Foreign Discount in International Corporate Bonds

Zhe Geng*

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Abstract

In the dollar-denominated corporate bond market, 41% of bonds with an amount outstanding of USD 6.2 Trillion are issued by non-US firms by 2023. Despite the increasing importance of cross-border financing, these foreign issuers are paying an extra premium of 20 bps, compared with their US counterparts. A similar foreign discount exists in the euro-denominated corporate bond and dollar-denominated sovereign bond market. While the standard risk measures fail to account for the discount, the Economic Policy Uncertainty (EPU) index from Baker, Bloom, and Davis (2016) can explain a substantial portion of the foreign discount, consistent with the calibration result from an uncertainty-based model. Using COVID-19 as an event study, I further document a foreign squeeze effect, where foreign dollar bonds suffer higher selling pressure than US dollar bonds. Such foreign discount (USA effect) dominates the dollar safety premium (USD effect). My results highlight the foreign discount and foreign squeeze effects in international corporate bonds, particularly amidst a backdrop of escalating global economic instability and uncertainty.

Keywords: international corporate bonds, foreign discount, foreign squeeze, economic political uncertainty, home bias

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1 Introduction

In the international financial system, dollar-denominated debts have surged in the past two decades, especially after the 2008 global financial crisis.[1] By 2023, 41% of the dollar-denominated corporate bonds are issued by non-US entities, with an amount outstanding of USD 6.2 Trillion.[2] This trend underscores the unique role of the US dollar in global capital markets and its increasing importance to the financing activities of multinational corporations. While the current literature mainly focuses on US corporate bonds, the pricing of dollar bonds issued by these non-US firms is understudied and not well understood. Given the rising prominence of cross-border dollar financing, this paper aims to address a pivotal asset pricing question: When issuing dollar bonds, can foreign firms enjoy the same dollar premium as their US counterparts? Studying this question can also shed light on the classical home bias effect by quantifying the magnitude at the pricing level, complementary to the existing holding level evidence in the literature.

Empirically, I find foreign issuers are paying an extra premium of 20 bps relative to US issuers from January 2005 to June 2023, which is denoted as the foreign discount (FD). The discount is measured as the credit spread difference between dollar-denominated bonds issued by non-US firms and those by US firms, controlling for bond-level characteristics, liquidity, and fixed effects for both industry and year. Across countries, the foreign discount is consistently positive and significant for developed countries like Canada (CA, 13 bps), Japan (JP, 18 bps), Eurozone (EU, 19 bps), United Kingdom (GB, 21 bps), and even larger for developing countries like China (CN, 66 bps) and Mexico (MX, 60 bps). Given that over 90% of dollar bonds issued by non-US firms in TRACE originate from developed countries, the main result of this paper is then predominantly driven by developed countries rather than developing countries. In the time series, the discount becomes more prominent amidst market turmoil, including the global financial crisis, the European debt crisis, the oil price collapse, the COVID-19 pandemic, the Russia-Ukraine War, and the Fed rate hike.

Moreover, I show that the foreign discount phenomenon is not unique to dollar-denominated corporate bonds, it also exists within euro-denominated corporate bonds. In this case, the EU-based issuers will be viewed as home issuers, whereas non-EU issuers, such as those

[1]See Shin (2012), Cetorelli and Goldberg (2012), McCauley, McGuire, and Sushko (2015), Ivashina, Scharfstein, and Stein (2015), Bruno and Shin (2014, 2017) and Maggiori, Neiman, and Schreger (2020).

[2]The existing literature documents why and when non-US firms issue dollar bonds, including the special role of the dollar, the dollar bias, the safe dollar premium and the dollar carry trade by Krishnamurthy and Vissing-Jorgensen (2012), Caballero, Farhi, and Gourinchas (2017), Bruno and Shin (2017), Caballero and Farhi (2017), Jiang, Krishnamurthy, and Lustig (2018, 2021, 2023), Liao (2020), Maggiori, Neiman, and Schreger (2020), Caramichael, Gopinath, and Liao (2021), Eren and Malamud (2022), Eren, Malamud, and Zhou (2023) and others.

from the US, will be treated as foreign issuers. In addition to the US, I also include the United Kingdom (GB), Switzerland (CH), Sweden (SE), Norway (NO), and China (CN), selected based on the amount outstanding of their euro-denominated corporate bonds. Symmetrically, these non-EU issuers also pay an additional 21 bps relative to their EU counterparts. Furthermore, such foreign discount also prevails in dollar-denominated sovereign bonds. Even after adjusting for the sovereign CDS spreads, the discounts are 7 bps for Germany, 13 bps for Canada, and 23 bps for Japan – these nations being the top three non-US issuers of dollar-denominated sovereign bonds. To sum up, the foreign discount emerges as a pervasive and symmetrical phenomenon across the international bond market, underscoring its significance in both corporate and sovereign debt instruments.

To understand the potential drivers behind the foreign discount, I first examine whether the standard risk measures can explain the discount effect, categorized into issuer-level risks, country-level risks, and US risk premia. Focusing first on issuer-level risks, I mainly consider credit risk and liquidity risk. Specifically, to control for the credit risk beyond ratings, I focus on the non-US issuers with listed equity in the US and construct the credit risk proxy based on Merton's distance-to-default. Moreover, from Moody's default and recovery data, I find that non-US issuers on average have lower default probability and higher recovery rates compared to US issuers, suggesting that non-US issuers tend to have better credit quality than US issuers. Despite this, they still need to pay a non-trivial discount to investors for being foreigners. For the liquidity risk, I use both a quantity-based measure – turnover, and a price-based measure – gamma from Bao, Pan, and Wang (2011). Although both the credit risk and liquidity risk measures are important in credit pricing, they have negligible explanatory power on the foreign discount.

