Is Foreign Exchange Exposure Priced? Evidence from the Bond Market

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Abstract

This study offers empirical evidence on the relation between foreign exchange risk and firms' cost of public debt. Using Fama–MacBeth two-step regressions, we find that currency risk is priced on average, and foreign currency risk explains 17.6% of bond risk premiums. Moreover, the absolute value of currency risk exposure matters as either larger positive or negative exposures imply higher spreads. We also find that currency exposure is greater for firms in more competitive or more fluid markets, and lower for firms with greater multinational activity. Additional tests show that greater tariffs are associated with lower currency risk exposures.

Keywords: Foreign exchange exposure; currency risk premium; bond pricing; market competition; multinational activity

JEL Classification: F3; F31

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Introduction

Foreign exchange rate exposure, or the sensitivity of firm value to currency movements, is a key determining factor of security prices in international capital asset pricing models (Solnik, 1974; Adler and Dumas, 1983). Empirically, however, research in this area yields mixed results. Initial tests of foreign exchange risk in equity markets showed weak or non-existent evidence of exposure using stock returns (Jorion, 1990, 1991; Bodnar and Gentry, 1993; Bartov and Bodnar, 1994). In contrast, Dumas and Solnik (1995) show that exchange rate risk premia are a significant determinant of securities' returns in major international financial markets using a conditional asset-pricing framework that allows for time variation in the risk premium.[1] He and Ng (1998) show that exchange rate risk exposure positively affects stock returns for Japanese multinational firms, and Williamson (2001) finds evidence of exposure in the automotive sector. More recently, Francis, Hasan, and Hunter (2008) employ a conditional GARCH model and find that foreign exchange exposure explains a large portion (about 12%) of the total US equity risk premium. Alternatively, Bartram, Brown, and Minton (2010) find that a lack of foreign exchange exposure can be explained by some firms passing through currency risk to customers or using financial and operational hedges.[2] However, firms are not able to fully pass through exchange rate changes (Bodnar, Dumas, and Marston, 2002; Williamson, 2001), and while firms are able to hedge simple transactional exposure, they are less able to hedge long-term economic exposure to exchange rates (Brown, 2001).

While the vast majority of empirical work examines how foreign exchange exposure affects equity prices, little if any research investigates whether foreign exchange exposure is a priced factor in the publicly traded bond market. We focus on the bond market because of its sheer size as well as it

[1] International financial markets include those of Germany, United Kingdom, Japan, and United States.

[2] However, while hedging can mitigate the risks associated with foreign exchange exposure, most firms either engage in selective hedging based on homemade forecasts (Bodnar, Hayt, and Marston, 1998; Glaum, 2000; Bartram, Brown, and Fehle, 2009), or cannot hedge all the components of exchange rate movements (for example, the competitive exposure).

contribution to the real economy. In addition, bond pricing is relatively well defined when compared to equity pricing, and, by using bond yield spreads, we are able to consider an ex-ante measure of long-term expected returns rather than the much noisier realized ex post returns (Campello, Chen, and Zhang, 2008). We posit that foreign exchange exposure can significantly affect cash flows, revenues, and competitive positions in product markets, which leads to changes in firm valuation (Hung, 1992; Williamson, 2001). Specifically, we test whether the exposure of corporate bonds to foreign currencies is a priced factor in cross-sectional bond prices, whether the pricing of foreign exchange is asymmetric, with both more positive and more negative exposures implying greater spreads, and whether bonds of firms facing greater product market competition have higher foreign exchange risk exposure.[3]

Prior research on the relation between foreign exchange exposure and the cost of debt is limited. One exception is Chow, Lee, and Solt (1997), who examine the effect of exchange rate risk on the returns of bond and stock indices. Chow et al. show that bonds differ from stocks in that they are positively exposed to exchange-rate changes across short and long horizons, while stocks are positively exposed only for longer horizons.[4] This finding, they argue, may explain why prior empirical studies have failed to find an association between stock returns and exchange rate movements. However, their study is limited because it does not examine the effect of exchange rate risk on individual corporate bonds; rather it focuses on aggregate Treasury bond indices and on AAA- and BAA-rated corporate bond indices. As exchange rate exposures can be either positive or negative, studying only aggregate indices can create a misleading view of actual currency risk. Our research differs from the Chow et al. study in that we

[3] In a survey on foreign exchange exposure, Giambona et al. (2018) document that about 53% of respondent firms have risk management programs, and about 63% face material foreign exchange risk, and of the firms that attempt to manage their exposure, over 60% do so in order to reduce the cost of debt (p. 798, figure 2).

[4] The exposure for bonds arises from a negative correlation between exchange rate and domestic interest-rate changes, while the exposure for stocks is complicated by two additional cash flow components: transaction exposure and economic exposure, both of which are economically relevant in different horizons.

directly test whether currency risk is a priced risk factor in the bond market, and focus on the association between exchange rate risk exposure and the cross-section of bond spreads.

Using a monthly panel data set of publicly traded corporate bonds over the 1973–2016 period, we document that exchange rates are a priced risk factor in the corporate bond market, and that exchange rate risks are able to explain 17.6% of the variations in bond yield spreads in the cross section.[5] Compared with other commonly used risk variables such as size and growth factors, only the default premium explains more than the currency risk factors at 18.8%. When examining the relation between spreads and exchange rate risk more closely, we find that either larger positive or larger negative exposures imply higher spreads, and thus it is the magnitude of the currency risk exposure that best explains the yield spreads. In other words, bond investors are concerned with asset volatility (Campbell and Taksler, 2003), and either additional positive or negative exposures imply that investors will demand significantly higher spreads. Economically, a one standard deviation increase in the risk exposure to major trading partners' (MAJOR) currencies implies an increase in bond spreads of about 45 basis points, and a one standard deviation increase in the risk exposure to other important trading partners' (OITP) currencies implies an increase in bond spreads of about 25 basis points.

After confirming that exchange rate risk is a priced risk factor in the corporate bond market, we investigate two factors known to have an impact on foreign exchange exposure, namely market power and multinational activity. Allayannis and Ihrig (2001) and Bodnar et al. (2002) provide theoretical models that show how industry-competitive structure affects the amount of foreign currency exposure passed through to consumers. Therefore, in our next set of tests, we examine whether market power affects the relation between exposure and the cost of debt. We proxy for market power using the concentration in the firm's competitive space (Hoberg and Phillips, 2016), and fluidity (Hoberg, Phillips,

[5] Note that 1973 marks the collapse of the Bretton Woods system and the beginning of floating exchange rates for most developed markets.

and Prabhala, 2014), which measures how likely the product space is to change given actions by rivals. Our results show that firms in industries with greater market competitiveness and lower fluidity have lower foreign currency exposure, and this is consistent with these firms being able to pass through a greater portion of their exposure to consumers.

In addition to market power, there is a large theoretical and empirical literature on how multinational activity affects the cost of capital (Solnik, 1974; Errunza and Senbet, 1981, 1984). Reeb, Mansi, and Allee (2001) and Mansi and Reeb (2002) find that firms with international activity have a lower cost of borrowing and an increase in firm leverage. Allayannis, Ihrig, and Weston (2001) show that firms with more multinational activity are better able to use financial hedges to decrease currency exposure. We test the impact of multinational activity, proxied by whether the firm reports foreign revenues or taxes and the number of countries in which a firm owns subsidiaries, on foreign exchange exposure. We expect firms with more multinational operations to have more flexibility to manage economic exposure. Testing this conjecture, we find that bonds of firms with more multinational activities have lower levels and lower absolute values of foreign exchange exposures. This evidence is consistent with internationalization providing more flexibility for multinational corporations to hedge currency risk. We further test whether exposure to foreign exchange rates changes with tariff changes or with the entry of China into the World Trade Organization (WTO) in 2001.[6] Our findings are consistent with both decreases in tariffs and China's entry into the WTO increasing the absolute value of currency exposures.

Our research is related to, but distinct from, prior work on debt valuation in an international setting. For example, Reeb et al. (2001) find that the degree of a firm's international activities is negatively related to the cost of debt financing. However, the degree of a firm's internationalization is not necessarily a

[6] Burfisher, Robinson, and Thierfelder (2001) survey the effects of NAFTA on trade and US employment, and Valta (2012) describes how NAFTA was the largest single shock in his sample. Pierce and Schott (2016) show how China's entry into the WTO caused a large drop in US manufacturing employment.

complete proxy of its exchange rate risk exposure. Thus, Reeb et al.'s (2001) paper is only tangentially related to the pricing effect of exchange rate risk in bond markets. Our finding that firms with more international operations have lower foreign exchange exposure is consistent with Reeb et al., but it also shows one channel through which international activities reduce firm bond spreads. Our research differs from prior work in that we directly test whether currency risk is a pricing risk factor in the bond market, and focus on the association between exchange rate risk exposure and the cross-section of bond spreads.

We contribute to the literature on the effect of currency exposure on asset prices in three important ways. First, although a large strand of the literature has explored the effect of foreign exchange risk on the cost of equity capital, to the best of our knowledge no research has directly focused on the effect of exposure on corporate bond pricing. We provide cross-sectional evidence that foreign exchange risk is a key determinant in bond prices using a long series of market data. The magnitude of this association is not only statistically significant, but also economically similar to that of the effect of default on bond yield spreads.

Second, we show how corporate bond foreign exchange exposures are affected by factors such as market power, multinational activity, and changes in tariffs. We find that firms that face less product market competition or operate in less fluid markets have lower currency risk exposure, and this result is consistent with models in which imperfect competition allows firms to pass through more exchange rate risk. Consistent with multinational firms being better able to take advantage of operational hedging strategies (Bartram et al., 2010), we find that multinationals' debt has lower currency exposures. Third, this paper is timely given the recent trade uncertainty in the world economy. With the changing pattern of tariffs and trade agreements, firms expect to face increased uncertainty with respect to international supply chains and foreign competition. These changes are consequential to the firms' cost of capital, and particularly the cost of debt, as well as to investors in the corporate bond market.

The remainder of the paper is organized as follows. Section 2 develops our hypotheses on the relation between foreign exchange exposure and the cost of debt. Section 3 highlights the data sources used in the analysis and provides summary statistics. Section 4 illustrates the methods used in our analysis. Section 5 provides the empirical results of the effect of foreign exchange rate risk on the cost of debt. Section 6 concludes.

