FEDERAL RESERVE BANK OF SAN FRANCISCO

WORKING PAPER SERIES

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February 2010

Working Paper 2010-04
http://www.frbsf.org/publications/economics/papers/2010/wp10-04bk.pdf

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# Bond Currency Denomination and the Yen Carry Trade

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**Abstract**

We examine the determinants of issuance of yen-denominated international bonds over the period from 1990 through 2010. This period was marked by low Japanese interest rates that led some investors to pursue "carry trades," which consisted of funding investments in higher interest rate currencies with low interest rate, yen-denominated obligations. In principle, bond issuers that have flexibility in their funding currency could also conduct a carry-trade strategy by funding in yen during this low interest rate period. We examine the characteristics of firms who appeared to have adopted this strategy using a data set containing almost 80,000 international bond issues. Our results suggest that there was a movement towards issuing in yen in the international bond markets starting in 2003, but this appears to have ended with the outbreak of the global financial crisis in 2007. Furthermore, the breakdown of carry-trade conditions in 2007 corresponds to a resurgence in the ability of economic fundamentals, such as the volume of trade with Japan, to explain the decision to issue international bonds denominated in yen.

JEL classification: F31, G15

Keywords: Carry trade, bond issuance

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# 1 Introduction

The early-to-mid portion of the previous decade was marked by the combination of low levels of exchange rate volatility and low interest rate policies in a number of countries. This combination encouraged investors to adopt currency "carry trade positions", whereby investments in high interest rate yielding currencies were financed through debt obligations denominated in low interest rate currencies.[1] In particular, the poor performance of the Japanese economy during this period, combined with its low inflation and even deflationary price movements, afforded investors an attractive opportunity to fund investments in high interest-yielding currencies with yen-denominated debt obligations. Galati, Heath, and McGuire (2007) claim that the yen and the Swiss franc were the most commonly cited funding currencies for carry trades in 2007.[2]

While standard uncovered interest rate parity theory suggests that carry trades should not be profitable, as interest rate differentials should be compensated ex post by appreciation in the funding currency, numerous studies studies have found that carry-trade positions can be profitable ex post; for example, Burnside, Eichenbaum, and Rebelo (2007) and Darvas (2009). In the specific case of yen-funded carry trades, some empirical studies, such as Gyntelberg and Remonola (2007) and Fong (2010), report that yen carry-trade transactions generated higher risk-adjusted returns than several other international investment opportunities. Still, it is commonly understood that carry-trade positions can be exposed to dramatic "crashes," as profits earned over long periods of exposure can be quickly lost, as discussed by Brunnermeier, Pedersen, and Nagel (2008). As a result, most studies of carry-trade activity indicate that it is most prevalent during tranquil times and quickly abandoned as volatility increases.[3]

Despite the apparent risk, carry-trade activity appears to have been of substantial scope in recent years. Galati and Melvin (2004) argue that a surge in currency trading in 2004 appears to be due in part with increased profit opportunities through carry-trade activity. There is also

[1] See Galati, Heath, and McGuire (2007) for a more detailed definition and discussion of the carry trade.

[2] Japanese interest rates were also low during the second part of the 1990s, leading to some yen carry trade activity. However, the pursuit of carry trade activity in that decade broke down during the ruble crisis of 1998, as hedge funds unwinded positions in response to increased volatility [e.g. Ito (2002)].

[3] See Jordà and Taylor (2009) for a detailed analysis of carry-trade strategies and measures of profitability.

an understanding that carry trade activity can depreciate the value of the funding currency and appreciate the value of the target currency due to the large capital allocations to carry-trade activity.

In practice, it is difficult to identify carry-trade positions. For example, Galati, Heath, and McGuire (2007) identify $45 billion in yen-denominated capital flows into Caribbean financial centers between 2002 and 2007 that appear to be associated with carry-trade activity, but they grant that these flows could alternatively be purchases of securities by special purpose vehicles. They still argue that turnover patterns in derivatives and foreign exchange markets that they observe in the data during this period are correlated with conditions that would be associated with profitable carry trade activity.

While the literature has concentrated on carry trades as leveraged positions funded in one low interest rate currency and placed in another high interest rate currency, in principle, any investment which is funded in one currency and has a revenue stream associated with another can be loosely considered to be a form of a "carry trade." In these instances, the investor has chosen to fund an investment in a currency other than that associated with the investment to be made, presumably because of anticipated reductions in funding costs associated with denominating debt in that currency. In this paper, we consider one hybrid form of such carry trade activity, the decision to issue yen-denominated international bonds.

The currency denomination decision in international bond issuance has been studied in the context of the advent of the euro by Hale and Spiegel (2008).[4] Using bond-level data, they found that firms responded to the increased scale economies in European bond markets associated with the advent of the euro by issuing larger shares of euro-denominated debt. Moreover, they found the responsiveness of firms to be heterogeneous. The impact of the euro was greater on non-financial firms and on new issuers relative to issuers already seasoned in bond markets. In the first case, the larger response appears to reflect the fact that non-financial firms are less adept at hedging foreign exchange risk than financial firms and would therefore be more reluctant to issue in the national currencies of the future euro area. In the latter case, the greater responsiveness by new

[4]See also the earlier study by Santos and Tsatsaronis (2006).

issuers appears to reflect the fact that seasoned issuers may already be locked–in to a given currency of issue, perhaps due to a relationship with an underwriter of a given nationality. For example, Lopez and Spiegel (2009b) found that Japanese borrowers in the international yen-denominated bond market faced lower underwriting costs from Japanese underwriters after issuer characteristics were taken into account. A similar result was found for non-Japanese borrowers and non-Japanese underwriters.

In this paper, we concentrate on the impact of carry-trade opportunities on firm currency denomination decisions with particular emphasis on the yen. In particular, we look for evidence that the carry trade diminished the strength of economic fundamentals in explaining debt issuance decisions. We concentrate on trade patterns as economic drivers of foreign-currency funding. Firms typically have a revenue stream denominated by the home currency of the location of their sales. For most firms, this would be their home country, but exporting firms may also have a substantial portion of their revenues associated with the currencies of their export destinations. As such, one might expect that holding all else equal, firms with greater shares of exports to a given country would be more likely to issue some of their debt obligations in that nation's currency. Our data set consists of nearly 80,000 international bond issues of which 16% are denominated in yen, 33% in U.S. dollars and 17% in euros.

Evidence along these lines has been found for other financial instruments and other currencies. Kedia and Mozumdar (2003) found that U.S. firms with greater foreign operations are more likely to use foreign currency debt to hedge their increased exposure. Similarly, Nandy (2010) found that a one standard deviation increase in the ratio of a firm's foreign sales in the United States increased the probability of commercial bank borrowing in U.S. dollars by 23%. In our case, considering the decision to denominate issuance in international bond markets in yen, we would expect firms with greater exports to Japan to be more likely to issue in yen, again after conditioning for other characteristics that might influence firm issuance decisions.

Unfortunately, we do not have export data available at the firm level to match our bond-level data set. Instead, we use the trade patterns of the firm's home country as a proxy for the relative

intensity of that firm's exports to Japan. For our full sample and for sub-samples of financial and nonfinancial firms, we find that increased national trade with Japan is significantly positively correlated with the decision of an individual firm to issue in debt denominated in yen, even after controlling for a variety of firm characteristics that also may influence currency denomination decisions. However, the sign on our proxy variable changes when we condition on whether the issuing firm is headquartered in the United States or Europe. In addition, the coefficient estimates on the national indicators for these issuers are negative and statistically significant. These results suggest that the economic relationship between export activities and bond issuance is weaker for these countries, perhaps due to firms based in these countries having more desirable alternatives in their home currencies. The negative coefficients on the trade proxy variable over our sample period for yen-denominated bonds issued by firms based in countries other than Japan, the United States and Europe suggest that carry-trade incentives may have weakened the hypothesized issuance relationships; that is, low Japanese interest rates may have given firms with little or no Japanese export activity an incentive to fund issues in yen in order to conduct carry-trade related transactions.

To examine this hypothesis, we estimate the impact that the global financial crisis and the sudden decline in carry-trade activities has on our empirical analysis. Specifically, we date the end of the carry-trade period as June 2007, when the yen began its most recent period of appreciation with respect to the U.S. dollar. When we interact our trade proxy variable with the sample period following the end of the carry-trade period, we get positive and mainly significant coefficients that suggest a positive relationship between Japanese trade and yen bond issuance is present after carry-trade distortions are reduced. We conclude from this empirical evidence that the breakdown of carry-trade opportunities, due in large part to the increased volatility and tighter credit conditions associated with the outbreak of the global financial crisis, was associated with a resurgence of the importance of economic fundamentals in the currency denomination of international bond issues.

We also find that this effect appears to be more important for financial firms, suggesting that financial firms were more active in carry-trade activities and thus had their debt currency denomination decisions more affected by the carry trade opportunities present in our sample period.

