Unconditional and conditional exchange rate exposure

Ines Chaieb

University of Geneva and Swiss Finance Institute

Stefano Mazzotta

Kennesaw State University*

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*Ines Chaieb can be reached at Ines.Chaieb@unige.ch, University of Geneva and Swiss Finance Institute, UNIMAIL, Bd du Pont d'Arve 40, CH-1211 Geneva 4, Tel: +41 (0) 22 379 8568, Fax: +41 (0) 22 379 8104. Stefano Mazzotta can be reached at smazzott@kennesaw.edu. Michel J. Coles College of Business, Kennesaw State University, 1000 Chastain Road, #0403 Kennesaw, GA 30144-5591. Phone: (770) 423-6341. Fax: (770) 499-3209. We thank Francesca Carrieri, Fabio Fornari, Laurent Gheeraert, Elaine Hutson, Delroy Hunter, Tom O'Brien, Filippo di Mauro, Basma Majerbi, Ulf Nielsson, Max Stevenson, Vihang Errunza, and the participants to the MFA 2008 (San Antonio, Texas), EFA 2008 (St. Pete Beach, Florida) and INFINITI 2008 (Dublin, Ireland), EFMA 2009 (Milan, Italy) conferences and the participants to the European Central Bank seminar (June 2008) for insightful comments. The usual disclaimer applies. This paper has been previously circulated as "Foreign exchange exposure of U.S. firms and macroeconomic conditions: Is there a link?" Mazzotta gratefully acknowledges financial support by the Michael J. Coles College of Business.

Abstract. We re-examine the relationship between exchange rate movements and firm value. We estimate the exchange rate exposure of U.S. firms to two currency indices. Firms are clustered into eleven industries. The sample includes exporters and non-exporters. Using a panel approach, we uncover statistically significant and sizable unconditional exposure. We also examine the dynamics of exchange rate exposure modeled as a function of business cycle indicators and firm characteristics. We find that exposure varies over time with macroeconomic and financial variables and increases during economic contractions. Deviations from the unconditional measure of exposure driven by the macroeconomic variables are economically meaningful.

JEL Classification: F31, E32

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I. Introduction

Adler and Dumas (1984) define foreign exchange (FX) economic exposure as the sensitivity of the firm's returns to unexpected changes in real exchange rates. The extant literature finds a puzzling weak relationship between exchange rates and returns.[1] There are several reasons that render identifying and estimating the FX exposure difficult. First, methodology matters in how exposure is measured.[2] Second, exposure is temporally unstable.[3] Third, exposure is measured net of operational and financial hedging.[4] Ignoring any of these issues could understate the statistical significance or the economic importance of exposure.

Our contribution is twofold. First, using a panel approach in an unconditional setup, we find evidence of statistically significant and economically important exposure for U.S. firms. Second, in a conditional setup, we show that currency exposure varies over time with financial business cycle indicators and macroeconomic variables and increases in periods of contractions.

[1] Jorion (1990), Amihud (1994), Bartov and Bodnar (1994), Choi and Prasad (1995), and Griffin and Stulz (2001) among others, find a weak link between exchange-rate fluctuations and stock returns of US firms with international activity. Doidge et al. (2006) find evidence for economically sizeable exposure. Jorion (1990), He and Ng (1998), and Dominguez and Tesar (2006), among others, uncover cross-sectional variation in exposure. Exposure is correlated with firm size, the degree of hedging motive, foreign sales, and competitiveness at the industry level.

[2] Bartov and Bodnar (1994), Bodnar and Wong (2003), Dominguez and Tesar (2001, 2006), and Priestley and Ødegaard (2007) among others, examine implications of differences in research designs, such as sample selection, return measurement horizon, model specification, and choice of the exchange rate, on the measure of exposure.

[3] Levi (1994) argues that many factors could change over time introducing variability in the regression coefficients measuring exposure: The elasticity of demand might not be constant, the profitability of operations could change substantially over the business cycle, and the firm's hedging position could be influenced by financial market changes and other factors.

[4] Pantzalis, Simkins and Laux (2001) document the importance of financial and operational hedges for managing the exchange rate risk of US multinationals. Bartram et al. (2010) show that for a typical firm pass-through and operational hedging each reduce exposure by 10 percent to 15 percent and financial hedging reduces exposure by 45 percent to 50 percent. Bartram (2006) supports that operational and financial hedging by multinationals mitigate their large exposure significantly. Other studies, such as Allayannis and Ofek (2001) and Simkins and Laux (1997), document significant negative relationships between exposures and the use of financial derivatives.

We measure industry level exposure and its dynamics using firm level data as opposed to industry indices. We cluster individual firms into industry panels and explicitly allow for heterogeneous exposure of firms within the same industry. Our approach is meaningful economically and statistically. Economically, an unexpected change in the exchange rate should affect industry's competitiveness but not equally affect each firm within the same industry.[5] Statistically, the use of a panel model takes advantage of expanded observations to yield greater testing power and higher precision in estimation. It also overcomes the potential loss of information and bias induced by grouping firms. The results of the methodology augment the traditional firm-by-firm approach. They provide a manager with industry exposure benchmarks useful to better manage operations and possibly design more effective hedging strategies.

We study the universe of US firms from COMPUSTAT over the period 1973-2005 using quarterly data. The sample includes firms with international involvement and purely domestic firms.[6] The latter could be indirectly exposed through for instance import-competing. We measure exposure to two trade-weighted real currency indexes: the major index (MJ) and the other important trading partners (EM) index.

In a static framework, we find that exposure is statistically significant and economically important. We first replicate the well known puzzling finding of a low proportion of firms significantly exposed as in Jorion (1990)[7]. However, panel regressions show that the results from the individual firms regressions do not imply that exposure is unimportant or insignificant. Taking into account the joint evidence from the cross-section

[5] Both theoretical and empirical works have shown that industrial structure affects exposure. See for example, Marston (2001), Bodnar, Dumas, and Marston (2002) and Allayanis and Ihrig (2001).

[6] Previous work primarily focused on multinationals. Some studies, such as Dominguez and Tesar (2001, 2006), Starks and Wei (2006), and Doukas, Hall and Lang (1999), measure exposure of all firms regardless of their degree of international activity. Aggarwal and Harper (2010) examine domestic firms that have no identifiable direct exposure to foreign exchange risk.

[7] Jorion (1990) finds that it is difficult to measure exposure coefficients precisely to distinguish them individually from zero. However, he rejects the hypothesis that they are jointly zero at standard significance levels.

of firms we find statistically significant and sizable unconditional exposure in most industries. We also provide a detailed statistical analysis of the exposures by introducing additional controls, examining exporters and non-exporters, and by looking at two subperiods. We then relate our findings to some stylized facts and statistics about the industry trade balance of US industries by region. We uncover significant changes of the exposure over time. These results motivate the analysis of the dynamics of exposure that we discuss next. Importantly, the changes in exposures are overall consistent with the changes in the trade balance for some industries. In addition, we analyze the cross sectional determinants of exposure. Exporters and non-exporters show noticeable qualitative similarities both in their level of exposure and the determinants of the exposures. Our findings show that firms with higher international involvement, that are smaller, that are more levered, or that have lower growth opportunities, are also more exposed.

Our second contribution is to relate the dynamics of exposure to the business cycle. Several studies examine time variation in exposure using subperiod dummies (see e.g. Williamson (2001), Parsley and Popper (2006)), or using rolling regressions (see for example, Glaum, Brunner and Himmel (2000), Starks and Wei (2006)).[8] A few other studies allow exposure to vary as a function of industry or firm level variables. Allayannis (1997) finds that the foreign exchange exposure of U.S. manufacturing industry varies with changes in the imports and exports. Gao (2000) discovers that exposure of US multinationals vary with firms' foreign sales and foreign production. Allayanis and Ihrig (2001) find that allowing exposure to vary with industry's markup, export share, and imported import share, helps uncovering exposure for U.S. manufacturing industries. Priestley and Ødegaard (2007) relate exposure dynamics to exchange rate regimes.

Therefore, there is evidence that FX exposure changes over time. However, what

[8]Jorion (1990), Amihud (1994), and Dominguez and Tesar (2001, 2006) among others show that foreign exchange exposure varies across subperiods.

drives the dynamics of exposure is still an open question. In particular, very little is known about how exposure varies over the business cycle. A seminal paper by Bodnar et al. (2002) shows that pass-through and exposure are related to the elasticity of demand.[9] The authors assume a two country model with an exporting firm competing with a foreign-importing firm in the export market. They show that pass-through is incomplete because the demand functions permit price elasticities and hence markups to vary as prices change. They also show that exposure changes with markups which is consistent with the empirical evidence in Allayannis and Ihrig (2001). Furthermore, several studies argue for cyclical elasticity of demand and markups. Therefore, it is plausible that changes in elasticity of demand and markups can induce variation in exposure over the business cycle.

We use panel regressions and a parametric specification to model the time variation in exposure over the business cycle. We set exposure as a function of financial business cycle indicators and firm-specific variables. As business cycle predictors, we use the default premium and the term premium along with the lagged world market return. The default premium captures the long run effect of business conditions, while the term premium reflects the short run effect (see for example, Fama and French (1989), Chow, Lee and Solt (1997), Avramov (2002)). We also run extensive robustness tests using a wide array of macroeconomic variables. As for firm characteristics, we report results for financial leverage and liquidity. We also include other important variables such as foreign sales, size, profit margin, degree of operating leverage, and proxies for growth opportunities in the robustness section.

We find that the exposure to the two currency indexes is significantly time-varying except the Chemicals and Telephone & TV industries. The time variation in the exposure

[9] Levi (1994) and Marston (2001) show that exchange rate exposure depends on the elasticity of demand in the foreign market and on other factors.

to the two currency indexes is mainly driven by the financial business cycle predictors. Moreover, the exposure increases in periods of recession. Using the case of Non-Durables industry, we illustrate how the unconditional measure of exposure could significantly under or over-state the effect of exchange rate fluctuations on stock returns. The under or over estimation of exposure is economically meaningful both in relative and absolute terms. The robustness results confirm that the exposure's dynamics are mainly driven by the macroeconomic variables.

Both the unconditional and conditional evidence indicate that exposure to the EM currency index affects US firms returns in an important way statistically and economically. This is interesting in view of the large currencies volatilities experienced by the emerging markets along with the difficulties to hedge against these currencies.

The rest of the paper is organized as follows. Section II outlines the model and empirical methodology used in the study. Section III describes the data. Section IV reports the empirical results. Section V concludes.

II. Methodology

We measure industry level exposure and its dynamics using firm level data rather than industry indices. Specifically, we cluster individual firms into industries and use a panel design. The benefit of the panel approach is twofold; i) it greatly increases power to precisely estimate exposure parameters, ii) it overcomes the potential loss of information and bias induced by grouping firms. The results of the methodology augment the traditional firm-by-firm approach in a valuable way. They provide the manager with an industry exposure benchmark.

We measure exposure to two trade weighted currency indexes, the major (MJ) index and the emerging markets (EM) index detailed in the data section. In view of the importance of the emerging markets as trade partners to the U.S., we include the EM exchange rate index separately. An alternative approach would be to use bilateral exchange rates. However, only a small number of bilateral rates can be used, which makes the analysis of exposure to emerging currencies intractable. In addition, the use of bilateral rates that are highly correlated introduces multicollinearity problems. As noted in the literature, currency indexes tend to bias downward exposure.[10] Therefore our results should be regarded as conservative. Since Section II-B relates the dynamics of exposure to firm-specific variables that are available only at the quarterly frequency, we measure exposure using quarterly returns data. In addition, in the exposure regressions, we control for the market factor as in Jorion (1990) and other studies. That is, we measure *excess* exposure.[11] We use the MSCI total return world market as a proxy for the market portfolio.

