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## Foreign exchange exposure of exporting and importing firms

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### Abstract

The existing literature reports insignificant ‘total’ exposure for multinational or exporting firms, where total exposure incorporates both firm-specific and macroeconomic effects. We propose a dual-effect hypothesis to explain this result which seemingly contradicts conventional wisdom. According to our proposed hypothesis, firms are affected by both the domestic economy and foreign markets. These effects are at least partially offsetting for exporters and additive for importers. The resulting predictions of insignificant total exposure for exporters and positive total exposure for importers are borne out in our tests. The literature also reports insignificant ‘residual’ exposure for multinationals or exporting firms, where residual exposure estimates the firm-specific exposure. This result is explained by biases in the residual exposure estimates introduced by the choice of the value-weighted market index as the control portfolio. We propose an equally-weighted portfolio of purely domestic firms as an alternative portfolio to reduce such biases and report significantly negative exposure for exporters and significantly positive exposure for importers, as predicted by theory.

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### 1. Introduction

The estimate of a firm’s exchange rate exposure is of obvious interest to investors seeking to hedge their portfolios and to corporate managers making risk

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management decisions. However, the search for statistically significant and economically meaningful exposure estimates in the vast literature of the last decade has largely been unsuccessful. Whereas economic theory and conventional wisdom suggest, for example, that export oriented US firms are adversely affected by a strengthening dollar and benefit from a depreciating dollar, the empirical evidence in support of the expected inverse relation between stock prices and contemporaneous changes in exchange rate is weak, at best. Most studies report insignificant exposure estimates for exporting firms, on average, whether measured as “total” exposure in a univariate regression of stock returns on exchange rate changes, or as “residual” exposure in a multivariate regression with returns on a value-weighted market portfolio as a control variable. The objectives of our study are to (i) re-interpret the finding of insignificant total exposure for exporters in the context of our proposed dual-effect hypothesis and to test the prediction of the hypothesis of significant positive exposure for importers and (ii) to examine the biases in the estimates of residual exposure from using a value-weighted market index as the control portfolio, and to test alternative control portfolios that may reduce such biases.

A firm’s total foreign exchange exposure measured as the coefficient of a univariate regression of stock returns on changes in exchange rates, following Adler and Dumas (1984), incorporates both the firm-specific cash flow effects and the value-relevant macroeconomic effects that influence cash flows or valuation of all firms, and are correlated with the exchange rate. The total exposure measuring the joint firm-specific and macroeconomic effects would be of interest to practitioners seeking to hedge the firm’s net exposure. However, empirical estimates of this measure, to date, seemingly lack economic meaning and are inconsistent with conventional expectation. Most studies (Bodnar and Wong, 1999, among others) report insignificant total exposures, on average.

In the first part of this study we offer a simple extension to the prevailing set of economic arguments relating stock price changes to changes in exchange rate that could explain the commonly observed insignificant *total* exposure estimates in the large broad-based samples or samples of exporting firms, typically tested. The conventional expectation that stock prices of multinational firms with significant foreign sales will fall when the value of the dollar rises is based primarily on consideration of their (declining) competitiveness in foreign markets. It ignores the effect on stock prices of changes in the domestic economy associated with changes in the value of the dollar. According to the monetary theory of exchange rates, the dollar is expected to increase in value if the domestic GDP increases, *ceteris paribus*, and according to the asset view of exchange rates the expectation of a strengthening dollar is incorporated in the current exchange rate. Thus, if an increase in the value of the dollar is associated with a strengthening of the domestic economy then the reduced demand for a multinational’s higher priced exports when the dollar is strong is at least partially offset by the increased demand for its products in the strong domestic economy. Similarly, when the dollar weakens, the increased demand for a multinational’s now lower priced exports may be offset by the reduced demand for its products in the weakening domestic markets. The domestic and foreign market impacts of a change in exchange rate on the

value of the firm are at least partially offsetting and this may explain why the expected inverse relation between exchange rate changes and stock returns is not observed for US multinationals.

