The panel of 52 firms are divided into seven subsamples of: high versus low foreign sales firms, more versus less competitive firms, and three subsamples of industrial classification (textile, machinery and food). Finally, each interaction term is parameterized for the complete sample of 52 firms.

Table 3: Extended exposure model; testing for determinants of exposure

Determining factor/category	Coefficient	
	Current	Average
A. Foreign sale (interaction term S_f*R_s for) [a]:		
High foreign sale firms	0.35****	7.66*
Low foreign sale firms	0.94****	12.75*
More competitive firms	1.43*	9.85*
Less competitive firms	0.37****	2.80****
Textile firms	-0.49****	7.96*
Machinery firms	1.52*	9.05*
Food firms	0.75****	9.93*
All firms	1.08*	9.01*
B. Competitiveness (interaction term *(-1/OPCM)*R_s for) [b]:		
High foreign sale firms	0.03****	0.11***
Low foreign sale firms	-0.01****	0.04****
More competitive firms	0.00****	0.07**
Less competitive firms	0.19****	-1.07**
Textile firms	-0.08****	0.00
Machinery firms	0.02****	-0.08****
Food firms	0.12*	0.26*
All firms	0.01****	0.06***

C. Net foreign currency debt (interaction term $D_{f*}R_s$ for) [c]:		
High foreign sale firms	-1.02****	-4.60**
Low foreign sale firms	-1.34**	-6.19**
More competitive firms	-1.01***	-4.52**
Less competitive firms	-1.01***	-6.47**
Textile firms	-1.73***	-3.84****
Machinery firms	-1.69*	-6.22**
Food firms	0.32****	-6.62**
All firms	-1.21*	-5.34*
D. Foreign non-financial liability (interaction term $L_{f*}R_s$ for) [d]:		
High foreign sale firms	-0.12****	-0.34****
Low foreign sale firms	-0.17****	-2.27**
More competitive firms	-0.26**	-2.87*
Less competitive firms	0.08****	1.73****
Textile firms	-0.58****	1.01****
Machinery firms	-0.18***	-2.31*
Food firms	0.17****	-1.59****
All firms	-0.16****	-1.79**
E. Risk-free domestic asset return (interaction term R_{rf}*R_s for)[e]:		
High foreign sale firms	4.93***	15.64*
Low foreign sale firms	-0.64****	-4.32****
More competitive firms	-0.55****	-0.44****
Less competitive firms	6.20****	3.88****
Textile firms	4.63****	19.23****
Machinery firms	0.68****	1.83****
Food firms	2.23****	0.39****
All firms	0.88****	3.47***

Explanations: Only the parameters of interaction terms from equation (3), $R_{st}({}^{j}X_{it})$, where R_{st} is the real exchange rate change and $({}^{j}X_{it})$ is the *jth* determinant for firm *i*, are presented here, the details of estimations are given in Appendix 2.

* Denotes the significance at 1 % level, ** at 5 %, *** at 10 %, and **** denotes insignificance.

[a]Foreign to total sales ratio (S_f)is the identifying variable.

[b]Competitiveness is measured by the negative reciprocal of the operational price-cost margin, (-1/OPCM).

[c]Net foreign currency debt to total assets ratio (D_f), each of them is obtained from footnotes.

[d]Net foreign non-financial assets (payables minus receivables) to total sales ratio (L_f), each is obtained from footnotes.

[e] Real return on repos and reverse repo funds in government papers up to fourteen days of maturity (R_{rf}).

Parallel with the first stage estimations, we obtain contemporaneous, lagged and average coefficients for interaction terms. However, only two sets of coefficients, the contemporaneous and average ones, are presented in Table 3 to ease the exposition. The first observation from Table 3 is that most of the contemporaneous coefficients on interaction terms are insignificant while almost all interaction terms have a significant lagged coefficient[22]. Among 40 current coefficients only 13 ones are significant up to 10 % level. Foreign currency debt (determining factor C), yields the highest number of significant current coefficients, followed by foreign sales, foreign non-financial liabilities, and the return on risk-free domestic assets. The interaction term on foreign currency debt is also the one that yields the most stable (a negative) sign. That is, foreign currency debt introduces a negative effect on firm value as the real exchange rate depreciates. Foreign sales introduce a positive effect on firm values as the real exchange rate depreciates. Foreign non-financial liabilities also insert a negative effect on firm value when the real exchange rate depreciates. There is only one significant current coefficient for each of the two remaining interaction terms related to competition and domestic risk-free asset, and each is a positive one.