A. Unconditional model

We measure exposure in a *static* framework. First, we run firm-by-firm regressions similar to extant studies. Second, we measure industry level exposure using a random coefficient panel. In firm-by-firm estimations, exposure coefficients are obtained from the following regression,

$$r_{it} = \gamma_i^{MJ} MJ_t + \gamma_i^{EM} EM_t + \gamma_i^c C_t + \alpha_i + \varepsilon_{it}, \quad t = 1...T, \tag{1}$$

[10]Most studies use trade-weighted currency indexes.Williamson (2001), Dahlquist and Robertson (2001), Fraser and Pantzalis (2004), Parsley and Popper (2006), Priestley and Ødegaard (2007), among others, use bilateral exchange rates and argue that individual currency effects may be masked by a trade-weighted index. On the other hand, Bartram (2006) shows that the use of individual exchange rates does not improve the measurement of exposure.

[11]Bodnar and Wong (2003) show that the choice of the market index might introduce biases in the *excess* exposure estimates. Priestley and Ødegaard (2007) suggest orthogonalizing the market return and the exchange rates on macroeconomic variables to measure a *total* exposure.

where r_{it} is the return on the ith company's stock, MJ_t is the rate of change in the trade-weighted major currency index, EM_t is the rate of change in the trade-weighted emerging market currency index. The currency indexes are measured as the dollar price of the foreign currency. C_t is either the return on the value-weighted MSCI market index or a vector including additional macro control variables such interest rate, oil prices changes, default premium and term premium. Note that the above regression measures association rather than causality since exchange rates and equity prices are jointly endogenous variables (see for example, Adler and Dumas (1984) and Jorion (1990)).

We then cluster firms into Fama-French eleven industries and measure exchange rate exposure using a panel approach. We explicitly allow for heterogeneous exposure of firms within the same industry panel. Heterogeneity can take the form of a firm specific average expected return, i.e. each firm has different intercept, or as a different sensitivity of returns to changes in the foreign exchange rate, i.e. each firm has a different exposure coefficient. We estimate the panels using random effects on the slope. This type of model is known as random coefficient or linear mixed panel. Beck and Katz (2007) emphasize the benefits of the random coefficient model. They suggest that random coefficient cannot mislead analysts into finding parameter variation when there is none or if parameters vary in some ways that are quite different from the assumptions underlying the RCM. For each industry, the regression equation is written as,

$$r_{it} = \left(\gamma^{MJ} + \gamma_i^{MJ}\right) MJ_t + \left(\gamma^{EM} + \gamma_i^{EM}\right) EM_t + \left(\gamma^{c} + \gamma_i^{c}\right) C_t + \alpha + \varepsilon_{it}, \quad t = 1...T \quad (2)$$

where γ^{MJ}, γ^{EM} are the average exposure coefficients, γ_i^{MJ}, and γ_i^{EM} are firm-specific deviations from the common coefficients, and γ^c and γ_i^c are the average exposure to market and other macro variables and the firm-specific deviations respectively.[12]

[12] We do not include a random effect for the constant α, as its extremely low variance results in a de-facto collinear covariate and makes estimation of other parameters unstable.

Equation (1) is a simple linear model of the form,

$$r_i = X_i \beta_i + \varepsilon_i, \tag{3}$$

where r_i is a vector of returns, X_i is a matrix of the independent variables (the exchange rates and market return) and β_i is a parameter vector. The random coefficient model in equation (2) is a generalization of a linear regression allowing for the inclusion of random deviations other than those associated with the overall error term. The generalization of (3) to a model allowing for heterogeneity for firm i can be represented as,

$$r_i = X_i \beta + Z_i b_i + \varepsilon_i, \tag{4}$$

where b_i is a firm-specific deviation from the common mean β, and Z_i is a subset of X_i for which we allow firm-specific coefficients. The firm-specific coefficients are treated as random variables having zero mean and constant variance. The random effects are not directly estimated but are summarized in the tables. Each industry panel is represented as,

$$r = X\beta + Zb + \varepsilon, \tag{5}$$

where r is the $TN \times 1$ vector of all the returns, X and Z are the fixed effect and random effect covariates, respectively. The fixed portion, $X\beta$, is analogous to the usual OLS regression. For the random portion, $Zb + \varepsilon$, we assume variance of the form

$$Var \begin{bmatrix} b \\ \varepsilon \end{bmatrix} = \begin{bmatrix} \sigma_b^2 I & 0 \\ 0 & \sigma_\varepsilon^2 I \end{bmatrix},$$

i.e. we assume that b and ε are orthogonal, and that b_i are independent across firms. Assuming that $\varepsilon \backsim N(0, \sigma_\varepsilon^2 I)$, and considering the combined error $Zb + \varepsilon$, the distribution function of r is $r \backsim N(X\beta, \Sigma)$, where $\Sigma = \sigma_b^2 Z'Z + \sigma_\varepsilon^2 I$.

The model is then estimated by maximizing the likelihood function,

$$L(\beta, \sigma_b^2, \sigma_\varepsilon^2) = -\frac{1}{2}\left[n\log(2\pi) + \log|\Sigma| + (r - X\beta)'\Sigma^{-1}(r - X\beta)\right]. \tag{6}$$

B. Conditional model

Next, we study the *dynamics* of foreign exchange exposure. Exposure to currency risk is allowed to vary with financial business cycle indicators, as well as with firm-specific variables. Bodnar et al. (2002) show that price elasticities and markups are related to pass-through and exposure which is consistent with the empirical evidence in Allayannis and Ihrig (2001). Furthermore, several studies argue for cyclical elasticity of demand and markups.[13] Therefore, it is plausible that changes in elasticity of demand and markups can induce variation in exposure over the business cycle. We investigate empirically how exposure varies over the business cycle. Specifically, we model exposure as a function of default spread, term premium, and the world market return. All of the instrumental variables are lagged. Though many variables may help predict future economic conditions, only a few can be included in order to ensure some precision in the estimation procedure. Several authors (see for example, Ferson and Harvey (1993), Avramov (2002), Avramov and Chordia (2006), Stock and Watson (1989) and Bernanke (1990)) suggest that among a number of potential candidates the default spread and the term premium perform well in predicting future macroeconomic conditions.

We also rely on the insight gained from the work on intertemporal models and specifically on the argument in Campbell (1993) that it is less likely to be misled by spurious

[13] For instance, Kimball (1995) links cyclicality in elasticity of demand to changing production technology; Gali (1994) to changing demand composition; Bilbiie, Ghironi, and Melitz (2006) to change in product variety, and Edmond and Veldkomp (2008) to earnings dispersion. Papers on counter-cyclical markups include Rotemberg and Saloner (1986) and Bils (1989).

patterns if one links time series and cross-sectional findings. Therefore, we model the exposure measures as a function of firm-specific variables that explain the cross-sectional variation in firms' exposure. We conduct a battery of robustness checks with different macroeconomic and firm variables. The macro variables include the gross domestic product (GDP), the industrial production, the money supply, unexpected inflation, the total return market factor, the default premium, the term premium, the export as proportion of GDP, the import as a proportion of GDP. The firm variables include foreign sales, size, sales growth, profit margin, R&D, market to book, and the degree of operating leverage.

To examine the dynamics of exchange rate exposure, we implement the random coefficient panel model as follows,

$$r_{i,t} = \sum_{j=0}^{K} \left(\gamma_j^{MJ} + \gamma_{j,i}^{MJ}\right) IV_{j,t-1} MJ_t + \sum_{j=0}^{K} \left(\gamma_j^{EM} + \gamma_{j,i}^{EM}\right) IV_{j,t-1} EM_t + \sum_{j=0}^{k} \left(\gamma_j^{m} + \gamma_{j,i}^{m}\right) IV_{j,t-1} R_t^m + \alpha + \varepsilon_{i,t}, \tag{7}$$

where K is the total number of instrumental variables IV including k financial business-cycle indicators and $K - k$ firm variables. The model is then estimated by maximum likelihood as in equation (6).

III. The data

In this section we describe the data used in the empirical analysis. In sub-sections III-A and III-B, we describe respectively, the firm-specific variables, and the business-cycle indicators and other macroeconomic variables. In subsection III-C, we describe the exchange rate indexes.

A. Firms returns and characteristics

We examine exchange rate exposure of U.S. firms from 1973:2 to 2005:4 at the quarterly frequency. The data on firms returns and characteristics are from COMPUSTAT. We exclude foreign owned companies and financial companies. To insure that there is no sample selection bias, we include firms with twenty observations or more. The resulting sample comprises 4,265 firms, for a total of 194,000 data points. We cluster firms according to the eleven Fama and French industry classification. We cluster firms by industry because, despite differences in exposure within industries, both theoretical and empirical work (see e.g. Marston (2001) and Allayanis and Ihrig (2001) respectively) have shown that industrial structure affects exposure. We favor a fairly high level of aggregation across SIC numbers to increase power. The returns data used are continuously compounded quarterly total returns (i.e. dividend inclusive).

Foreign sales and net sales data are merged from the COMPUSTAT, Historical Segments database. The export variable is then defined as ratio of foreign over net sales.[14] As proxies of size we use the natural log of total assets (data44). The leverage variable is defined as the ratio of debt over equity. The debt is computed as the sum of total liabilities (data54) and preferred stock (data55). The value of equity is computed as the product of common shares outstanding (data61) and price at the end of the quarter (data14). As a measure of liquidity we use the quick ratio, which is computed as current assets (data40) minus inventories (data38) divided by current liabilities (data49). The degree of operating leverage is computed as the ratio of change in operating income (data21) to change in sales. For growth opportunities, we use sales growth (data2), R&D (data4), or book-to-market ratio. Profit margin is the ratio of net income (data69) to

[14] From the Historical Segments database we obtain 11,128 firm-quarter observations, equivalent to about 5 per cent of the total firm obervation sample. We average export by firm over the time dimension to create a firm average export variable for cross sectional analysis. We end up with a sample of 1247 firms which report foreign sales versus 2778 which do not.

sales. All variables are winsorized at the one per cent level. We use quarterly data as firms report financial results quarterly.

In Table I we report summary statistics of the U.S. firms of our sample, specifically the number of firms in each industry and the median firm market value, firm returns, export, size, leverage, liquidity, operating leverage, and real growth opportunities. The number of firms varies from 85 for Chemicals to 954 for Business Equipment industry. Business Equipment has the smallest firms with a median firm market value of $67 million. Utilities has the largest firms with a size of $1,513 million. The other firm characteristics vary substantially across firms and industries.

[Insert table I here]

B. The macro variables

We use business cycle indicators that are extensively used in studies on the predictability of equity returns (see, e.g., Keim and Stambaugh (1986), Fama and French (1989), Ferson and Harvey (1991), Avramov and Chordia (2005)). Namely, we use the total return market factor, the default premium (DP) defined as the yield difference between the U.S. Moody's Aaa and Baa Corporate Bonds, and the term spread (TP) defined as the difference between the U.S. 10 year Treasury with constant maturity and the U.S. 3-month T-Bill. DP and TP are from the Federal Reserve Board. The oil price is the change in the West Texas Intermediate (WTI) spot oil price.[15]

As robustness for the dynamic analysis of exposure, we also use the first three principal components of a large set of macroeconomic variables. The macro variables are from Datastream, unless mentioned otherwise. The data series used to compute these macro variable instruments are the gross domestic product (GDP), the industrial production

[15] The source is http://data360.org/dsg.aspx?Data_Set_Group_Id=275

(IP), the money supply ($M2$), unexpected inflation (UI), the return market factor, the default premium, the term premium, the export as proportion of GDP (Ex/GDP), the Import as a proportion of GDP (Im/GDP). U.S. export and import data are from the Bureau of Economic Analysis. We use log differences of the GDP, IP, and $M2$ series. UI is computed as the residuals of an $ARMA(1,1)$ regression of the first differences of continuously compounded rates of change of the Consumers Price Index (CPI). The cumulative proportion of variance of all macro variables explained by the first three components is 0.3, 0.45, and 0.58 respectively.