The hypothesis of a dual-effect of exchange rate changes on stock returns arising from changes in the domestic economy and foreign markets (henceforth referred to as the dual-effect hypothesis) is unambiguously testable on a sample of importing firms, a sample not hitherto tested in the empirical literature. Whereas the two effects tend to offset each other to various degrees for exporting multinationals, they accentuate each other for importing firms leading to an unambiguous expectation of a positive relationship between exchange rate changes and stock returns. When the dollar strengthens, the demand for the products of importing firms increases because of the lower price of imports *and* because of higher consumer income in the strengthening domestic economy. Similarly, a weakening dollar is associated with reduced demand in the domestic markets because of higher price of imports *and* a weakening domestic economy. The two effects accentuate each other leading to an unambiguous expectation of a positive relationship between exchange rate changes and stock returns.

We test the dual-effect hypothesis on sub-samples of export and import oriented firms and report insignificant total exposure for exporting firms and significantly positive total exposure for importing firms, consistent with the hypothesis.

In the second part of the study we focus on explanations for the insignificant *residual* exposure for multinationals and exporters reported in most studies. These studies typically include returns on a value-weighted market portfolio as an additional explanatory variable to improve the power and the precision of the estimation and to isolate the firm-specific cash flow exposure by implicitly controlling for macroeconomic factors. However, even with the expanded specification there is, at best, weak and inconsistent support for a significant relation between stock returns and exchange rate changes, even when the samples are screened to find such a relationship (see, for example, Jorion, 1990; Amihud, 1993; Bartov and Bodnar, 1994; Allayannis, 1996; Doidge et al., 2000; among others). To the extent that market return as the control variable does not fully incorporate the value-relevant macroeconomic factors, the extant empirical findings could be due to the offsetting dual-effects that we hypothesize. Our own multiple regression results for samples of export and import oriented firms continue to show insignificant exposure for exporting firms and significant positive exposure for importing firms.

An alternative, and more likely, explanation lies in the interpretation of the exposure coefficient in a multiple regression, with returns on a *value-weighted* market portfolio as the control variable. Bodnar and Wong (1999) point out that whereas the coefficient of exchange rate changes in the univariate regression measures “total” exposure, the coefficient in the multiple regression measures “residual” exposure or the deviation of the firm’s exposure from the market portfolio’s exposure. Thus, a finding of insignificant residual exposure does not imply that the firm-specific exposure is zero, but that the firm has the same exposure as the market portfolio. Since a value-weighted market portfolio is likely to be dominated by large multinational firms with expected negative exposure, the residual exposure, or deviation from

the negative market exposure, underestimates the true firm-specific negative exposure expected for exporters and overestimates the true firm-specific positive exposure expected for importers.

Ideally, in order to avoid such biases, the market index chosen should control for macroeconomic factors but have insignificant cash flow exposure. We examine two alternatives to the value-weighted market portfolio returns as the control variable: (i) returns on an equally-weighted market portfolio, and (ii) returns on an equally-weighted portfolio of domestic firms. We report that using an equally-weighted control portfolio produces an opposite bias consistent with its having positive exposure, on average. The portfolio of domestic firms, however, is expected to have the “desirable” properties of a control portfolio in that it controls for the macroeconomic factors and, by design, has negligible foreign exchange exposure. With returns on an equally-weighted portfolio of domestic firms as the control variable we report significantly positive cash flow exposure for importers and significantly negative cash flow exposure for exporters, consistent with theory and conventional expectations.