[22] Of course, the lags that yield significant coefficients differ, and sometimes, there are multiple significant lags.

Given that the current coefficients are mostly insignificant and there found to be multiple significant lagged coefficients with different signs, we estimate average coefficients for interaction variables to obtain a single parameter that is stable in sign and magnitude[23]. The average coefficients are in turn based on a calculated exchange rate series[24]. As expected, the average coefficients estimated are extremely stable as the offsetting effects of different periods are netted out, representing a statistically reliable average effect.

A much clearer picture emerges from the average coefficients. Firstly, the interaction terms on foreign sales have the largest and positive coefficients. The single category in which the foreign sales and exchange rate interaction term has no significant coefficient is the less competitive category. Secondly, the second largest but negative interaction coefficients are related to the foreign currency debt. The negative exposure from the (net) foreign currency debt is confirmed for all categories except the textile firms. This finding is at stark contrast with that in most advanced countries whereby foreign currency debt leads to positive exposure as it provides a natural hedge against foreign sales or procurement costs (Allayannis et al. (2001). Similarly, all significant interaction coefficients on foreign non-financial liabilities are negative, reducing the firm value as the real exchange rate depreciates.

Thirdly, firms with high foreign sales ratio gain enormously from informal hedging through government papers as they have an exceptionally large and positive interaction term. The firms in others categories have no significant interaction coefficient, while the complete sample has a positive coefficient at only a questionable level of significance.

[23] This restriction on the exchange rate series and thus on the interaction terms eliminates the potential multicollinearity problem when otherwise multiple lags of each interaction variables are used.

[24] The calculated series is an arithmetically weighted average of the periods from t to t-3. However, the results are qualitatively same when it is extended to period t-4 or when a geometric weighting is used.

Finally, the food, more competitive and high foreign sales categories are the ones that benefit from competition and increase their values in times of real depreciation, while less competitive firms lose from the real depreciation.

Summarizing, the largest significant interaction coefficient is a positive one and is related to the foreign sales ratio. The second largest interaction coefficient is a negative one and is related to the foreign currency debt ratio, followed by the foreign non-financial liabilities ratio. The firms most active in foreign markets are the only beneficiaries of informal hedging through domestic risk-free assets. High competition makes moderate positive contribution to exposure in most categories but it is destructive for the less competitive firms.

Besides the separate estimates for each category just discussed (seven subsamples and complete sample), we have also estimated the model for the complete panel with the competition and foreign sales dummies, two critical determinants of exposure. That is, rather than breaking into more (and less) competitive and high (and low) foreign sales categories, we assigned dummies for these categories and run the regression for the entire sample. The relevant equation is now

$$R_{it} = \beta_{0i} + \beta_{1i} R_{mt} + \beta_{3i} (D_c R_{st}) + \beta_{4i} (D_f R_{st}) + \varepsilon_{it}, \qquad (4)$$

D_c and D_f are respectively the dummies of competition and foreign sales.

D_c takes a value of one for firms with high price-cost margin (thus low elasticity and low competition) and zero otherwise[25]. Therefore it represents low competition and is expected to have a negative (interaction) coefficient. D_f takes a value of one for firms with high foreign as the sales ratio and therefore is expected to have a positive (interaction)

[25] Firms with profit margins between 0.07 and 0.29 (or elasticity between 14.4 and 3.44) are classified as more competitive and firms with profit margins between 0.30 and 0.43 (or elasticity between 3.33 and 2.32) are classified as less competitive.

coefficient[26]. The estimation results that were delegated to Table 3B in the data Appendix A.2.2 confirm the findings in Table 3. The coefficient on the interaction term involving the (high) price-cost margins is negative and this implies that firms in low (high) competition lose (gain) from the real depreciation. The coefficient on the interaction term related to the foreign sales ratio is positive and this implies that high (low) foreign sales firms gain (lose) from the real depreciation.