All the instruments, both macro variables and firm characteristics are lagged. Panel A of Table II presents the descriptive statistics of the macro variables. The correlation between DP and TP is 0.11. Also, the correlation among all macro variables does not exceed 0.5 in absolute terms. We refer to macroeconomic variables and financial business-cycle indicators as "macro" variables.

[Insert table II here]

C. The exchange rate indexes

It is well known that inflation differentials between the U.S. and foreign countries, especially emerging countries, are highly variable. We therefore use continuously compounded rates of change of two exchange rate indexes expressed in real terms; the major currency index (MJ) and the emerging market currency index (EM). The rates are expressed in U.S. dollars per unit of foreign currencies i.e. higher index values represent an appreciation of the foreign currency. The two currency indexes are obtained from the Federal Reserve Board. The Fed uses moving average trade weights based on annual trade flows of U.S. trading partners.[16]

[16]For details on the construction of the weights, please refer to the Winter 2005 Federal Reserve Bulletin. http://www.federalreserve.gov/pubs/bulletin/2005/winter05_index.pdf

The two currency indexes are subindexes of the broad dollar index that includes twenty-six currencies. The MJ currency index includes the widely traded currencies in foreign exchange markets and comprised sixteen currencies until the introduction of the euro in January 1999. After that, the index reflects the value of the dollar against seven major currencies, namely the euro, Canadian dollar, Japanese yen, British pound, Swiss franc, Australian dollar, and Swedish krona. The EM currency index, termed "other important trading partners" (OITP) by the Fed, shows the dollar value against the remaining nineteen currencies in the broad index. These currencies are not heavily traded outside their home markets and are mainly emerging market currencies. Countries whose currencies are included in the other important trading partners index are Mexico, China, Taiwan, Korea, Singapore, Hong Kong, Malaysia, Brazil, Thailand, Philippines, Indonesia, India, Israel, Saudi Arabia, Russia, Argentina, Venezuela, Chile, and Colombia.

The trade with the developing countries represents about 48 per cent of U.S. total trade in 2006.[17] We therefore use the EM currency index in addition to the MJ. Rather than relying on a single broad index, we measure separately exposure to the MJ and EM because of the different type of trade patterns between the US the developed countries vs. the emerging markets. In addition, while it is easier to hedge exposure to the major currencies, hedging emerging market currencies can be more involved. Hence if hedging were the reason for the insignificant exposure as argued e.g. by Allayannis and Weston (2001) or Bartram et al. (2010), we should uncover exposure to the EM currency index and only weak exposure to the MJ currency index. However, if the previous weak results are rather driven by the methodology used, then we may expect to find significant exposure with both currency indexes.[18]

[17] See Federal Reserve, Bulletin (2007).

[18] A similar argument with respect to the pricing of exchange risk is made in Francis et al. (2008).

Panel B of Table II presents the descriptive statistics of the changes in exchange rates, in nominal and real terms, for the two currency indexes. The mean real depreciation of the dollar against the currencies in the MJ index is about 0.02 per cent per quarter. The mean real appreciation of the dollar against the currencies in the EM index is about 0.21 per cent per quarter. The correlation between the two currency indexes is low. It is equal to 0.17 and 0.14, respectively in nominal and real terms.

IV. Empirical results

In this section, we first discuss the results of the estimation of exchange rate exposure in an unconditional setting, then the cross sectional determinants of exposure, and finally the time variation in the exposure.

A. Unconditional exposure

First, we run the firm-by-firm regressions of equation (1) without and with additional controls. In table III, we report the percentage of firms with significant exposure to the two currency indexes as well as the fraction of negative exposures and significant negative exposures without and with the additional controls. The percentage of firms that show significant unconditional exposure to one of the two currency indexes is generally single digit in most industries. Hence, we reproduce the puzzling result of a small fraction of firms with statistically significant exposure found in the literature.

Panel A of Table IV reports the average exposure of firm-by-firm regressions by industry, the standard error of the estimated parameters and their ratio, i.e. the Fama MacBeth t-stats. Panel A shows that the average exposures are significant in most industries. Similarly, Jorion (1990) reports strong rejections of the hypotheses that the exposure coefficients are all zero when estimating equation (1) jointly for all firms. The standard error of the firm-by-firm exposure coefficients also suggests that exposure is heterogeneous across firms within the same industry. Although the Fama-MacBeth t-stats should be taken with caution, they suggest that by focusing on individual firms one is limited by the low power of the individual regression and ends up ignoring the joint statistical evidence available by considering all the firms at the same time. In other words, by using firm-by-firm regressions to detect exposure "one cannot see the forest for the tree".

The significance level suggested by the t-stats in Panel A and the heterogeneity of the individual firms exposure motivates the use of the linear mixed panel approach with a random effect on the slope. This methodology addresses the joint significance of the firms' exposures using the power from the cross section while allowing for different exposure across firms in the same industry. This methodology does not provide the percentage of firms with significant exposure. It instead provides the standard deviation around the exposure of the average firm. For the conditional analysis of exposure we only use the mixed linear panel approach. Panel B of Table IV shows the results of the unconditional exposure regressions (2) estimated using the linear mixed model detailed in the Methodology section. We report the coefficient estimates, their t-stats, and the standard deviation of the zero-mean random effect.

Panel B shows that in all industries, except Non-Durables, the average U.S. firm is significantly exposed to at least one of the two currency indexes. We also run the panel with additional controls. Untabulated results are overall similar, while we uncover significant exposure to at least one of the two currency indices for all industries. As expected, the average exposure from the mixed panel regression in Panel B has the same sign and comparable magnitudes to exposures shown in Panel A. Also, significance levels are broadly consistent. It is noteworthy that given the small fraction of firms with significant exposure in the firm-by-firm regressions, the significance of our results cannot be attributed to the quarterly frequency.[19]

Overall Panels A and B of table IV indicate that, with the exception of Utilities, the average U.S. firm shows a negative exposure to the MJ currency index and a positive exposure to the EM index. That is, a real depreciation of the dollar against the major currency index would negatively impact the returns on the average U.S. firm. This result is consistent with the U.S. being a net-importer from its major developed countries (DV) partners therefore benefitting from a real appreciation of the dollar. However, a real depreciation of the dollar against the EM index would positively affect the returns on the average U.S. firm. This is consistent with the U.S. being a net-exporter to its main emerging countries trading partners over most of the sample period covered in this study.[20]

[Insert table IV about here]

Real exchange rate shocks affect the firm value through different channels that are difficult to isolate. Typical channels are cost structure and input prices that are affected by supplier reactions and competition among suppliers, as well as revenues structure that depends on consumer reactions and the nature of firms' competition. Hence, the traditional view that a depreciating dollar benefits US firms' exporters could be oversimplifying. Our econometric approach allows to measure an aggregate residual exposure. It does not, however, isolate the different channels. We next provide a more detailed statistical analysis of the exposures. We also relate our findings to some stylized facts and statistics about the industry trade balance.

[19]Some studies, see e.g. Chow, Lee, and Solt (1997), and Di Iorio and Faff (2000), show that the use of long-term horizon returns helps uncovering significant exposure.

[20]Some supportive data regarding US balance of goods and services can be obtained from the Bureau of Economic Analysis (BEA) statistics of U.S. International Transactions Accounts Data. Muller and Verschoor (2008) find that U.S. multinationals 'exposure to Latin-American exchange rate changes is in most cases positive, indicating that the value of U.S. firms returns increase when the U.S. dollar depreciates in real terms.

A.1. Analysis of the industry exposures

To further refine the statistical analysis, we re-run the firm-by-firm regressions with additional controls, over two sub-periods (1989-1994 and 1995-2005) and for exporters and non-exporters. Data on the trade balance of the US industries and its distribution by regional partners are available from 1989. The choice of the sub-periods is dictated by data availability. The additional controls are oil price changes, interest rate risk, business-cycle indicators namely the default premium and the term premium. We report the sub-period results with additional controls in Panel C of Table IV.

Overall, the introduction of additional controls confirms and strengthens the sign, significance and magnitude of exposure to MJ currency index for all industries except Utilities.[21] However, the significance of the exposure to the EM index is reduced. For Chemicals and Telephone and TV industries, we uncover insignificant exposure to the MJ and EM currency indices with and without the additional controls. These industries have the lowest number of firms (less than or equal to 100). Nonetheless, we do find significant exposure of Chemicals to MJ and EM over the sub-period 1995-2005.[22]

A large fraction of firms display a negative exposure to the MJ index [see Table III]. Albeit smaller, the fraction of firms with negative exposure to EM is also important. Notice that the fractions of significant negative exposures are much smaller as previously discussed. These results indicate on the one hand that the negative sign of exposure to MJ is not driven by only few firms. On the other hand, the average significant positive exposure to EM does not negate the importance of the large fraction of US firms with negative exposure to EM.

Additionally, there are significant changes of the exposure over time and switches in

[21] We discuss the case of Utilities later in this sub-section

[22] The coefficients on the controls are not reported for brevity but have the expected sign. Specifically, exposure to oil price changes of Utilities, Health and Shops is negative and significant. Only Energy shows a positive exposure, while the other industries have negative and insignificant exposure.

sign in some cases. These results motivate the analysis of the dynamics of exposure that we discuss in Section IV-C. Importantly, the changes in exposures are overall consistent with the changes in the trade balance by industry reported in Table V. Specifically, for exposures to MJ, we observe that Non-Durables, Energy, Chemicals, and Health exposures became more negative over the second sub-period. This result is driven mainly by the non-exporters.[23] Table V shows that these industries record a higher deficit vis-à-vis their developed markets (DV) partners over 1995-2005. On the other hand, the decline in the MJ exposure of Manufacturing and Business Equipment is not much in line with their increase in deficit towards DV.

For EM index, the exposure of Manufacturing becomes less positive over the second sub-period. The change in exposure is in line with the change in the trade balance from net exporter to EM to next importer from the EM. The sign of exposure is not as expected and may be due to firm size heterogeneity and to the difference between exposure of the average firm and exposure of the industry as a whole. The trade balance of US Chemical industry vis-à-vis EM has been positive and the surplus has increased over the second sub-period. We find that the exposure to EM becomes positive and significant over the second sub-period, while is insignificant over 1989-1994. However, the EM exposures of Business Equipment and Energy are not as expected. The positive and significant exposure for the former and the insignificant positive exposure for the latter are at odds with the deficit trade balance of these industries vis-à-vis their emerging countries partners. Given that the industry classification used in the trade balance data is based on NAICS codes and is not an exact match with the Fama-French industries used, table V provides remarkable support to several of our findings.

[Insert Table V]

[23] Results for exporters and non-exporters are untabulated and are available upon request.

Notwithstanding the complexity of interpreting the statistical measures of exposure and their heterogeneity, these findings overall are consistent with the average firm in an industry being a net exporter to emerging markets and a net importer from the major developed partners. However, this pattern has changed over time with some US industries becoming net importers from emerging markets. We next link our findings to some facts and other circumstantial evidence for Utilities and Health, to better understand the nature of their exposure.