In examining country-level risks, I take into account country-level currency risk, political risk, and credit risk, proxied by exchange rate movements, the International Country Risk Guide (ICRG) political risk index, and local corporate bond index return, respectively. Moving to US risks, following Longstaff et al. (2011), I choose three risk premia proxies, including equity risk premium proxied by the changes in S&P 500 Shiller PE ratio, variance risk premium proxied by the changes in the spreads between implied and realized volatility for S&P 500, and term premium proxied by the changes in the expected excess returns of 10-year treasury bond. Furthermore, institutional discrepancies such as tax regulations, default and bankruptcy laws, collateral and covenant differences, and investor clientele are also considered. However, these risk proxies and institutional factors offer limited insight into the pricing disparity between foreign and US dollar-denominated bonds.

After documenting the persistence and robustness of the foreign discount, I now turn to explore potential explanations. I hypothesize that the persistent foreign discount can be attributed to uncertainty-based explanations. Theoretically, the equilibrium asset returns are driven by risk and risk aversion. On top of that, the investors could also exhibit uncertainty aversion towards assets which are difficult for them to estimate the true distribution.[3] In the context of cross-border investment, this uncertainty effect could be particularly relevant. Since the major business of foreign issuers happens outside the US, it can be challenging for US investors to collect accurate and timely information about the foreign asset-generating process. As a result, investors ask for higher compensation on the bonds issued by foreign firms, especially during deteriorating market conditions.

Firstly, I study whether the country-level uncertainty can explain the foreign discount. To quantify heterogeneous degrees of uncertainty across countries, I utilize the country-level Economic Policy Uncertainty (EPU) index from Baker, Bloom, and Davis (2016). Empirically, I find that EPU has a positive and significant explanatory power on credit spreads, with a coefficient of 1.98 and a t-statistic of 4.66. Notably, the EPU index can explain a substantial portion of the foreign discount, reducing it from 17.00 basis points to 5.91 basis points – a decrease of 11.09 basis points or 65%. Consequently, the discount's statistical significance diminishes, with the t-statistic falling from 3.26 to 0.99. This result remains robust after controlling for risk and risk premia proxies. In addition, I use the 2020 GDP growth forecasts on different countries from the Consensus Economics survey, reported by both global (predominantly US-based) and local institutions.[4] Interestingly, US investors on average provide more conservative and less accurate GDP growth forecasts for foreign countries than local investors do, suggesting that US investors exhibit a greater degree of pessimism regarding foreign economies. Furthermore, the dispersion of forecasts on foreign countries among US investors, which can be viewed as the proxy for country-level uncertainty, tends to be wider than that of local investors, pointing to the possibility that US investors may exhibit uncertainty aversion toward foreign countries, leading them to demand more compensation on bonds issued by foreign entities.

Secondly, I explore the relationship between the foreign discount and the degree of uncertainty at the issuer level. As it is challenging to measure issuer-level uncertainty, I utilize two indirect proxies: (1) the duration of the issuer's presence in the US bond market; and (2) the proportion of the issuer's sales revenue generated within the US. Intuitively, the longer a foreign issuer participates in the US bond market, the more familiar investors become, potentially leading to a reduced discount. Likewise, foreign issuers with a substantial portion

[3]See Gilboa and Schmeidler (1989), Anderson, Hansen, and Sargent (2003), Uppal and Wang (2003), Maenhout (2004, 2006), Liu, Pan, and Wang (2005), and others.

[4]Consensus Economics is an international survey of professional forecasters from a variety of economists, industry, and research institutions. This data has been used in papers like Marco, Macchiavelli, and Valchev (2021).

of their sales in the US market are anticipated to face lower uncertainty and, consequently, a smaller foreign discount. I find consistent results in the data. Moreover, I show that bonds with higher institutional holdings have a smaller discount.

Thirdly, studying the time-series determinants of foreign discount, I find that the global EPU index has the strongest explanatory power on the aggregate foreign discount, with a coefficient estimate of 7.26 and a t-statistic of 4.06, surpassing other important economic factors such as the CBOE Volatility Index (VIX), Intermediary Capital Risk (ICR) factor, and other market indicators. This is consistent with our hypothesis that the foreign discount tends to increase amidst heightened uncertainty. Further examining the interaction effect between uncertainty and market conditions, I document that the EPU index exerts a more pronounced effect on the discount during times of market stress, as evidenced by an uptick in the VIX, a decline in the ICR, a rise in bond yields, a downturn in the stock market. These dynamics suggest that uncertainty emerges as a particularly effective factor in explaining the aggregate foreign discount. Importantly, its explanatory power intensifies during deteriorating market conditions.

To explore the implications of the foreign discount, I take COVID-19 as an event study and closely examine the investors' trading behavior on the US dollar bonds v.s. foreign dollar bonds. Prior literature has documented the "dash for cash" and "dash for dollar" phenomena during the COVID-19 pandemic.[5], where investors sold high-rated, short-maturity dollar-denominated bonds to secure liquidity amidst market turmoil. I further study the heterogeneous trading behavior based on the bond's ultimate country of origin. My results suggest that it is the foreign dollar bonds that suffer more selling pressure and more severe discounts relative to US dollar bonds during market distress.[6] The discount jumps from below 20 bps before the pandemic to well over 60 bps afterward. This insight provides a novel economic mechanism – the foreign squeeze on foreign dollar bonds during market turmoil – which has important implications for the classical home bias literature.

As a second implication, I compare the foreign discount with the safe dollar premium from Liao (2020) to further show its importance. Theoretically, the pricing of the foreign dollar bond is influenced by the tradeoff between the dollar safety premium (the USD effect) and the foreign discount (the USA effect). On the one hand, the USD effect benefits the non-US issuer by reducing their borrowing cost due to the perceived safety of the dollar. On the other hand, the USA effect may cost foreign issuers with higher credit spreads arising from

[5]Haddad, Moreira, and Muir (2021), Ma, Xiao, and Zeng (2022), O'Hara and Zhou (2021), Cesa-Bianchi and Eguren-Martin (2021), Li et al. (2021), Kargar et al. (2021).

[6]The selling pressure is defined as the fraction of sell-initiated transactions by customers within all the customer-dealer transactions for each bond each day.

higher uncertainty. Empirical analysis reveals that, while the safe dollar premium can be negative,[7] the foreign discount is always positive, indicating that the investors consistently ask for additional compensation for holding foreign dollar bonds. In this regard, the foreign discount tends to outweigh the dollar safety premium, especially for the EU and GB in market turmoil like the global financial crisis and the European debt crisis. In other words, the full benefits of the safe dollar premium can only be enjoyed by US issuers.