2. Motivation and Hypotheses

2.1. Foreign Exchange Exposure

In the post–Bretton Woods era, international businesses face a complex and volatile foreign exchange environment, as currency exchange rates vary in response to changes in global economic conditions. Standard economic analysis suggests that exchange rate movements affect firm cash flows as well as their costs of capital. Theoretically, exchange rate fluctuations are an important source of macroeconomic uncertainty, and therefore should have significant effects on firm value (Levi, 1994; Marston, 2001). Research in this area focuses on a complex set of determinants of currency risk exposure (e.g., pricing, cost structure, competition) to provide mechanisms through which exchange rate shocks impact the cost of capital and firm value. Empirically, however, research on exchange risk exposure is mixed. While evidence from US studies often documents weak contemporaneous relations between exchange rates and equity returns, international evidence that allows for conditional exposures finds more significant currency risk exposure estimates (Dumas and Solnik, 1995). One possible explanation for the insignificant relation found by some studies in the US is that firms not only are aware of their foreign exchange risk, but are also able to manage their foreign currency exposure by hedging (Bartov and Bodnar, 1994) or passing through exchange rate changes (Bartram et al., 2010). However, while managing currency risk is achievable in the short run, it is less feasible in the long run (Brown, 2001).

The mixed empirical findings on currency exposure in the equity markets have thus influenced the developments of new foreign exchange exposure estimation procedures. Starting from the estimation models of Adler and Dumas (1984) and Jorion (1990), subsequent papers study the impact of different variable definitions, model specifications, and estimation designs while others explore the interrelations between exchange rate exposures and economic competitive environments. While recent findings generally favor the conclusion that exchange rate fluctuations affect—to a certain extent—equity values, these findings are sufficiently varied that an examination of currency exposure in the fixed income markets can provide significant insights.

2.2 Foreign Exchange Exposure and Bond Yield Spreads

While there is ample evidence on the relation between foreign exchange exposure and equity prices, there is a paucity of research on the effect of exchange rate risk in bond markets with the exception of Chow et al. (1997). The Chow et al. study is limited as they only consider the effect of exchange rate risk on aggregate Treasury bond, AAA-, and BAA-rated corporate bond indices. They do not study the impact of exchange rate risk on individual corporate bonds. Additionally, two working papers (Bergbrant, Francis, and Hunter, 2016; Kim, Lee, and Yi, 2018) examine whether currency risk can help explain the cost of bank loans. Neither of these papers considers public bonds or examines Fama–MacBeth two-step regressions to study whether foreign exchange risk is priced.[7]

In an indirectly related study, Reeb et al. (2001) find that the degree of a firm's international activities, proxied by the foreign sales ratio, foreign assets ratio, and the number of geographical segments where the firm operates, is negatively related to the cost of debt financing. However, the degree of a firm's internationalization is not necessarily a complete proxy of its exchange rate risk exposure. Our research

[7] Note that the secondary market for bank loans is relatively recent, thus it is more feasible to examine the long-term relation between bonds and various pricing factors than bank loans.

differs from prior research in that we directly test whether currency risk is a pricing risk factor in bond markets, and we focus on the association between *exchange rate risk exposure* and the *cross-section of bond spreads.*

Given the strong theoretical motivation for foreign exchange exposure (Solnik, 1974; Adler and Dumas, 1983; and others), we hypothesize that foreign exchange rates are related to the yield spread (and thus value) of corporate bonds. As firms can have both positive and negative exposures to foreign exchange rates, and as these exposures can vary by industry and time (Jorion, 1991; Bodnar and Gentry, 1993; Allayannis, 1997; Griffin and Stulz, 2001; Williamson, 2001; Allayannis and Ihrig, 2001; Francis et al., 2008), we test whether bonds from different industries have time-varying exposures to foreign exchange rates. We then use Fama–MacBeth (1973) tests to see whether these exposures are priced in bond spreads. Our first two hypotheses are:

H1: Corporate bond spreads are significantly related to changes in foreign currency values

H2: The exposure of corporate bonds to foreign currencies is a priced factor in cross-sectional bond prices

Because corporate bondholders have limited upside but potentially large downside, greater firm risk implies higher spreads. Thus, both positive and negative exposures of greater magnitude could imply greater risk to bond holders. We therefore hypothesize:

H3: The pricing of foreign exchange is asymmetric, with both more positive and more negative exposures implying greater spreads.

Additionally, we consider whether product market competition affects foreign exchange exposure. Allayannis and Ihrig (2001) and Bodnar et al. (2002) demonstrate how greater market power implies lower exposure to foreign exchange risk. We expect that firms with greater market power would pass through a larger part of exchange rate changes (Bartram et al., 2010), whereas firms in more competitive (or more fluid markets) would instead have greater changes in the values of their assets due to foreign exchange changes. We therefore hypothesize:

H4: Bonds of firms facing greater product market competition or greater fluidity have higher foreign exchange risk exposure.

We next consider how internationalization impacts foreign exchange exposure. Reeb et al. (2001) find that firms with more international activity have lower bond spreads, and Pantzalis, Simkins, and Laux (2001), Williamson (2001), and Bartram et al. (2010) suggest that more international activity allows firms to reduce the foreign exchange exposure of equity. We therefore hypothesize:

H5: Firms with more international activities have bonds with lower foreign exchange exposure.

Lastly, we examine how foreign exchange betas respond to changes in tariffs. Specifically, we consider whether decreases in tariff rates increase the magnitude of foreign exchange exposures. Valta (2012) argues that competition can influence the cost of debt by increasing the risk of default. Because the intensity of competition reduces future income, increases cash flow risk, as well as business risk (Bolton and Scharfstein, 1990), competition can increase firms' default risk. We hypothesize that a cut in tariffs could also increase firms' exposures to foreign exchange risk, as firms would face increased foreign competition. For instance, if tariffs are very high, changes in foreign exchange rates would have little impact on the amount of competition firms face from abroad. A decrease in tariffs would then both increase foreign competition and increase the sensitivity of the firm's future cash flows (and thus the sensitivity of the debt and equity outstanding) to foreign exchange movements. Whereas Valta (2012) shows how the cost of bank debt increases with decreases in tariffs, we examine whether foreign exchange risk of public bonds increases with decreases in tariffs.

H6: Decreases in tariffs increase the magnitude of bonds' foreign exchange exposures

3. Data Sources and Variable Measurements

3.1. Bond Data and Yield Spread

Our bond data come from two sources. The first is the Lehman Brothers Bond Fixed Income database (LBFI). This database provides month-end security-specific information, such as market value, coupon, yield and credit ratings for more than 3,000 firms from 1973 until 2006. The second data source is the Trade Reporting and Compliance Engine (TRACE). We extract a sample of 1,279 firms from TRACE with monthly data from 2007 to 2016.[8] We then augment the LBFI with TRACE to generate a longer time series. Because the TRACE data set includes only pricing information, we merge it with Moody's Fixed Income Securities database (FISD) to obtain debt-specific characteristics.

Our final dataset includes a large sample of corporate bonds from 1973 to 2016 with detailed firm and issue characteristics including the bid price, coupon, yield, credit ratings from Moody's and S&P, duration, issuance, and maturity dates for all nonconvertible bonds that are in the Lehman Brothers Bond Indexes and bonds that are reported in TRACE. Securities are included in the Lehman Brothers Bond Indexes based on firm size, liquidity, credit rating, maturity, and trading frequency. This large panel allows us to study the cross-sectional variation of the pricing effect of exchange rate risk on firms' and industries' debt. The long sample period also allows us to examine the degree of time variation in the exchange rate risk premium.

The dependent variable when measuring exposure is the yield spread or bond risk premium. The yield spread is defined as the difference between the yield to maturity on a corporate bond and the yield to maturity on its equivalent Treasury security. For firms with multiple observations in the sample, a weighted average yield spread is computed, with the weight being the amount outstanding for each security divided by the total amount outstanding for all available publicly traded debt. In the cases where no corresponding Treasury yield is available for a given maturity, the yield spread is calculated using an interpolation based on the Svensson (1994) exponential functional form model.

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[8] Although the TRACE database provides data from July 2002 to December 2015, for the purpose of our main analysis we only use data from TRACE when the LBFI dataset is no longer available (i.e., December 2006).

3.2. Foreign Exchange Risk

Following Francis et al. (2008), we include two exchange rate risk factors. The first is the returns of a trade-weighted real exchange rate index made up of seven currencies that circulate outside of the country of issue (R_{MAJOR}). The major currency index includes the Euro Area, Canada, Japan, the United Kingdom, Switzerland, Australia, and Sweden. The second factor is the returns in a trade-weighted real exchange rate index of currencies for the other important trading partners from emerging economies (R_{OITP}). These include Mexico, China, Taiwan, Korea, Singapore, Hong Kong, Malaysia, Brazil, Thailand, Philippines, Indonesia, India, Israel, Saudi Arabia, Russia, Argentina, Venezuela, Chile and Colombia. Both indices are obtained from the Federal Reserve Economic Data (FRED). These indices measure the rates of return of the foreign currency relative to the US dollar, thus an increase (decrease) in R_{MAJOR} implies an appreciation (depreciation) of the dollar.

3.3. Other Risk Factors

We add a number of standard risk factors in our analysis as controls. We include the Fama–French three factors from Prof. Kenneth French's web page. We add the momentum factor and the Pastor and Stambaugh (2003) liquidity risk factor from Wharton Research Data Services. Following Fama–French (1993), we further control for the default spread and the term spread. The default spread is the difference in yield spread between AAA-r and Baa-rated corporate bonds, and the term spread is the difference in yield spread between 10-year and 1-year Treasury bonds. Both of these variables are collected from FRED.

3.4. Market Structure and Other Determinants of Foreign Exchange Exposure

Our third set of tests focuses on explaining firms' foreign exchange exposures. We consider how product market competition affects exchange rate exposure. We use two measures of market structure from the Hoberg–Phillips Data Library. The first is the TNIC3_HHI index that measures the product concentration based on the 10-K text-based industry classification (Hoberg and Phillips, 2016). A higher value of HHI indicates stronger pricing power and lower product market competition from peer firms. The second measure is Fluidity, which captures how intensively the product market around a firm changes in each year (Hoberg et al., 2014). A higher value of Fluidity indicates more intensive product market competition. We expect firms with greater market power in less fluid markets to be able to pass on a greater portion of their foreign exchange exposure to consumers.

Further, we consider the degree of internationalization of the firms in our sample. Our first proxy is a dummy variable that equals one if a firm is a multinational enterprise (MNE), i.e., the firm reports either foreign income or foreign taxes in its financial statement. We collect foreign income and foreign tax data from Compustat. Our second proxy is the number of countries in which a firm owns subsidiaries. This variable is collected from the EX-21 dataset provided by Prof. Scott Dyreng. This dataset uses text analysis to provide a count of the number of countries appearing in Exhibit 21 of 10-K filings for 1994–2014.

We also consider how exposure is impacted by tariffs in the firm's industry. To obtain a long time-series, we use tariff data for the period 1972–1988 from the Center for International Data at UC Davis. We estimate industry-level tariffs from 1989 to 2016 using the US import data provided on Peter Schott's International Economics Resource webpage.[9] It is worth noting that these tariff data are only available for manufacturing firms with SIC codes between 2000 and 3999. We use both the level of tariffs and a dummy variable equal to one for the largest tariff rate reduction in an industry as long as that reduction

[9] See https://faculty.som.yale.edu/peterschott/international-trade-data/.

is larger than three times the median tariff rate reduction in that industry (Post Tariff Cut) as in Valta (2012).