A.2. Utilities

Panels A and B of Table IV uncover a puzzling positive and significant exposure of Utilities to MJ index while a negative and significant exposure to EM. Utilities are mainly domestic firms with little international involvement. The industry is essentially exposed to interest rate risk and commodity price risks, specifically oil price changes. Interestingly, with the additional controls (see Panel C of Table IV) the exposure of Utilities to MJ index becomes insignificant while the exposure to EM currency index retains its sign and significance although the size is reduced. Many U.S. Utilities moved from purely domestic to multinational firms since 1992, with the passage of The Energy Policy Act (EPAct). U.S. Utilities acquired foreign Utilities, many of which are located in emerging market countries.[24] The uncertain regulatory framework for Utilities in many emerging markets may affect U.S. MNC Utilities exchange exposure through limitations in setting prices (see e.g. Pinto (2003)). To further understand the nature of FX exposure of Utilities through their FDI, we studied the case of AES, the global power utilities company, using its 2004 10-K SEC filings. AES has mainly three large utilities located in the United States, Brazil and Venezuela. The Company's financial position

[24]In 2004, according to the US Treasury, Utilities FDIs amount in millions of dollars to 27,615 in Brazil, 3,283 in India, $10,330 in Venezuela, and $10,341 in Indonesia.

and results of operations have been significantly affected by fluctuations in the value of the Argentine peso, Brazilian real, and the Venezuelan Bolivar relative to the U.S. dollar. Depreciation of the Argentine Peso and Brazilian Real has resulted in foreign currency translation and transaction losses. Conversely, depreciation of the Venezuelan Bolivar has resulted in foreign currency gains. Foreign currency transaction losses amounted to $644 million as of 2002. Therefore, AES faces severe exchange rate uncertainty in the Latin American countries and is expected to face exposure to EM currencies. Albeit anecdotal, this evidence is consistent with our findings.

A.3. Health

Healthcare industry includes Medical Equipment and Pharmaceutical products. The average exposures we uncover imply that a rise in the industrialized major currencies hurt this sector. A potential explanation is that there is significant US industry production of Pharmaceuticals in countries such as Ireland and Singapore, from which companies export to third countries including intra-company exports to the US. This has resulted in US trade deficit in pharmaceutical products since 1990's (Source: International Trade Administration). As for the Medical Equipment industry, the Medical device exports have generated a consistent trade surplus. The EU has been the largest regional export market for US medical devices. Therefore, medical device firms should benefit from depreciating dollar against the developed markets and especially against the euro. Nevertheless, the U.S. industry is mainly facing competition from Germany, Japan, the Netherlands and Italy in high-technology products. Most of these foreign companies manufacture a significant amount of their products in the United States. Thus, the US firms might not benefit from depreciating dollar against the MJ currency index due to a cost structure likely similar to that of their competitors.

B. Cross sectional findings

To better understand how exposure varies across industries and firms, we analyze the cross sectional determinants of exposure. We use both fixed effect panel regressions which include all the industries at the same time and industry-by-industry regressions. Following He and Ng (1998) we use dummies to estimate separate coefficients for positive and negative exposure coefficient from the first-stage exposure regressions. The equations take the form

$$\widehat{\gamma}_{i,j} = DX_i'\beta_{\gamma>0} + (1-D)X_i'\beta_{\gamma<0} + c + c_j + \varepsilon_{i,j}. \tag{8}$$

The left hand side variable $\widehat{\gamma}_{i,j}$ of equation (8) is the estimated exposure coefficient for firm i in industry j from firm-by-firm first stage regressions with additional controls. Panel regressions are run with both exposure coefficients to the MJ and to the EM indices as the dependent variable. The right hand side includes candidate determinants of foreign exchange exposure. The vector X_i' includes exposure's determinants, namely export, size, leverage, operating leverage, liquidity and real growth opportunity proxies as defined in the data section. Given the large proportion of non-exporters, we study exporters and non-exporters separately. The Export variable is omitted for non exporters. D is a dummy variable that takes value one if $\widehat{\gamma}_{i,j}$ is positive and zero otherwise. The vectors $\beta_{\gamma>0}$ and $\beta_{\gamma<0}$ contain the coefficients that capture the relationship between the foreign exposure coefficients $\widehat{\gamma}_{i,j}$ and each determinant when $\widehat{\gamma}_{i,j}$ is positive and negative respectively. The common constant is c. The industry specific fixed effect coefficient is c_j, not reported for brevity. The elements of $\beta_{\gamma>0}$ and $\beta_{\gamma<0}$ reported in Table VI take the name from the determinant they refer to and the sign of corresponding $\widehat{\gamma}_{i,j}$. For instance, $Export_{\gamma>0}$ is the sensitivity to Export of positive exposure coefficient $\widehat{\gamma}_{i,j}$.

The second stage coefficients $\widehat{\gamma}_{i,j}$ in equation (8) are still consistently estimated even though the left hand side variable of the regression is estimated with error. However, since the theoretical distribution of the coefficients underlying the computation of the standard error is unknown, ignoring the error in the variable can lead to over rejection. Therefore, to assess the significance of the cross-sectional determinants we use bootstrapped standard error computed using 1000 replications for each regression.

Aggarwal and Harper (2010) document that domestic companies with no direct international involvement face significant foreign exchange exposure. Since only about 30 per cent of firms in our sample report foreign sales, we study exporters and non-exporters separately. This paper therefore contributes to the understanding of the determinants of exposure of firms for which there is no evidence of direct foreign involvement via export. We caution the reader that since these firms could still be importers, or engaged in foreign direct investment, these firms are not necessarily purely domestic. Results of regression (8) are reported in Table VI.

We first note that for both exporters and non-exporters with respect to MJ and EM currencies, the model displays significant predictive power with R-squared ranging between 53 and 60 per cent. Remarkably, the model explains 80 or more cent of the variation across industries for exporters' exposure to MJ and for non-exporters. The high level of the "Between" R-squared indicates that industrial structure itself is an important determinant of exposure. Despite the different sample, our results are broadly consistent with optimal hedging theories and support previous results (see e.g. He and Ng (1998) for Japanese multinationals.)

For exporters, the sign of the first-stage regression exposure coefficients with respect to MJ (EM) is positive in 54 per cent (60 per cent) of the firms. Since a positive exposure coefficient implies that a firm benefits from the depreciation of the US dollar, we expect a higher number of positively exposed exporting firms. For non-exporters, exposure to MJ (EM) is positive in 43 per cent (51 per cent) of the cases. Interestingly, the level of exposure of the average firm across the eleven industries to MJ and EM is overall of the same sign, significance and magnitude for exporters and non-exporters. A similar finding is reported in Aggarwal and Harper (2010) for domestic firms with no foreign sales and no foreign assets.

For exporters with positive exposure to MJ, the coefficient on foreign sales ratio, termed Export, is positive and highly significant as expected. The coefficient of 0.63 is economically significant and implies that the larger the foreign sales ratio the larger the exposure. For exposure to the EM, the coefficient is still positive but insignificant.

Size is inversely related to exposures to both indices and highly significant in all cases. The coefficients across exporters and non-exporters range between -0.13 and -0.52. This implies that larger firms tend to be less exposed to a US dollar depreciation vis-à-vis both the MJ and the EM indices. The positive and highly significant coefficient for negative exposures for exporters and non-exporters and with respect to both EM and MJ implies that the larger the size the lower (in absolute value) the exposure.

Smith and Stulz (1985) and He and Ng (1998) argue that more levered firms face higher cost of distress and thus have a high incentive to hedge foreign exchange risk. With a small and insignificant coefficient, leverage (Lev) does not explain positive exposure to the MJ for exporters. Consistently with hedging theory, this could be indirect evidence that highly levered exporters hedge their exposure with respect to MJ currency. Leverage is instead positively related to positive exposures to EM and negatively related to negative exposures to both MJ and EM for exporters. This implies that the higher the exporters' leverage the more the company value is affected by the fluctuation of EM currencies. It is therefore plausible that the hedging argument may not hold with respect to the exposure to EM due to the documented greater difficulty in effectively hedging with respect to the emerging market currencies. For non-exporters, leverage is significant for both MJ and EM with 0.07 and 0.17 for positively exposed firms and

-0.11 and -0.08 for negatively exposed firms.

Operating Leverage (OL) and liquidity (Liq) have overall the expected sign, though insignificant for both exporters and non-exporters. Growth opportunities as captured by sales growth (RGO) show mixed signs and significance. They are however negative and significant for the positive exposures to the EM and positive and highly significant for the negative exposures to MJ for both exporters and non-exporters. This result is in line with the case that firms with higher growth opportunities have the incentive to hedge and face then lower exposure.

Our results are broadly consistent with the hedging argument. Determinants that have been found significant in the literature for multinationals carry most of their explanatory power for non-exporters. Exporters and non-exporters show noticeable qualitative similarities both in their level of exposure and the determinants of the exposures. Our findings show that firms with higher international involvement, that are smaller, that are more levered, or that have lower growth opportunities, are also more exposed.

Finally, these results not only provides additional insight with respect to what determines the level of exposure regardless of the business cycle fluctuations, they also provides an explicit motivation for the variable selection in the following section.

C. Time-variation in foreign exchange exposure

We use a parametric specification to model the time variation in exposure. The advantage of such an approach is that it explicitly links time variation in exposure to macroeconomic state variables and firm characteristics. A similar approach is widely used in the specification of the dynamics of market betas. We use it to examine how much of the changes in the exposure is driven by fundamental economic variables.

Table VII reports the Wald test of the null hypothesis that i) exposure to each currency index (MJ or EM) is not significant, ii) exposure is not time-varying, iii) the joint coefficients in the firm-specific variables are all equal to zero, iv) the joint coefficients in the business-cycle indicators are all equal to zero.

Table VII shows that the exposure to the MJ currency index is significant for the average firm in each industry except for those in Chemicals and Telephone and TV industries. In all cases where MJ currency index exposure is significant it is also statistically time-varying except for the Durable industry. Moreover, exposure to the EM currency index is significant for the average firm of each industry and is statistically time-varying in all cases except for Chemicals and Telephone and TV industries. Interestingly, time variation for the exposure to the two currency indexes is mainly driven by the business-cycle indicators. For the exposure to the MJ currency index, there are no instances where the Wald test rejects the null hypothesis of joint zero coefficients on the firm-specific variables, while the null of zero coefficients on business-cycle indicators is rejected in all cases. For the exposure to the EM currency index, the Wald tests suggest the firm variables significantly contribute to the time variation of exposure only for the average firm in two industries, namely Durables and Business Equipment. Business-cycle indicators significantly drive the time variation in exposure in all cases.

Table VIII reports the results from the estimation of equation (7). The table shows the estimated coefficients on the different instruments, their t-stats, and the standard deviation of the random component. A clear pattern emerges from the table. First, for the exposure to the MJ currency index, the coefficients on the term premium are significantly positive for the average firm in half of the industries and significantly negative for the average firm in Utilities. A negative term premium, i.e. an inverted yield curve, tends to precede a downturn of the economy. When the unconditional exposure is negative, all else equal, a positive coefficient on the term spread implies that the exposure to the MJ index increases in absolute terms in periods of recession. Second, for the exposure to the EM currency index the default premium coefficients are negative in all cases and are significant for the average firm in seven out of eleven industries. A large spread indicates the bottom of a recession and thus predicts recovery. Given the positive unconditional exposure coefficient, a negative coefficient on the default spread implies, all else equal, that the exposure to the EM index increases in periods of recession. The effect of the default premium on exposure of utilities to the EM is the only exception. In the following section we provide an illustration of the economic importance of the time variation in exposure.

The coefficients on liquidity and leverage are only significant for the average firm in two industries. It is noteworthy that the factors that explain the cross-sectional difference in exchange exposure among firms will not explain the time series of a firm's specific exposure if they do not change much over time. Francis et al. (2008) examines the role of currency risk premium for US industries returns and find that the cross-industry variation in the currency premium is explained by industry characteristics while its time variation is explained by macroeconomic variables.

In addition, our methodology allows to capture only the effect on exposure dynamics driven by changes in firms' characteristics that are common across firms within the same industry. Idiosyncratic changes in firm characteristics only contribute to the dispersion of the random deviation around the mean.

The next sub-section discusses the economic magnitude of exposure and provides some illustrative examples.