To rationalize the foreign discount and uncertainty-based explanation, I build a simple Leland-type model augmented with model uncertainty. The basic model setting adheres closely to that presented Leland (1994), with the extension of introducing two types of perpetual bonds: one issued by the home issuer while another issued by a foreign issuer. To differentiate the two issuers within the model, two critical elements are incorporated. First, I assume the foreign firm's cash flow can be affected by both the home and foreign aggregate output shocks, whereas the home firm's cash flow is solely influenced by the home market shocks. To ensure comparability, I fix the total risk faced by the two firms to be the same. Second, I assume the representative (home) investor exhibits uncertain aversion toward the true growth rate of the foreign market process. As a consequence, the pricing difference between the two bonds is determined by the degree of uncertainty, giving rise to the foreign discount. If there is no model uncertainty, the discount reduces to zero. When the uncertainty is present, the foreign discount is increasing in the degree of uncertainty. Notably, the sensitivity of the foreign discount to uncertainty will be further amplified when risk aversion rises, particularly in worsening market conditions. The model calibration results are consistent with those model implications. More importantly, with reasonable parameters, the model can match the empirical evidence quite well in both normal and stressful times, further supporting the uncertainty-based explanation.

Related Literature – This paper contributes to several streams of literature. First, my paper is part of the literature on corporate and sovereign bond pricing. The determinants of credit spreads in the US corporate bonds are well documented by Collin-Dufresne, Goldstein, and Martin (2001), Campbell and Taksler (2003), Longstaff, Mithal, and Neis (2005a), Edwards, Harris, and Piwowar (2007), Bao, Pan, and Wang (2011), Kuehn and Schmid (2014), Culp, Nozawa, and Veronesi (2018). For sovereign credit risk, Longstaff et al. (2011) find the sovereign credit spreads are more related to US factors than local factors. In the international bond market, Huang, Nozawa, and Shi (2024) explore the global credit spread puzzle within G7 countries' corporate bonds and show how it co-moves with the US and

[7]For example, in Liao (2020), the safe dollar premium for EUR turned negative after 2013, suggesting that it is cheaper to borrow in EUR-denominated bonds than USD-denominated bonds. He then links this negative premium with the positive debt issuance flow from the US to the EU.

affects economic growth. Unlike these studies either focusing on the US corporate bonds or non-US corporate bonds denominated in local currency, I concentrate on the dollar bonds issued by non-US firms, specifically examining the pricing discrepancies relative to US dollar bonds. My paper is the first to document the foreign discount effect as an important factor in international bond pricing, which can not be explained away by the standard risk and risk premia. More recently, a follow-up paper by Wang (2024) offer a complementary explanation for the foreign discount based on exchange rate risk. He finds that non-US dollar bonds have a larger exposure to exchange rate risk than US dollar bonds, particularly for foreign firms with a higher proportion of outstanding dollar bonds and a greater proportion of non-US investor holdings. These findings are, in spirit, aligned with my issuer-level evidence that foreign issuers with a high portion of sales in the US and a higher share of US institutional holdings tend to have a smaller discount. However, at the aggregate level, I find the uncertainty index plays a more dominant role in explaining the foreign discount compared to the exchange rate risk.

Secondly, my paper contributes to the home bias literature as the first comprehensive study on the foreign discount effect at the pricing level rather than the holding level, which has been documented in previous papers.[8] The most related paper is the work of Maggiori, Neiman, and Schreger (2020), who demonstrate a strong dollar or home-currency bias in investors' bond portfolios within the realm of international cross-border investment. While their findings pertain to the holding level, I examine the pricing implication for foreign dollar bonds already present in investors' portfolios. After controlling for the currency effect, I find that the foreign discount effect, or the home country effect, remains important in the pricing of foreign dollar bonds. With the rapid development of international cross-border investment, the home bias effect at the quantities level could be less pervasive, as indicated in Coeurdacier and Rey (2013). However, even if investors become more willing to hold foreign assets and expand their investment frontier, it is still not clear what price they are willing to accept. Therefore, exploring the home bias effect at the pricing level can provide valuable insights and further evidence to this well-established puzzle. Additionally, my paper uncovers that foreign dollar bonds suffer higher selling pressure compared to US dollar bonds, highlighting a novel economic channel, foreign squeeze during market turmoil, as an important implication of this literature.

Thirdly, my paper is also related to the literature on the dollar debt dominance and safe dollar premium. The dollar bonds have been increasingly prevalent, outweighing the

[8]See French and Poterba (1991), Coval and Moskowitz (1999), Obstfeld and Rogoff (2000), Coeurdacier and Rey (2013), Cooper, Sercu, and Vanpée (2013), Burger, Warnock, and Warnock (2018) and others.

wealth share of the US in the world.[9] While several papers have studied why and when non-US entities issue dollar-denominated bonds,[10] this paper shifts the focus to the pricing implications of these foreign dollar bonds. The pricing of the dollar bond issued by non-US firms could depend on both the currency (USD) effect and the foreigner (USA) effect. The existing literature has predominantly highlighted the benefits of issuing dollar-denominated bonds, attributed to the USD premium.[11] In contrast, this paper investigates the potential cost associated with the dollar bond issuance arising from the foreigner effect. I find that the foreign discount tends to dominate the dollar safety premium, particularly for the EU and GB during periods of economic stress, such as the global financial crisis and the European debt crisis.

The rest of our paper is organized as follows. Section 2 summarizes the data. Section 3 documents the main empirical results on the foreign discount, its cross-sectional and time-series variations, as well as its persistence and robustness. Section 4 presents an uncertainty-based explanation with supporting empirical evidence. Section 5 delves into two implications: the foreign squeeze effect during the COVID-19 pandemic, and the comparison between the foreign discount and safe dollar premium. Section 6 introduces a Leland-type model augmented with model uncertainty to rationalize the foreign discount phenomenon. Section 7 concludes.