The study contributes to the large extant literature on foreign exchange exposure in two ways: (i) it re-interprets the reported insignificant “total” exposure for exporting firms as being economically meaningful in the context of our proposed dual-effect and confirms the prediction of our hypothesis of a significantly positive total exposure for importing firms, and (ii) it demonstrates the biases in the estimate of the firm-specific, “residual” cash flow exposure related to the choice of the control portfolio in the multivariate framework. Specifically, it shows that the use of a value-weighted market index or an equally-weighted market index produces (opposite) biases in the exposure estimates. These biases are mitigated when the control portfolio is an equally-weighted index of domestic firms resulting in residual exposure estimates that are positive and significant for importers and negative and significant for exporters, as predicted by theory. To the best of our knowledge, our findings that importing firms have significantly positive total and residual exposure, on average, while exporting firms have significantly negative residual exposure, on average, are new results.

The rest of the paper is organized as follows. Section 2 presents the main hypotheses of the paper. Section 3 describes the data and methodology for estimating total and residual exposures while Section 4 presents and discusses the results. Section 5 concludes the paper.

## **2. Hypotheses**

“...traders bid up the Japanese currency on news of unexpectedly strong GDP growth in Japan.” – Wall Street Journal, September 10, 1999.

The above statement in a Wall Street Journal story suggests a positive association between currency movement and growth in the domestic economy and is consistent

with the prediction of the Flexible Price Monetary model<sup>1</sup> (Mussa, 1976). The positive association between GDP changes and exchange rate movements is directly relevant to our dual-effect hypothesis.

Since total exposure, measured as the regression coefficient of stock returns on contemporaneous changes in exchange rates, jointly incorporates the domestic and foreign market effects of change in exchange rates on firm value, such changes will have dual valuation effects. For exporting firms, the adverse effects of a strengthening dollar in its foreign markets is expected to be at least partially offset by gains in the stronger domestic economy associated with the stronger dollar. Similarly, the benefits of a weakening dollar in the foreign markets are at least partially offset in the weaker domestic market associated with the weak dollar. Importing firms, on the other hand, benefit from a strengthening dollar in both the foreign and domestic markets and are adversely affected in both markets by a weakening dollar. Thus the dual-effect hypothesis suggests offsetting foreign and domestic market effects for exporting firms and additive effects for importing firms leading to the following testable hypotheses:

H<sub>1</sub>: The total exposure coefficient for exporting firms is expected to be insignificant, on average.

H<sub>2</sub>: The total exposure coefficient for importing firms is expected to be positive, on average.

Empirical studies that attempt to explicitly control for macroeconomic effects, thereby isolating the firm-specific exposure, typically do so by adding returns on a value-weighted market index as the control variable. Since the coefficient of the exchange rate variable in such a multivariate specification actually measures the residual exposure or deviation from the market exposure, the estimated firm-specific exposure will be a biased estimate of the “true” exposure to the extent that the market exposure itself is negative or positive (see Bodnar and Wong, 1999). Further, since the value-weighted index is likely to be dominated by large multinational firms with expected negative exposure, the residual exposure, or deviation from the negative market exposure, is expected to underestimate the true negative exposure expected for exporters and overestimate the true positive exposure expected for importers. Thus, the underestimated firm-specific exposure coefficient for exporters is likely to tend towards insignificance and the overestimated coefficient for importers is likely to be strongly positive.

H<sub>3</sub>: When a value-weighted market index is used as the control portfolio in the multivariate specification, the residual, firm-specific exposure estimates are expected

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<sup>1</sup> We tested for the predicted positive association by regressing  $\Delta GDP_t$ , the surprise in the GDP announcement on day  $t$  against  $G_t$ , the rate of change in the exchange rate for that day. While the explanatory power of the model is low, the coefficient of the GDP surprise variable is significantly positive in three of the four regressions based on two measures of  $\Delta GDP_t$ , the absolute and percentage change, and two measures of exchange rate changes from two currency indices.

to be insignificant for exporting firms and significantly positive for importing firms.