The remainder of this paper is divided into four sections. Section 2 introduces the data used in the study, describes some of the stylized facts concerning currency denomination of international bonds in our sample, and introduces the specification used in the parametric portion of the study. Section 3 presents our empirical results, and Section 4 concludes.

# 2 Empirical approach

## 2.1 Data and summary statistics

Our bond data are collected from Dealogic's DCM Analytics database. We construct a data set of internationally placed bond deals between January 1, 1990 and January 15, 2010. We choose this starting point for our sample period because less information is available on international bond markets in this database prior to 1990. Note, however, that we use data available prior to 1990 to define whether an issuer is seasoned (i.e., has issued international bonds before). We include foreign, Euromarket and global bond issues in our analysis. Focusing on our analysis of yen-denominated international bonds, foreign bonds are those issued in the so-called "samurai" market, which is a domestic Japanese bond market that allows only foreign issuers; Euro-yen bonds are issued outside of Japan, most typically from London; and international bonds are simultaneously placed in both markets and perhaps the Japanese domestic market.[5]

As summarized in Tables 1 and 2, our data sample includes 79,346 international bond issues by 8,075 distinct firms.[6] Note that nearly two-thirds of the issues are by financial firms and only one-third by non-financial firms. We conduct our analysis on separate subsamples of financial and nonfinancial firms as their issuance patterns and currency-denomination choices could differ for various reasons, not the least of which is their willingness to engage in carry-trade related

[5]Please see Lopez and Spiegel (2009a) as well as Lopez and Spiegel (2009b) for further details on these yen-denominated bond markets.

[6]Note that in 2,623 cases, a borrower issued several bonds simultaneously as separate tranches that differ according to bond characteristics, such as maturity or collateralization. We chose to treat these tranches as separate observations in our analysis. As a robustness check, we also collapsed an issue's tranches into a single bond observation by averaging the tranche-specific variables, and we obtained qualitatively similar results. For indicator variables that differed across tranches, we recoded the variable with a value of one if its mean was greater than or equal to 0.5 and zero otherwise. These results are available from the authors on request.

activities.

By issuer nationality, the full sample includes 3,140 issues (or 4% of the total) from 625 distinct Japanese borrowers; 15,967 issues (or 20%) from 1,609 U.S. borrowers; and 44,187 issues (or 56%) from borrowers headquartered in the European Union. While Japanese issues and firms are predominantly non-financial, U.S. and especially European issuance is mainly by financial firms at 55% and 70% of national issuance, respectively. Financial firms from these countries issue disproportionately more international bonds than non-financial firms, as financial firms only make up 23% and 37% of the total number of national firms, respectively.

Currency denomination for the full data set is 16% yen, 33% U.S. dollar, and 17% euro, even though the latter was only an available option after 1998. As yen issuance is the focus of our analysis, it is interesting to note that 73% of issues by Japanese borrowers are denominated in yen. In our analysis in Section 3, we examine yen issuance by non-Japanese borrowers to reduce this home currency effect. Of the yen issuance, U.S. firms accounted for 13% of the bond issues, and European firms accounted for 49%, of which 80% were financial firms.

For our regression analysis, we use several issue-specific variables that have been shown to be appropriate in other studies; for example, see Lopez and Spiegel (2009b) and the studies cited therein. Table 3 contains summary statistics for these variables both for the sample with and without Japanese borrowers. The variable $Unseasoned$, which takes a value of one if it is a firm's first time issuing in international bond markets since 1980 and zero otherwise, is used to examine whether there are important differences between new and established bond issuers. About 10% of the total issues are by unseasoned borrowers, suggesting that firms that issue debt in the international bond markets do so several times. Given our emphasis on the carry trade and yen-denominated bond issuance, we also consider the distinction between seasoned, Japanese and foreign borrowers using the variable ($JPNIssuer \times Unseasoned$), which is an interaction between the $Unseasoned$ variable and an indicator variable for issuing firms headquartered in Japan. While Japanese borrowers are responsible for only 4% of total issuance, they make up only 1% of unseasoned issuers, which may suggest that Japanese borrowers access the international bond market for yen funding regularly as

a complement to their domestic bond funding.

Regarding issue characteristics, we examine the logged value of the deal (or issue) size in nominal U.S. dollars, denoted as $Log(DealVal)$. Both the mean and median deal value are just under \$100 million (or 18.4) with a relatively narrow interquartile range. The yield to maturity of the issue, denoted $YTM$, was found to be an important determinant of bond underwriter nationality for yen-denominated bonds by Lopez and Spiegel (2009b), and we include it here in our analysis of currency denomination choice for international bonds as well. The average YTM for the full sample is 5.59%, which increased only slightly to 5.73% when the Japanese issuers are removed from the sample. Bond maturity, expressed as the logged value of the years to maturity and denoted $Log(YrsToMat)$, averaged 5.75 years (or 1.75) for the full sample. Regarding the remaining issue characteristics, 23% of the issues are callable, 93% are investment grade, and only 9% are collateralized.

When we condition for Japanese trade in the second part of our analysis, we supplement our bond data set with bilateral trade data from the IMF's Direction of Trade Statistics (November 2009 CD-ROM) and with GDP data from the World Bank's World Development Indicators Online database. Because we do not have firm level trade data, we focus on national merchandise trade with Japan in a given year. We construct a measure of total trade, the sum of exports and imports, that takes into account four different trade flows: (a) Japan's exports to country $j$; (b) Japan's imports from country $j$; (c) country $j$'s exports to Japan; (d) country $j$'s imports from Japan. We average flows (a) and (d) to get a measure of Japan's exports to country $j$, and we average flows (b) and (c) to get a measure of Japan's imports from country $j$. The sum of the resulting two measures is total trade.

We scale our total trade measure using nominal GDP from the World Development Indicators. From 1990 to 2007, the average trade ratio is 5.6% over 104 countries. In 2008, the average trade ratio over 59 countries is 4.0%. Because GDP data and trade data are not widely available for 2009, our data sample will not include bonds issued after 2008 when conditioning for trade. It is also important to note that Japanese bond issues are naturally dropped from our trade sample, as

Japan cannot have bilateral trade with itself.

Figure 1 presents the scatterplot of countries' average annual ratio of trade with Japan to GDP over the period from 1990 through 2007 and the percentage of their firms' international bond issuance that is yen-denominated. The relationship is relatively loose with a correlation coefficient of 0.07 and a slope coefficient of 0.10. The correlation is low for two reasons: (1) many countries have very few yen-denominated bond issues (i.e., points very close to the x-axis); (2) several countries have little trade with Japan (i.e., points very close to the y-axis). The relationship in 2008, as shown in Figure 2, is different in that yen-denominated bond issuance declined for many countries. As a result, the correlation coefficient increased to 0.31 and the slope coefficient increased to 0.63.[7]

## 2.2 Econometric specification

We conduct our analysis using a logit specification concerning the determinants of currency denomination in bond issuance with heteroscedasticity-consistent standard errors. Our baseline specification satisfies

$$I(Yen_{ifjt} = 1) = c + X'_{ifjt}\gamma_1 + Y'_j\gamma_2 + Z'_t\gamma_3 + \varepsilon_{ijt} \tag{1}$$

where $Yen_{ifjt}$ represents the currency denomination decision of bond issue $i$ by firm $f$ from country $j$ in year $t$. This variable takes value one for bond issues in yen and zero otherwise. Among the dependent variables, $X_{ifjt}$ represent our issue-specific variables summarized in Table 3, $Y_j$ represents dummies for the country of origin (i.e., issuers headquartered in Japan, the United States, and the European Union), and $Z_t$ represents different time indicators. In particular, we use a linear trend with a dummy equal to one subsequent to the advent of the euro area and a more flexible specification using individual year dummies.[8].

[7] In Figure 2, Thailand is an outlier, as it only issued yen denominated bonds in our 2008 sample. After dropping Thailand, we obtain a correlation coefficient of 0.04 and a slope coefficient of 0.02.

[8] Hale and Spiegel (2008) have shown that the advent of the euro led to a substantial movement towards issuing in euro, albeit primarily at the expense of dollar issues.

# 3 Results

## 3.1 Full sample results

The full sample estimation results for our model of the probability of issuing an international yen-denominated bond is shown in Table 4 for the specification with an annual time trend and an indicator for the introduction of the euro in 1999. Unsurprisingly, Japanese firms are more likely to issue in yen, while firms headquartered in the United States and the European Union are less likely than average to do so. Overall, the sample suggests that unseasoned issuers are less likely to issue in yen, but Japanese unseasoned issuers, especially non-financial firms, appear more likely to issue in yen as we consistently obtain a positive, albeit not always statistically significant, coefficient estimate on the ($JPNIssuer \times Unseasoned$) variable. This latter result seems reasonable as one would expect unseasoned non-financial firms to be less adept at issuing foreign currency-denominated debt and that Japanese unseasoned non-financial firms would thus be more likely to issue in yen.