2 Data

In this section, I describe the sample of international corporate bonds employed in this paper. First, at the aggregate level, I show the distribution of all the corporate bonds across countries and major currencies. Then I focus on the dollar-denominated corporate bonds issued in the US bond market, which is our main sample as we can take advantage of the detailed bond pricing and bond description information from TRACE and Mergent FISD. Next, I present summary statistics on euro-denominated corporate bonds using data from Bloomberg. Firm-level equity and financial data are obtained from standard CRSP and

[9]See Shin (2012), Cetorelli and Goldberg (2012), Bruno and Shin (2014, 2017), McCauley, McGuire, and Sushko (2015), Ivashina, Scharfstein, and Stein (2015), and Maggiori, Neiman, and Schreger (2020).

[10]See Bruno and Shin (2017), Liao (2020), Maggiori, Neiman, and Schreger (2020) and others.

[11]See Krishnamurthy and Vissing-Jorgensen (2012), Caballero, Farhi, and Gourinchas (2017), Caballero and Farhi (2017), and Mota (2021) for the shortage of safe assets. Du, Tepper, and Verdelhan (2018) and Cenedese, Della Corte, and Wang (2021) explore the failure of LIBOR CIP for dollar-denominated LIBOR deposits. Jiang, Krishnamurthy, and Lustig (2018, 2021, 2023) study the safe dollar premium in the international treasury market. Liao (2020), Caramichael, Gopinath, and Liao (2021) and Hu et al. (2022) examine the safe dollar premium in the international corporate bond market.

Compustat datasets.

2.1 Overview of International Corporate Bonds

Figure 1 plots the distribution of corporate bond amount outstanding across countries from 2014 to 2023.[12] As Bloomberg can trace back the ultimate country of origin for each issuer, the country-level cross-border bond financing can be better and more precisely identified .[13] Panel (a) shows the distribution within dollar-denominated corporate bonds. The left axis is the fraction of the amount outstanding and the right axis is the total amount outstanding in trillions of USD. The corporate bonds are categorized into nine groups based on their ultimate country of origin, including the United States (US), Eurozone (EU), China Mainland (CN), United Kingdom (GB), Canada (CA), Japan (JP), Asia excluding China Mainland and Japan, Europe excluding Eurozone and the United Kingdom, and the rest of the world. The black line is the total amount outstanding for all countries while the green line refers to the amount outstanding for the US. As we can see, US-issued bonds account for the majority of the dollar bonds, with the share rising from 56.2% in 2014 to 59.4% in 2023. In other words, 40.6% of the dollar-denominated corporate bonds, amounting to a total of 6.2 trillion USD, are issued by non-US entities, including those from EU, CN, GB, CA, JP and other regions. The main focus of this paper is to examine the pricing of the foreigner-issued dollar bonds to the dollar bonds issued by US firms. Moving to panel (b) for euro-denominated bonds, by 2023, the overwhelming majority of bonds are issued by the EU (72.0%), followed by the US (8.4%) and then the GB (6.8%). In Section 3.2, I will also investigate the pricing difference between home bonds (in this scenario, EU-issued bonds) and foreign bonds (mainly US-issued and GB-issued bonds).

2.2 USD-Denominated Corporate Bonds in TRACE

Taking advantage of the detailed bond pricing and bond characteristics information from TRACE and Mergent FISD, I can uncover the most important market for dollar-denominated bonds in the world. I find that the total amount outstanding of corporate bonds in TRACE accounts for about two-thirds of the global dollar-denominated corporate bonds. To further identify the ultimate country of origin for each issuer in TRACE, I first use the ISIN code in TRACE to merge with Bloomberg and then further trace back the ultimate parent country

[12] The choice of 2014 as the starting year is because the Bloomberg BQL function and the underlying dataset are only available after 2014. Later on, I will provide summary statistics for an extended period using data from TRACE.

[13] A similar point made by Coppola et al. (2021) in the context of the international cross-border financing.

of domicile for each issuer.[14] Then I can group the corporate bonds based on their ultimate country of origin and calculate the corresponding amount outstanding. Within the universe of TRACE dollar bonds, about 25% of the dollar bonds are issued by non-US firms, which is smaller than the share in the global market (41%). Nonetheless, any result found in this most transparent TRACE sample could be potentially applied to the rest of offshore dollar-denominated corporate bonds.

Figure 2 outlines the fraction of dollar bonds issued by non-US firms to all dollar bonds in TRACE along three dimensions, including the number of bonds (red line), the amount outstanding (blue line), and trading volume (yellow line). Starting from 2002 when TRACE became available, the three measures are around 17%. Over time, we can see a gradually increasing trend for foreign bonds. In June 2014, all three measures experienced a sudden jump, especially for the amount outstanding (blue line) sharply increased to over 30%. This is because FINRA brought 144A corporate debt transactions into the TRACE system.[15] Since most of the 144A corporate bonds are issued by foreign firms, the steep increase is to be expected. Based on this observation, in the main empirical analysis, I will consider both the shorter but more complete sample period from July 2014 to June 2023, as well as the longer period from January 2005 to June 2023. Since the inclusion of 144A bonds, the fraction of non-US bonds has stayed relatively stable and has a slight decline post-COVID-19. For the trading volume (yellow line), the drop was much more significant. As for the number of bonds (red line), the pattern is relatively stable from July 2014 to June 2023.

Based on the amount outstanding of dollar corporate bonds across countries, I include developed countries like the US, EU, GB, CA, and JP, and developing countries like CN and MX in the main sample. As over 90% dollar bonds issued by non-US firms in TRACE are from developed countries, the main result of this paper is then mostly driven by developed countries rather than developing countries. Table 1 reports detailed summary statistics for the dollar bonds issued by major countries before and after July 2014. For each bond and each month, we consider its yield to maturity using the last trading-day price. Following the convention, we use the Treasury Constant Maturity Rate (CMT) released by the St. Louis Fed as the base rate and adopt the interpolation method to expand the full yield curve for the calculation of credit spreads. Specifically, credit spread is measured as the difference between the corporate bond yield and the CMT of the same maturity. To be included in the empirical analysis, I apply the following standard filters to the TRACE corporate bonds

[14] In Mergent FISD, the variables related to country information are "Country Domicile (country_domicile)" and "Country (country)", which are more likely to be the operating or registration country. It fails to track the ultimate country of domicile information due to the absence of parent country information.