3.5. Control Variables

In additional analyses, we include a number of firm- and security-specific controls. Firm-specific controls include size, leverage, growth opportunities, profitability, liquidity, asset tangibility, and stock return volatility. Firm size is measured as the natural log of total assets. Firm leverage (Leverage), a proxy for financial health, is measured as the ratio of total debt to total assets. Firm growth opportunities (Tobin's Q) are estimated as the summation of total asset and market value of equity less the book value of equity all scaled by total assets. Firm liquidity (Quick Ratio) is estimated as the difference between current assets and inventories scaled by current liabilities. Firm profitability (ROA), a proxy for financial performance, is measured as the ratio of earnings before interest, taxes, depreciation, and amortization scaled by total assets. Asset tangibility (PPE/TA) is measured as ratio of property, plant, and equipment scaled by total assets. Stock return volatility is computed as the square root of the annualized variance of the residuals from the market model. To ensure that outliers are not driving our results, we winsorize all the control variables at the 1% level.

Security-specific variables include credit ratings, maturity, and liquidity. Firm credit rating (Rating) is the average of Moody's and S&P bond ratings and represents the average firm credit rating at the date of the yield observation.[10] Bond ratings are computed using a conversion process in which AAA-rated bonds are assigned a value of 22 and D-rated bonds receive a value of 1. We also control for term structure effects using debt maturity, and for liquidity effects using bond age. For an individual security, maturity is defined as the number of years until the bond matures. The age of the bond is the length of time (in years) that a bond has been outstanding. For firms with multiple bonds, we compute weighted average

[10] If only one rating is available from either Moody's or S&P, we use that one in our analysis.

maturity, bond age, and credit rating using the summation of the weighted measures of all bonds for each firm, with the weight being the amount outstanding for each debt issue divided by total amount outstanding for all publicly traded debt for the firm. Appendix 1 provides a complete description of the variables used in the analysis. Appendix 2 provides bond rating conversions from S&P and Moody's.

3.6. Summary Statistics

Table 1 presents summary statistics by industry for the 30 industries with continuous data. The table provides the number of observations, number of firms, number of months, the yield spread, bond rating, total assets, and percentage of MNEs. For each industry, we have 517 monthly observations covering the period January 1973–March 2016. The average spreads vary from 135 basis points over Treasuries for tobacco products, to 548 basis points over Treasuries for the textiles sector. The majority of firms in our sample are large with bond ratings close to BBB, and generate about 65% their income internationally.

Panel A of Table 2 reports summary statistics. Included are the mean, median, standard deviation, 25th, and 75th percentiles. Firms in the sample have mean total assets of $15.3 billion with a median of $2.7 billion and a standard deviation of $7.7 billion. The median leverage ratio is 34.5% with standard deviation of 18.7%, which indicates that a large portion of the sample consists of firms that have significant liabilities in their capital structure. The firms are slightly profitable on average with mean and median profitability ratios at 0.7% and 0.9%, respectively. Firms, on average, have a market-to-book ratio of 1.4 and mean daily volatility of 2.4%. The remaining variables are security-specific. The mean, median, and standard deviation of the yield spreads in the overall sample are 296, 176, and 360 basis points, respectively. The mean bond rating variable roughly equates to an S&P rating of BBB- and the median equates to a rating of BBB, which indicates a rating just above non-investment grade debt. The mean traded debt has a maturity of 7.9 years and has been outstanding for 4.4 years.

Panel B of Table 2 provides the correlation matrix for selected variables and our risk factors. The *MAJOR* and *OITP* currency indices move together with a 0.311 correlation. Both the *MAJOR* and *OITP* indices are negatively related to the market factor as a whole. The *SMB* factor is negatively correlated with *OITP*, and the *HML* factor has a positive correlation with both the *MAJOR* and *OITP* indices. Default spread also has a negative and significant correlation with the *MAJOR* and *OITP* factors, and the term spread is positively correlated with the *OITP* factor.

4. Methods

Competition in international trade often occurs at the industry level, and the existing literature argues that exchange rate exposure differs systematically between industries because some industries are more responsive to competitive challenges from foreign firms (Westphal, 1990; Murtha, 1991; Marston, 2001). Following the methods used in the currency risk and stock return literature, we perform our first analyses at the industry level, and we also extend these analyses to include firm-level tests. Using Fama and French industry classifications based on SIC codes, we construct 30 industry portfolios with sufficient data to be useable in our tests. We then estimate value-weighted monthly yield spreads for these 30 industry portfolios, where the yield spread is the difference between the average bond yield and the yield of duration-matched Treasury bonds.

4.1. Estimating Foreign Exchange Exposure

We use Fama–MacBeth two-pass regressions to examine whether exchange rate risk is priced in bond markets. It is well recognized that exchange rate risk changes over time (Dumas and Solnik, 1995). We therefore use five-year (i.e. 60 months) rolling regressions to estimate time-varying betas associated with exchange rate risk for the 30 industry portfolios. In the first step of our estimation procedure, we regress industry bond spreads on R_{MAJOR} and R_{OITP}. We also include regressions with a number of control variables found to influence bond yield spreads including the market return less the risk-free rate (R_{Mktrf}), the returns on the *SMB* and *HML* factors, the term spread, the default spread, momentum, and liquidity factors. Our specification is

$$\begin{aligned} Spread_{i,t} = {} & \alpha_i + \beta_{i,M,t} R_{MAJOR,t} + \beta_{i,O,t} R_{OITP,t} + \beta_{i,V,t} R_{MKTRF,t} + \beta_{i,S,t} R_{SMB,t} + \beta_{i,H,t} R_{HML,t} \\ & + \beta_{i,T,t} R_{TERM,t} + \beta_{i,D,t} R_{DEFAULT,t} + \beta_{i,M,t} R_{MOMENTUM,t} + \beta_{i,L,t} R_{LIQUIDITY,t} + \varepsilon_{i,t} \end{aligned} \quad (1)$$

where $Spread_{i,t}$ is the value-weighted yield spread of industrial portfolio i at time t. Our focus is on the two exchange rate risk factors: R_{MAJOR}, the risk associated with currencies in developed countries, and R_{OITP}, the risk associated with currencies in emerging countries.[11] We estimate equation (1) at each month t using observations from the prior 60 months (i.e., t-60 to t-1). This procedure yields a time series of monthly betas associated with the nine risk factors for the 30 industry portfolios. For example, for $\beta_{i,M,t}$ the beta loading of major currency risk R_{MAJOR} captures the risk exposure of portfolio i to major currency risk at time t.

4.2. Is Foreign Exchange Exposure Priced?

In our second step, we use a Fama–MacBeth procedure to examine the degree to which the estimated exposures explain corporate bond spreads. Using the betas in equation (1), we estimate cross-sectional regressions. Specifically, at each time t, we run the following regressions using the 30 industry portfolios:

$$\begin{aligned} Spread_{i,t} = {} & \gamma_t + \gamma_{M,t} \beta_{i,MAJOR,t} + \gamma_{O,t} \beta_{i,OITP,t} + \gamma_{V,t} \beta_{i,MKTRF,t} + \gamma_{S,t} \beta_{i,SMB,t} + \gamma_{H,t} \beta_{i,HML,t} \\ & + \gamma_{T,t} \beta_{i,TERM,t} + \gamma_{D,t} \beta_{i,DEFAULT,t} + \gamma_{M,t} \beta_{i,MOMENTUM,t} + \gamma_{L,t} \beta_{i,LIQUIDITY,t} + \varepsilon_{i,t} \end{aligned} \quad (2)$$

where $Spread_{i,t}$ is the yield spread of industrial portfolio i at time t; and the betas (β) are estimated beta loadings from equation (1). The purpose of this test is to determine whether the beta loadings have

[11] Note that currency risk may affect the default spread, and therefore including the default risk may understate the effect of currency risk.

explanatory power on the cross-sectional pattern of bond yields. The estimated coefficients in equation (2), γ, represent the estimated price of risk associated with a specific risk factor. For example, $\gamma_{M,t}$ is the price of risk associated with the major currencies at time *t*. The product of the market risk premium for major currency risk and the corresponding exchange rate risk exposure, $\gamma_{M,t}\ \beta_{i,M,t}$, is the risk premium associated with major currency risk for industry *i* at time *t*.

The method illustrated in equations (1) and (2) is similar to the standard asset-pricing test methodology and has been used extensively in prior research. However, one difference between our method and that typically used in the equity pricing literature is that we focus on yields, or more specifically the spread over the Treasuries, rather than on bond returns. We focus on spreads because they provide an ex ante estimate of expected returns, whereas realized returns provide a noisy estimate of expected returns (Campello et al., 2008). Since these spreads provide us with a more accurate estimate of expected return, we use a simpler OLS estimation strategy than Francis et al. (2008).

If currency risk is fully hedged or passed through to consumers, then industry-level bond yields should not be affected by changes in exchange rates. We would observe insignificant $\beta_{i,M,t}$ and $\beta_{i,O,t}$ in equation (1). In contrast, if currency risk cannot be fully hedged or passed through and is a priced risk factor, then we would obtain significant $\beta_{i,M,t}$ and $\beta_{i,O,t}$, indicating currency risks indeed affect industry-level bond yields. We would also observe a systematic pattern in terms of the magnitudes of $\beta_{i,M,t}$ and $\beta_{i,O,t}$ across industries, suggesting that the exchange rate risk exposures are different in different industries. Also, we would obtain significant $\gamma_{M,t}$ and $\gamma_{O,t}$, indicating priced risk premiums related to currency risks.

4.3. Determinants of Foreign Exchange Exposure

We use two types of analyses to measure how exposure is impacted by market structure and firm characteristics. In the first, we include interactions between our variable of interest, such as market power or fluidity, and currency returns. In the second type of analysis, we regress the absolute value of the estimated firm exposure on the variable of interest. Thus we measure both how these variables are related to the level and to the absolute value of exposure.

5. Empirical Analysis

5.1. Evidence on the Relation between Foreign Exchange Exposure and Bond Yield Spread

5.1.1. Panel Regressions

Table 3 presents the results from regressing returns on currency risk and a number of typical risk factors controls. Model 1 includes the *MAJOR* and *OITP* factors, as well as the market, *SMB*, *HML*, term spread, and default spread factors. Model 2 is similar to Model 1 but includes momentum and liquidity factors. Model 3 is similar to Model 2 but also includes firm characteristics such as size, leverage, Tobin's Q, quick ratio, ROA, tangibility, and the daily standard deviation of stock returns. Model 4 is similar to Model 3 but also includes a number of bond-specific features such as maturity, age, callability, size of the issue, and bond ratings. Model 5 is similar to Model 4 but considers the log(spread) as the dependent variable.