We also obtain a negative and statistically significant coefficient estimate on $Invgrade$, suggesting that issues from investment grade companies are less likely to be denominated in yen. An interesting refinement of this result is that the coefficient on this variable for financial firms is insignificant for in column (2) and actually positive in column (5) with indicators for U.S. and European firms. These results suggest that investment-grade, financial firms are relatively more likely to issue yen-denominated bonds than non-financial firms. The reasons for this outcome are not perfectly clear, but they may be related to carry-trade related activities. For example, these investment-grade financial firms may have been more adept at capitalizing on the carry trade opportunities that prevailed over the course of the sample than their non-financial counterparts.

Concerning the conditioning variables based on bond characteristics, we find that increases in deal values are negatively related to the probability of issuing in yen, as are increases in yields to maturity. In terms of carry-trade related activities, this maturity result suggests that firms issuing in yen tend to do so for shorter tenors. However, the direction of causality in this relationship

is open to question. We also find that callable and collateralized issues are more likely to be denominated in yen.

The results for our time indicator variables provide two insights into the patterns of yen-denominated international bond issuance. First, the linear trend is consistently and significantly negative, suggesting that all types of firms were relatively less likely to issue these bonds in recent years. Second, after the introduction of the euro, financial firms were relatively less likely to issue these bonds and non-financial firms were more likely to do so. The aggregate effect was not statistically significant as the sectoral effects are of roughly equal magnitude, but opposing signs.

These results suggest that the time trends related to yen-bond issuance are more nuanced than this specification allows. The issuance statistics for the yen-denominated international bonds reported in Lopez and Spiegel (2009a) also suggest that non-linear trends are evident in the data. To address this specification concern, we introduce individual year dummies to capture these time effects in a simple and flexible way. These model estimates are reported in Table 5, while the yearly coefficients are graphed in Figure 3 and reported in Appendix Table A.1.

The estimation results for the other conditioning variables remain basically unchanged with the introduction of this new time specification. The time coefficients are generally trending downward, as might be expected given the relatively poor performance of the Japanese economy over this period, particularly the turbulence in Japanese financial markets in the latter portion of the 1990s. As the Japanese economy faltered, firms had less yen-denominated revenues to match against yen-denominated liabilities. In essence, there was a decrease in the magnitude of fundamentals pushing towards issuance in yen.

However, evidence of carry-trade like strategies appear to emerge in the middle portion of the decade, as we see a substantial movement upwards relative to trend in the yearly coefficients from 2003 through 2007. This roughly corresponds to the period reported by Galati, Heath, and McGuire (2007) as exhibiting activities that could be associated with the pursuit of carry trade positions. As the entire decade was marked by very low Japanese interest rates, we would conclude that this era in the middle of the decade represented the pursuit of carry trade like activity in

international bond markets, as new issues were denominated in yen at an exceptional rate after conditioning for bond characteristics.

### 3.2 Conditioning for trade with Japan

Table 6 repeats our empirical analysis but excludes Japanese firms from the sample in order to concentrate on the nature of the relationship between trade activity and funding in the context of the international bond markets. It can be seen that the removal of the Japanese-related issuers reduces our sample moderately. To incorporate the trade data into our analysis, we add a new variable, denoted as $Trade/GDP$, which measures the bilateral trade with Japan of the issuing firm's home country as a share of its GDP. As discussed above, we view this variable as potentially important indicator of firm fundamentals that may influence its currency denomination decision. In particular, since firms that export to Japan have a revenue stream that is likely to be positively correlated with yen movements, they might chose to access yen-denominated funding through the international bond markets to align the currency denomination of their liabilities with those of their revenue streams.

As shown in Table 6, the coefficient estimates for the firm-specific and issue-specific variables are qualitatively similar to the results in Table 4 that include the Japanese issuers. In addition, the year coefficient estimates presented in Figure 4 and Appendix Table A.2 are similar as well.

The key result for this analysis is the significant coefficient estimate for the $Trade/GDP$ variable for our three data samples. The coefficients are positive and significant when we do not condition for where firms are headquartered; see columns (1) through (3). However, the sign changes for the full and the financial samples when we include indicators for firms headquartered in the U.S. and Europe. Even for the non-financial firms, while the coefficient estimate is still positive, the point estimate is less than halved and is no longer statistically significant. The reasons for this sign change are not fully clear, but it is most certainly tied to specific issues corresponding to firm nationality. As in the previous section, the U.S. and European indicators have negative and significant coefficients, suggesting that they are less likely to issue yen-denominated debt. A

potential explanation is again that the home country currencies of these countries are attractive as funding alternatives due to the large volumes of bond issuance in U.S. dollars and euro.

Regardless of the explanation, it also suggests that a relationship that has been found to be prevalent in the literature, as in Kedia and Mozumdar (2003) and Nandy (2010), is not as strong in explaining the probability of yen-denominated bond issuance, at least for the 16,502 issues in our sample originating from countries other than Japan, Europe, and the United States. The relative weakness we find in this relationship may be attributable to the carry-trade incentive faced by firms in the latter portion of our sample, where low Japanese interest rates gave even firms with little Japanese export activity an incentive to fund issues in yen.[9]

Figure 4 presents the coefficients on the year dummies and provides evidence that carry-trade associated incentives may have driven the movement towards issuance in yen, particularly for financial firms, during the latter portion of our sample. In particular, there is a notable uptick in the probability of yen issuance for financial firms in 2004, the period most associated with the beginning of attractive yen carry-trade opportunities when one considers both the interest rate differentials and the riskiness of market conditions. The response by non-financial firms appears later, turning up after 2006. Again, this result is intuitive, as we would expect that non-financial firms would be less likely to consider interest differentials in most currency denomination decisions, unless the incentives associated with such positions were extremely strong.

### 3.3 Breakdown of the Carry Trade

With the onset of the global financial crisis in 2007, investors began rapidly unwinding their carry-trade positions and reducing their reliance on yen funding. As funding in carry-trade positions led to a depreciation in the value of the yen, we would expect the unwinding of such positions to reverse this effect. Indeed, Figure 5 shows that the Japanese yen bottomed on June 22, 2007, and then began a long period of appreciation. In 2008, the yen nominal effective exchange rate appreciated by 32.4 percent, its largest move since the breakdown of Breton Woods in 1971 [Robinson (2009)].

[9] Of course, the carry-trade opportunities also gave those firms that did export to Japan an even greater incentive to fund issues in yen, but our empirical specification does not seem capable of detecting that effect.

With the removal of carry trade-incentives that may have been distorting the funding decisions of bond issuers, we would expect to see a resurgence in the relationship between fundamentals and currency denomination decisions. As such, we next introduce an interacted variable, $(Trade/GDP) \times I(date \geq 6/22/07)$, which takes the values of the $Trade/GDP$ variable for issues after this date and zero otherwise.[10] There are 7,944 observations in our full sample that satisfy this criterion. This interacted variable is meant to measure the impact that the breakdown of the carry trade had on the importance of economic fundamentals in the currency denomination decision.

The logit regression results including this variable are shown in Table 7; the year coefficient estimates are reported in Table A.3. The coefficient estimates for the firm- and issue-specific variables are qualitatively unchanged relative to the results in Table 6. For the specifications without the $USIssuer$ and $EUIssuer$ indicator variables included, the $Trade/GDP$ coefficients are similar, but a little smaller, than those reported in Table 6. When the nationality indicators are included, these estimated coefficients appear to be slightly large in absolute value for the full and financial sub-samples, but slightly smaller and still insignificant for the sample of non-financial firms.

Of more interest to us are the coefficient estimates on the interacted variable. These estimates are universally positive and significant. For the period after June 2007, the aggregate coefficients in the specifications without the nationality indicators are now much larger, suggesting that issuance of yen-denominated international bonds during this period was much more closely related to trade activity than before that date. The aggregate coefficients for the specifications with the nationality indicators net to a positive and clearly significant coefficient for the full sample, a small positive and probably significant coefficient for the financial firm sample, and positive but insignificant coefficient for the non-financial firm sample. These latter results also suggest that there was a resurgence in the role of fundamentals in the currency of issue decision subsequent to the breakdown of the carry trade in 2007. In summary, this refinement of the trade proxy variable indicates that the sharp reduction in the carry trade subsequent to the start of the global financial crisis in 2007 allowed

[10] It can be seen that there is also a local maximum at the later date of 8/15/2008. As a robustness check, we also examined a variable interacting Trade/GDP and this later date. These results were essentially the same and are available from the authors upon request.

the fundamental economic drivers of currency denomination decisions to become more relevant, especially for firms not headquartered in the U.S. or Europe.