[15] https://www.finra.org/media-center/news-releases/2014/finra-brings-144a-corporate-debt-transactions-light

dataset. Firstly, I only include fixed-coupon or zero-coupon bonds. Secondly, bonds due within one year are excluded from our sample. Thirdly, bonds without any trading during a month are excluded from that month. Fourthly, bonds with an issuance size of less than 100 thousand dollars are excluded from our sample. Lastly, as most non-US issuers in the US bond market are relatively large corporations with high ratings, I only include investment-grade (IG) bonds to make the comparison more fair.

Panel A reports the summary statistics for the sample period from July 2014 to June 2023. Overall, there are 1448 US issuers with 13179 bonds, 192 EU issuers with 1028 bonds, 114 GB issuers with 729 bonds, 99 CA issuers with 710 bonds, 54 JP issuers with 515 bonds, 56 CN issuers with 214 bonds. Panel B reports the summary statistics for the sample period from January 2005 to June 2014. The number of issuers and bonds is relatively smaller compared to that in Panel A. For JP and CN, the numbers are too small to conduct any meaningful statistical references. Table 1 further includes bond characteristics variables such as rating, maturity, age, issuance size, and coupon rate; and bond trading variables such as credit spreads, monthly turnover, number of transactions per month (NumTrades), number of trading days per month (NumTradingDays), average trading size per monthly (TradeSize), and the monthly illiquidity measure gamma from Bao, Pan, and Wang (2011).

For credit ratings, we apply a numerical translation of Moody's rating by assigning 1 to Aaa, 2 to Aa+, and so on until 21 to C. As shown in Panel A of Table 1, the average credit ratings vary between 6 (A) to 8 (BBB) across the six countries. The US on average has lower ratings than other countries. Comparing the US and non-US samples further, we see that US-issued bonds on average have longer maturity, smaller issuance size, higher coupon rates and are older. Because of these differences in bond characteristics, a direct comparison between their credit spreads is therefore not meaningful. For this reason, we will compare their bond pricing after controlling for credit ratings and other bond characteristics. Moving to the bond trading variables, interestingly, different measurements of bond liquidity yield different conclusions. For example, in terms of trading turnover, which is measured as the average monthly trading volume as a percentage of its amount outstanding, US-issued bonds are traded more frequently than bonds issued by EU, GB, JP, and CN, which is also true for NumTrades. For the number of trading days per month, the bonds issued by US firms are only larger than CA and CN, but not for EU, GB, and JP. As for trade size, measured as the average trade size of the bond in millions of dollars of face value, and Gamma, measured as the negative auto-correlation between daily log bond prices, US-issued bonds have a smaller trade size and higher gamma thus less liquid compared to the rest countries.[16]

[16]The negative correlation between trade size and gamma is consistent with Bao, Pan, and Wang (2011)'s findings.

2.3 EUR-Denominated Corporate Bonds in Bloomberg

In addition to dollar-denominated bonds recorded in TRACE, I also collect data on euro-denominated corporate bonds from Bloomberg. Following the literature (Longstaff, Mithal, and Neis (2005b), Chen, Lesmond, and Wei (2007) and Bao, Pan, and Wang (2011)), I use Bloomberg Generic Quote (BGN) to download the yields information as BGN provides both executable and indicative quotes (as opposed to a model-based valuation). Standard data cleaning filters mentioned in the previous subsection also apply. As shown in Table 2, from January 2015 to March 2021,[17] there are in total 75 EU issuers with 752 bonds, 40 US issuers with 401 bonds, 22 GB issuers with 221 bonds, 15 CH (Switzerland) issuers with 62 bonds, 10 SE (Spain) issuers with 36 bonds, 10 CN issuers with 25 bonds. Comparing the EU and US samples further, we can see that EU-issued bonds on average have lower ratings (high numerical value), shorter maturity, slightly larger issuance size, higher coupon rates and are older. Due to those differences in bond characteristics, a careful examination of differences in credit spreads after controlling for credit ratings and other bond characteristics would be necessary, which will be provided in Section 3.2.

3 Empirical Results: Foreign Discount

3.1 Foreign Discount in Dollar-Denominated Corporate Bonds

Focusing first on the dollar-denominated bonds in TRACE, I estimate the foreign discount from the following panel regression,

$$\text{CreditSpread}_{i,t} = a + b\,\text{Foreign}_{i,t} + c\,\text{Rating}_{i,t} + \sum_k \text{Controls}^k_{i,t} + \epsilon_{i,t}\,, \tag{1}$$

where the credit spread of bond i in month t is regressed on the dummy variable $Foreign_{i,t}$, which equals one if the ultimate country of origin for bond i in month t is non-US and zero otherwise. To control for the difference in bond characteristics, I include credit rating, maturity, issuance size, age, and liquidity in the regression. Furthermore, the year and industry-fixed effects are added to control for potential market-wide fluctuations and industry differences in credit spreads. Hence, the loading b on $Foreign_{i,t}$ captures the credit spread difference between bonds issued by non-US firms and US firms, which is reported in Table 3. The t-stats are in squared brackets by using standard errors double clustered by year and issuer to take into account cross-sectional and time-series correlations in credit spreads.

[17] I choose January 2015 as the starting date because Bloomberg's download algorithm (BQL) is only feasible after 2014.

The first column shows the estimation result for all countries, aiming to quantify the extent of the foreign discount at the aggregate level. As shown in Panel A of Table 3, from July 2014 to June 2023, the aggregate discount is 22.06 bps with t-statistics 6.57. This suggests that the bonds issued by US firms in general enjoy a premium of about 22 bps over their foreign counterparts after controlling for bond characteristics and liquidity. This difference is significant both economically and statistically.