In order to reduce/eliminate the biases in the exposure coefficient estimates, the control portfolio itself should have insignificant foreign exchange exposure. A possible candidate for such a control portfolio is an equally-weighted index. However, there is no a priori reason to believe that the equally-weighted index has insignificant exposure. If the index, dominated by small firms, contains a large proportion of importers it is likely to have positive exposure, on average, introducing an opposite bias in the estimate of the firm-specific exposure. The true negative residual exposure expected for exporters is now overestimated relative to the positive exposure of the index and the true positive exposure expected for importers is underestimated. We test for these possible outcomes by estimating the multivariate model with an equally-weighted index as the control portfolio.

We postulate that a more promising choice of the control portfolio is an equally-weighted index of pre-dominantly domestic firms which, by design, is expected to have insignificant foreign exchange exposure. The residual firm-specific exposure estimates, relative to the index with insignificant exposure, are expected to be unbiased.

**H<sub>4</sub>:** When an index of equally-weighted domestic firms is used as the control portfolio in the multivariate specification, the residual, firm-specific exposure estimates are expected to be significantly negative for exporting firms and significantly positive for importing firms, as predicted by theory.

### **3. Sample, methodology and data**

We describe, below, the sample, methodology and data used to estimate the total foreign exchange exposure in a univariate regression and the residual exposure in a multiple regression with returns on the value-weighted market portfolio, equally-weighted market portfolio and an equally-weighted portfolio of purely domestic firms, as alternative measures of the control variable.

#### *3.1. Sample*

From a starting sample of S&P 500 firms as of December 1997, we identify subsamples of export oriented firms, import oriented firms and domestic firms. All data used to categorize the sample are for the fiscal year ending 1997 or earlier. If data are missing on Compustat, then the percent of foreign sales and foreign assets is obtained from the July 1997 Forbes list of “100 largest multinationals.” Whenever sufficient detail about companies’ international trade is not available, the Value Line Investment Survey is consulted, following Jorion (1990, 1991) and Chow et al. (1997).

Exporters (E) are firms that have at least 50% of their total sales in foreign countries and/or have at least 50% of their assets located overseas. Foreign sales include

exports as well as goods produced and sold overseas.<sup>2</sup> While the 50% cut-off is ad hoc, it is high enough for the firms to be significantly affected by foreign markets. Previous studies tend to focus on this category (see Jorion, 1990, 1991; Amihud, 1993; Bartov and Bodnar, 1994, among others) and hypothesize a negative exposure coefficient.

Importers (I) are firms that import a significant part of their sales. Since companies do not report quantitative information about imports, we identify importing firms based on qualitative information about their import activity obtained from Value Line Investment Survey, corporate annual reports, footnotes accompanying financial statements, and from web sites. The industries are primarily in the retailing business and typical firms are Wal-Mart, Circuit City, Toys R Us, Liz Claiborne and Home Depot.

Domestic firms (D) are firms with insignificant foreign trade and foreign assets, typically less than 10%, and little foreign competition. Examples include domestic service organizations, restaurant chains, newspapers, railroads, and trucking.

Excluded from the analyses are firms that do not fall into the above categories and, as in most finance studies, financial institutions and foreign firms. Also excluded are firms that either trade or are heavily dependent on internationally traded commodities priced in dollars, such as oil and metals. Jorion (1990) also excludes oil companies since they may not be “sensitive to fluctuations in the value of the dollar, in which case the structural relationship could yield different coefficients for oil and non-oil firms.”

Table 1 lists and describes the categories along with examples of firms in each category.

### 3.2. Methodology

We estimate the “total” exposure or elasticity as the coefficient in the univariate regression

$$R_{i,t} = \alpha_i + \beta_i G_t + e_{i,t}, \quad (3.1)$$

where  $R_{i,t}$  is the return of stock  $i$  in period  $t$  and  $G_t$  is the change in exchange rate over the same period, measured in foreign currency per dollar.