Consistent with our Hypothesis 1, in all regressions, the coefficient on *MAJOR* is negative and significant at the 1% or 5% level, implying that an appreciation of the dollar is associated with a decline in yield spreads. This decline in spreads is consistent with many of the US firms importing some portion of their products from foreign suppliers, and these imports would decrease in price as the *MAJOR* currency index increases, leading to an increase in profitability for US firms. Note, however, that this is an average exposure, with individual firms having larger positive and/or negative exposures of much larger magnitudes at different times. The coefficients on *OITP* are positive and significant in Models 1, 2, and 5 but insignificant in Models 3 and 4. This positive *OITP* coefficient is consistent with imports from developing countries providing substitutes for US goods, and this implies a decline in US firm profitability as the dollar appreciates against these developing countries. In unreported regressions we run these analyses at the firm rather than the industry level and use equal-weighted rather than value-weighted portfolios, and we find similar results.

The control variables across all four models have their theoretically predicted signs, and in general, are statistically significant. We find that firm size, profitability, and growth opportunities are negatively associated with yield spreads, while firm leverage and daily stock return volatility are positively related to bond yield spreads. The debt-specific variables bond issue size, credit ratings, and bond age are all negatively related to spreads, whereas bond maturity is positively related to spread because longer duration bonds are riskier than short-term bonds.

5.1.2. Using Fama–McBeth Regressions

Table 4 presents results from the Fama–MacBeth (FM) two-stage regressions. In the first stage, the beta loadings are estimated using rolling windows of 60 months. In the second stage, we regress the bond yield spread on the estimated beta loadings. We only report the estimated results of the second-stage regression in Table 4. The dependent variables in Models 1–3 are value-weighted bond spreads for the 30 industrial portfolios. In Models 4–6, we use the assigned beta approach (Fama and French, 1993) in which the dependent variables are bond spreads for individual firms. Specifically, betas are estimated using industry portfolios in the first-stage regression, and then the portfolio betas are assigned to each individual firm contained in the portfolios. This approach mitigates the estimation errors for betas in the first-stage time-series regression through the use of portfolios, and the use of individual firms as observations in the second-stage cross-sectional regression increases the power of the tests.

Consistent with Hypothesis 2, that the foreign exchange exposure is priced, the coefficients on β_MAJOR are negative and significant in all cases. Note that the estimated β_MAJOR coefficients are on average negative, and therefore a more negative β_MAJOR implies a higher yield spread. The coefficient on β_OITP is negative and significant in Models 2 and 3, but not significant in the other specifications.

In terms of economic impact, a one standard deviation increase in *β_MAJOR* is 0.105. Betas are on average negative (mean of -0.023), and a one standard deviation decrease in beta would therefore imply a 45 basis point increase in spreads given the specification in Model 3 of Table 4. About 56% of estimated *OITP* betas are positive, which means that an appreciation of the US dollar against emerging market currencies typically leads to a higher bond yield spread. This relation is consistent with these firms, on average, exporting goods and services to emerging markets, and hence increases in the dollar reduce the competitive advantages of these US products. Using the specification in Model 3 of Table 4, a one standard deviation increase in *β_OITP* is associated with a 25 basis point change in spreads.

Figure 1 provides the estimated betas for both *MAJOR* and *OITP* indexes by industry, and a graph of how these betas change over time. Panel A shows that the major currency betas for most industries are negative, with the telecommunications industry having the most negative beta and electrical equipment the most positive beta. Thus, an appreciation of the dollar against the major currencies implies a decline in spreads for telecommunications firms and an increase in spreads for electrical equipment firms. Panel B shows the betas for the *OITP* index; textiles has the most negative while electrical equipment again has the most positive. Figure 2 presents graphs of the estimated risk premiums by industry in Panels A and B. The aircraft, ship, and railroad industry (Carry) has the lowest risk premium to the *MAJOR* currency index, while the printing and publishing industry (Book) has the lowest risk premium to the *OITP* currency index. The textile industry has the highest risk premium to the *MAJOR* currency index, while personal and business services has the highest risk premium to the *OITP* index.

Figure 3 breaks down the contribution of the different risk factors to total risk. Panel A presents the proportion explained as a fraction of the total spread. Thus, the *MAJOR* currency index explains 12.5% of the total spread while variation in the *OITP* index explains 5.1% of the total risk. Together, the currency factors explain 17.6% of the total risk—only the default spread factor explains more at

18.8%. Thus, currency risk is an economically significant determinant of bond spreads overall. Panel B provides a graphic breakdown of the currency risk premiums relative to total risk by industry. Again, the impact of currency risk in the textile industry is particularly large.

In our sample, the estimated betas on the *MAJOR* currencies are negative for 57% of the sample observations. The industries with the highest proportion of negative betas are telecommunication (85%), mining (83%) and chemical (82%). Firms in these industries are more likely to import intermediate goods. Hence, a depreciation of the US dollar indicates increased cost of goods on average. The negative estimated betas in these industries reflect the fact that a US dollar depreciation leads to higher yields. The three industries with the lowest proportion of negative betas are Electrical equipment (33%), Personal and Business Services (40%), and Healthcare and Medical Equipment (41%). US firms in these industries are more likely to export their products. Therefore, a US dollar appreciation leads to lower competitive advantage for US firms. Not surprisingly, these industries have positive betas on average, which means that a US dollar appreciation causes higher bond yields.

We next test whether the relation between the currency exposures and spreads is linear. In particular, debt securities are primarily impacted by asset volatility and downside risk, and this additional volatility could come from either large positive or large negative betas. That is, bondholders may be negatively impacted by either a large positive or a large negative exposure to foreign exchange risk. Focusing on the exposure to the *MAJOR* currencies in Panel A of Table 5, we report whether positive and negative currency exposures are similarly priced. Thus, Model 1 presents the estimated coefficients from regressing spreads separately on positive and negative betas.[12] We use Fama–MacBeth cross-sectional regressions to study the explanatory power of betas on the cross-section of bond prices. This regression is similar to the one in Model 4 of Table 4 but differs in that we divided betas into positive and negative

[12] The positive beta variable is set to zero if the estimated beta is negative, and the negative beta variable is set to zero if the estimated beta is positive.

values and also control for firm characteristics. Consistent with our Hypothesis 3, the results show that positive betas have a positive loading, whereas negative betas have a negative loading. Thus, both larger positive and larger negative exposures to foreign exchange risk imply greater spreads.

The results in Model 2 (Panel A of Table 5) are instead based on a panel regression. The Fama–MacBeth test provided in Model 1 focuses on the cross-sectional relation between beta and spread, but does not adjust for correlation over time. The specification in Model 2 controls for unobserved firm characteristics using firm fixed effects and adjusts for autocorrelation in the residuals by estimating the standard error with firm-level clustering. In this specification, the coefficient on positive betas is positive but no longer significant, whereas the coefficient on negative betas is still negative and significant at the 1% level. Model 3 provides a similar specification but includes clustering by both year-month and firm with similar results. In Model 4, we instead consider the absolute value of the estimated beta, and we find a significant positive coefficient. Thus, larger exposures, be they positive or negative, imply higher corporate bond spreads. In Models 5–8 we repeat the analysis from Models 1–4 using firm-level rather than industry-level betas, and we find somewhat stronger results.

Panel B of Table 5 repeats similar tests for the *OITP* index of currencies. With the exception of Model 1, the results are similar, with more positive or more negative betas implying higher spreads. The results are particularly strong when examining firm-level betas, where the estimated t-statistic for the absolute value of beta on spreads is 5.66. Thus, the results show that fixed income investors demand higher spreads when faced with either larger positive or negative exposures to currencies.

5.2. Factors Influencing Foreign Exchange Exposure

5.2.1 Interactions: Market Concentration, Fluidity, and Multinational Activity

We next examine how measures of market competition and multinational activity are related to the exposures of firms' bonds to foreign exchange changes. We expect that firms with greater market power would be able to pass through more of their foreign exchange exposure to customers, and therefore market power would be negatively related to the magnitude of foreign exchange betas. Similarly, greater market fluidity would imply lower potential to pass through foreign exchange exposure. In contrast, firms with more multinational operations, measured by foreign sales, taxes paid, or by the number of foreign subsidiaries, may have more flexibility to manage economic exposure.

In Table 6 we provide regressions similar to those in Table 3 (although at the firm level) where the dependent variable is the yield spread and the independent variables include the various risk factors. In Model 1, we include TNIC3_HHI, which measures the concentration in the firm's competitive space using web crawling and text parsing algorithms of SEC filings (Hoberg and Phillips, 2016). Model 2 includes Fluidity instead, which measures how likely the product space is to change given actions by rivals (Hoberg et al., 2014). Model 3 includes the MNE Dummy, which equals one if the firm reports foreign revenues or taxes, and Model 4 includes the number of countries with subsidiaries. All specifications in Table 6 include interactions between these variables of interest and the Major and OITP index returns.

If market concentration affects exposure to the Major index, we expect the interaction between TNIC3_HHI and Major to be significant. Consistent with our Hypothesis 4, the coefficient on the TNIC3_HHI*Major interaction terms in Model 1 is positive and significant. As the average exposure to the Major index is negative, this market concentration mitigates foreign exchange risk. Similarly, as the average exposure to the OITP index is positive, the negative coefficient on TNIC3_HHI*OITP implies a reduction in exposure for firms with more market power. In Model 2, the interactions on Fluidity imply a more negative exposure to the Major index and a more positive exposure to the OITP index. In general, larger fluidity implies larger exposures, although the sign on OITP itself flips in this specification. In Model 3, the variables of interest are the interactions with the MNE dummy, which equals one if the firm reports foreign sales or taxes. The interaction between MNE and the Major index is not significant, but the interaction with the OITP index is negative and significant. Similarly, in Model 4, only the coefficient on the interaction with OITP is negative and significant. In both cases, the results show that firms with more multinational activity have lower average exposure to the OITP index.

5.2.2. Explaining the Absolute Value of Exchange Rate Exposure

Table 7 examines the same issues highlighted in Section 5.2.1 using a different set of specifications. The dependent variables in Table 7 are the absolute values of the time-varying firm-specific betas estimated for exposure to the Major foreign exchange index (β_*MAJOR*) and to the OITP foreign exchange index (β_OITP). In Models 1 and 5, we regress the absolute values of β_*MAJOR* and β_OITP on the TNIC3_HHI measure of market concentration. All regressions include time and industry dummy variables. Whereas the coefficient in the β_*MAJOR* regression is insignificant, the coefficient in the β_OITP regression is negative and significant, thus more product market concentration is associated with lower exposure to the OITP currency index. In Models 2 and 6, we instead use the Fluidity measure as the independent variable. In both of these specifications, the coefficient on Fluidity is positive and significant. Thus, consistent with our Hypothesis 4, firms in more fluid markets have greater exposures to foreign exchange risk. Overall, the results are consistent with firms being able to pass through more of their foreign exchange exposure if they have greater market power or operate in less fluid markets.