4. Conclusion

All types of firms from pure local producers to pure exporters can be exposed to real exchange rate changes as the value of their real assets are influenced by the ensuing changes in demand, cost and other fundamentals. This type of exposure, known as the economic exposure, is not easily measured and covered even in financially mature economies. Moreover, measurable exposures from fixed foreign currency contracts, known as the translation and transaction exposures, may not easily be hedged in developing countries because the markets for currency derivatives are generally not functioning.

Firms from emerging economies may thus face a higher degree of exposure compared to those in advanced economies. For instance, many of the formal foreign exchange derivatives are not operational in Turkey, whose currency is not traded and not a part of these hedging activities, except the few special contracts between the central bank and commercial banks and between large holdings and their banks. Similarly, foreign currency debt, generally seen as a natural hedge, may be value-reducing if short positions are soon to be considered unsustainable after a period of optimism that and over-borrowing. The price-taking position and thus limited pass-through capacity can be another factor amplify the exposure of emerging market firms. Finally, volatile real exchange rates (owing

[26] Foreign sales ratios below 0.30 are classified as low and high otherwise.

to volatile inflation and/or nominal exchange rates) in emerging countries like Turkey may themselves impinge on exposure by changing the present and future cash flows in domestic currency.

The present empirical analysis is based on a sample of firms with varying foreign market involvement measured by their foreign sales ratios, which on average ranges between 2 and 91 %. That is, the sample includes both primarily exporting firms with the foreign sales ratio close to hundred percent, primarily import competing firms with the foreign sales ratio close to zero, and firms in between. A categorization based on the foreign sales ratio is critical because it allows contrasting exposures across different categories.

Two additional determinants of exposure are considered in estimations. These are the net foreign currency payables (net transaction position) and an informal instrument of foreign currency hedging. Short transaction positions in foreign currency may not be fully covered because formal foreign currency derivatives for hedging are not available in Turkey as in many emerging markets. This fact leaves no choice but find informal instruments of hedging. Potential instruments are the foreign currency holdings, foreign currency debt and other indirect (domestic currency) instruments such governments bonds and papers. Indirect instruments provide coverage for foreign currency risks through the risk-free (and mostly higher) real interest rate returns that can be easily converted into foreign currency. Investments in government papers (for short-term hedging) and bonds (for longer-term hedging) are the indirect instruments considered.

A major result from the estimations of the two-factor model is the insignificant coefficients on the current exchange rate under all categories. This is a strong evidence against the Efficient Market Hypothesis (EMH) and an evidence for mispricing or a form of market inefficiency. The market inefficiency is double checked by the strong coefficients

on the lagged exchange rate under all categories. The exchange rate risk is priced but with some delay in stock prices.

The second striking result follows from the average exposure estimates. Two categories of firms, those of the textile and high foreign sales firms, are the most (positively) exposed, while those of the low foreign sales and food industry categories are the least exposed. Moreover, the largest cross-category divergences are according to the foreign sale and industry division. That is, the most divergent exposure is between the high and low foreign sales categories, followed by the one between the textile and food industries. A division according to the competitiveness does not lead to a notable divergence in exposure.

The third set of results concern the determinants of exposure. The largest significant determinant of exposure is a positive one and is related to the foreign sales. The second largest determinant is a negative one and is related to the foreign currency debt, followed by the foreign non-financial liabilities. The firms most active in foreign markets are the only beneficiaries of informal hedging through domestic risk-free assets. High competition makes moderate positive contribution to exposure in most categories but it is destructive for the less competitive firms.

To emphasize, the present evidence is similar to the evidence from advanced countries in that the foreign sales ratio is a key determinant of exposure. However, measurable exposures from the fixed foreign currency contracts are found to significantly reduce the firm value because they are not properly hedged in Turkey.

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DATA APPDENDIX

A.1 Data set: definitions and sources

Nominal exchange rate: Central Bank, end of period (three months) bilateral rates.

Price index: Central Bank, end of period (three months) industry-level price index.

Stock prices: Istanbul Stock Exchange, end of period (three months) prices.

Market portfolio: Istanbul stock Exchange, end of period value weighted national 100 firms index.