We estimate “residual” exposure, or deviation from the market exposure, as the regression coefficient of exchange rate changes,  $G_t$ , in the multivariate regression

$$R_{i,t} = \alpha_i + \beta_i G_t + \gamma_i R_{m,t} + e_{i,t}, \quad (3.2)$$

where  $R_{m,t}$  is the return on the control portfolio in period  $t$  and other variables are as described above.<sup>3</sup>

<sup>2</sup> Though Compustat reports exports and sale of foreign produced goods separately, the separation is not always reliable and is missing for many firms. For consistency and accuracy we use the combined figure.

<sup>3</sup> We re-estimated Eq. (3.2) using orthogonalized exchange rates to correct for potential multicollinearity problems. The results were qualitatively similar.

Table 1  
Categories of sample firms

Category	No. of firms	Types of firms, industries	Names of some firms
Importers	28	Large multi-product retailers, specialty retailers, and some textile companies	K-Mart, Walmart, Fruit of the Loom, Circuit City, Russell Corp., Gap, Toys R Us, Home Depot
Domestic	91	Service organizations, domestic restaurant chains, newspapers, railroads, and trucking	H&R Block, Kroger, Rubbermaid, Ryder, Times Mirror, Yellow Corp., Maytag
Exporters	67	Category leaders in any industry	Coca Cola, Boeing, Proctor and Gamble, General Electric, Microsoft, Colgate, Dow Chemical, Johnson and Johnson
Firms excluded		Banks, foreign firms, airlines, metal processors	Barrick Gold, Reynolds, Chevron, Alcan (Canadian), Unilever (Dutch), and Laidlaw (Canadian)

The S&P 500 firms as of December 1997 are categorized as under depending upon their exposure to exchange rates. Data from foreign operations is obtained from Compustat, Forbes listing of multinational companies, and Value Line Investment Survey.

### 3.3. Variable description and data sources

Eqs. (3.1) and (3.2) are estimated using monthly data from January 1975 to December 1997. Most studies use monthly data and in doing so implicitly assume that monthly returns and exchange rate changes are unanticipated. Empirical evidence that stock returns and exchange rate changes (Mussa, 1979) approximate random walks supports such an assumption.

Data for the dependent variable, measured as the individual firm's stock returns and returns on an equally-weighted portfolio of exporting and importing firms, are obtained from CRSP (Center for Research in Security Prices of the University of Chicago).

Returns on the control portfolio in the multivariate regressions are measured as (i) value-weighted returns on all NYSE/AMEX/NASDAQ stocks, (ii) equally-weighted returns on all NYSE/AMEX/NASDAQ stocks and (iii) equally-weighted returns on a portfolio of domestic firms, all using CRSP data.

Changes in exchange rates are measured as monthly percentage changes for two indices:

*The Major Currency index:*<sup>4</sup> The major currency index consists of currencies of sixteen countries (Euro-area currencies with Belgium/Luxembourg counted as one,

<sup>4</sup> At the same time, the Federal Reserve Board (FRB) developed another index called the "Broad" index that comprises of thirty-five currencies. However, the broad index includes currencies of high inflation countries that have experienced persistent depreciations. This restricts the usefulness of the nominal broad index as large nominal depreciations of a few countries swamp information on the value of the dollar against other countries.



Australia, Canada, Japan, Sweden, Switzerland, UK), with the currency weights revised each year. This index was constructed by the Federal Reserve Board in 1998, especially for the dollar, with a weighting scheme that focuses more directly on the competitiveness of US goods in US and foreign markets (Leahy, 1998). The index also serves as a gauge of financial pressures on the dollar. Values of the major currency index are obtained from the Board of Governors of the Federal Reserve System website (<http://www.bog.frb.fed.us>). The major index is superior to other indices used in previous studies that rely on too few currencies or are infrequently revised. While the major index is the primary index for the results of the paper, we use one other index for comparison with prior work and to examine the sensitivity of our results to the choice of index.