# 4 Conclusion

In this chapter, we examine micro evidence on the role of the carry trade in influencing issuers' individual currency of issue decisions. We find that during the period that many associate with carry trade opportunities, the role of trade patterns in influencing debt currency denomination decisions, something that had been identified in the previous literature as being influential, was muted. This suggests that issuers deviated from fundamental concerns during the middle portion of the previous decade to take advantage of the apparent profit opportunities afforded by the pursuit of carry trades. However, an interactive term that measures the influence of trade patterns after the peak of the carry trade indicates that the influence of trade patterns was over ten times larger after the breakdown of the carry trade than it was during the heavy carry trade period. Once these exceptional yen carry trade opportunities were no longer available, primarily due to increased market volatility associated with the onset of the global financial crisis, we observe a resurgence in the role of economic fundamentals in bond currency denomination.

Our results therefore provide mixed support for the literature that claims that economic fundamentals influence currency denomination decisions in international debt issues. On one hand, we do identify a period where the influence of trade patterns appears to work in the proper direction. After the onset of the global financial crisis in the summer of 2007 discouraged international bond issuers from funding in yen to pursue carry trade profits, we find that firms that originate in countries that export more to Japan are more likely to issue yen-denominated debt. This is in keeping with the notion that the issuance decisions of these firms are designed to align revenue and liability streams, and thereby mitigate exchange rate risk exposure.

However, the role of trade was much less apparent prior to the breakdown of carry trade opportunities. During this period, the coefficient estimate on trade was one-tenth of its magnitude subsequent to the breakdown of the carry trade, and entered either insignificantly or with the

wrong sign after conditioning for firms originating in the United States and the European Union. This suggests that the role of fundamentals was overcome during the carry trade period by the motivation to capitalize on potential reduced funding costs associated with carry trade gains.

To the extent that bond issuers funded in yen to take advantage of carry trade opportunities, international bond markets may provide an additional channel through which pursuit of carry trade like strategies can exacerbate exchange rate volatility. These issuers were funding in yen during the "carry trade period" identified in the paper, providing yet another force for yen depreciation during this period, and then likely raising yen to cover their debt obligations when the carry trade collapsed. To the extent that investors behaved in this manner, the pursuit of carry trade like strategies in international bond markets is likely to act towards expanding exchange rate volatility in the same manner as that of more standard carry trade activities.

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Figure 1: Relationship between trade and yen issuance: 1990-2007

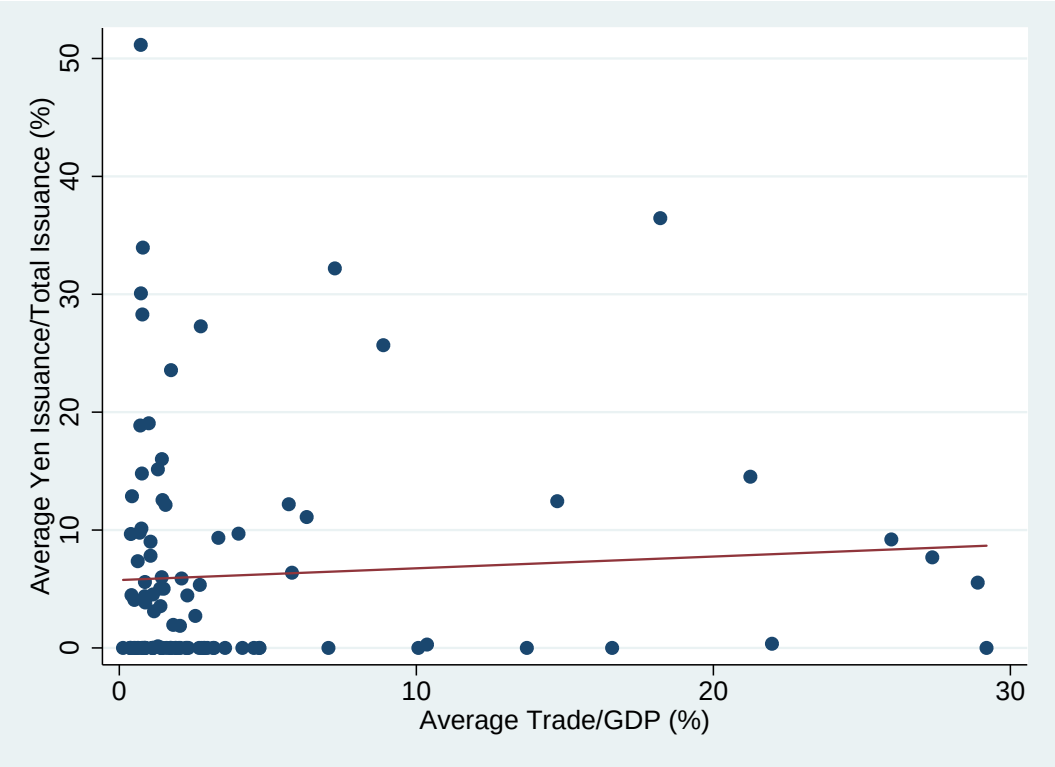

Figure 2: Relationship between trade and yen issuance: 2008

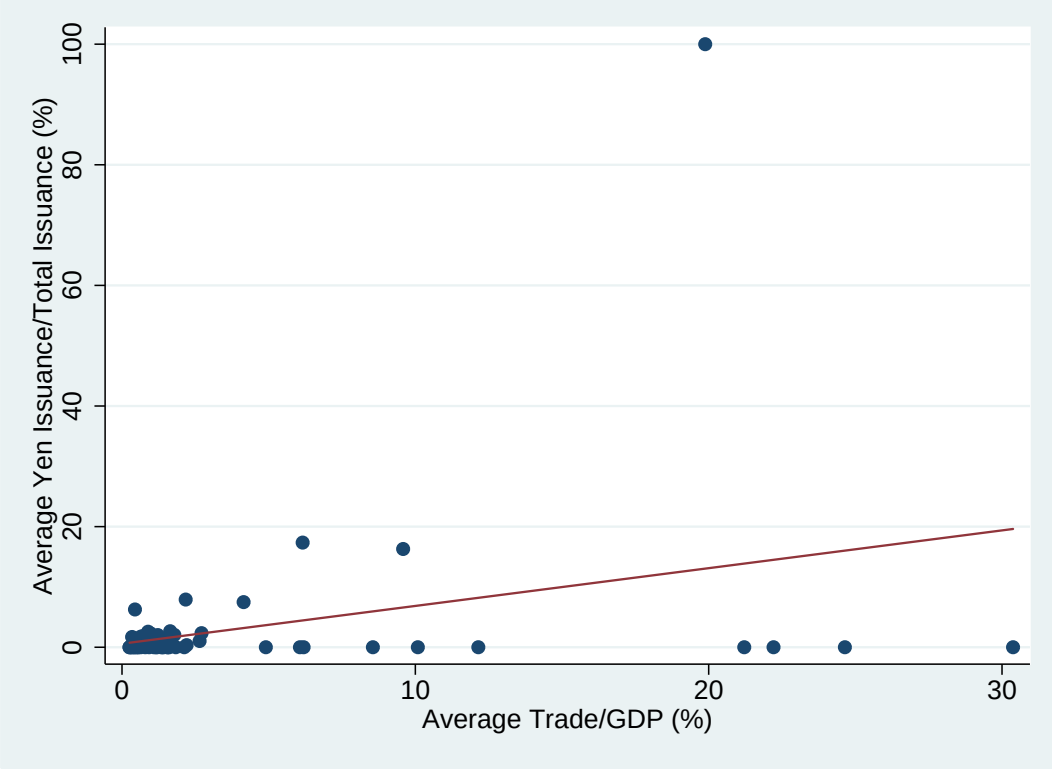

Figure 3: Coefficients on Year Dummies from Table 5, models (1) to (3)

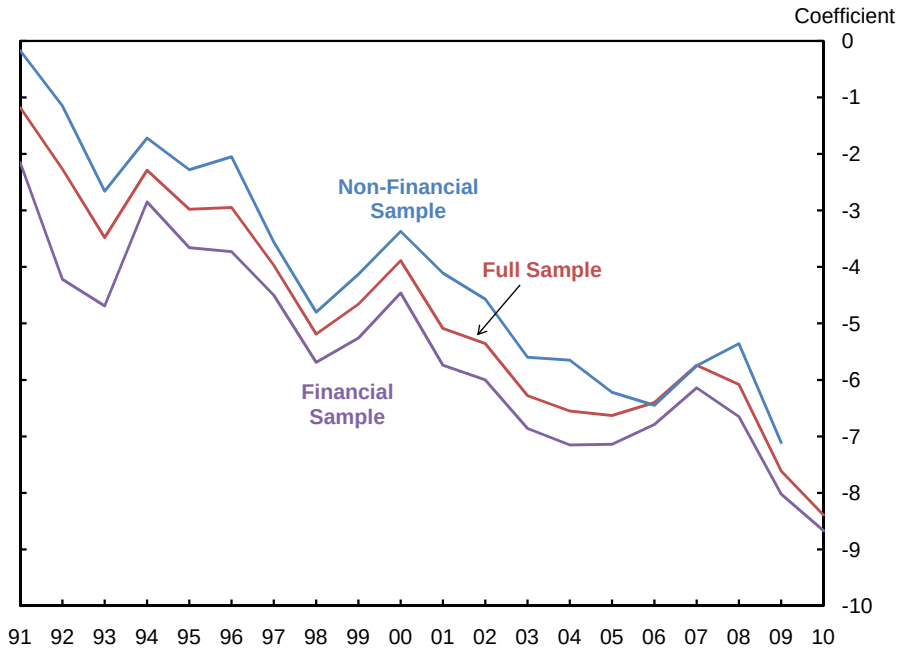

Figure 4: Coefficients on Year Dummies from Table 6, models (1) to (3)