In Models 3 and 7, we consider the relations between β_*MAJOR* and the MNE dummy and β_OITP and the MNE dummy. In Model 4, we consider the relation between β_*MAJOR* and the number of foreign countries with subsidiaries, and we consider a similar regression for β_OITP in Model 8. In all of these regressions, the coefficients are negative and are significant in three out of the four specifications. Our Hypothesis 5 states that we expect firms with more multinational operations to reduce their foreign exchange exposure through operational hedging. The results in Models 3, 4, and 8 are consistent with this hypothesis.

5.3. Tariffs, Risk Exposures, and Yield Spreads

We next consider whether tariffs or China's entry into the WTO affect average exposures or spreads. Valta (2012) shows that decreases in tariffs imply higher spreads for bank loans, and we extend the analysis here to show how tariffs are related to foreign exchange exposure. As discussed above, we expect that declines in tariffs lead to greater foreign exchange exposure as firms would be more sensitive to change in foreign competitiveness. We consider three dependent variables: exposure to the major trading currencies (the absolute value of *β_MAJOR*), exposure to the other trading partners (the absolute value of *β_OITP)*, and bond yield spread itself. We consider three variables that measure shocks to the international competitive environment. First, China's entry into the WTO in 2001.[13] Second, the level of the tariff rate for each industry at each time period. Third, a variable equal to one if there is a large tariff cut in the industry as defined by Valta (2012). All regressions include firm fixed effects. As tariffs vary by industry, we cluster at the 4-digit SIC industry level.

Table 8 shows that China's entry into the WTO is associated with a significant increase in the absolute value of the exposure to both the major and other currency indices. However, the regressions in Table 8 do not include time dummies, and therefore the large increase in spreads around China's December 2001 entry into the WTO could be due to confounding effects such as the 9/11 terrorist attacks. Table 8 also shows that higher tariffs are associated with lower exposures to the major currencies and lower spreads. A one standard deviation increase in tariffs is associated with a 46 basis point decline in spreads. Considering a variable for just the time period after the largest tariff cut, as in Valta (2012), we find a significant increase in the absolute value of the exposure to the major currencies and an increase in spreads (a 50 basis points decline on average following the largest tariff cut for that industry). That

[13] Pierce and Schott (2016) show how China's entry into the WTO caused a large drop in US manufacturing employment.

said, the tariff coefficients are not statistically significant if time dummies are included; therefore, they are at best only weakly supportive of our Hypothesis 6.

6. Conclusion

Prior literature provides conflicting evidence on the relation between foreign exchange exposure and the cost of equity capital. However, there is limited if any research on the relation between foreign exchange risk and the cost of debt financing. In this paper, we empirically investigate whether the pricing of public corporate bonds is related to currency exposure. Using a large panel of bonds from 1973-2016 we find that exposures to currencies are significant on average. A one standard deviation increase in risk exposure implies a 45 basis point increase in yield spreads. Fama–MacBeth tests show that these exposures are priced in corporate bond spreads, and that currency factors explain 17.6% of the total risk premium. Moreover, as bond investors are largely sensitive to volatility, both more positive and more negative exposures to currency risk are associated with significantly higher spreads.

In additional analyses, we examine factors that can mitigate firms' currency exposures. We find that firms which face less product market competition or operate in less fluid markets have lower currency risk exposures, and this result is consistent with models in which imperfect competition allows firms to pass through more exchange rate risk. We also find that multinationals have lower currency exposures, evidence consistent with these firms being better able to take advantage of operational hedging strategies. Taken together, our findings extend prior work on the relation between foreign exchange exposure and asset valuation and help to clarify the prior mixed evidence on exposure and equity valuation.

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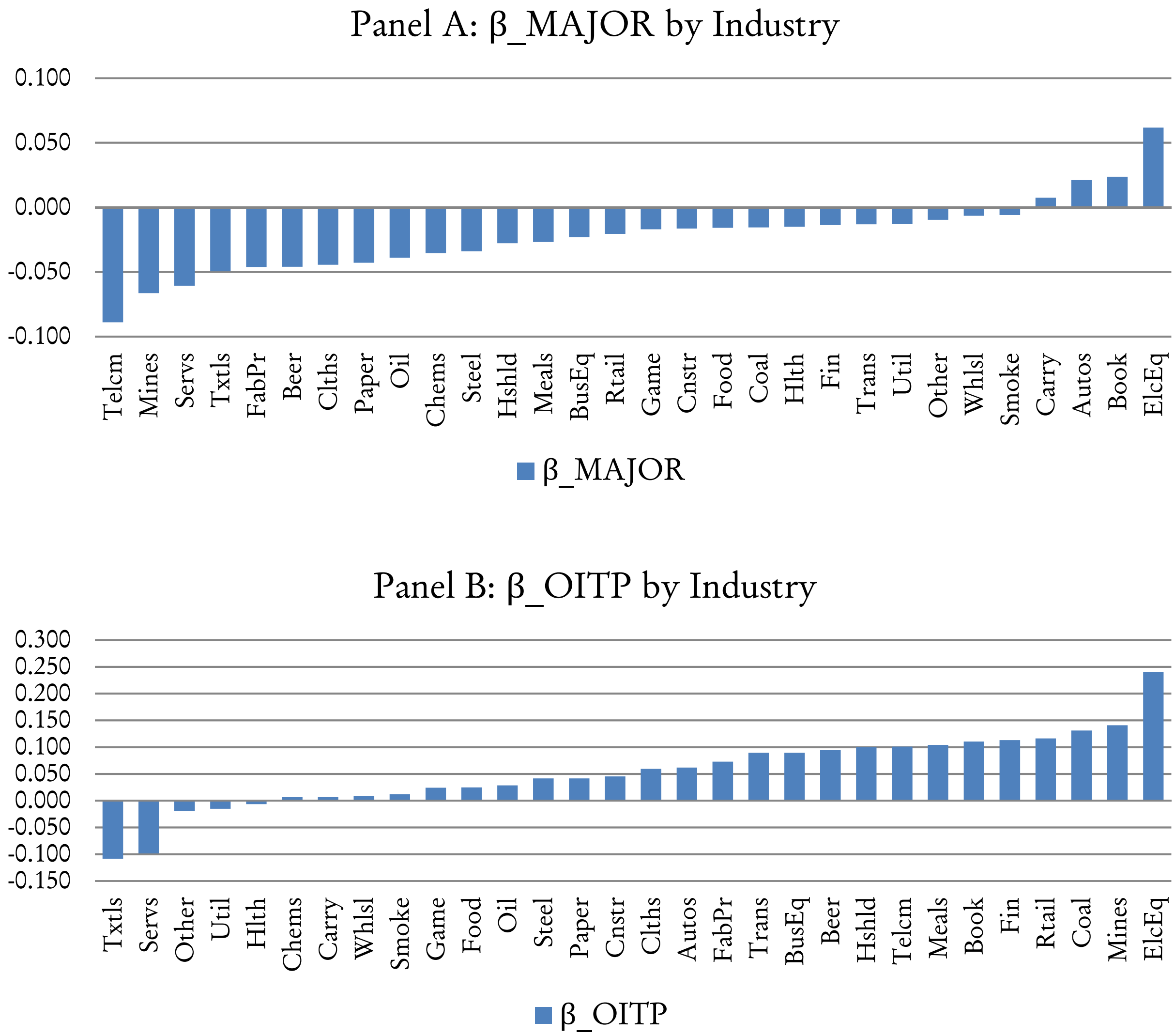

Figure 1: Currency Risk Exposure (estimated beta) by Industry. This figure depicts the estimated betas in the first-stage of the Fama–MacBeth tests for the real change of Major and OITP currency indexes.

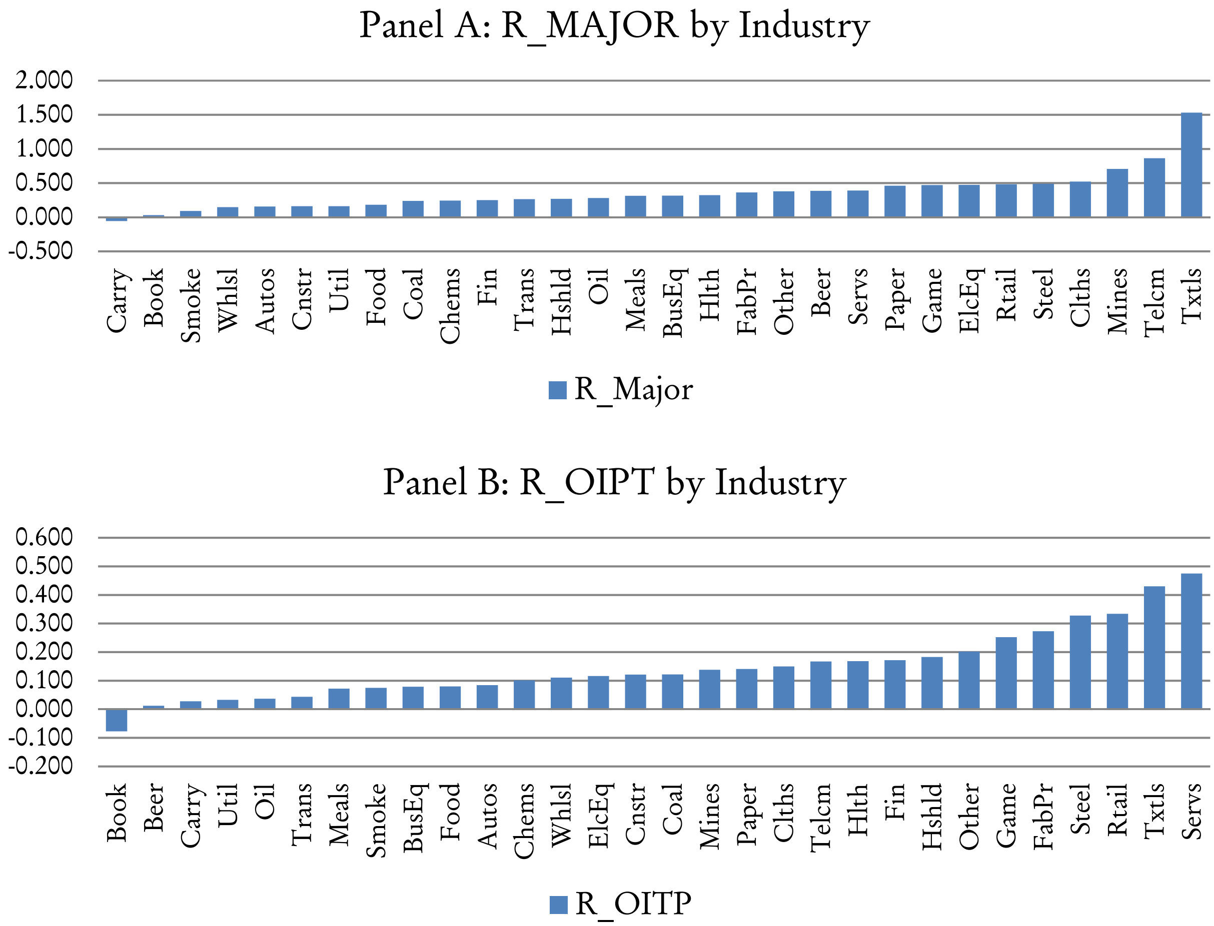

Figure 2: Currency Risk Premium by Industry.
This figure depicts the estimated risk premium for Major currency index using the regression estimates in column (3) of Table 4.