*The Special Drawing Right (SDR) index:* The SDRs value is determined by the International Monetary Fund based on a basket of currencies. Until 1980, the IMF used currencies of 16 countries with the largest share of world exports of goods and services. Since January 1981, the IMF uses five currencies (the US\$, J¥, FFr, DM, and £) and the weights assigned to these currencies in the SDR basket are revised every 5 years.<sup>5</sup>

## 4. Results

Our estimates of total exposure that jointly incorporates the firm-specific cash flow effects and the macroeconomic effects, and the residual exposure that attempts to isolate the firm-specific cash flow effects are presented and discussed below.

### 4.1. Total foreign exchange exposure

We estimate the univariate regression (Eq. (3.1)) at the portfolio and firm levels. Table 2 presents the results of the regressions of portfolio returns for the sub-samples of exporting and importing in month  $t$  against the rate of change in the exchange rate in month  $t$ . For the sample of exporting firms, the coefficient of the exchange rate variable is insignificantly different from zero at the portfolio level for both measures of exchange rates. Regressions at the individual firm level (not reported) show statistically significant negative exposure for only 4% of the firms in a two-tailed test at a 10% significance level when the Major Currency index is used to measure exchange rate changes. Another 4% of the firms exhibit statistically significant positive exposure. When exchange rate measures are based on the SDR index, none of the exporters have significantly negative exposure and four percent have significantly positive exposure. These results are consistent with hypothesis H1 derived from the dual-effect hypothesis of at least partially offsetting domestic and foreign market effects for

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<sup>5</sup> FFr and DM have been replaced by the euro since January 1, 1999.

Table 2  
Estimates of total exchange rate exposure,  $\gamma_i$

	FX index	
	Major	SDR
Importers	0.3402* (0.198)	0.4960** (0.240)
Exporters	-0.0593 (0.151)	0.0444 (0.183)

Model:  $R_{it} = \alpha_i + \gamma_i G_t + \varepsilon_{it}$ .

The model is estimated for each portfolio of exporting and importing firms using OLS.  $R_{it}$  is the portfolio return for month  $t$ , and  $G_t$  is the rate of change in the nominal exchange rate index (FX index) in month  $t$ . An increase in  $G_t$  represents an appreciation of the US dollar.  $\gamma$  is the exchange rate exposure coefficient. Standard errors are in parentheses.

\*\* , \* indicate statistical significance at the 5% and 10% level, respectively.

exporting firms. Further, the support for the dual-effect hypothesis is robust to the level of exports used to identify the sub-sample.<sup>6</sup>

For the sample of importing firms, the stock returns are positively correlated with contemporaneous changes in exchange rates at the portfolio level for both measures of exchange rates.<sup>7</sup> The correlation is both statistically and economically significant. A 10% appreciation of the dollar translates into a 3.4–5.0% increase in the stock price of the average importer. Further, from the firm level regressions (not reported) we observe that 39–43% of the firms have statistically significant coefficients depending on the exchange rate index used, and *all* the significant coefficients are positive<sup>2</sup>. In contrast, only about 15% of the firms in Bodnar and Wong's (1999) broad-based sample had statistically significant total exposure elasticity at the 10% level. Our finding of significantly positive exposure for importing firms, on average, is consistent with hypothesis H2 based on the dual-effect hypothesis according to which the domestic and foreign market effects are additive for importing firms.

In a cross-sectional analysis of the importing firms' exposure, we examine their reported currency hedging activities as an explanatory variable for differences in their foreign exchange exposures. We find that the average exposure for the unhedged importers is indeed higher than for hedged importers, the difference, however, is not statistically significant. A possible explanation for this result is that the importers' currency hedging transactions primarily hedge against translation

<sup>6</sup> We test for the sensitivity of exchange rate exposure to the level of exports, by re-estimating the regression for a sample of firms with foreign sales of less than 25%. For this sample M of 'marginal exporters', the exposure coefficient is still insignificant but less negative/more positive than for the primary sample of high exporters, E, with exports greater than 50%. The result is consistent with a larger offset of the foreign market effects by the domestic market in sample M which has a higher domestic to foreign market ratio than sample E. Doidge et al. (2000) and He and Ng (1998) report less negative exposure for US multinational (with higher domestic to foreign market ratio) than Japanese multinationals.