Columns 2-7 in Panel A further report country-level foreign discounts,[18] which are 19.44 bps (t-stat=5.17) for EU, 20.70 bps (t-stat=3.80) for GB, 12.65 bps (t-stat=2.21) for CA, 18.17 bps (t-stat=2.67) for JP, 65.70 bps (t-stat=8.06) for CN, and 60.24 bps (t-stat=3.77) for MX. Not surprisingly, developing countries like CN and MX have considerably higher discounts than developed countries. Across developed countries, CA has the smallest discount, followed by JP, EU, and GB. As firms in developing countries share less similar backgrounds with the US and are potentially exposed to higher risk than firms in developed countries, a higher discount in developing countries is to be expected. Panel B of Table 3 shows the estimation of foreign discount for a longer sample period from January 2005 to June 2023. The aggregate foreign discount is 19.69 bps with t-statistics of 5.10, similar in magnitude to the result in Panel A. The country-level discounts are 25.67 bps (t-stat=3.54) for EU, 18.80 bps (t-stat=3.38) for GB, and 5.03 bps (t-stat=0.83) for CA. The increase in the discount for the EU is mainly driven by the Global Financial Crisis and the European Debt Crisis.

Next, to better capture the dynamic fluctuations of the foreign discount, I conduct the cross-sectional regression (1) on a monthly basis for each foreign country and plot the time series of coefficient b_t in Figure 3. Panel A plots the aggregate discount from January 2005 to June 2023. We can see that the foreign discount tends to surge during market turmoil. The first peak occurred during the global financial crisis when the discount rose to approximately 100 bps. The subsequent peak coincided with the European debt crisis and the third spike happened at the beginning of 2016 when the oil price collapsed. During the COVID-19 pandemic, we also find a sharp rise in the discount to around 50 bps. The most recent and notable surge in the foreign discount is attributed to the Russia-Ukraine War and the Federal Reserve's sharp interest rate hikes. To further pin down the major driving force for this increase, I estimate the foreign discount at a daily frequency. As shown in Figure 4, the foreign discount suddenly increased since the beginning of the war. These spikes indicate that the foreign discount can timely reflect investors' changing attitude toward foreigner-issued bonds. Intuitively, the foreign discount provides a novel perspective to capture the dynamic relationship between different countries.

[18]Specifically, if the foreign country is GB, by running regression (1) on the sample consisting of dollar bonds issued by US and GB firms only, I can estimate the foreign discount for GB relative to the US.

Panel B in Figure 3 plots the country-level discount over time. I find that most of the discounts are positive over the sample period except for CA in the earlier years. To be more specific, during the 2008 global financial crisis, the discounts in the EU, GB, and CA have substantially increased. Interestingly, when it comes to the European debt crisis, while the discount for the EU and GB both spiked, we do not find any similar upward trend for CA. This divergence aligns with the fact that the European debt crisis had a more pronounced impact on European nations. Shifting focus to the COVID-19 pandemic, all the countries witnessed a surge in the discount, which I will provide more evidence in Section 5.1. When examining more recent events, including the Russia-Ukraine War and the Fed's interest rate hike, we can see that the discount for European countries such as the EU and GB and Asian countries such as CN and JP experienced a steady increase, but not for CA and MX.

To sum up, upon the occurrence of a negative shock to the global economy, US investors will become more worried about the future economic prospects. Therefore, investors are more likely to demand high compensation for holding dollar bonds issued by foreign firms, particularly in the worsening economic situation. When the bad shock happens to a specific country or region, everything else being equal, the investor would ask for higher credit spreads to hold bonds issued in that country or region, as we observed during the European debt crisis. These observations suggest that the foreign discount is a dynamic measure that reflects the varying levels of risk perception and market conditions associated with different countries. For other control variables reported in Table 3, they are all informative in explaining the credit spreads. However, they can not explain the presence of the foreign discount, suggesting that there are other unique risks or perceptions associated with foreign bonds that are beyond the standard bond characteristics.

3.2 Foreign Discount in Euro-Denominated Corporate Bonds

To examine whether the foreign discount phenomenon is unique to dollar-denominated corporate bonds or not, I further look into euro-denominated corporate bonds and find that such a discount also exists. Specifically, we compare bonds issued by EU firms, which we designate as the "home issuers," with those issued by firms in the US and other countries, categorized as "foreign issuers." Panel A of Table 4 reports the estimated value of coefficient b for a selection of countries, based on the amount outstanding of euro-denominated corporate bonds. These countries include the US, GB, CH, SE, NO, and CN. Similar to Table 3, the coefficients associated with the dummy variable $Foreign$ are consistently positive and statistically significant across all countries studied: 22.59 (t-stat=4.07) for All, 18.54 (t-stat=3.66) for US, 22.22 (t-stat=4.83) for GB, 26.70 (t-stat=1.59) for CH, 13.98 (t-stat=2.89) for SE, 20.79 (t-stat=2.76) for NO and 80.34 (t-stat=10.92) for CN. These findings suggest that, after accounting for credit ratings and other bond characteristics, EU-issued bonds tend to enjoy a premium of approximately 23 basis points over bonds issued by other nations. This premium is comparable to that observed in the dollar-denominated bond market, suggesting that the foreign discount phenomenon is widespread and exhibits symmetry between the euro and the dollar markets.[19]

To provide a clearer understanding of the cross-country dynamics of the foreign discount, the top panel of Figure 5 outlines the time-series and country-specific fluctuations in the slope coefficient b derived from cross-sectional regressions. Since 2014, the discount has consistently been positive across six nations. Notably, there have been two significant peaks over the sample period. The first peak occurred from mid-2015 to early 2016, potentially linked to the collapse of the oil price. The second peak, in March 2020, coincides with the onset of the COVID-19 pandemic. These sharp increases during crisis periods indicate that EU investors are more likely to require high returns on bonds issued by foreign entities during economic downturns. In other words, bonds issued by foreign firms are perceived to be less secure compared to investment-grade bonds issued by home firms. This observation aligns with the model calibration result in Jiang, Krishnamurthy, and Lustig (2021). In their argument, around 90% of the convenience yield on the US treasury is attributable to the dollar exposure rather than the inherent safety or liquidity of the treasury department. That is to say, if the U.S. Treasury Department were to issue bonds denominated in euros, it would likely not benefit from the same convenience yield and could instead incur a discount, reflecting a home-country bias. This discount is typically modest during stable market conditions but can escalate rapidly during times of market stress.