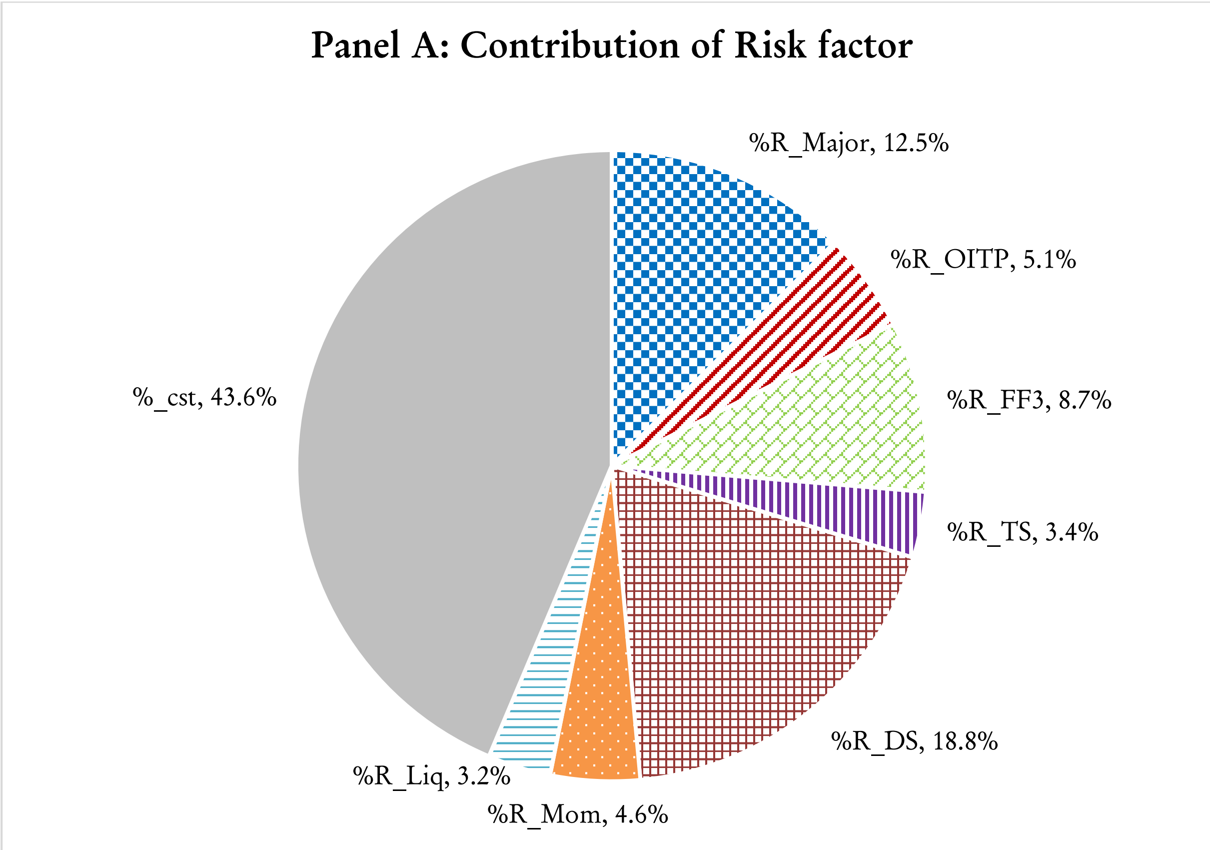

Figure 3: Relative Importance of Currency Risk Premium in Bond Spreads
These figures depict the fraction of the bond yield spread related to different risk factors using the regression estimates in column (3) of Table 4. Panel A is the overall average and Panel B is by industry.

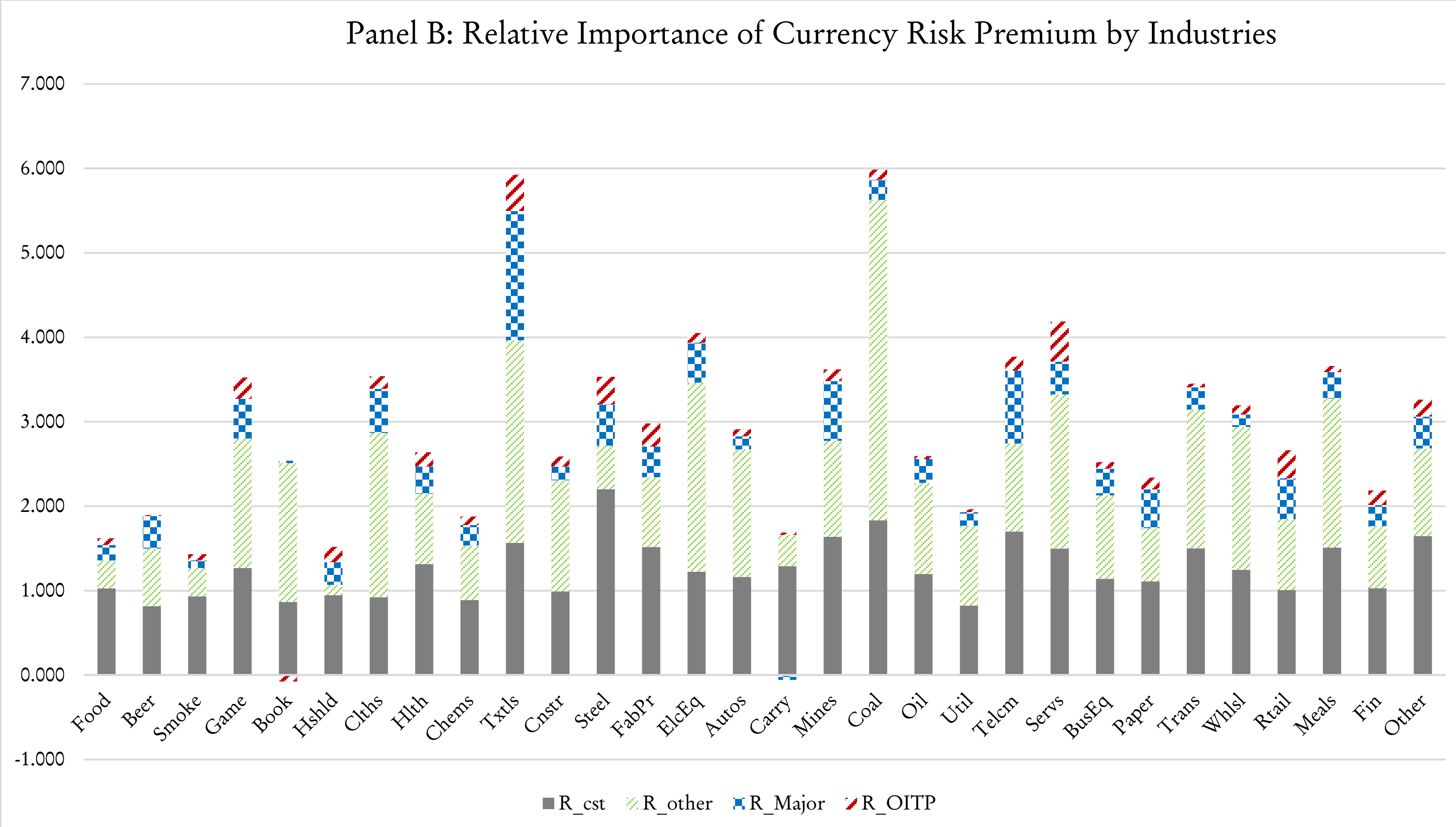
Panel B: Relative Importance of Currency Risk Premium by Industries
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
-1.000
Food
Beer
Smoke
Game
Book
Hshld
Clths
Hlth
Chems
Txtls
Cnstr
Steel
FabPr
ElcEq
Autos
Carry
Mines
Coal
Oil
Util
Telcm
Servs
BusEq
Paper
Trans
Whlsl
Rtail
Meals
Fin
Other
R_cst
R_other
R_Major
R_OITP

Table 1
Summary Statistics by Industry

Industry	Description of Industry	Obs.	No. Firms	No. Months	Yield Spread	Bond Rating	Total Assets	MNE (%)
Food	Food Products	11,498	93	517	1.640	A-	13,049	0.761
Beer	Beer & Liquor	1,892	14	517	1.797	BBB+	5,950	0.482
Smoke	Tobacco Products	1,838	13	517	1.350	A	29,671	0.778
Game	Recreation	6,755	87	517	3.559	BB+	10,381	0.657
Book	Printing & Publishing	4,725	47	517	2.494	BBB+	4,200	0.607
Hshld	Consumer Goods	7,589	59	517	1.416	A	77,330	0.938
Clths	Apparel	3,232	39	517	3.419	BBB-	2,569	0.609
Hlth	Healthcare, Medical Equip. & Pharmaceutical Products	16,055	229	517	2.448	BBB	8,919	0.715
Chems	Chemicals	10,802	79	517	1.767	BBB+	11,248	0.967
Txtls	Textiles	1,991	25	517	5.481	B+	935	0.787
Cnstr	Construction & Construction Materials	16,191	145	517	2.482	BBB	4,877	0.661
Steel	Steel Works Etc.	8,331	80	517	3.436	BB+	5,595	0.673
FabPr	Fabricated Products & Machinery	12,747	114	517	2.753	BBB	5,892	0.918
ElcEq	Electrical Equipment	3,316	49	517	3.730	BB+	4,354	0.892
Autos	Automobiles and Trucks	7,987	63	517	2.740	BBB-	29,939	0.918
Carry	Aircraft, ships, & railroad equipment	3,781	31	517	1.656	A-	17,287	0.742
Mines	Precious Metals, Non-Metallic, & Industry Metal Mining	2,171	22	517	3.322	BBB-	6,405	0.670
Coal	Coal	550	8	229	5.401	BB-	5,659	0.407
Oil	Petroleum & Natural Gas	22,505	268	517	2.393	BBB+	15,634	0.733
Util	Utilities	38,268	243	517	1.902	BBB+	12,108	0.067
Telcm	Communication	13,221	207	517	3.451	BBB-	27,700	0.328
Servs	Personal & Business Services	12,192	246	517	4.310	BB	6,737	0.584
BusEq	Business Equipment	16,394	216	517	2.396	BBB	15,117	0.921
Paper	Business Supplies & Shipping Container	10,440	75	517	2.185	BBB+	6,866	0.795
Trans	Transportation	7,944	112	517	3.432	BBB-	7,485	0.316
Whlsl	Wholesale	8,249	104	517	3.171	BB+	4,608	0.545
Rtail	Retail	15,685	165	517	2.503	BBB+	17,152	0.356
Meals	Restaurants, Hotels, Motels	6,065	77	517	3.503	BB+	4,411	0.557

Fin	Banking, Insurance, Real Estate, & Trading	51,416	577	517	2.108	A-	148,529	0.389
Other	Everything Else	8,083	172	517	3.116	BBB-	6,584	0.595

Note: This table provides descriptive statistics of selected variables for Fama–French 30 industry portfolios. The sample period is January 1973 to March 2016. Bond ratings is based on the S&P rating convention. Variables definition are provided in Appendix 1.