<sup>7</sup> The regressions for both sub-samples appear to be well specified in terms of serially uncorrelated residuals. The Durbin–Watson (DW) statistics are 1.6 and 1.8 for the sub-sample of importers and exporters, respectively, and fail to reject the null of no-autocorrelation in each case.

and transaction exposure, but not against economic exposure which, arguably, has the largest valuation impact.

#### 4.2. Firm-specific foreign exchange exposure

Table 3 presents the results from the multivariate regression (Eq. (3.2)) at the portfolio level for the sub-samples of exporting and importing firms using alternative control portfolios.

Panel A of Table 3 shows that when the control portfolio is the value-weighted market index, the residual exposure coefficients are insignificant for exporters, as in other studies, and significantly positive for importers. These results support hypothesis H3 which is based on the argument that the residual exposure coefficients are likely to be biased when the value-weighted index is used as the control portfolio. Since the value-weighted market portfolio is likely to be dominated by large multinational firms its own exposure is expected to be negative. The residual exposure or deviations from the (negative) market exposure, therefore, underestimates the true negative exposure expected for exporters and overestimates the true positive exposure for expected exporters leading to insignificant exposure estimates for exporters and strongly significant estimates for importers.

Replacing the value-weighted market portfolio with an equally-weighted market portfolio appears to generate an opposite bias. As shown in Panel B of Table 3,

Table 3  
Estimates of residual exchange rate exposure,  $\gamma_i$

	FX index	
	Major	SDR
<i>Panel A. Market portfolio = CRSP value-weighted portfolio</i>		
Importers	0.3440*** (0.114)	0.3902*** (0.139)
Exporters	-0.0560 (0.055)	-0.0480 (0.066)
<i>Panel B. Market portfolio = CRSP equally-weighted portfolio</i>		
Importers	0.1733 (0.123)	0.1554 (0.150)
Exporters	-0.1870** (0.093)	-0.2174* (0.113)
<i>Panel C. Market portfolio = equally-weighted portfolio of domestic firms</i>		
Importers	0.2313** (0.091)	0.2316** (0.111)
Exporters	-0.1428** (0.068)	-0.1591* (0.083)

Model:  $R_{it} = \alpha_i + \beta_i R_{mt} + \gamma_i G_t + \varepsilon_{it}$ .

The model is estimated for each portfolio of exporting and importing firms using OLS.  $R_{it}$  is the portfolio return for month  $t$ ,  $R_{mt}$  is the market portfolio return in month  $t$ , and  $G_t$  is the rate of change in the nominal exchange rate index (FX index) in month  $t$ . An increase in  $G_t$  represents an appreciation of the US dollar.  $\gamma$  is the exchange rate exposure coefficient. Standard errors are in parentheses.

\*\*\*, \*\*, \* indicate statistical significance at the 1%, 5%, and 10% level, respectively.

we now report a significantly negative exposure for exporters and an insignificant exposure for importers at the portfolio level. These findings are consistent with a positive exposure for the equally-weighted index dominated by smaller firms. The deviation, or residual exposure, relative to the positive exposure for the market index, overestimates the true negative exposure expected for exporters and underestimates the true positive exposure expected for importers. Indeed, Bodnar and Wong (1999) report more positive average exposures for the equally-weighted market index than for the value-weighted market index, on average.