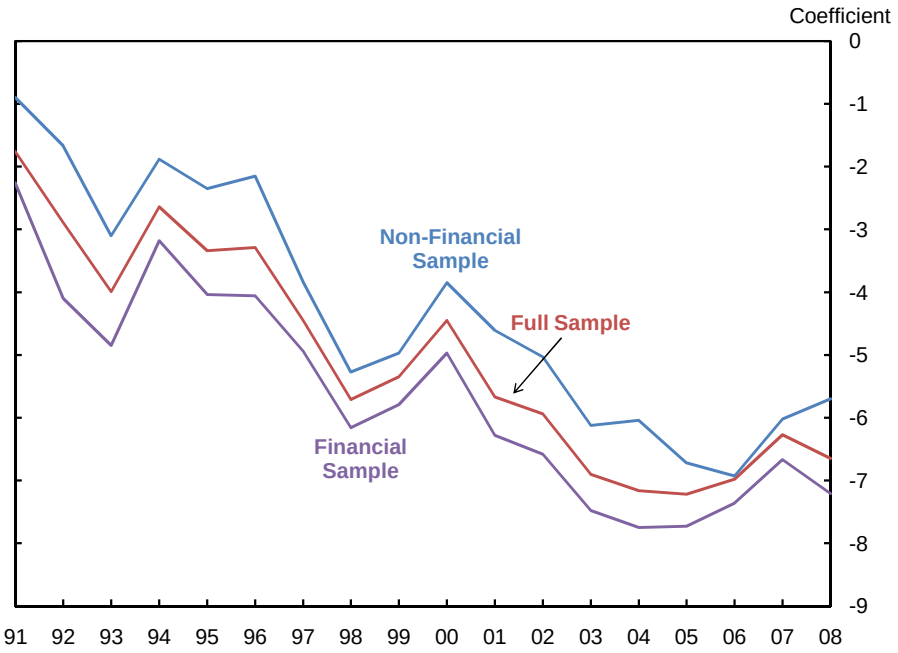

Figure 5: JPY/USD Exchange rate

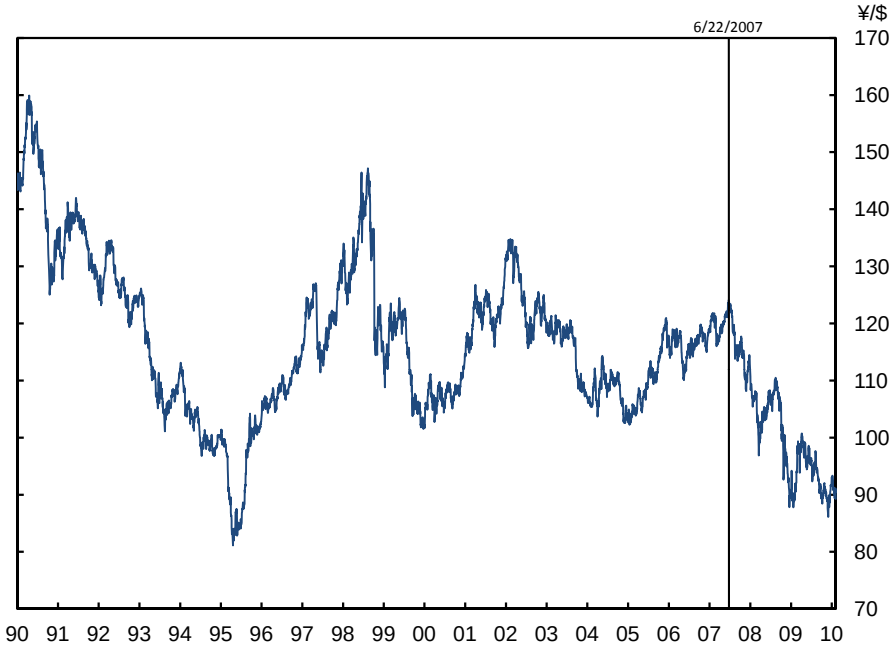

Table 1: Tabulations of bond issues in our sample

| *Number of:* | Full Sample | Financials | Non-Financials |
|---|---|---|---|
| Issues | 79,346 | 49,803 | 29,534 |
| JPN issues | 3,140 | 720 | 2,420 |
| US issues | 15,967 | 8,795 | 7,170 |
| EU issues | 44,187 | 31,184 | 13,002 |
| Other issues | 16,052 | 9,104 | 6,942 |
| JPY denominated issues | 12,364 | 7,742 | 4,622 |
| USD denominated issues | 26,377 | 16,170 | 10,205 |
| EUR denominated issues | 13,868 | 9,093 | 4,774 |
| JPN issues in JPY | 2,291 | 432 | 1,859 |
| US issues in JPY | 1,614 | 754 | 860 |
| EU issues in JPY | 6,019 | 4,806 | 1,213 |

Table 2: Tabulations of firms in our sample

| *Number of:* | Full Sample | Financials | Non-Financials |
|---|---|---|---|
| Firms | 8,075 | 2,486 | 5,585 |
| JPN firms | 625 | 120 | 505 |
| US firms | 1,609 | 371 | 1,237 |
| EU firms | 3,237 | 1,193 | 2,043 |
| Other firms | 2,604 | 802 | 1,800 |
| Firms placing JPY issues | 1,341 | 587 | 754 |
| Firms placing USD issues | 4,521 | 1,406 | 3,114 |
| Firms placing EUR issues | 2,366 | 832 | 1,533 |
| JPN firms placing JPY issues | 371 | 70 | 301 |
| US firms placing JPY issues | 143 | 73 | 70 |
| EU firms placing JPY issues | 535 | 314 | 221 |

Table 3: Summary Statistics

(a) Sample with Japanese issuers

| | Mean | SD | Median | IQR |
|---|---|---|---|---|
| I(Yen=1) | 0.16 | 0.36 | 0 | 0 |
| Euro: I(year>=1999) | 0.73 | 0.44 | 1 | 1 |
| JPNIssuer | 0.040 | 0.19 | 0 | 0 |
| Unseasoned | 0.11 | 0.31 | 0 | 0 |
| JPNIssuer×Unseasoned | 0.0065 | 0.080 | 0 | 0 |
| Log(Dealval) | 18.2 | 1.87 | 18.3 | 2.71 |
| YTM | 5.59 | 4.63 | 5.27 | 3.38 |
| Log(YrsToMat) | 1.75 | 0.86 | 1.61 | 1.20 |
| Callable | 0.27 | 0.44 | 0 | 1 |
| Invgrade | 0.93 | 0.26 | 1 | 0 |
| Collateralized | 0.085 | 0.28 | 0 | 0 |
| USIssuer | 0.20 | 0.40 | 0 | 0 |
| EUIssuer | 0.56 | 0.50 | 1 | 1 |
| Observations | 79346 | | | |

(b) Sample with trade, excluding Japanese issuers

| | Mean | SD | Median | IQR |
|---|---|---|---|---|
| I(Yen=1) | 0.14 | 0.35 | 0 | 0 |
| Trade/GDP | 2.11 | 2.81 | 1.51 | 1.12 |
| Trade/GDP×I(date≥22Jul2007) | 0.23 | 1.05 | 0 | 0 |
| Unseasoned | 0.10 | 0.30 | 0 | 0 |
| Log(Dealval) | 18.2 | 1.85 | 18.3 | 2.71 |
| YTM | 5.73 | 4.76 | 5.36 | 3.15 |
| Log(YrsToMat) | 1.77 | 0.88 | 1.64 | 1.20 |
| Callable | 0.27 | 0.45 | 0 | 1 |
| Invgrade | 0.93 | 0.26 | 1 | 0 |
| Collateralized | 0.082 | 0.27 | 0 | 0 |
| USIssuer | 0.21 | 0.41 | 0 | 0 |
| EUIssuer | 0.58 | 0.49 | 1 | 1 |
| Observations | 67226 | | | |