[Insert tables VIII and VII about here]

D. Economic interpretation of the results

In this sub-section we discuss the magnitude of exposure and present some examples to illustrate the economic significance of the results. Panel C of Table IV shows that the unconditional exposure to the EM currency index is economically larger than that to the MJ index for some industries. In addition, the magnitude of exposures to the two currency indexes varies across industries. The exposure coefficients to the MJ currency index range in absolute terms from 0.01 to 0.4, while those to the EM currency index range from 0.04 to 0.98. Recall that these are measures of *excess* exposure and hence the *total* exposure can be fully measured only in combination with the exchange rate exposure of the market.

The magnitude of the excess exposure is defined as the sum of exposure to the MJ and EM indexes. In the manufacturing industry for instance, the exposure coefficients on the MJ and EM currency indexes are respectively -0.26 and 0.25. Assuming a one percent real depreciation of the dollar against major and emerging market trading partners simultaneously, the total average impact on the returns would be negligible as the exposures would offset each other. However this implicitly amount to assuming that the two currency indexes are perfectly correlated while they are not as evidenced by the low correlation of 0.23 in Panel B of Table II. Other industries as well do not show offsetting exposures to the two currency indexes even if we assume the same percentage real depreciation of the dollar against the two currency indexes. For instance, in the Energy industry, the exposure coefficients on the MJ and EM currency indexes are respectively -0.30 and 0.66. Assuming a one percentage real depreciation of the dollar against major and emerging market trading partners, the total impact on the firm stock excess return is an increase by 0.33%, on average.

To illustrate the economic importance of the time variation in exposure, we take the case of the Non-Durables industry and assume a negative and a positive shock of one standard deviation to the term premium. Because the unconditional excess exposure can be positive or negative, we need to consider an increase and a decrease in the term premium separately. First, consider a negative shock in the term premium, that is a clockwise twist of the yield curve. Table VIII shows that the unconditional excess exposure to the major currency index is -0.181, and that the coefficient for the term premium is 0.323. These coefficients imply that, ceteris paribus, a *decrease* of one standard deviation in the term premium is associated with a change in the exposure from -0.181 to -0.62, which in turn implies that a one percent real depreciation of the US dollar vis-a-vis the MJ index is associated with 0.62 per cent decline in excess returns, on average. Second, consider a positive shock in the term premium, that is a counterclockwise twist of the yield curve. Such an *increase* of one standard deviation in the term premium is instead associated with a change in exposure from -0.181 to 0.26, which in turn implies that a one percent depreciation of the US dollar is associated with an increase in the excess returns of 0.26 per cent. Therefore, the unconditional measure of exposure could significantly understate or overstate the effect of exchange rate fluctuations on stock returns. The under or over estimation of exposure is important both in relative and absolute terms. Similar considerations hold for the default premium and for the other industries. Overall, the results imply that the economic importance of exposure varies depending on the macroeconomic conditions.

To further gauge the economic importance of exchange rate exposure to the two currency indexes, we plot the excess exposure as driven only by the business-cycle indicators.[25] Figure 1 presents the quarterly excess exposure for the eleven industries between 1973 and 2005. Figures 2 and 3 show the contribution of the MJ and the EM to the excess exposure. Figure 1 indicates that excess exposure varies substantially across

[25] We exclude firm variables as they are generally not significant drivers of exposure dynamics.

industries and over time. Excess exposure not only varies over time but also changes sign. Related papers that examine time variation in exposure also find that exposure change sign over time. For instance Allayannis and Ihrig (2001) relate exposure dynamics to mark-ups, Priestley and Ødegaard (2007) relate exposure dynamics to exchange rate regimes, we relate exposure dynamics to the business cycle. In addition, the plots suggest that the size of exposure and its variation around the mean are economically important. The excess exposure increases during economic contractions, which are represented by the shaded areas in the figures, and peaks near business cycle troughs.[26] Figures 2 and 3 also illustrate that the exposure to the MJ index increases during economic contractions and that the exposure to the EM index tends to increase in absolute terms during economic recessions and around the 1997-1998 Asian financial crisis. Our findings are consistent with the following economic story. High markups result in a decrease of pass-through and increase in exposure (see e.g. Bodnar et al. (2002)). If markups are higher in periods of recessions than in booms then pass-through is lower and exposure is higher in recessions.[27]

E. Robustness

To ensure the validity of our results, we carry out several robustness tests with different firm variables and macroeconomic variables.

E.1. Macroeconomic variables

We re-estimate the model with alternative macroeconomic variables. Specifically, we use the principal components of other important macroeconomic variables widely used in

[26] The period of contraction is measured from peak to trough as determined by the National Bureau of Economic Research, NBER

[27] Papers on counter-cyclical markups include Rotemberg and Saloner (1986), Bils (1987) and Chevalier and Scharfstein (1995).

the literature (e.g. Doukas et al., 1999, Kandil and Mirzaie, 2002). The macroeconomic variables include GDP, industrial production, money supply, trade, inflation variables, market return, the default premium and the term premium. The untabulated results show that the unconditional exposures are of the same economic magnitude to the ones displayed in Table VIII. Moreover, the three principal components of the macroeconomic variables explain the dynamics of the exposure to the MJ currency index for the average firm in all industries except for Telephone and TV. These three components also explain the dynamics of the exposure to the EM currency index for the average firm in all industries except for Energy and Telephone and TV. In addition, the results with regards to the firm variables are unchanged. Hence our results are robust to the specification of the macroeconomic variables.

E.2. Firm variables

Our earlier findings that firm-specific variables generally do not significantly explain the time variation of exposure clearly does not contradict the empirical evidence of their explanatory power in the cross section as per our findings in Section IV-B and the extant literature. Nevertheless, to test whether the lack of explanatory power of the firm variables in the dynamics of exposure is driven by the selection of firm variables, we re-estimate the model using alternative firm variables that have been related to cross-section changes in firms' exposure. We include different proxies for growth opportunities, namely, sales growth, R&D, and market to book ratio. We also include foreign sales, size, profit margin and the degree of operating leverage. All these variables are investigated in turn. It is noteworthy that profitability, leverage, and liquidity are related to financial distress and hence bankruptcy risk. Highly levered firms will experience financial distress after only small declines in operating performance (see e.g. Jensen (1989)). In addition, Bodnar at al. (2002) emphasize the importance of industry competition and profit margin to exchange rate exposure. In general, we do not find that the alternative firm specific variables explain the time variability of exposure. Importantly, the coefficients on the business-cycle indicators and macroeconomic variables retain their statistical and economic significance. Overall, the robustness results confirm that the financial business-cycle indicators and the macroeconomic variables mainly drive the time variation in exposure.

V. Conclusion

We study industry level exposure to the major and the emerging market currency indexes using firm level data as opposed to industry indices. We measure exposure both in a static and in a conditional framework. Using firm-by-firm regressions we replicate the well known and puzzling result in the literature that only a relatively small number of firms show significant exposure coefficients. However, the Fama MacBeth t-tests of the estimated exposure coefficients suggest that the average of the exposure coefficients are significantly different from zero in most industries. Moreover, formal inferences based on a random coefficient panel approach provide strong evidence that the exposure to the two currency indexes, and particularly to the emerging market index, is statistically and economically significant. Our findings also highlight the important role that emerging markets play in the U.S. economy.

We also provide a detailed statistical analysis of the exposures by introducing additional controls, by examining exporters and non-exporters separately, and by looking at two sub-periods. We then relate our findings to trade balances of US industries by region. We uncover two important facts. First, there is sensible time variation in exposures to both currency indices. Second, the results are overall consistent with the changes in the trade balance for some industries vis-à-vis their developed and emerging market partners. In addition, we analyze the cross sectional determinants of exposure. Exporters and non-exporters show noticeable qualitative similarities both in their level of exposure and the determinants of the exposures. Our findings are broadly consistent with the hedging argument. They show that the level of exposure is negatively related to size, and growth opportunities, while positively related to the degree of international involvement and leverage.

We also examine the dynamics of exposure. We use a parametric specification to model the time variation in exposure. The advantage of such an approach is that it explicitly links time variation in exposure to macroeconomic state variables and firm characteristics. We use the default premium and the term premium for their ability to capture the macroeconomic conditions and report results about financial leverage and liquidity for firm characteristics. We also run extensive robustness tests using a wide array of both macroeconomic and firm variables.

Our conditional results can be summarized as follows. The exposure to the two currency indexes is significantly time-varying except in Chemicals and Telephone & TV industries and the economic importance of exposure varies over time. The dynamics of exposure to the two currency indexes are mainly driven by business-cycle indicators and macroeconomic variables and are such that excess exposure increases during economic contractions. Using the case of Non-Durables industry, we illustrate how the unconditional measure of exposure could significantly under or over-state the effect of exchange rate fluctuations on stock returns. The under or over estimation of exposure is economically meaningful both in relative and absolute terms. The robustness results confirm that the exposure's dynamics are mainly driven by the macroeconomic variables.

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Table I

Industry	firms	m.cap.	mean	med.	sd
	Returns				
All ex Financials	4,265	103	-0.006	0.000	0.352
Non Durables	218	105	0.000	0.001	0.298
Durables	124	102	-0.008	0.000	0.327
Manufacturing	496	93	-0.004	0.000	0.318
Energy	197	72	-0.001	0.000	0.371
Chemicals	85	133	-0.001	0.004	0.328
Business Equip.	954	67	-0.017	-0.001	0.402
Telephone and TV	101	279	-0.005	0.006	0.388
Utilities	208	1513	0.023	0.031	0.141
Shops	525	134	-0.006	0.000	0.328
Health	518	79	-0.006	0.000	0.385
Other	640	70	-0.011	0.000	0.375

	Export		**Size**		**Leverage**	
Industry	mean	sd	mean	sd	mean	sd
Non Durables	0.120	0.131	4.406	1.705	1.201	1.798
Durables	0.126	0.126	4.212	1.598	1.357	1.973
Manufacturing	0.184	0.156	4.234	1.787	1.186	1.753
Energy	0.300	0.322	4.066	2.148	1.153	1.838
Chemicals	0.148	0.126	4.471	2.332	0.893	1.536
Business Equip.	0.242	0.194	3.747	1.840	0.640	1.236
Telephone and TV	0.211	0.296	5.179	2.758	1.193	1.778
Utilities	n.a.	n.a.	7.095	1.684	2.162	1.255
Shops	0.177	0.170	4.534	1.699	1.398	1.973
Health	0.214	0.169	3.544	1.739	0.478	1.132
Other	0.252	0.242	3.873	2.028	1.224	1.943

	Liquidity		**Op. Leverage**		**Growth Opp.**	
Industry	mean	sd	mean	sd	mean	sd
Non Durables	1.910	2.523	0.096	27.297	-8.826	0.618
Durables	1.888	2.054	0.416	7.531	-8.797	0.506
Manufacturing	1.917	2.374	1.028	71.875	-8.802	0.557
Energy	2.443	4.208	3.494	198.213	-8.727	0.589
Chemicals	2.472	3.807	0.659	16.838	-8.821	0.591
Business Equip.	2.817	3.067	0.505	49.892	-8.850	0.548
Telephone and TV	1.898	2.506	-1.986	80.706	-8.844	0.524
Utilities	0.735	0.370	0.450	8.836	-8.379	0.711
Shops	1.218	1.616	0.588	59.046	-8.838	0.510
Health	5.029	5.974	0.417	76.374	-8.902	0.725
Other	2.465	3.879	-0.088	34.062	-8.815	0.648

This table presents the number of firms, the median market capitalization, and the mean and standard deviation of the U.S. firms returns. Firms are clustered according to the eleven Fama and French industry classification. The sample period is from 1973:2 to 2005:4 at the quarterly frequency. The sample comprises 4,265 firms, for a total of 194,000 data points. Foreign Sales and Net Sales data are merged from the COMPUSTAT, Historical Segments database. The Export variable is defined as ratio of foreign over net sales. size is the natural log of total assets (data44), and growth opportunities, is computed as the sales growth (data2)

The debt is computed as the sum of total liabilities (data54) and preferred stock (data55). The value of equity is computed as the product of common shares outstanding (data61) and price at the end of the quarter (data14). The leverage variable is defined as the ratio of debt over equity. The measure of liquidity is the quick ratio, which is computed as current assets (data40) minus inventories (data38) divided by current liabilities (data49). All firm data in the table are from COMPUSTAT.