3.3 Foreign Discount in Dollar-Denominated Sovereign Bonds

Next, I extend the analysis to study the foreign discount phenomenon within the context of dollar-denominated sovereign bonds. Rather than employing a regression approach to gauge the extent of the foreign discount, I directly calculate the sovereign spread by subtracting the US treasury yield from the foreigner-issued sovereign dollar bond yield with the same maturity. To mitigate the impact of sovereign credit risk, the sovereign credit default swap (CDS) spread, obtained from Bloomberg, is deducted from the sovereign spread to derive the adjusted sovereign spread. Given that the most actively traded sovereign CDS contracts have a 5-year term, I focus on foreign sovereign dollar bonds with maturities ranging from

[19] Due to difficulties in obtaining daily trading volumes from Bloomberg, liquidity adjustments using the turnover variable were not incorporated into the analysis.

3 to 7 years. The monthly average of these adjusted sovereign spreads is used to quantify the foreign discount. Since the majority (90%) of the dollar-denominated government bonds are issued by the US, I only include Canada (CA), Germany (DE), and Japan (JP) in this analysis based on the amount outstanding of dollar-denominated sovereign bonds.

On average, the sovereign spreads for CA, DE, and JP are 43.9 bps, 21.8 bps, and 53.9 bps, respectively. After adjusting by the 5-year sovereign CDS spread, the resulting adjusted sovereign spreads or the foreign discounts are 12.9 bps for CA (t-stat=9.03), 7.2 bps for DE (t-stat=10.53), and 22.5 bps for JP (t-stat=12.06). Examining the time-series variations, as depicted in Panel B of Figure 5, the foreign discounts for the three countries are all positive. Collectively, these findings imply that the foreign discount is a pervasive feature, not confined to corporate bonds but also extending to sovereign bonds denominated in dollars. In conclusion, the foreign discount emerges as a widespread phenomenon across the international bond market.

3.4 Foreign Discount Under Risk and Institutional Factors

After documenting the persistence of the foreign discount in dollar-denominated corporate bonds, euro-denominated corporate bonds, and dollar-denominated sovereign bonds, I then turn to explore the potential causes. Specifically, I examine whether the foreign discount is driven by conventional risk and risk aversion measures, encompassing issuer-specific risk in Section 3.4.1, US risk premium in Section 3.4.2, country-specific risk in Section 3.4.3. The underlying premise is that foreign issuers might face elevated firm-specific risks, such as credit and liquidity risks, as well as additional exposures to country-specific risks like currency, political, and local credit risks. Foreign dollar bonds may also co-move more with the US risk premium embedded in US investors' pricing kernel, leading to the foreign discount. Additionally, the roles of institutional settings and investor clientele are explored in Sections 3.4.4 and 3.4.5, respectively.

3.4.1 Issuer-Level Risk

Focusing first on the issuer-specific risk, I mainly look at issuer-level credit risk and liquidity risk. To control the credit risk beyond ratings, I explore three dimensions: default risk measure from the Merton (1974) model, actual ex-post default probability, and recovery rate. For estimating the issuer-level default risk, I focus on a subset of issuers with equities listed in the US. By taking advantage of the public equity and balance sheet information, including leverage, asset growth, and equity volatility, I can construct the credit risk proxy based on Merton's distance-to-default. To control for the liquidity risk, I use both a quantity-based measure – turnover and a pricing-based illiquidity measure – gamma from Bao, Pan, and Wang (2011). All the results are reported in Table 5.

Column 1 of Table 5 presents the aggregate discount (17 bps), unadjusted for credit or liquidity risk, which is smaller than the whole sample result (20 bps) in Table 3, driven by a refined focus on US-listed stocks. Upon incorporating liquidity proxies (Column 2), although the two liquidity proxies are significant in explaining the credit spreads, the discount hovers at 17.86 bps. While higher turnover rates correlate with increased credit spreads, indicating a "reaching for yield" story, the gamma measure of illiquidity exhibits a positive correlation with credit spreads, more accurately capturing liquidity risk. When leverage, asset growth, and equity volatility – the three key components of Merton's model – are included (Column 3), leverage and equity volatility are found to be positively associated with credit spreads, whereas asset growth inversely relates to them. To better control credit risk, I further add the default risk measure. In the absence of Moody's Expected Default Frequency (EDF) data, the inverse of the distance-to-default is utilized to address the fat-tail issue inherent in normal distribution assumptions, labeled as "DefaultRisk". This proxy has significant pricing power in credit spreads but does not eliminate the discount, which persists at 17.01 bps.

Moreover, I manually collect ex-post bond default and recovery data from Moody's Annual Default Study across major regions from 2014 to 2020. Two points are worthwhile to mention. First, non-US issuers' default rate averages 26.4%, closely resembling the proportion of non-US issuers' outstanding amounts (28.3%), suggesting a comparable or slightly lower default propensity relative to U.S. issuers. Second, recovery rates vary by country, with US issuers generally exhibiting a lower rate (19.5%) than issuers in CA (29.5%), the EU (19.8%), CN (59.3%), and MX (32.1%), but higher than those in the GB (7.1%).[20] As documented by Maggiori, Neiman, and Schreger (2020), only large foreign firms can be able to issue bonds denominated in multi-currencies, which may explain the observed lower default rates and higher recovery rates among these foreign issuers. Overall, these pieces of evidence on actual default rates and recovery rates suggest that non-US issuers may possess credit quality equivalent to or superior to that of US issuers. Despite this, they are still subject to a significant foreign discount when issuing dollar bonds in the US bond market.

3.4.2 US Risk Premium

Next, I investigate whether the foreign discount is driven by the variations of the US risk premia, which are important components in investors' pricing kernel. If foreign bonds and

[20]The recovery data is based on one-month bond trading prices after defaulting in 2020, not the ultimate recovery rate.