Table 4: All bond issuers, with time trend

| | (1) Full | (2) Fin | (3) NonFin | (4) Full | (5) Fin | (6) NonFin |
|---|---|---|---|---|---|---|
| Year | -0.29*** | -0.25*** | -0.35*** | -0.29*** | -0.26*** | -0.35*** |
| | (0.0068) | (0.0081) | (0.013) | (0.0069) | (0.0083) | (0.013) |
| Euro: I(year>=1999) | -0.088 | -0.30*** | 0.33*** | -0.082 | -0.32*** | 0.35*** |
| | (0.058) | (0.071) | (0.11) | (0.058) | (0.072) | (0.11) |
| JPNIssuer | 1.93*** | 1.64*** | 1.76*** | 1.37*** | 0.99*** | 1.35*** |
| | (0.061) | (0.11) | (0.086) | (0.068) | (0.12) | (0.10) |
| Unseasoned | -0.63*** | -0.48*** | -0.97*** | -0.74*** | -0.56*** | -1.00*** |
| | (0.080) | (0.15) | (0.11) | (0.079) | (0.14) | (0.10) |
| JPNIssuer×Unseasoned | 0.29* | 0.45 | 0.41** | 0.38** | 0.55 | 0.46** |
| | (0.15) | (0.38) | (0.19) | (0.15) | (0.38) | (0.19) |
| Log(Dealval) | -0.43*** | -0.42*** | -0.49*** | -0.44*** | -0.42*** | -0.49*** |
| | (0.0091) | (0.011) | (0.018) | (0.0093) | (0.012) | (0.018) |
| YTM | -0.95*** | -0.91*** | -1.05*** | -0.96*** | -0.92*** | -1.06*** |
| | (0.016) | (0.022) | (0.021) | (0.016) | (0.022) | (0.021) |
| Log(YrsToMat) | 1.10*** | 1.27*** | 0.69*** | 1.13*** | 1.31*** | 0.72*** |
| | (0.024) | (0.032) | (0.039) | (0.025) | (0.033) | (0.040) |
| Callable | 0.81*** | 0.72*** | 1.10*** | 0.80*** | 0.71*** | 1.04*** |
| | (0.032) | (0.035) | (0.072) | (0.032) | (0.036) | (0.071) |
| Invgrade | -0.78*** | -0.025 | -1.57*** | -0.43*** | 0.29*** | -1.30*** |
| | (0.070) | (0.11) | (0.11) | (0.068) | (0.11) | (0.11) |
| Collateralized | -1.10*** | -1.44*** | -0.63*** | -1.04*** | -1.31*** | -0.73*** |
| | (0.077) | (0.12) | (0.12) | (0.079) | (0.12) | (0.12) |
| USIssuer | | | | -0.45*** | -0.61*** | -0.13 |
| | | | | (0.047) | (0.064) | (0.082) |
| EUIssuer | | | | -0.78*** | -0.82*** | -0.73*** |
| | | | | (0.039) | (0.048) | (0.077) |
| Constant | 584.4*** | 515.1*** | 702.5*** | 595.7*** | 530.2*** | 708.4*** |
| | (13.7) | (16.3) | (25.3) | (13.8) | (16.6) | (25.4) |
| Observations | 79346 | 49803 | 29534 | 79346 | 49803 | 29534 |
| Pseudo $R^2$ | 0.54 | 0.50 | 0.62 | 0.54 | 0.51 | 0.62 |

Dependent variable: I(Yen = 1)
Logit estimation. Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: All bond issuers, with year dummies

| | (1) Full | (2) Fin | (3) NonFin | (4) Full | (5) Fin | (6) NonFin |
|---|---|---|---|---|---|---|
| JPNIssuer | 1.85*** | 1.67*** | 1.65*** | 1.22*** | 0.91*** | 1.18*** |
| | (0.065) | (0.12) | (0.092) | (0.072) | (0.13) | (0.11) |
| Unseasoned | -0.69*** | -0.57*** | -0.98*** | -0.81*** | -0.67*** | -1.02*** |
| | (0.090) | (0.15) | (0.12) | (0.090) | (0.15) | (0.12) |
| JPNIssuer×Unseasoned | 0.21 | 0.17 | 0.36* | 0.30* | 0.25 | 0.42** |
| | (0.16) | (0.41) | (0.19) | (0.16) | (0.42) | (0.19) |
| Log(Dealval) | -0.43*** | -0.41*** | -0.49*** | -0.44*** | -0.41*** | -0.49*** |
| | (0.0094) | (0.011) | (0.019) | (0.0096) | (0.012) | (0.019) |
| YTM | -1.05*** | -1.02*** | -1.12*** | -1.06*** | -1.04*** | -1.14*** |
| | (0.020) | (0.027) | (0.024) | (0.020) | (0.028) | (0.024) |
| Log(YrsToMat) | 1.16*** | 1.38*** | 0.71*** | 1.19*** | 1.42*** | 0.74*** |
| | (0.026) | (0.035) | (0.041) | (0.027) | (0.036) | (0.042) |
| Callable | 1.02*** | 0.95*** | 1.22*** | 1.02*** | 0.95*** | 1.16*** |
| | (0.036) | (0.040) | (0.081) | (0.037) | (0.042) | (0.081) |
| Invgrade | -0.86*** | -0.093 | -1.65*** | -0.49*** | 0.22* | -1.36*** |
| | (0.075) | (0.12) | (0.12) | (0.073) | (0.12) | (0.12) |
| Collateralized | -1.14*** | -1.44*** | -0.65*** | -1.07*** | -1.30*** | -0.73*** |
| | (0.087) | (0.12) | (0.13) | (0.089) | (0.13) | (0.14) |
| USIssuer | | | | -0.60*** | -0.83*** | -0.18** |
| | | | | (0.050) | (0.070) | (0.086) |
| EUIssuer | | | | -0.86*** | -0.94*** | -0.76*** |
| | | | | (0.041) | (0.050) | (0.079) |
| Constant | 13.8*** | 12.8*** | 16.2*** | 14.3*** | 13.3*** | 16.5*** |
| | (0.24) | (0.32) | (0.42) | (0.25) | (0.32) | (0.43) |
| Observations | 79346 | 49803 | 29446 | 79346 | 49803 | 29446 |
| Pseudo $R^2$ | 0.56 | 0.54 | 0.64 | 0.57 | 0.55 | 0.64 |

Dependent variable: I(Yen = 1)
Logit estimation. Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
See Table A.1 for year dummy coefficients. Omitted year dummy is 1990

Table 6: Non-Japanese issuers, with year dummies

| | (1) Full | (2) Fin | (3) NonFin | (4) Full | (5) Fin | (6) NonFin |
|---|---|---|---|---|---|---|
| Trade/GDP | 0.039*** | 0.058*** | 0.020** | -0.017** | -0.061*** | 0.0071 |
| | (0.0061) | (0.0087) | (0.0083) | (0.0082) | (0.014) | (0.0095) |
| Unseasoned | -0.96*** | -0.68*** | -1.05*** | -0.99*** | -0.68*** | -1.01*** |
| | (0.10) | (0.16) | (0.14) | (0.10) | (0.16) | (0.14) |
| Log(Dealval) | -0.45*** | -0.42*** | -0.54*** | -0.46*** | -0.41*** | -0.54*** |
| | (0.010) | (0.012) | (0.021) | (0.011) | (0.013) | (0.022) |
| YTM | -1.04*** | -1.03*** | -1.12*** | -1.05*** | -1.05*** | -1.13*** |
| | (0.018) | (0.023) | (0.026) | (0.018) | (0.023) | (0.027) |
| Log(YrsToMat) | 1.22*** | 1.45*** | 0.74*** | 1.23*** | 1.46*** | 0.76*** |
| | (0.027) | (0.034) | (0.047) | (0.027) | (0.035) | (0.047) |
| Callable | 1.11*** | 1.04*** | 1.48*** | 1.11*** | 1.04*** | 1.40*** |
| | (0.037) | (0.042) | (0.092) | (0.038) | (0.043) | (0.092) |
| Invgrade | -0.87*** | -0.20 | -1.57*** | -0.66*** | -0.19 | -1.54*** |
| | (0.091) | (0.14) | (0.13) | (0.086) | (0.13) | (0.13) |
| Collateralized | -1.59*** | -1.30*** | -1.80*** | -1.52*** | -1.19*** | -1.93*** |
| | (0.12) | (0.13) | (0.23) | (0.12) | (0.13) | (0.23) |
| USIssuer | | | | -0.53*** | -0.99*** | 0.24** |
| | | | | (0.056) | (0.081) | (0.098) |
| EUIssuer | | | | -0.83*** | -1.15*** | -0.38*** |
| | | | | (0.048) | (0.064) | (0.094) |
| Constant | 14.5*** | 13.3*** | 17.4*** | 15.3*** | 14.5*** | 17.6*** |
| | (0.26) | (0.32) | (0.50) | (0.27) | (0.33) | (0.51) |
| Observations | 67226 | 43692 | 23527 | 67226 | 43692 | 23527 |
| Pseudo $R^2$ | 0.54 | 0.53 | 0.57 | 0.54 | 0.54 | 0.58 |