Table II

Panel A
Macro

	mean	sd	GDP	IP	M2	Ex/GDP	Im/GDP	UI	DP	TP	Mkt. Ret.	Oil
			Correlation									
GDP	1.734	0.914										
IP	0.606	1.617	0.418									
M2	0.572	1.014	-0.166	0.044								
Ex/GDP	0.450	2.750	0.146	0.039	-0.439							
Im/GDP	0.762	3.327	0.146	0.328	-0.332	0.435						
UI	0.001	0.006	0.313	0.168	-0.434	0.302	0.368					
DP	1.089	0.442	0.095	-0.303	0.184	-0.269	-0.177	-0.298				
TP	1.661	1.364	-0.188	0.027	0.262	-0.295	-0.187	-0.284	0.109			
Market Return	0.631	3.866	0.049	0.119	0.082	0.073	-0.002	-0.122	-0.098	0.039		
Oil Price	0.423	3.613	0.108	0.029	-0.291	0.134	0.242	0.526	-0.121	-0.119	-0.172	
Interest rate (per cent)	-0.009	0.012	0.335	0.481	-0.193	0.119	0.139	0.247	-0.175	-0.409	-0.092	0.108

Panel B
FX

	obs	mean	sd	MJ	EM	NMJ
				Correlation		
MJ	131	0.017	1.657			
EM	131	-0.211	1.053	0.144		
NMJ	131	0.036	1.633	0.982	0.145	
NEM	131	-1.160	1.294	0.132	0.666	0.169

Panel A reports the descriptive statistics of the macro data series. The variables are the gross domestic product (GDP, first differences of continuously compounded rates of change), industrial production (IP, first differences of continuously compounded rates of change), Money supply (M2, first differences of continuously compound rates of change), unexpected inflation (UI, computed as the residuals of an ARMA (1,1) regression of the first differences of continuously compounded rates of change of the Consumer's Price Index, CPI), the total return market factor. These variables are from Datastream. The export as proportion of GDP (Ex/GDP), import as a proportion of GDP (Im/GDP), are from the Bureau of Economic Analysis. The default premium (DP) defined as the yield difference between the U.S. Moody's Aaa and Baa Corporate Bonds, and the term spread (TP) defined as the difference between the U.S. 10 year Treasury with constant maturity and the U.S. 3-month T-Bill are from the Federal Reserve Board. The oil price is the change in the spot oil price, West Texas Intermediate. The interest rate is the 3-month T-Bill yield change. Panel B reports the mean and standard deviation of the real major (MJ) and emerging market (EM) currency indexes, and the nominal major (NMJ) and emerging (NEM) market currency indexes returns and the correlations. Data are from Federal Reserve Board. The sample period is from 1973:2 to 2005:4 at the quarterly frequency.

Table III

Industry	Without additional controls $t(\gamma^{MJ})^{**}$	$\gamma^{MJ} < 0$	$t(\gamma^{MJ})^{**}$ *and* < 0	With additional controls $t(\gamma^{MJ})^{**}$	$\gamma^{MJ} < 0$	$t(\gamma^{MJ})^{**}$ *and* < 0
Non-Durables	6.02	56.48	5.09	6.02	57.87	5.56
Durables	13.93	63.11	10.66	15.57	65.57	13.93
Manufacturing	6.71	56.30	4.88	6.71	59.55	5.49
Energy	3.23	53.23	2.69	3.23	58.06	2.69
Chemicals	8.43	51.81	4.82	9.64	56.63	6.02
Business Equip.	6.72	49.63	3.95	7.15	52.29	4.16
Telephone and TV	7.00	52.00	2.00	6.00	56.00	2.00
Utilities	13.17	20.00	0.98	5.37	45.85	1.95
Shops	7.38	55.73	5.24	7.77	58.64	5.83
Health	4.32	60.51	2.95	7.47	63.26	6.29
Other	6.25	53.78	3.29	5.26	55.43	2.96

Industry	Without additional controls $t(\gamma^{EM})^{**}$	$\gamma^{EM} < 0$	$t(\gamma^{EM})^{**}$ *and* < 0	With additional controls $t(\gamma^{EM})^{**}$	$\gamma^{EM} < 0$	$t(\gamma^{EM})^{**}$ *and* < 0
Non-Durables	10.19	54.17	4.63	8.80	52.78	4.63
Durables	4.92	48.36	2.46	2.46	44.26	1.64
Manufacturing	7.32	45.33	3.05	7.32	45.93	3.46
Energy	6.45	37.10	1.61	4.30	41.40	0.54
Chemicals	2.41	40.96	1.20	6.02	44.58	2.41
Business Equip.	5.98	46.96	2.24	5.44	46.64	2.13
Telephone and TV	5.00	34.00	2.00	5.00	37.00	2.00
Utilities	29.27	86.34	29.27	10.73	78.54	10.73
Shops	4.47	45.44	2.33	3.30	45.83	1.55
Health	3.73	44.79	0.39	4.91	46.17	0.79
Other	5.26	49.18	1.81	5.76	49.01	1.97

This table shows, for each of the eleven Fama-French industries, the percentage of U.S. firms that display a significant exposure (t-stats larger than two), negative exposure and significant negative exposure with respect to the major and emerging markets real currency indexes. We run firm-by-firm OLS regressions of the form $r_{it} = \gamma_i^{MJ} MJ_t + \gamma_i^{EM} EM_t + \gamma_i^{c} C_t + \alpha_i + \varepsilon_{it}, \quad t = 1...T$. The sample period is from 1973:2 to 2005:4 at the quarterly frequency. The sample comprises 4,265 firms, for a total of 194,000 data points. The exchange rate indexes are the major trading partners currency index (MJ) and the emerging countries currency index (EM) from the Federal Reserve Board. C_t is the return on the value-weighted MSCI market index in the "Without additional controls" or a vector including additional macro control variables such Interest Rate, Oil Prices changes, Default Premium and Term Premium in "With additional controls".

Table IV

Unconditional Exposure for Real Major and Emerging Markets

Panel A
Firm-by-firm.

Industry	γ^{MJ}	SE	t-stats	γ^{EM}	SE	tstats
Non Durables	-0.185	0.11	-1.7	0.002	0.18	0.0
Durables	**-0.559**	0.17	-3.3	-0.015	0.26	-0.1
Manufacturing	**-0.293**	0.07	-4.3	**0.304**	0.14	2.1
Energy	**-0.285**	0.14	-2.1	**0.574**	0.24	2.4
Chemicals	-0.114	0.19	-0.6	0.520	0.28	1.9
Business Equip.	-0.024	0.07	-0.3	**0.243**	0.12	2.0
Telephone and TV	0.092	0.21	0.4	**0.737**	0.38	2.0
Utilities	**0.332**	0.03	9.6	**-0.804**	0.07	-11.8
Shops	**-0.140**	0.07	-2.0	0.169	0.13	1.3
Health	**-0.430**	0.08	-5.7	**0.472**	0.13	3.7
Other	-0.064	0.09	-0.7	0.121	0.14	0.9

Panel B
Mixed linear panel.

Industry	γ^{MJ}	sd_i	t-stats	γ^{EM}	sd_i	t-stats
NonDurables	-0.147	0.28	-1.8	0.037	1.02	0.3
Durables	**-0.434**	0.38	-3.6	0.184	0.00	1.0
Manufacturing	**-0.257**	0.37	-4.4	**0.249**	0.97	2.5
Energy	**-0.303**	0.01	-2.8	**0.666**	0.04	3.8
Chemicals	-0.014	0.65	-0.1	**0.472**	0.00	2.2
Busines Equip.	0.019	0.57	0.4	**0.425**	0.91	4.8
Telephone and TV	-0.018	0.01	-0.1	**0.977**	0.01	3.7
Utilities	**0.272**	0.00	8.5	**-0.688**	0.00	-12.8
Shops	**-0.189**	0.39	-3.1	**0.230**	0.15	2.5
Health	**-0.282**	0.00	-4.1	**0.484**	0.00	4.5
Other	-0.053	0.64	-0.8	**0.206**	0.04	2.0

Panel C
Firm-by-firm with control variables and sub-periods

	1975-2005		1989-1994		1995-2005	
Industry	MJ	EM	MJ	EM	MJ	EM
Non-Durables	**-0.322**	0.023	-0.327	0.216	**-0.431**	0.319
Durables	**-0.693**	0.013	**-1.273**	**1.410**	**-0.703**	0.129
Manufacturing	**-0.412**	**0.398**	**-0.720**	**0.627**	**-0.467**	**0.413**
Energy	**-0.432**	0.414	**-0.577**	0.014	**-1.110**	0.415
Chemicals	-0.332	0.362	-0.084	-0.292	**-0.537**	**0.872**
Business Equip.	**-0.185**	**0.332**	**-0.435**	-0.432	-0.133	**0.730**
Telephone and TV	0.054	0.641	-0.731	**2.043**	0.153	0.281
Utilities	0.043	**-0.464**	**0.156**	-0.042	0.213	**-0.279**
Shops	**-0.256**	0.268	**-0.409**	0.235	**-0.444**	**0.683**
Health	**-0.725**	**0.574**	**-0.501**	0.008	**-0.889**	**1.146**
Other	-0.189	0.229	**-0.551**	-0.403	**-0.489**	**0.369**

This table shows the exchange rate exposure coefficients to two real currency indexes. The sample period is from 1973:2 to 2005:4 at the quarterly frequency. The sample comprises 4,265 firms, for a total of 194,000 data points. Firms are clustered according to the eleven Fama-French industry classification. C_t is a set of control variables. The exchange rate indexes are the major trading partners currency index (MJ) and the emerging countries currency index (EM), from the Federal Reserve.

Panel A reports the average of the estimated exposure coefficients, the standard error, and their ratio (i.e. Fama MacBeth t-stats) of firm-by-firm exposure regressions of the form $r_{it} = \gamma_i^{MJ} MJ_t + \gamma_i^{EM} EM_t + \gamma_i^c C_t + \alpha_i + \varepsilon_{it}, \quad t = 1...T$, for all the firms in the sample. In Panel A, the control C_t is the continuously compounded MSCI world market return.

Panel B reports the exposure coefficients γ^{MJ}, γ^{EM}, the t-stats, and the standard deviation sd_i of the slope's random effects γ_i^{MJ} and γ_i^{EM} of random coefficient panel regressions. Each industry panel has the form. $r_{it} = \left(\gamma^{MJ} + \gamma_i^{MJ}\right) MJ_t + \left(\gamma^{EM} + \gamma_i^{EM}\right) EM_t + \left(\gamma^c + \gamma_i^c\right) C_t + \alpha + \varepsilon_{it}$. The slope coefficient's t-stats larger than two are in bold.

Panel C reports results from regressions similar to those in panel A when oil price changes, interest rates changes, default premium and term premium are included in addition to the market factor as control variables. Sub periods coefficients are also shown. For each industry and period, the average exposure coefficients is reported. Cases for which the Fama MacBeth t-stats is larger than two in absolute value are shown in bold.

Table V

US trade balance by industry and by region

	1989-1994		1995-2005	
Million USD	DV	EM	DV	EM
Manufacturing	-61,429	16,884	-98,754	-52,413
Energy	-12,562	-21,925	-36,294	-43,863
Chemicals	4,095	13,316	-11,665	18,469
Business Equip.	-2,138	-15,674	-5,584	-57,889
Healthcare	2,115	72	-10,194	-1,967

The International Trade Administration reports the trade balance by country partner and by merchandise using NAICS codes. The match with SIC codes used in Fama-French industry portfolios is imperfect. Some industries (Non-Durables, Durables, Telephone and TV, Shops, and Other) are not reported as there is insufficient information to match the SIC codes. Source: The data on trade balance by country is from the International Trade Administration (ITA) and Foreign Trade Division, U.S. Census Bureau. Data is available since 1989. Table shows authors' calculations.