Table 2
Sample Statistics

Panel A: Descriptive Statistics

	N	Mean	Standard Deviation	P25	Median	P75
			Bond-level variables			
Yield Spread (%)	331,911	2.960	3.602	1.014	1.759	3.538
Bond Rating	331,913	BBB-	A+/B	B+	BBB	A
Bond Maturity	331,913	7.933	4.884	5.060	6.833	9.254
Bond Age	331,913	4.418	3.964	1.780	3.384	5.850
			Firm-level variables			
Total Assets	323,351	15261	77177	944	2653	8387
Leverage	300,676	0.345	0.187	0.211	0.320	0.443
Tobin's Q	314,096	1.394	0.656	1.000	1.170	1.547
ROA	322,912	0.007	0.021	0.002	0.009	0.017
PPE/TA	317,019	0.375	0.280	0.131	0.328	0.606
Quick Ratio	254,526	1.241	1.783	0.729	1.015	1.403
Stock Return Volatility	331,045	0.024	0.014	0.015	0.020	0.029
MNE dummy	331,913	0.499	0.500	0.000	0.000	1.000
Foreign Countries with Subs.	152,614	10.900	16.004	0.000	3.000	16.000
Fluidity	94,181	6.399	3.504	3.776	5.614	8.400
TNIC3_HHI	101,067	0.256	0.253	0.079	0.156	0.349
			Aggregate-level variables			
MAJOR (%)	331,474	0.004	1.705	-1.086	0.080	1.158
OITP (%)	331,474	0.006	1.175	-0.649	-0.137	0.470
MKTRF (%)	331,913	0.577	4.574	-2.020	1.020	3.600
SMB (%)	331,913	0.163	3.090	-1.580	0.090	1.950
HML (%)	331,913	0.319	2.897	-1.180	0.230	1.740
Term Spread (%)	331,913	1.241	1.181	0.400	1.430	2.080
Default Spread (%)	331,913	1.093	0.465	0.770	0.950	1.280
Momentum (%)	331,913	0.653	4.434	-0.830	0.770	2.880
Liquidity (%)	331,913	0.011	5.731	-2.168	0.657	2.869
			Industry-level variables			
Tariff Rate	78,345	0.0259	0.035	0.002	0.002	0.002
Post Tariff Cut	78,345	0.351	0.477	0	0	1

Note: Panel A presents descriptive statistics for selected firm and bond specific variables used in the analysis. The data cover the period 1973–2016. Bond ratings is based on the S&P rating convention. Variable definitions are provided in Appendix 1.

Panel B: Correlation Matrix

	Yield Spread	MAJOR	OITP	MktRF	SMB	HML	Term Spread	Default Spread	Momentum	Liquidity
Yield Spread	1.000									
MAJOR	-0.007	1.000								
OITP	**0.042**	**0.311**	1.000							
MKTRF	**-0.053**	**-0.162**	**-0.200**	1.000						
SMB	-0.012	0.013	**-0.126**	**0.260**	1.000					
HML	**-0.061**	**0.035**	**0.018**	**-0.285**	**-0.215**	1.000				
Term Spread	**0.186**	-0.001	**0.133**	**0.035**	**0.082**	**-0.049**	1.000			
Default Spread	**0.180**	**-0.119**	**-0.026**	**0.105**	**0.082**	-0.020	0.044	1.000		
Momentum	**-0.054**	**0.077**	**0.149**	**0.144**	0.002	**0.174**	**0.133**	**-0.079**	1.000	
Liquidity	**-0.054**	0.032	**-0.073**	**0.321**	**0.115**	**-0.087**	**-0.037**	**0.126**	**-0.065**	1.000

Note: Panel B provides Pearson correlation coefficients of key variables. Correlation coefficients in bold denote statistical significance at the 1% level. The data cover the period 1973–2016. Variable definitions are provided in Appendix 1.

Table 3
Regression of Yield Spread on Currency Risk and Other Risk Factors

	Primary Specification	Momentum and Liquidity	Firm-Level Variables	Bond-Level Variables	Log (Yield spread)
	(1)	(2)	(3)	(4)	(5)
MAJOR	-0.015[a]	-0.011[b]	-0.027[a]	-0.027[a]	-0.010[a]
	(-2.73)	(-2.07)	(-3.82)	(-3.69)	(-7.57)
OITP	0.045[a]	0.043[a]	0.012	0.014	0.008[a]
	(4.89)	(4.79)	(1.30)	(1.51)	(4.85)
MKTRF	-0.016[a]	-0.012[a]	-0.017[a]	-0.017[a]	-0.003[a]
	(-6.91)	(-5.30)	(-8.15)	(-7.19)	(-8.21)
SMB	-0.010[a]	-0.009[a]	-0.013[a]	-0.013[a]	-0.004[a]
	(-5.59)	(-5.26)	(-7.09)	(-7.56)	(-8.51)
HML	-0.021[a]	-0.022[a]	-0.015[a]	-0.015[a]	-0.004[a]
	(-5.59)	(-5.40)	(-4.64)	(-4.82)	(-8.21)
Term Spread	-0.088[a]	-0.071[a]	0.088[a]	0.077[b]	0.020[a]
	(-4.41)	(-3.48)	(2.79)	(2.55)	(2.95)
Default Spread	1.795[a]	1.790[a]	0.438[b]	0.581[a]	0.179[a]
	(12.20)	(12.20)	(2.70)	(3.06)	(10.07)
Momentum		-0.002	0.008[a]	0.008[a]	0.002[a]
		(-1.23)	(6.67)	(6.46)	(7.05)
Liquidity		-0.012[a]	-0.004[a]	-0.004[a]	-0.002[a]
		(-9.55)	(-3.41)	(-3.54)	(-8.40)
Firm Size			-0.082	0.061	-0.023
			(-1.29)	(1.30)	(-1.26)
Quick Ratio			0.290[a]	0.159[c]	0.088[a]
			(3.01)	(1.72)	(3.00)
Tobin's Q			-0.518[a]	-0.459[b]	-0.131[b]
			(-2.75)	(-2.31)	(-2.18)
Leverage			3.481[a]	2.270[a]	0.620[a]
			(5.20)	(2.96)	(4.41)
ROA			-18.738[a]	-18.681[a]	-2.356[a]
			(-5.18)	(-5.36)	(-3.67)
PPE/TA			0.820	0.521	0.119
			(1.49)	(1.10)	(0.79)
Stock Return Volatility			116.305[a]	102.904[a]	17.302[a]
			(7.80)	(6.19)	(12.46)
Bond Maturity				0.042[b]	0.006
				(2.50)	(1.54)
Bond Age				-0.032	-0.008
				(-1.02)	(-0.74)
Callable				0.339	0.172[b]
				(1.37)	(2.33)
Ln(Bond Issue)				-0.068[b]	-0.020[b]
				(-2.19)	(-2.24)
Bond Ratings				-0.186[a]	-0.096[a]
				(-4.76)	(-9.22)
Observations	15,193	15,193	14,634	14,634	14,634
Adjusted R-Sq.	0.348	0.349	0.646	0.666	0.7704

Note: This table presents results from regressing yield spreads of industry portfolios on currency risk and other factors. Major (*OITP*) is the monthly change of the US currency index against major (other) trading partners. All models control for industry and year fixed effects. The *t*-statistics are calculated using standard errors clustered by industry level and are reported in parentheses. The notations [a], [b], and [c] denote statistical significance at 1%, 5%, and 10% levels. Variable definitions are provided in Appendix 1.

Table 4
Fama–MacBeth Second-Stage Regression of Yield Spread on Currency Risk and Other Risk Factors

	Value Weighted Ind30			Assigned Beta Approach		
	FX Only	Fama–French	All Factors	FX Only	Fama–French	All Factors
	(1)	(2)	(3)	(4)	(5)	(6)
	-1.242[a]	-3.852[a]	-4.298[a]	-2.814[a]	-4.695[a]	-5.515[a]
β_MAJOR	(-2.89)	(-9.30)	(-10.10)	(-7.89)	(-11.64)	(-12.67)
	0.386	-0.639[b]	-0.861[a]	-0.316	-0.203	-0.338
β_OITP	(1.60)	(-2.45)	(-3.62)	(-1.36)	(-0.78)	(-1.40)
		0.005	2.030		5.785[a]	8.042[a]
β_MKTRF		(0.004)	(1.48)		(5.35)	(6.78)
		-1.902[b]	-1.227[c]		0.119	2.754[a]
β_SMB		(-2.36)	(-1.65)		(0.18)	(3.77)
		-4.397[a]	-4.311[a]		-0.696	-2.834[a]
β_HML		(-7.55)	(-7.35)		(-1.25)	(-4.86)
		0.260[a]	0.285[a]		0.291[a]	0.212[b]
β_TermSpread		(2.94)	(3.23)		(3.42)	(2.43)
		0.333[a]	0.307[a]		0.217[a]	0.085[a]
β_DefaultSpread		(12.80)	(12.5)		(10.44)	(3.93)
			-1.628			0.623
β_Momentum			(-1.58)			(0.66)
			-9.215[a]			-13.290[a]
β_Liquidity			(-7.18)			(-8.43)
Observations	13,454	13,454	13,454	302,765	302,765	302,765
Number of groups	458	458	458	458	458	458
R-squared	0.003	0.021	0.014	0.003	0.018	0.005

Note: This table presents estimates from two-stage Fama–MacBeth (FM) regression. In the first stage, we estimate the beta (□) loadings using a 60-month rolling window based on equation (1). In the second stage, we regress bond spreads on the estimated beta loadings using equation (2). This table reports the estimated gamma (γ) from the second-stage cross-sectional regression. The notations [a], [b], and [c] denote statistical significance at 1%, 5%, and 10% levels. Variable definitions are provided in Appendix 1.