Dependent variable: I(Yen = 1)
Logit estimation. Robust standard errors in parentheses
$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$
See Table A.2 for year dummy coefficients. Omitted year dummy is 1990

Table 7: Non-Japanese issuers, Add iteraction term with year dummies

| | (1) Full | (2) Fin | (3) NonFin | (4) Full | (5) Fin | (6) NonFin |
|---|---|---|---|---|---|---|
| Trade/GDP | 0.033*** | 0.048*** | 0.018** | -0.023*** | -0.074*** | 0.0053 |
| | (0.0066) | (0.0091) | (0.0089) | (0.0086) | (0.015) | (0.010) |
| Trade/GDP×I(date≥22Jun2007) | 0.047*** | 0.073*** | 0.017 | 0.046** | 0.077*** | 0.017 |
| | (0.017) | (0.028) | (0.023) | (0.019) | (0.029) | (0.024) |
| Unseasoned | -0.95*** | -0.67*** | -1.05*** | -0.98*** | -0.67*** | -1.01*** |
| | (0.10) | (0.16) | (0.14) | (0.10) | (0.16) | (0.14) |
| Log(Dealval) | -0.45*** | -0.42*** | -0.54*** | -0.46*** | -0.41*** | -0.54*** |
| | (0.010) | (0.012) | (0.021) | (0.011) | (0.013) | (0.022) |
| YTM | -1.04*** | -1.03*** | -1.12*** | -1.06*** | -1.05*** | -1.13*** |
| | (0.018) | (0.023) | (0.026) | (0.018) | (0.023) | (0.027) |
| Log(YrsToMat) | 1.22*** | 1.45*** | 0.74*** | 1.23*** | 1.46*** | 0.76*** |
| | (0.027) | (0.034) | (0.047) | (0.027) | (0.035) | (0.047) |
| Callable | 1.11*** | 1.04*** | 1.48*** | 1.11*** | 1.04*** | 1.40*** |
| | (0.037) | (0.042) | (0.092) | (0.038) | (0.043) | (0.092) |
| Invgrade | -0.89*** | -0.23 | -1.58*** | -0.67*** | -0.21 | -1.55*** |
| | (0.091) | (0.14) | (0.13) | (0.086) | (0.13) | (0.14) |
| Collateralized | -1.59*** | -1.30*** | -1.80*** | -1.52*** | -1.19*** | -1.93*** |
| | (0.12) | (0.13) | (0.23) | (0.12) | (0.13) | (0.23) |
| USIssuer | | | | -0.52*** | -0.99*** | 0.24** |
| | | | | (0.056) | (0.081) | (0.098) |
| EUIssuer | | | | -0.83*** | -1.16*** | -0.38*** |
| | | | | (0.048) | (0.065) | (0.094) |
| Constant | 14.5*** | 13.4*** | 17.5*** | 15.3*** | 14.5*** | 17.7*** |
| | (0.26) | (0.32) | (0.50) | (0.27) | (0.33) | (0.51) |
| Observations | 67226 | 43692 | 23527 | 67226 | 43692 | 23527 |
| Pseudo $R^2$ | 0.54 | 0.53 | 0.57 | 0.54 | 0.54 | 0.58 |

Dependent variable: I(Yen = 1)
Logit estimation. Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
See Table A.3 for year dummy coefficients. Omitted year dummy is 1990

# Appendix A

Table A.1: Year dummies for Table 5

| | (1) Full | (2) Fin | (3) NonFin | (4) Full | (5) Fin | (6) NonFin |
|---|---|---|---|---|---|---|
| I(year=1991) | -1.18*** | -2.15*** | -0.17 | -1.21*** | -2.21*** | -0.19 |
| | (0.14) | (0.23) | (0.19) | (0.14) | (0.23) | (0.19) |
| I(year=1992) | -2.27*** | -4.22*** | -1.15*** | -2.33*** | -4.30*** | -1.18*** |
| | (0.14) | (0.38) | (0.19) | (0.14) | (0.38) | (0.19) |
| I(year=1993) | -3.48*** | -4.69*** | -2.66*** | -3.56*** | -4.86*** | -2.69*** |
| | (0.14) | (0.26) | (0.20) | (0.15) | (0.26) | (0.20) |
| I(year=1994) | -2.29*** | -2.85*** | -1.72*** | -2.33*** | -2.94*** | -1.75*** |
| | (0.13) | (0.16) | (0.20) | (0.13) | (0.17) | (0.20) |
| I(year=1995) | -2.98*** | -3.66*** | -2.28*** | -3.02*** | -3.73*** | -2.33*** |
| | (0.14) | (0.18) | (0.21) | (0.14) | (0.19) | (0.21) |
| I(year=1996) | -2.95*** | -3.73*** | -2.05*** | -3.03*** | -3.84*** | -2.14*** |
| | (0.14) | (0.19) | (0.21) | (0.15) | (0.19) | (0.22) |
| I(year=1997) | -3.97*** | -4.50*** | -3.56*** | -4.06*** | -4.62*** | -3.67*** |
| | (0.15) | (0.20) | (0.23) | (0.15) | (0.20) | (0.23) |
| I(year=1998) | -5.19*** | -5.69*** | -4.80*** | -5.26*** | -5.79*** | -4.91*** |
| | (0.17) | (0.22) | (0.26) | (0.17) | (0.22) | (0.26) |
| I(year=1999) | -4.66*** | -5.26*** | -4.13*** | -4.73*** | -5.37*** | -4.21*** |
| | (0.15) | (0.20) | (0.22) | (0.15) | (0.21) | (0.22) |
| I(year=2000) | -3.89*** | -4.46*** | -3.37*** | -3.92*** | -4.52*** | -3.43*** |
| | (0.14) | (0.19) | (0.21) | (0.15) | (0.19) | (0.21) |
| I(year=2001) | -5.09*** | -5.74*** | -4.11*** | -5.21*** | -5.90*** | -4.22*** |
| | (0.14) | (0.19) | (0.21) | (0.15) | (0.19) | (0.21) |
| I(year=2002) | -5.36*** | -6.00*** | -4.57*** | -5.48*** | -6.19*** | -4.69*** |
| | (0.15) | (0.20) | (0.21) | (0.15) | (0.20) | (0.21) |
| I(year=2003) | -6.28*** | -6.86*** | -5.60*** | -6.42*** | -7.09*** | -5.65*** |
| | (0.16) | (0.21) | (0.22) | (0.16) | (0.21) | (0.22) |
| I(year=2004) | -6.55*** | -7.15*** | -5.65*** | -6.67*** | -7.36*** | -5.69*** |
| | (0.15) | (0.20) | (0.22) | (0.16) | (0.21) | (0.22) |
| I(year=2005) | -6.63*** | -7.14*** | -6.22*** | -6.75*** | -7.36*** | -6.25*** |
| | (0.16) | (0.21) | (0.24) | (0.16) | (0.21) | (0.24) |
| I(year=2006) | -6.40*** | -6.79*** | -6.45*** | -6.52*** | -7.00*** | -6.42*** |
| | (0.16) | (0.21) | (0.27) | (0.16) | (0.21) | (0.27) |
| I(year=2007) | -5.74*** | -6.14*** | -5.75*** | -5.85*** | -6.31*** | -5.85*** |
| | (0.15) | (0.19) | (0.26) | (0.15) | (0.20) | (0.25) |
| I(year=2008) | -6.08*** | -6.65*** | -5.36*** | -6.21*** | -6.84*** | -5.44*** |
| | (0.16) | (0.20) | (0.24) | (0.16) | (0.21) | (0.24) |
| I(year=2009) | -7.61*** | -8.02*** | -7.11*** | -7.74*** | -8.23*** | -7.20*** |
| | (0.17) | (0.22) | (0.28) | (0.17) | (0.22) | (0.28) |
| I(year=2010) | -8.39*** | -8.67*** | | -8.56*** | -8.88*** | |
| | (0.65) | (0.67) | | (0.64) | (0.65) | |
| Observations | 79346 | 49803 | 29446 | 79346 | 49803 | 29446 |
| Pseudo $R^2$ | 0.56 | 0.54 | 0.64 | 0.57 | 0.55 | 0.64 |

Dependent variable: I(Yen = 1)