Informal hedging instrument: returns on money market repurchase funds (2-weak maturity), Central Bank.

Balance sheet variables: exports to (net) total sales ratio, net foreign debt to total assets ratio, net foreign transaction balance to total sales ratio, Istanbul Stock Exchange.

A.2. Detailed estimations

A2.1 First stage estimations

The first set of first stage estimates involves the contemporaneous exposure coefficients based on equation (1), which is specified in the fixed-effects form as

$$R_{it} = \beta_{0i} + \beta_1 R_{mt} + \beta_2 R_{st} + \varepsilon_t , \qquad (1')$$

and is estimated by a GLS based on the cross-section weights.

The detailed test statistics along with the exposure coefficients for different categories or sub-samples are presented in Table 2A.

Table 2A: First stage estimates involving the contemporaneous exposure coefficients

Category or sub-sample	Coefficients on		
	Exchange rate	Market portfolio	Common statistics
A. Foreign sale			
High sales firms	0.25 (1.52)	1.04 (27.8)	R^{-2}: 0.54; SER: 0.40; DW: 2.05 F: 524 (p: 0.0); SSR: 61.7; OBS: 420
Low sales firm	-0.20 (1.28)	1.13 (27.9)	R^{-2}: 0.68; SER: 0.28; DW: 2.10 F: 678 (p: 0.0); SSR: 22.1; OBS: 308
B. Competitiveness			

More competitive	-0.02	1.10	R^{-2}: 0.62; SER: 0.37; DW: 2.00
	(0.12)	(35.0)	F: 731 (p: 0.0); SSR: 54.4; OBS: 434
Less competitive	0.04	1.05	R^{-2}: 0.60; SER: 0.33; DW: 2.20
	(0.22)	(23.5)	F: 462 (p: 0.0); SSR: 30; OBS: 294
C. Industry type			
Textile	-0.12	1.16	R^{-2}: 0.59; SER: 0.39; DW: 2.11
	(0.54)	(26.7)	F: 439 (p: 0.0); SSR: 43; OBS: 294
Machinery	0.05	1.12	R^{-2}: 0.67; SER: 0.30; DW: 2.04
	(0.35)	(28.5)	F: 576 (p: 0.0); SSR: 22; OBS: 266
Food	0.02	0.89	R^{-2}: 0.51; SER: 0.35; DW: 2.08
	(0.10)	(15.5)	F: 188 (p: 0.0); SSR: 19; OBS: 168
D. All firms	-0.00	1.08	R^{-2}: 0.61; SER: 0.35; DW: 2.09
	(0.00)	(41.8)	F: 1195 (p: 0.0); SSR: 84; OBS: 728

Explanations:
Estimations are based on the two-factor model in equation (1), whereby only the current value of the exchange rate variable is included. Estimation method is the fixed-effects GLS based on cross-section weights. Fixed-effect constants are not presented. t-statistics are given in parentheses.

The second set of first stage estimations involve the lagged exposure coefficients from equation (1), which is specified in the fixed-effects form as

$$R_{it} = \beta_{0i} + \beta_1 R_{mt} + \beta_2 R_{st-k} + \varepsilon_{it}, \qquad (1'')$$

where, k = 1, ,4, is the first significant lag encountered on the exchange rate variable. That is, only the lagged exposure coefficients but not the current ones take place. The detailed test statistics along with the exposure coefficients for different categories or sub-samples are presented in Table 2B. A caution about the lagged coefficients is need: only the first significant lag is included and this is most time the third lag. However, some other lags, which are insignificant when individually included, tend to be significant when included together with other lags (especially with the third lag that is significant in all cases). Moreover, these other lags sometimes take opposite (negative) signs. All these imply that the exposure coefficients based on the lagged exchange rate variable in Table 2B cannot be taken as a final measure of exposure (average or total).