Table VI

Cross Sectional Determinants of FX Exposure

Panel A: Exporters

	Exposure to MJ		Exposure to EM	
	Coefficient	p-value	Coefficient	p-value
$Export_{\gamma>0}$	**0.629**	0.006	0.733	0.163
$Export_{\gamma<0}$	-0.009	0.969	**-0.607**	0.074
$Size_{\gamma>0}$	**-0.128**	0.001	**-0.400**	0.000
$Size_{\gamma<0}$	**0.211**	0.000	**0.343**	0.000
$Lev_{\gamma>0}$	0.034	0.428	**0.321**	0.002
$Lev_{\gamma<0}$	**-0.126**	0.000	**-0.253**	0.013
$OL_{\gamma>0}$	0.008	0.664	**0.069**	0.100
$OL_{\gamma<0}$	-0.024	0.241	0.030	0.586
$Liq_{\gamma>0}$	0.011	0.671	0.025	0.404
$Liq_{\gamma<0}$	0.013	0.666	0.001	0.984
$RGO_{\gamma>0}$	0.186	0.338	**-0.935**	0.000
$RGO_{\gamma<0}$	**0.590**	0.001	-0.254	0.112
$Constant$	**3.105**	0.046	**-5.150**	0.000
	R-sq		R-sq	
$Within$	0.60		0.579	
$Between$	0.57		0.800	
$Overall$	0.60		0.580	
$N. of\, Firms$	1247		1247	
$Proportion\, of\, \gamma < 0$	0.46		0.40	

Panel B: Non-exporters

	Exposure to MJ		Exposure to EM	
	Coefficient	p-value	Coefficient	p-value
$Size_{\gamma>0}$	**-0.211**	0.000	**-0.523**	0.000
$Size_{\gamma<0}$	**0.288**	0.000	**0.369**	0.000
$Lev_{\gamma>0}$	**0.070**	0.017	**0.171**	0.000
$Lev_{\gamma<0}$	**-0.110**	0.000	**-0.085**	0.037
$OL_{\gamma>0}$	0.007	0.303	0.009	0.464
$OL_{\gamma<0}$	0.006	0.626	-0.020	0.293
$Liq_{\gamma>0}$	-0.007	0.344	-0.023	0.115
$Liq_{\gamma<0}$	0.006	0.624	0.018	0.182
$RGO_{\gamma>0}$	0.000	0.996	**-0.771**	0.000
$RGO_{\gamma<0}$	**0.518**	0.000	0.113	0.444
$Constant$	**1.979**	0.000	**-2.475**	0.037
	R-sq		R-sq	
$Within$	0.55		0.53	
$Between$	0.81		0.85	
$Overall$	0.55		0.53	
$N. of\, Firms$	2778		2778	
$Proportion\, of\, \gamma < 0$	0.57		0.49	

The table reports estimates of fixed effect cross sectional panel regressions for the eleven industries. The left hand side variable $\widehat{\gamma}_{i,j}$ is the estimated exposure coefficient for firm i in industry j from firm-by-firm first stage regressions. Panel regressions are run with both exposure coefficients to the Major and to the Emerging market currency indices as the dependent variable. The right hand side includes candidate determinants of foreign exchange exposure. The equations take the form

$$\widehat{\gamma}_{i,j} = DX_i'\beta_{\gamma>0} + (1-D)X_i'\beta_{\gamma<0} + c + c_j + \varepsilon_{i,j}.$$

The vector X_i' includes exposure's determinants, namely export, size, leverage, operating leverage, liquidity and real growth opportunity proxies as defined in the data section. The equation is estimated separately for exporters and for non exporters. The export variable is omitted for non exporters. D is a dummy variable that takes value one if $\widehat{\gamma}_{i,j}$ is positive and zero otherwise. The vectors $\beta_{\gamma>0}$ and $\beta_{\gamma<0}$ contain the coefficients that capture the relationship between the foreign exposure coefficients $\widehat{\gamma}_{i,j}$ and each determinant when $\widehat{\gamma}_{i,j}$ is positive and negative respectively. The common constant is c. The industry specific fixed effect coefficient is c_j, not reported for brevity. The elements of $\beta_{\gamma>0}$ and $\beta_{\gamma<0}$ reported in the table take the name from the determinant they refer to and the sign of corresponding $\widehat{\gamma}_{i,j}$. For instance, $Export_{\gamma>0}$ is the sensitivity to Export of positive exposure coefficient $\widehat{\gamma}_{i,j}$. Since the left hand side is estimated in first stage regression, standard errors are computed by bootstrapping with 1000 replications. Coefficients in bold are significant and the level is shown by the P-value.

Table VII

Wald tests for Major Currencies

Industry	$\gamma_i^{MJ}=0\ \forall\ i$ χ^2	*pval*	$\gamma_i^{MJ}=0\ \forall\ i>0$ χ^2	*pval*	$\gamma_i^{MJ}=0\ i=1,2$ χ^2	*pval*	$\gamma_i^{MJ}=0\ i=3,4,5$ χ^2	*pval*
NonDurables	20.906	**0.002**	19.053	**0.002**	1.267	0.531	17.952	**0.000**
Durables	16.312	**0.012**	8.229	0.144	1.945	0.378	6.252	0.100
Manufacturing	42.899	**0.000**	29.638	**0.000**	0.104	0.949	29.315	**0.000**
Energy	18.810	**0.004**	12.833	**0.025**	1.066	0.587	11.464	**0.009**
Chemicals	7.399	0.286	7.111	0.213	0.750	0.687	6.516	0.089
Busines Equip.	47.694	**0.000**	47.329	**0.000**	4.873	0.087	43.037	**0.000**
Telephone and TV	6.708	0.349	6.628	0.250	1.206	0.547	5.004	0.171
Utilities	216.484	**0.000**	136.959	**0.000**	0.211	0.900	131.811	**0.000**
Shops	37.534	**0.000**	30.866	**0.000**	4.102	0.129	26.380	**0.000**
Health	50.902	**0.000**	37.306	**0.000**	2.919	0.232	34.438	**0.000**
Other	26.454	**0.000**	26.200	**0.000**	4.677	0.096	21.219	**0.000**

Wald tests Emerging Markets Currencies

Industry	$\gamma_i^{EM}=0\ \forall\ i$ χ^2	*pval*	$\gamma_i^{EM}=0\ \forall\ i>0$ χ^2	*pval*	$\gamma_i^{EM}=0\ i=1,2$ χ^2	*pval*	$\gamma_i^{EM}=0\ i=3,4,5$ χ^2	*pval*
NonDurables	12.620	**0.049**	11.924	**0.036**	1.871	0.392	9.992	**0.019**
Durables	26.972	**0.000**	22.625	**0.000**	14.648	**0.001**	7.771	0.051
Manufacturing	22.946	**0.001**	9.428	0.093	1.588	0.452	8.162	**0.043**
Energy	26.189	**0.000**	12.260	**0.031**	1.030	0.597	11.350	**0.010**
Chemicals	11.798	0.067	3.071	0.689	0.023	0.989	2.935	0.402
Busines Equip.	60.657	**0.000**	24.916	**0.000**	8.344	**0.015**	15.945	**0.001**
Telephone and TV	20.941	**0.002**	3.450	0.631	0.328	0.849	3.233	0.357
Utilities	287.732	**0.000**	139.724	**0.000**	2.548	0.280	119.145	**0.000**
Shops	31.003	**0.000**	18.425	**0.002**	1.596	0.450	16.217	**0.001**
Health	74.520	**0.000**	45.912	**0.000**	0.046	0.977	45.729	**0.000**
Other	24.550	**0.000**	13.943	**0.016**	1.929	0.381	12.071	**0.007**

This table reports Wald tests from the estimation of equation (7) at the quarterly frequency, when firm-specific variables and business-cycle indicators are used as instruments. The Wald tests are that i) exposure to each currency index (MJ or EM) is not significant, ii) exposure is not time-varying, iii) the joint coefficients in the firm-specific variables are all equal to zero, iv) the joint coefficients of the business-cycle indicators are all equal to zero.

Table VIII. Conditional Exposure

Exposure Coefficients Estimates for MJ Currencies

Industry	γ_0^{MJ}	t-stats	sd_i	$\gamma_1^{MJ\cdot Lev}$	t-stats	sd_i	$\gamma_2^{MJ\cdot Liq}$	t-stats	sd_i
Non-Durables	**-0.181**	-2.197	0.011	-0.095	-0.830	0.765	-0.041	-0.846	0.064
Durables	**-0.433**	-3.282	0.509	-0.120	-0.903	0.703	0.127	0.939	0.514
Manufacturing	**-0.273**	-4.467	0.340	0.004	0.051	0.878	0.013	0.322	0.155
Energy	**-0.251**	-2.220	0.010	-0.064	-0.394	1.230	0.054	0.914	0.215
Chemicals	0.055	0.322	0.736	-0.171	-0.866	0.676	-0.004	-0.081	0.004
Busines Equip.	0.038	0.642	0.638	-0.199	-1.937	1.313	0.017	0.747	0.003
Telephone and TV	-0.123	-0.716	0.120	0.352	1.027	2.067	0.063	0.502	0.323
Utilities	**0.354**	10.461	0.001	0.018	0.375	0.265	0.033	0.304	0.006
Shops	**-0.228**	-3.584	0.286	0.012	0.205	0.548	**0.112**	2.025	0.152
Health	**-0.379**	-5.117	0.019	0.370	1.655	2.325	0.011	0.618	0.009
Other	-0.116	-1.596	0.628	-0.080	-0.996	0.865	0.054	1.805	0.149

Industry	$\gamma_3^{MJ\cdot Mkt}$	t-stats	sd_i	$\gamma_4^{MJ\cdot DP}$	t-stats	sd_i	$\gamma_5^{MJ\cdot TP}$	t-stats	sd_i
Non-Durables	-0.527	-0.397	0.044	-0.114	-0.372	0.038	**0.323**	3.988	0.258
Durables	0.054	0.028	0.028	0.603	1.338	0.004	0.176	1.514	0.003
Manufacturing	-1.126	-1.203	0.024	**0.613**	2.799	0.004	**0.170**	3.040	0.001
Energy	-2.689	-1.487	0.155	**1.221**	2.984	0.019	-0.087	-0.828	0.022
Chemicals	-4.339	-1.873	0.303	0.152	0.282	0.007	0.165	1.218	0.002
Busines Equip.	**-4.978**	-5.783	0.081	-0.204	-0.971	0.008	0.105	1.995	0.002
Telephone and TV	-1.143	-0.416	0.139	0.595	0.843	0.015	0.262	1.550	0.009
Utilities	**2.486**	4.614	0.108	**0.362**	3.630	0.005	**-0.227**	-9.628	0.002
Shops	0.025	0.025	0.026	-0.270	-1.126	0.005	**0.301**	5.012	0.002
Health	-0.360	-0.308	0.359	0.124	0.410	0.083	**0.378**	5.126	0.022
Other	1.144	1.048	0.035	0.387	1.465	0.006	**0.237**	3.627	0.002

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Exposure Coefficients Estimates for EM Currencies and Fixed Effect