Logit estimation. Robust standard errors in parentheses

$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

Table A.2: Year dummies for Table 6

| | (1) Full | (2) Fin | (3) NonFin | (4) Full | (5) Fin | (6) NonFin |
|---|---|---|---|---|---|---|
| I(year=1991) | -1.76*** | -2.26*** | -0.90*** | -1.79*** | -2.27*** | -0.89*** |
| | (0.18) | (0.24) | (0.30) | (0.18) | (0.23) | (0.30) |
| I(year=1992) | -2.89*** | -4.10*** | -1.67*** | -2.96*** | -4.17*** | -1.68*** |
| | (0.20) | (0.35) | (0.28) | (0.20) | (0.34) | (0.28) |
| I(year=1993) | -3.99*** | -4.85*** | -3.10*** | -4.05*** | -4.95*** | -3.10*** |
| | (0.16) | (0.24) | (0.26) | (0.16) | (0.24) | (0.26) |
| I(year=1994) | -2.64*** | -3.18*** | -1.88*** | -2.67*** | -3.22*** | -1.88*** |
| | (0.13) | (0.17) | (0.24) | (0.14) | (0.17) | (0.24) |
| I(year=1995) | -3.34*** | -4.04*** | -2.35*** | -3.36*** | -4.05*** | -2.37*** |
| | (0.14) | (0.19) | (0.25) | (0.14) | (0.19) | (0.25) |
| I(year=1996) | -3.29*** | -4.06*** | -2.15*** | -3.35*** | -4.12*** | -2.19*** |
| | (0.15) | (0.19) | (0.25) | (0.15) | (0.19) | (0.25) |
| I(year=1997) | -4.45*** | -4.94*** | -3.84*** | -4.49*** | -5.00*** | -3.87*** |
| | (0.15) | (0.20) | (0.27) | (0.16) | (0.20) | (0.27) |
| I(year=1998) | -5.71*** | -6.16*** | -5.27*** | -5.74*** | -6.19*** | -5.29*** |
| | (0.17) | (0.22) | (0.33) | (0.17) | (0.22) | (0.33) |
| I(year=1999) | -5.35*** | -5.79*** | -4.97*** | -5.38*** | -5.83*** | -5.00*** |
| | (0.15) | (0.20) | (0.27) | (0.16) | (0.20) | (0.27) |
| I(year=2000) | -4.45*** | -4.97*** | -3.85*** | -4.46*** | -4.97*** | -3.88*** |
| | (0.14) | (0.19) | (0.25) | (0.15) | (0.19) | (0.25) |
| I(year=2001) | -5.67*** | -6.28*** | -4.61*** | -5.74*** | -6.38*** | -4.66*** |
| | (0.14) | (0.19) | (0.25) | (0.15) | (0.19) | (0.25) |
| I(year=2002) | -5.94*** | -6.58*** | -5.03*** | -6.02*** | -6.71*** | -5.13*** |
| | (0.15) | (0.19) | (0.25) | (0.15) | (0.19) | (0.25) |
| I(year=2003) | -6.90*** | -7.48*** | -6.12*** | -7.00*** | -7.66*** | -6.13*** |
| | (0.15) | (0.20) | (0.26) | (0.16) | (0.20) | (0.26) |
| I(year=2004) | -7.16*** | -7.75*** | -6.04*** | -7.27*** | -7.94*** | -6.03*** |
| | (0.15) | (0.19) | (0.26) | (0.15) | (0.20) | (0.26) |
| I(year=2005) | -7.22*** | -7.73*** | -6.72*** | -7.32*** | -7.91*** | -6.70*** |
| | (0.15) | (0.20) | (0.28) | (0.16) | (0.20) | (0.28) |
| I(year=2006) | -6.98*** | -7.36*** | -6.93*** | -7.09*** | -7.56*** | -6.88*** |
| | (0.16) | (0.20) | (0.34) | (0.16) | (0.20) | (0.34) |
| I(year=2007) | -6.27*** | -6.67*** | -6.02*** | -6.38*** | -6.83*** | -6.08*** |
| | (0.15) | (0.19) | (0.29) | (0.15) | (0.19) | (0.29) |
| I(year=2008) | -6.65*** | -7.21*** | -5.70*** | -6.76*** | -7.36*** | -5.74*** |
| | (0.16) | (0.20) | (0.27) | (0.16) | (0.20) | (0.27) |
| Observations | 67226 | 43692 | 23527 | 67226 | 43692 | 23527 |
| Pseudo $R^2$ | 0.54 | 0.53 | 0.57 | 0.54 | 0.54 | 0.58 |

Dependent variable: I(Yen = 1)
Logit estimation. Robust standard errors in parentheses
$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

Table A.3: Year dummies for Table 7

| | (1) Full | (2) Fin | (3) NonFin | (4) Full | (5) Fin | (6) NonFin |
|---|---|---|---|---|---|---|
| I(year=1991) | -1.76*** | -2.26*** | -0.90*** | -1.79*** | -2.27*** | -0.89*** |
| | (0.18) | (0.24) | (0.30) | (0.18) | (0.23) | (0.30) |
| I(year=1992) | -2.89*** | -4.10*** | -1.67*** | -2.96*** | -4.17*** | -1.68*** |
| | (0.20) | (0.35) | (0.28) | (0.20) | (0.35) | (0.28) |
| I(year=1993) | -3.99*** | -4.84*** | -3.10*** | -4.05*** | -4.95*** | -3.10*** |
| | (0.16) | (0.24) | (0.26) | (0.16) | (0.24) | (0.26) |
| I(year=1994) | -2.65*** | -3.18*** | -1.88*** | -2.67*** | -3.22*** | -1.88*** |
| | (0.13) | (0.17) | (0.24) | (0.14) | (0.17) | (0.24) |
| I(year=1995) | -3.34*** | -4.04*** | -2.35*** | -3.36*** | -4.05*** | -2.37*** |
| | (0.14) | (0.19) | (0.25) | (0.14) | (0.19) | (0.25) |
| I(year=1996) | -3.29*** | -4.06*** | -2.15*** | -3.35*** | -4.12*** | -2.19*** |
| | (0.15) | (0.19) | (0.25) | (0.15) | (0.19) | (0.25) |
| I(year=1997) | -4.45*** | -4.95*** | -3.84*** | -4.49*** | -5.00*** | -3.87*** |
| | (0.15) | (0.20) | (0.27) | (0.16) | (0.20) | (0.27) |
| I(year=1998) | -5.71*** | -6.17*** | -5.27*** | -5.75*** | -6.20*** | -5.30*** |
| | (0.17) | (0.22) | (0.33) | (0.17) | (0.22) | (0.33) |
| I(year=1999) | -5.36*** | -5.80*** | -4.98*** | -5.39*** | -5.84*** | -5.01*** |
| | (0.15) | (0.20) | (0.27) | (0.16) | (0.20) | (0.27) |
| I(year=2000) | -4.46*** | -4.97*** | -3.85*** | -4.47*** | -4.97*** | -3.89*** |
| | (0.14) | (0.19) | (0.25) | (0.15) | (0.19) | (0.25) |
| I(year=2001) | -5.67*** | -6.28*** | -4.61*** | -5.74*** | -6.38*** | -4.66*** |
| | (0.14) | (0.19) | (0.25) | (0.15) | (0.19) | (0.25) |
| I(year=2002) | -5.94*** | -6.58*** | -5.03*** | -6.03*** | -6.72*** | -5.13*** |
| | (0.15) | (0.19) | (0.25) | (0.15) | (0.19) | (0.25) |
| I(year=2003) | -6.91*** | -7.49*** | -6.12*** | -7.01*** | -7.66*** | -6.13*** |
| | (0.15) | (0.20) | (0.26) | (0.16) | (0.20) | (0.26) |
| I(year=2004) | -7.16*** | -7.76*** | -6.04*** | -7.27*** | -7.94*** | -6.03*** |
| | (0.15) | (0.19) | (0.26) | (0.15) | (0.20) | (0.26) |
| I(year=2005) | -7.23*** | -7.74*** | -6.72*** | -7.33*** | -7.92*** | -6.71*** |
| | (0.15) | (0.20) | (0.28) | (0.16) | (0.20) | (0.28) |
| I(year=2006) | -6.99*** | -7.37*** | -6.94*** | -7.10*** | -7.57*** | -6.88*** |
| | (0.16) | (0.20) | (0.34) | (0.16) | (0.20) | (0.34) |
| I(year=2007) | -6.30*** | -6.73*** | -6.03*** | -6.41*** | -6.89*** | -6.10*** |
| | (0.15) | (0.19) | (0.29) | (0.15) | (0.19) | (0.29) |
| I(year=2008) | -6.76*** | -7.38*** | -5.75*** | -6.87*** | -7.54*** | -5.79*** |
| | (0.17) | (0.21) | (0.28) | (0.17) | (0.22) | (0.29) |
| Observations | 67226 | 43692 | 23527 | 67226 | 43692 | 23527 |
| Pseudo $R^2$ | 0.54 | 0.53 | 0.57 | 0.54 | 0.54 | 0.58 |

Dependent variable: I(Yen = 1)
Logit estimation. Robust standard errors in parentheses
$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$