Table 2B: First stage estimates involving the lagged exposure coefficients			
Category or sub-sample	Coefficients on		
	Exchange rate	Market portfolio	Common statistics
A. Foreign sale			
High sales firms	1.50 (4.72)	1.08 (25.3)	R^{-2}: 0.55; SER: 0.38; DW: 2.16 F: 441 (p: 0.0); SSR: 43.9; OBS: 330
Low sales firm	1.85 (5.04)	1.02 (23.1)	R^{-2}: 0.65; SER: 0.28; DW: 2.20 F: 473 (p: 0.0); SSR: 17.2; OBS: 242
B. Competitiveness			
More competitive	1.50 (5.29)	1.04 (28.4)	R^{-2}: 0.59; SER: 0.35; DW: 2.07 F: 521 (p: 0.0); SSR: 38.1; OBS: 341
Less competitive	1.96 (4.94)	1.05 (21.6)	R^{-2}: 0.61; SER: 0.33; DW: 2.34 F: 389 (p: 0.0); SSR: 23; OBS: 231
C. Industry type			
Textile	2.25 (6.59)	1.08 (21.6)	R^{-2}: 0.58; SER: 0.40; DW: 2.20 F: 339 (p: 0.0); SSR: 33.3; OBS: 231
Machinery	1.78 (4.19)	1.07 (23.4)	R^{-2}: 0.65; SER: 0.30; DW: 2.25 F: 404 (p: 0.0); SSR: 17; OBS: 209
Food	0.95 (1.92)	0.94 (13.7)	R^{-2}: 0.56; SER: 0.29; DW: 2.02 F: 177 (p: 0.0); SSR: 9.9; OBS: 132
D. All firms	1.69 (7.35)	1.05 (35.6)	R^{-2}: 0.60; SER: 0.34; DW: 2.18 F: 917 (p: 0.0); SSR: 61; OBS: 572
Explanations: Estimations are based on the two-factor model in equation (1), whereby only the first significant lag of the exchange rate variable is included. Estimation method is the fixed-effects GLS based on cross-section weights. Fixed-effect coefficients are not presented. t-statistics are given in parentheses. Some observations are lost depending on the lags used and therefore there number of observations are smaller than those in contemporaneous version.			

The third set of first stage estimates of exposure is based on a weighted exchange rate series (arithmetically weighted from periods t to t-3). Alternative average series based on higher dimension (from periods t to t-4) and geometric weighting are also tried, but their results are not presented as they are qualitatively the same. As in the previous two estimations the fixed-effects form equation (1)

$$R_{it} = \beta_{0i} + \beta_1 R_{mt} + \beta_2 {}^{a}R_{st} + \varepsilon_t , \qquad (1''')$$

where ${}^{a}R_s$ is the arithmetically weighted average exchange rate series.

Table 2C: First stage estimates involving the average exposure coefficients			
Category or sub-sample	Coefficients on		
	Exchange rate	Market portfolio	Common statistics
A. Foreign sale			
High sales firms	3.78	1.13	R^{-2}: 0.55; SER: 0.38; DW: 2.03
	(5.51)	(28.1)	F: 427 (p: 0.0); SSR: 43; OBS: 330
Low sales firm	0.54	1.12	R^{-2}: 0.61; SER: 0.28; DW: 2.15
	(0.75)	(25.9)	F: 401 (p: 0.0); SSR: 18; OBS: 242
B. Competitiveness			
More competitive	2.23	1.13	R^{-2}: 0.57; SER: 0.35; DW: 1.98
	(3.79)	(32.7)	F: 486 (p: 0.0); SSR: 38.2; OBS: 341
Less competitive	2.15	1.12	R^{-2}: 0.56; SER: 0.33; DW: 2.21
	(2.55)	(21.5)	F: 311 (p: 0.0); SSR: 23; OBS: 231
C. Industry type			
Textile	3.36	1.16	R^{-2}: 0.53; SER: 0.40; DW: 2.07
	(3.02)	(20.8)	F: 280 (p: 0.0); SSR: 34; OBS: 231
Machinery	1.78	1.15	R^{-2}: 0.62; SER: 0.30; DW: 2.14
	(2.52)	(27.3)	F: 364 (p: 0.0); SSR: 17; OBS: 209
Food	1.49	1.02	R^{-2}: 0.52; SER: 0.28; DW: 1.97
	(1.66)	(15.0)	F: 159 (p: 0.0); SSR: 9.6; OBS: 132
D. All firms	2.20	1.13	R^{-2}: 0.56; SER: 0.34; DW: 2.08
	(4.54)	(39)	F: 806 (p: 0.0); SSR: 61; OBS: 572

Explanations:
Estimations are based on the two-factor model in equation (1), whereby a weighted average exchange rate series instead of the actual series is included. Estimation method is the fixed-effects GLS based on cross-section weights. Fixed-effect coefficients are not presented. t-statistics are given in parentheses. Some observations are lost depending on the lags structure in the calculated weighted series.