Finally, Panel C of Table 2 reports the exposure estimates for the sub-samples of exporting and importing firms when the control portfolio is an equally-weighted index of domestic firms. We have argued that since this control portfolio is expected to have insignificant exposure, the residual, firm-specific exposures measured as the coefficient of the exchange rate variables are expected to be unbiased. Consistent with this argument and hypothesis H4, we now report significantly negative exposure for exporting firms<sup>8</sup> and significantly positive exposure for importing firms at the portfolio level.<sup>9,10</sup> Notably, the size of the positive and significant exposure coefficient for importers lies below the ‘overestimated’ value in the regression using the value-weighted market index and above the ‘underestimated’ value obtained with the equally-weighted market index as the control portfolio. Similarly the size of the negative and significant exposure for exporters lies above the ‘underestimated’ value with the value-weighted index and below the ‘overestimated’ value with the equally-weighted index. These results are consistent with reduced distortion in the residual exposure estimations when the equally-weighted domestic firm index is chosen as the control portfolio. Further, these estimates of the firm-specific, residual exposure are economically significant. A 10% appreciation of the dollar results in about a 1.5% decline in stock price for exporters and a 2.3% increase in stock price for importers, on average. Regressions at the individual firm level (not reported) show that depending on the exchange rate index used to measure changes in exchange rates, 73–76% of exporters have negative exposure, 21% significantly so, and 68–71% of importers have positive exposure, 25–32% significantly so.

## 5. Conclusions

Investors and managers are interested in reliable and economically meaningful measures of a firm’s foreign exchange exposure in order to make their hedging

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<sup>8</sup> Sensitivity analysis of the residual exposure of exporters to levels of sales shows less negative exposure for the marginal exporters M, consistent with higher firm-specific exposure for high exporters E, with higher foreign market activity.

<sup>9</sup> The DW statistics for the multivariate regressions are 1.7 and 1.9 for importers and exporters, respectively, and fail to reject the null of no-autocorrelation.

<sup>10</sup> To test for the stability of the coefficients over sub-periods, we re-estimate the multivariate regressions with a control portfolio of domestic firms for sub-periods of weak and strong dollars following Choi and Prasad (1995). We report that while the signs of the coefficients are stable over the two periods, exporting firms are more sensitive to exchange rate changes during the weak dollar sub-period.

and risk management decisions. However, the attempt in the literature to provide such measures has been less than fully successful. One such measure is the estimate of ‘total’ exposure that jointly captures the exchange rate and macroeconomic effects on the value of the firm in a univariate regression. The literature typically reports insignificant total exposure for multinational or export oriented firms, on average, and generally concludes that the finding is inconsistent with the expected negative exposure for such firms. We propose a dual-effect hypothesis to argue that it is the expectation of negative total exposure for exporters that is flawed and that the reported insignificant exposure is economically meaningful. Our hypothesis argues that exporting firms are at least partially hedged with respect to total exposure that jointly incorporates the (offsetting) foreign and domestic market effects of changes in exchange rates on the firm value. These effects are additive for importers resulting in significantly positive total exposure and a greater need for hedging. Our empirical results are consistent with the predictions of the hypothesis of insignificant exposure for exporters and significantly positive exposure for importers.

An alternative measure of a firm’s exposure is the ‘residual’ or firm-specific exposure estimated in a multivariate regression with the returns on a control portfolio as an additional variable. This regression attempts to isolate the firm’s cash flow exposure from the macroeconomic effects. Studies typically use a value-weighted market index as the control portfolio and report insignificant exposure for large multinational firms, on average. We report insignificant residual exposure for exporters and significantly positive exposure for importers with a similar control portfolio. These results are explained by the downward (upward) biases in the residual exposure estimates for exporters (importers) measured with respect to a value-weighted market index, which itself has negative exposure. We show that an equally-weighted index introduces an opposite bias resulting in insignificant exposure for importers and significantly negative exposure for exporters, on average. However, when we replace the value-weighted market portfolio with an equally-weighted portfolio of purely domestic firms, which have insignificant cash flow exposure by design, we report significantly negative exposure for exporters and significantly positive exposure for importers, consistent with theoretical predictions. The exposure coefficients are also economically significant. The accuracy of the residual exposure measure depends critically on the choice of the appropriate control portfolio.

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