Industry	γ_0^{EM}	t-stats	sd_i	$\gamma_1^{EM \cdot Lev}$	t-stats	sd_i	$\gamma_2^{EM \cdot Liq}$	t-stats	sd_i
Non-Durables	0.023	0.159	0.644	-0.230	-1.237	1.162	-0.055	-0.707	0.001
Durables	0.339	1.692	0.005	0.294	1.436	0.852	**-0.390**	-3.331	0.001
Manufacturing	**0.333**	2.978	1.021	0.180	1.253	1.482	0.004	0.044	0.577
Energy	**0.591**	3.082	0.043	-0.177	-1.011	0.689	-0.018	-0.182	0.311
Chemicals	**0.529**	2.193	0.010	-0.018	-0.048	1.349	-0.031	-0.146	0.729
Busines Equip.	**0.375**	3.847	0.751	**-0.542**	-2.880	2.349	-0.013	-0.254	0.436
Telephone and TV	**1.024**	3.447	0.029	0.055	0.140	1.874	0.063	0.567	0.001
Utilities	**-0.808**	-13.588	0.003	-0.113	-1.528	0.341	0.080	0.419	0.008
Shops	**0.216**	2.093	0.007	-0.087	-0.808	0.986	-0.093	-1.058	0.228
Health	**0.323**	2.577	0.037	-0.028	-0.102	2.114	0.004	0.174	0.015
Other	**0.308**	2.701	0.006	-0.139	-1.129	1.096	-0.048	-0.928	0.270

Industry	$\gamma_4^{EM \cdot Mkt}$	t-stats	sd_i	$\gamma_4^{EM \cdot DP}$	t-stats	sd_i	$\gamma_5^{EM \cdot TP}$	t-stats	sd_i	α	t-stats
Non-Durables	-2.634	-1.456	0.505	**-0.963**	-2.092	0.013	-0.213	-1.241	0.643	-0.027	-8.801
Durables	-3.990	-1.530	0.027	**-1.585**	-2.374	0.005	0.165	0.681	0.018	-0.038	-8.296
Manufacturing	0.124	0.095	0.146	**-0.950**	-2.853	0.005	0.140	1.179	0.003	-0.033	-14.661
Energy	3.719	1.276	18.675	-0.464	-0.769	0.021	**0.742**	3.242	0.008	-0.020	-4.668
Chemicals	1.979	0.606	0.022	-1.065	-1.295	0.023	-0.062	-0.214	0.008	-0.026	-4.758
Busines Equip.	1.757	1.466	0.063	**-1.022**	-3.084	0.012	-0.030	-0.270	0.007	-0.049	-23.732
Telephone and TV	-5.042	-1.305	0.140	-1.285	-1.054	0.046	-0.226	-0.638	0.015	-0.052	-8.019
Utilities	**-3.113**	-4.017	0.056	**-1.009**	-7.585	0.271	**0.550**	8.751	0.003	-0.007	-5.117
Shops	-1.639	-1.201	0.046	**-1.252**	-3.348	0.027	-0.116	-0.858	1.034	-0.032	-13.847
Health	**8.306**	5.063	0.338	-0.866	-1.733	0.079	-0.272	-1.863	0.072	-0.039	-14.383
Other	**-3.278**	-2.212	0.079	-0.452	-1.069	0.008	**-0.321**	-2.323	0.003	-0.041	-16.120

This table shows results from the estimation of equation (7) at the quarterly frequency, when firm-specific variables and business-cycle indicators are used as instruments. The sample period is from 1973:2 to 2005:4 at the quarterly frequency. The table reports the exposure coefficient γ, the t-stats, and the standard deviation of the slope's random effect sd_i. Firms are clustered according to the eleven Fama and French industry classification. The data on firms leverage, and liquidity are from COMPUSTAT. The debt is computed as the sum of total liabilities (data54) and preferred stock (data55). The value of equity is computed as the product of common shares outstanding (data61) and price at the end of the quarter (data14). The leverage variable is then defined as the ratio of debt over equity at time t for firm i. The measure of liquidity is the quick ratio, which is computed as current assets (data40) minus inventories (data38) divided by current liabilities (data49). All firm variables are winsorized at the one per cent level. The real exchange rate indexes are the major trading partners currency index (MJ) and the emerging countries currency index (EM) described in the data section. The two currency indexes are the trade-weighted values of US dollar against a number of currencies where the trade-weights are allowed to vary over time. The data series used to compute the financial business-cycle indicators are the lagged total market return factor, the default premium (DP), and the term spread (TP) described in the data section. The slope coefficient's t-stats larger than two are in bold.

Figure 1. Total macro driven FX exposure

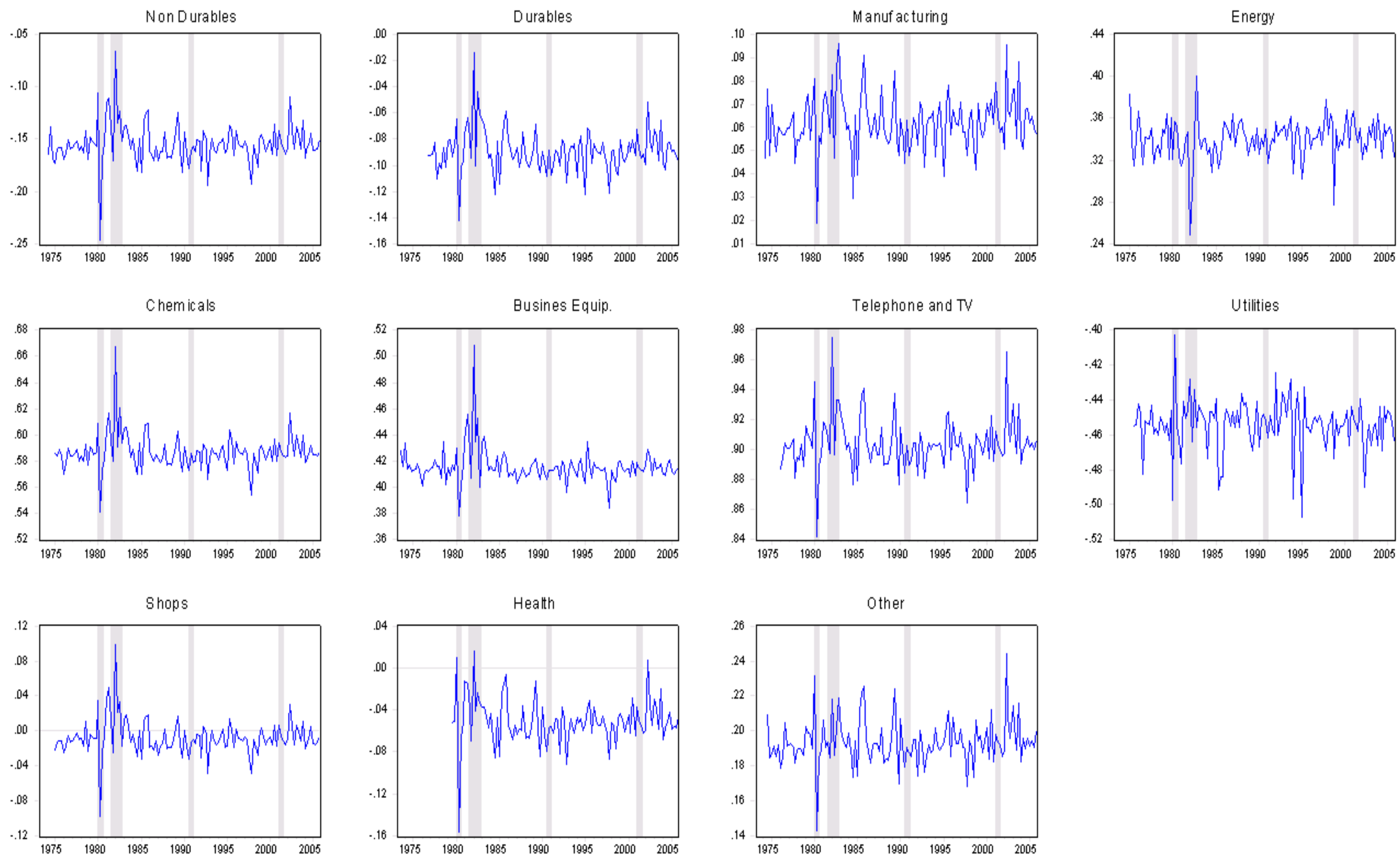

Figure 2. Macro driven FX exposure to major currencies

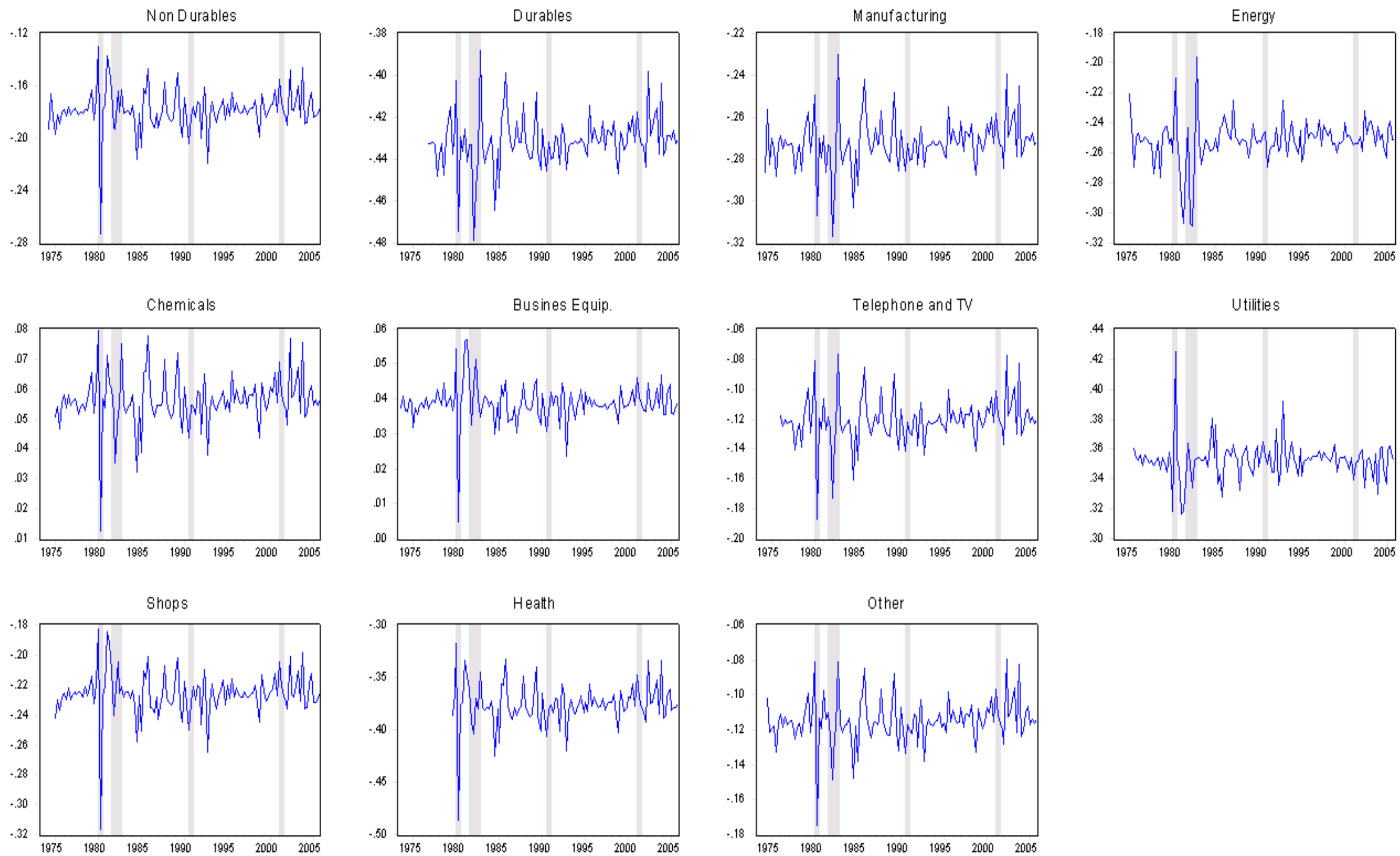

Figure 3. Macro driven FX exposure to EM currencies