The last set of first stage estimates are the cross-section specific exposure coefficients based on the average exchange rate series. Given the large number of coefficients involved (number of exposure coefficients equals the number of cross-section units for each category), these estimates, available upon request, are not directly presented, but instead the number of the significant ones at 5 % level and their signs are given in the last column of Table 2.

A.2.2 Second stage estimations

The second stage of estimations that involve five interaction terms to parameterize the determinants of exposure are based on,

$$R_{it} = \beta_{0i} + \beta_{1i} R_{mt} + ({}^{j}X_{it} R_{st})\beta_{2ji} + \varepsilon_{it}, \qquad (3)$$

or, more explicitly,

$$\begin{aligned} R_{it} = {} & \beta_{0i} + \beta_{1} R_{mt} + \beta_{21}({}^{1}X_{it} R_{st}) + \beta_{22}({}^{2}X_{it} R_{st}) + \beta_{23}({}^{3}X_{it} R_{st}) \\ & + \beta_{24}({}^{4}X_{it} R_{st}) + \beta_{25}({}^{5}X_{it} R_{st}) + \varepsilon_{it}, \end{aligned} \qquad (3')$$

where $\beta_{2j,}$ $j = 1, 2, 3, 4, 5$ are five parameters on the interaction terms (between the real exchange rate change and the determinants of exposure, ${}^{j}X\, R_s$)., and

${}^{1}X$: the ratio of foreign to total sales,

${}^{2}X$: *(-1/OPCM), OPCM* is the operational price-cost margin,

${}^{3}X$: the ratio of net foreign currency debt (debt minus assets) to total assets,

${}^{4}X$: the ratio of net foreign currency payables (payables minus receivables) to total sales,

${}^{5}X$: real (quarterly) return on repos and reverse repos in government papers up to fourteen days of maturity.

As in the first stage estimations, three different sets of (interactive) exposure coefficients, namely, the contemporaneous, lagged and average, are obtained. However, only two sets of coefficients, contemporaneous and average, are presented to simplify the exposition. The difference between the two sets of estimates, like the first stage estimates, lays in the definitions of the exchange rate variables entering the interaction term ${}^{j}X\, R_s$. That is, the contemporaneous estimates are based on the current exchange rate R_s while the average estimates are based on the weighted exchange rate ${}^{a}R_s$. The statistical details of the second stage estimations presented in Table 3 are given in Tables 3A (for contemporaneous coefficients) and 3B (for average coefficients).