Table 5
The Different Impact of Positive vs. Negative Currency Beta on Bond Yield Spread

Panel A: Pricing of Major Currency Risk

	Assigned Ind30 Beta				Firm-level Beta			
Estimation Method:	FM	Firm FE	2D cluster	2D cluster	FM	Firm FE	2D cluster	2D cluster
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Positive β_MAJOR	7.415[a]	0.535	0.523		7.524[a]	3.184[a]	3.094[a]	
	(3.13)	(0.90)	(0.85)		(17.15)	(5.93)	(4.41)	
Negative β_MAJOR	-1.916[a]	-2.160[a]	-2.144[a]		-3.652[a]	-1.195[a]	-1.141[a]	
	(-3.90)	(-4.40)	(-3.98)		(-11.13)	(-3.62)	(-3.04)	
Absolute β_MAJOR				1.613[a]				1.422[a]
				(3.53)				(4.09)
Observations	195,833	195,833	195,833	195,833	133,245	133,245	133,245	133,245
R-squared	0.4417	0.46	0.6307	0.6305	0.5018	0.5348	0.6621	0.5679
With firm and bond controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Firm FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Clustering	N.A.	Firm	Firm Year-month	Firm Year-month	N.A.	Firm	Firm Year-month	Firm Year-month

Panel B: Pricing of Other Currency Risk

	Assigned Ind30 Beta				Firm-level Beta			
	FM	Firm FE	2D cluster	2D cluster	FM	Firm FE	2D cluster	2D cluster
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Positive β_OITP	-0.129	0.544[a]	0.532[a]		2.356[a]	1.003[a]	0.990[a]	
	(-0.88)	(3.97)	(3.78)		(14.49)	(6.13)	(4.74)	
Negative β_OITP	-0.085	-0.293	-0.284		-4.149[a]	-2.064[a]	-2.032[a]	
	(-0.37)	(-0.87)	(-0.82)		(-18.34)	(-6.16)	(-5.38)	
Absolute β_OITP				0.503[a]				0.917[a]
				(3.58)				(5.66)
Observations	195,833	195,833	195,833	195,833	133,245	133,245	133,245	133,245
R-squared	0.4445	0.4609	0.6305	0.6305	0.5108	0.5432	0.5874	0.5859
With firm and bond controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Firm FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Clustering	N.A.	Firm	Firm Year-month	Firm Year-month	N.A.	Firm	Firm Year-month	Firm Year-month

Note: This table reports regression results of bond yield spread on estimated betas for Major currency risk (Panel A) and Other currency risk (Panel B). *t*-statistics are reported in parentheses and calculated using standard errors clustered by firm in Models 2 and 6, and standard errors clustered by both firm and time in Models 3, 4, 7, and 8. The notation [a] denotes statistical significance at the 1% level. Variable definitions are provided in Appendix 1.

Table 6
Regression of Yield Spread on Currency Risk and Interactions

	TNIC3_HHI (1)	Fluidity (2)	MNE (3)	Foreign Subsidiaries (4)
MAJOR	-0.037[a]	0.023	-0.008	-0.017[b]
	(-4.83)	(1.19)	(-1.29)	(-2.46)
OITP	0.077[a]	-0.067[a]	0.037[a]	0.056[a]
	(7.26)	(-2.90)	(4.57)	(6.43)
TNIC3_HHI	-0.413[c]			
	(-1.90)			
TNIC3_HHI * MAJOR	0.064[b]			
	(2.52)			
TNIC3_HHI * OITP	-0.133[a]			
	(-3.88)			
Fluidity		0.127[a]		
		(5.74)		
Fluidity × MAJOR		-0.007[b]		
		(-2.44)		
Fluidity × OITP		0.019[a]		
		(5.05)		
MNE Dummy			-1.139[a]	
			(-8.67)	
MNE Dummy × MAJOR			-0.007	
			(-0.65)	
MNE Dummy × OITP			-0.037[a]	
			(-2.64)	
Countries with Foreign				-0.028[a]
Subsidiaries				(-6.54)
Foreign Subsidiaries × MAJOR				0.000
				(0.78)
Foreign Subsidiaries × OITP				-0.002[a]
				(-3.27)
MKTRF	-0.008[a]	-0.007[a]	-0.016[a]	-0.008[a]
	(-6.34)	(-5.17)	(-16.18)	(-6.22)
SMB	-0.012[a]	-0.014[a]	-0.008[a]	-0.012[a]
	(-8.60)	(-9.53)	(-7.17)	(-7.70)
HML	-0.013[a]	-0.012[a]	-0.018[a]	-0.014[a]
	(-4.54)	(-4.01)	(-8.79)	(-4.70)
Term Spread	0.017	0.025	-0.031[b]	0.033
	(0.53)	(0.74)	(-2.31)	(1.03)
Default Spread	2.312[a]	2.318[a]	1.867[a]	2.315[a]
	(24.69)	(24.61)	(25.55)	(24.03)
Observations	100,862	93,976	195,582	94,680
R-squared	0.306	0.310	0.275	0.342

Note: This table presents results from regressing firm yield spreads on currency risk and other factors, as well as interactions between currency risk and the variables of interest. Major (*OITP*) is the monthly change of the US currency index against major (other) trading partners. All models control for industry and year fixed effects. *t*-statistics are calculated using standard errors clustered by firm and are reported in parentheses. The notations [a], [b], and [c] denote statistical significance at 1%, 5%, and 10% levels. Variable definitions are provided in Appendix 1.

Table 7
Factors Affecting Currency Risk Exposures and Spreads

	Dependent Variable = Absolute Value of β_MAJOR				Dependent Variable = Absolute Value of β_OITP			
	Competition / Pass Through		Int. Business/ Operational hedge		Competition / Pass Through		Int. Business/ Operational hedge	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TNIC3_HHI	-0.016				-0.069[b]			
	(-1.09)				(-2.42)			
Fluidity		0.003[b]				0.006[b]		
		(2.19)				(2.17)		
MNE Dummy			-0.027[a]				-0.031	
			(-3.29)				(-1.28)	
Foreign Countries w/Subs				-0.001[a]				-0.002[b]
				(-3.69)				(-2.43)
Observations	100,862	93,976	195,584	94,680	100,862	93,976	195,584	94,680
R-squared	0.195	0.206	0.012	0.200	0.248	0.238	0.008	0.262

Note: This table provides regressions of estimated betas and bond yield spreads. All specifications include year-month and industry fixed effects. *t*-statistics are calculated using standard errors clustered by firm and are reported in parentheses. The notations [a], [b], and [c] denote statistical significance at 1%, 5%, and 10% levels. Variable definitions are provided in Appendix 1.

Table 8

Tariff Changes, Currency Risk Exposures, and Yield Spreads

	Absolute β_MAJOR	Absolute β_OITP	Yield Spread
	(1)	(2)	(3)
China-WTO	0.020[a]	0.074[a]	0.942[a]
	(4.93)	(7.62)	(7.77)
R-squared	0.438	0.432	0.486
Observations	196,492	196,492	196,492
Tariff Rate	-0.175[c]	-0.303	-13.279[a]
	(-1.79)	(-1.20)	(-4.01)
R-squared	0.415	0.413	0.469
Observations	78,345	78,345	78,345
Post Tariff Cut	0.012[b]	0.014	0.509[a]
	(2.24)	(1.33)	(4.47)
R-squared	0.416	0.413	0.468
Observations	77,680	77,680	77,680

Note: This table presents regressions for currency exposure and yield spread. All regressions include firm fixed effects, and standard errors are estimated using clustering at the 4-digit SIC industry level. The notations a, b, and c denote statistical significance at the 1%, 5%, and 10% levels. Variable definitions are provided in Appendix 1.

Appendix 1
Variable Definitions and Data Sources

Variable	Definition	Source
	Bond-Specific Variables	
Yield Spread (%)	The difference between corporate bond yield and its duration equivalent treasury bond yield	LBFI &TRACE
Bond Rating	Numerical bond ratings obtained from S&P and/or Moodys	LBFI &TRACE
Bond Maturity	Years to maturity	LBFI &TRACE
Bond Age	Years since bond issuance	LBFI &TRACE
	Firm-Specific Variables	
Total Assets	Total Assets	Compustat
Tobin's Q	Tobin's Q, estimated as (total asset – book value of equity + market value of equity)/total assets	Compustat
Leverage	Book debt-to-asset ratio, estimated as (short-term debt + long-term debt)/total assets	Compustat
ROA	Net profit/Total Assets	Compustat
PPE/TA	Net PPE / Total Assets	Compustat
Quick Ratio	(Current assets - inventories)/Current liabilities	Compustat
MNE Dummy	Dummy variable that equals one if the firm reports foreign taxes or foreign income	Compustat
TNIC3_HHI	Measures a firm's competitiveness using web crawling and text parsing algorithms of SEC filings	Hoberg & Phillips (2016)
Fluidity	Measures how likely the product space is to change given actions by rivals. This value is calculated from SEC filings	Hoberg et al. (2014) Data Library
MNE	Dummy variable that equals one if a firm is a multinational enterprise, i.e., reports either foreign income or foreign taxes in its financial statement	Compustat
Countries with Foreign Subsidiaries	The number of foreign countries in which a firm owns subsidiaries	EX-21 dataset form Dyreng's webpage
	Foreign Exposure/Macro Variables	
MAJOR	Monthly percentage change of currency index between US and major trading partners	FRED
OITP	Monthly percentage change of currency index between US and other important trading partners	FRED

MKTRF	Monthly market risk premium in percentage	Ken French Data Site
SMB	Monthly risk premium between small and large size portfolios	Ken French Data Site
HML	Monthly risk premium between high and low book-to-market portfolios	Ken French Data Site
Momentum	Month risk premium of momentum portfolio	WRDS
Liquidity	Liquidity risk premium from PS	WRDS
Default Spread	Monthly yield spread between AAA and Baa corporate bonds in percentage	FRED
Term Spread	Monthly yield spread between 10-year and 1-year Treasury bill in percentage	FRED
Post Tariff Cut	Dummy that equals one if there is a decrease in tariffs in that year and the cut is three times the median cut over sample period in that industry. For industry with multiple significant tariff cuts, we select the largest one	U.S. tariff data

Note: Major currencies index includes the Euro Area, Canada, Japan, United Kingdom, Switzerland, Australia, and Sweden. 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.

Appendix 2
Bond Rating Numerical Conversions

Conversion Number	Moody's Ratings	S&P Ratings
22	Aaa	AAA
21	Aa1	AA+
20	Aa2	AA
19	Aa3	AA-
18	A1	A+
17	A2	A
16	A3	A-
15	Baa1	BBB+
14	Baa2	BBB
13	Baa3	BBB-
12	Ba1	BB+
11	Ba2	BB
10	Ba3	BB-
9	B1	B+
8	B2	B
7	B3	B-
6	Caa1	CCC+
5	Caa2	CCC
4	Caa3	CCC-
3	Ca	CC
2	C	C
1	D	D

Note: This Appendix provides bond-rating conversion codes for Moody's and S&P ratings used in the analysis.