Table 3A: Second stage estimates involving the contemporaneous exposure coefficients			
	Coefficients on		
Category	Interaction term	Market portfolio	Common statistics
A. Foreign sale			
	$^{1}X R_s$: 0.35 (0.62)		
	$^{2}X R_s$: 0.03 (0.67)		R^{-2}: 0.55; SER: 0.39; DW: 2.03
High	$^{3}X R_s$: -1.02 (1.37)	1.06 (28.3)	F: 116 (p: 0.0); SSR: 61; OBS: 434
	$^{4}X R_s$: -0.12 (0.60)		
	$^{5}X R_s$: 4.94 (1.67)		
Low	$^{1}X R_s$: 0.95 (1.23)		
	$^{2}X R_s$: -0.01 (0.16)		R^{-2}: 0.57; SER: 0.28; DW: 2.07
	$^{3}X R_s$: -1.34 (2.16)	1.12 (26.6)	F: 138 (p: 0.0); SSR: 23; OBS: 322
	$^{4}X R_s$: -0.17 (1.41)		
	$^{5}X R_s$: -0.64 (0.33)		
B. Competition			
	$^{1}X R_s$: 1.43 (2.94)		
	$^{2}X R_s$: 0.01 (0.16)		R^{-2}: 0.62; SER: 0.37; DW: 1.95
High	$^{3}X R_s$: -1.01 (1.63)	1.10 (33.2)	F: 146 (p: 0.0); SSR: 53; OBS: 434
	$^{4}X R_s$: -0.27 (2.23)		
	$^{5}X R_s$: -0.55 (0.30)		
Low	$^{1}X R_s$: 0.37 (0.54)		
	$^{2}X R_s$: 0.19 (0.90)		R^{-2}: 0.60; SER: 0.33; DW: 2.18
	$^{3}X R_s$: -1.02 (1.43)	1.06 (22.5)	F: 92 (p: 0.0); SSR: 29; OBS: 294
	$^{4}X R_s$: 0.08 (0.45)		
	$^{5}X R_s$: 6.20 (1.32)		
C. Industry			
	$^{1}X R_s$: -0.49 (0.60)		
Textile	$^{2}X R_s$: -0.08 (1.44)		R^{-2}: 0.59; SER: 0.39; DW: 2.04
	$^{3}X R_s$: -1.73 (1.72)	1.15 (25.6)	F: 89 (p: 0.0); SSR: 41; OBS: 294
	$^{4}X R_s$: -0.58 (1.36)		
	$^{5}X R_s$: 4.62 (1.04)		
Machinery	$^{1}X R_s$: 1.52 (2.99)		
	$^{2}X R_s$: 0.02 (0.85)		R^{-2}: 0.68; SER: 0.30; DW: 2.02
	$^{3}X R_s$: -1.68 (3.70)	1.13 (28.2)	F: 116 (p: 0.0); SSR: 22; OBS: 266
	$^{4}X R_s$: -0.18 (1.82)		
	$^{5}X R_s$: 0.67 (0.49)		
Food	$^{1}X R_s$: 0.75 (0.70)		
	$^{2}X R_s$: 0.12 (2.37)		R^{-2}: 0.52; SER: 0.35; DW: 2.08
	$^{3}X R_s$: 0.33 (0.23)	0.89 (14.9)	F: 66 (p: 0.0); SSR: 18; OBS: 168
	$^{4}X R_s$: 0.16 (0.23)		
	$^{5}X R_s$: 2.22 (0.77		
D. All firms	$^{1}X R_s$: 1.08 (2.72)		
	$^{2}X R_s$: 0.01 (0.52)		R^{-2}: 0.61; SER: 0.35; DW: 2.05
	$^{3}X R_s$: -1.21 (2.74)	1.08 (40.6)	F: 238 (p: 0.0); SSR: 83; OBS: 728
	$^{4}X R_s$: -0.16 (1.56)		
	$^{5}X R_s$: 0.88 (0.62		

Explanations:
Regression on each category contains five interaction terms between the *current* real exchange rate change (R_s) and the determinants of exposure (^jX), , $^jX\ R_s$, where
^1X: the ratio of foreign to total sales,
^2X: *(-1/OPCM), OPCM* is the operational price-cost margin,
^3X: the ratio of net foreign currency debt (debt minus assets) to total assets,
^4X: the ratio of net foreign currency payables (payables minus receivables) to total sales,
^5X: real (quarterly) return on repos and reverse repos in government papers up to fourteen days of maturity.

Table 3B: Second stage estimates involving the average exposure coefficients

	Coefficients on		
Category	Interaction term	Market portfolio	Common statistics
A. Foreign sale			
	$^1X\ R_s$: 7.66 (5.02)		
	$^2X\ R_s$: 0.11 (1.76)		R^{-2}: 0.54; SER: 0.38; DW: 1.99
High	$^3X\ R_s$: -4.60 (2.08)	1.16 (27.4)	F: 86 (p: 0.0); SSR: 42; OBS: 330
	$^4X\ R_s$: -0.33 (0.22)		
	$^5X\ R_s$: 15.6 (3.11)		
Low	$^1X\ R_s$: 12.75 (3.93)		
	$^2X\ R_s$: 0.04 (0.75)		R^{-2}: 0.62; SER: 0.46; DW: 2.23
	$^3X\ R_s$: -6.19 (2.41)	1.10 (23.5)	F: 85 (p: 0.0); SSR: 17; OBS: 242
	$^4X\ R_s$: -2.27 (2.40)		
	$^5X\ R_s$: -4.32 (0.88)		
B. Competition			
	$^1X\ R_s$: 9.85 (6.10)		
	$^2X\ R_s$: 0.07 (2.04)		R^{-2}: 0.60; SER: 0.35; DW: 1.99
High	$^3X\ R_s$: -4.52 (2.33)	1.13 (31.3)	F: 109 (p: 0.0); SSR: 37; OBS:341
	$^4X\ R_s$: -2.87 (3.70)		
	$^5X\ R_s$: -0.44 (0.11)		
Low	$^1X\ R_s$: 2.80 (0.85)		
	$^2X\ R_s$: -1.07 (2.11)		R^{-2}: 0.550; SER: 0.33; DW: 2.23
	$^3X\ R_s$: -6.47 (2.20)	1.11 (19.3)	F: 62 (p: 0.0); SSR: 22; OBS: 231
	$^4X\ R_s$: 1.73 (0.97)		
	$^5X\ R_s$: 3.88 (0.56)		
C. Industry			
	$^1X\ R_s$: 7.96 (3.25)		
Textile	$^2X\ R_s$: 0.0 (0.03)		R^{-2}: 0.52; SER: 0.40; DW: 2.09
	$^3X\ R_s$: -3.84 (1.42)	1.15 (18.8)	F: 55 (p: 0.0); SSR: 32; OBS: 231
	$^4X\ R_s$: 1.01 (0.34)		
	$^5X\ R_s$: 19.2 (1.71)		
Machinery	$^1X\ R_s$: 8.05 (3.57)		
	$^2X\ R_s$: -0.08 (0.63)		R^{-2}: 0.63; SER: 0.30; DW: 2.18
	$^3X\ R_s$: -6.22 (2.30)	1.17 (27.4)	F: 75 (p: 0.0); SSR: 17; OBS: 209
	$^4X\ R_s$: -2.31 (2.71)		
	$^5X\ R_s$: 1.83 (0.37)		
Food	$^1X\ R_s$: 9.93 (3.52)		
	$^2X\ R_s$: 0.26 (2.91)		R^{-2}: 0.58; SER: 0.28; DW: 1.98

	^{3}X R_s: -6.62 (2.13) ^{4}X R_s: -1.59 (0.71) ^{5}X R_s: 0.37 (0.7)	0.99 (14.6)	F: 41(p: 0.0); SSR: 9; OBS: 132
D. All firms	^{1}X R_s: 9.00 (6.65) ^{2}X R_s: 0.06 (1.62) ^{3}X R_s: -5.34 (3.32) ^{4}X R_s: -1.79 (2.57) ^{5}X R_s: 3..47 (1.02)	1.13 (37.4)	R^{-2}: 0.61; SER: 0.34; DW: 2.10 F: 169 (p: 0.0); SSR: 59; OBS: 572
E. All firms with dummies[a]	D_1R_s: -0.53 (2.94) D_2R_s: 0.55 (2.70)	1.08 (41.5)	R^{-2}: 0.58; SER: 0.35; DW: 2.06 F: 597 (p: 0.0); SSR: 89; OBS: 727

Explanations:
Regression on each category contains five interaction terms between the *weighted average* real exchange rate change ($^{a}R_s$) and the determinants of exposure (^{j}X), , $^{j}X\ R_s$, where
^{1}X: the ratio of foreign to total sales,
^{2}X: *(-1/OPCM), OPCM* is the operational price-cost margin,
^{3}X: the ratio of net foreign currency debt (debt minus assets) to total assets,
^{4}X: the ratio of net foreign currency payables (payables minus receivables) to total sales,
^{5}X: real (quarterly) return on repos and reverse repos in government papers up to fourteen days of maturity.
[a] This estimation is based on equation (4) that contains two dummies (one for competition and one for foreign sales ratio) that are interacted with the real exchange rate variable, D_iR_s, for the complete sample. D_1R_s is the interaction term related to the competition dummy ($D1=1$ for less competitive firms and zero otherwise), and D_2R_s is the interaction term related to the foreign sales dummy ($D_2=1$ for high foreign sales firms and zero otherwise).