US bonds have different correlations with these US risk premia, it might explain the foreign discount. Following Longstaff et al. (2011), I choose three proxies for risk premia: the equity risk premium, represented by the changes in S&P 500 Shiller PE ratio; variance risk premium, proxied by the changes in the spreads between implied and realized volatility for S&P 500; and term premium, measured by the changes in the expected excess returns of 10-year treasury bond. I add these proxies into the regression setting in Equation (1) and report the results in Column 5 of Table 5. Consistent with the common view, an increase in the PE ratio is associated with a decrease in credit spreads as it indicates that the stock market performs well. However, they can not explain away the discount. Even after incorporating these risk premia proxies, the foreign discount persists, measured at 16.96 basis points with a t-statistic of 3.45.

3.4.3 Country-Level Risk

Lastly, I examine whether the country-level risks, such as political risk, currency risk, and local economic risk, can explain the foreign discount. The International Country Risk Guide (ICRG) political risk index serves as a proxy for political risk,[21] while currency risk is represented by the logarithmic change in exchange rates. Additionally, the return on the local corporate bond index is utilized as an indicator of local credit risk. Upon incorporating these country-level risk factors into the regression, as shown in Column 6 of Table 5, the foreign discount is adjusted to 14.83 bps with a t-statistic of 2.56, remaining both economically and statistically significant. To summarize, the standard risk and risk premia fail to explain away the foreign discount. A considerable portion of the discount remains unaccounted for, suggesting the presence of other factors.

3.4.4 Institutional Differences

Beyond standard risk factors, the foreign discount may stem from institutional discrepancies. In principle, bonds issued by non-US entities could be subject to distinct tax regulations, bankruptcy codes, and collateral requirements compared to those issued by US entities. To explore this, an examination of institutional frameworks across various dimensions is undertaken. In general, non-US firms have three primary avenues for issuing dollar-denominated bonds: registration with the SEC, which demands the most rigorous disclosure standards; utilization of Rule 144A, which caters to qualified institutional buyers (QIBs) with less

[21] The ICRG Researcher Dataset is a widely used dataset to measure country-level risks. In ICRG's construction, they calculate the country-level political index to assess a country's political stability based on 12 components, including government stability, conflict, law and order, and so on.

stringent requirements; and adherence to Reg S, targeting global investors in the euro-dollar market. Issuers may opt for multi-registration to broaden their investor base.

From a tax perspective, foreign entities are liable for corporate income tax, branch profits tax, and withholding tax in the US. However, many developed nations, including the UK, Japan, Canada, Germany, and France, implement a territorial system of international taxation, leading to tax rates comparable to those of US firms. In the realm of bankruptcy, the flexibility of the US legal system, particularly Chapter 11 provisions for reorganization and restructuring, makes it advantageous for foreign firms if their business runs into trouble. Even in the event of liquidation, the US courts can invoke international law to secure asset freezes in local courts further mitigating cross-jurisdictional concerns. Given most of my samples are from developed countries, such legal nuances should be less of a concern.[22] Collateral considerations are also standardized for most TRACE-listed bonds deposited with the Depository Trust Company (DTC), with similar haircuts applied to both US and foreign investment-grade bonds, typically ranging from 20% to 30%. Moreover, the covenants for such foreign-issued bonds are generally less restrictive, and often limited to negative pledge provisions. Therefore, all these institutional discrepancies are less pertinent to the foreign discount.

3.4.5 Investor Clientele

One potential concern is that the foreign discount could be driven by the investor clientele effect. To address this issue, I merge eMAXX's bondholder information from 2018Q2 to 2021Q1 with my TRACE sample. On average, eMAXX data reveals that mutual funds, insurance companies, and pension funds jointly hold 48% of bonds, with 94% of these investors based in the US, and 59% are insurance companies. As depicted in Figure 6, I find that the EU, UK, and CA have holding structures analogous to those in the US in terms of overall coverage, the proportion of US investors, and the share of insurance companies. Despite these similarities, foreign issuers from these developed nations still face a sizable discount. Additionally, trade size is employed as a proxy to control for investor heterogeneity. By categorizing bonds into three groups based on trade size thresholds of 100K and 25K, I examine how the foreign discount varies across different trade size groups. My findings indicate a foreign discount of 22.29 basis points (t-stats=5.76) for the largest trade size group (≥100K), 22.20 basis points (t-stats=5.20) for the median group (25K-100K), and 20.58 basis points (t-stats=4.65) for the smallest group (≤25K). These results suggest that the investor clientele effect is not the primary cause of the foreign discount.

[22]From an ex-post perspective, non-US issuers have lower default probability and higher recovery rates than US firms according to Moody's default and recovery data.

4 Potential Explanations Based on Uncertainty

In this section, I hypothesize that the persistent foreign discount can be attributed to uncertainty-based explanations. Section 4.1 shows that the country-level uncertainty proxy can explain away the majority of the foreign discount. Section 4.2 presents consistent evidence at the issuer level – the foreign discount is lower if the issuer-level uncertainty is lower. Lastly, in section 4.3, I find that the uncertainty proxy has the strongest explanatory power on foreign discount in the time series, surpassing other factors.

4.1 Country-Level Evidence

Firstly, I study whether the foreign discount can be attributed to country-level uncertainty. To quantify heterogeneous degrees of uncertainty across countries, I utilize the country-level Economic Policy Uncertainty (EPU) index from Baker, Bloom, and Davis (2016). The EPU index is predominantly compiled from newspaper coverage concerning policy-related economic uncertainty within each country. For the US, additional factors are considered, such as the expiring federal tax code provisions from the Congressional Budget Office (CBO) and the variance among economic forecasters as surveyed by the Federal Reserve Bank of Philadelphia Survey of Professional Forecasters. I add this EPU index, serving as a proxy for country-level uncertainty, into the regression (1) and report the results in Table 6.

The first column shows the foreign discount without controlling for any risk, which is the same as the first column in Table 5. Upon introducing the EPU index as a country-level uncertainty proxy in the second column, we can see the EPU has a positive and significant explanatory power on credit spreads, with a coefficient of 1.98 and a t-statistic of 4.66. Notably, the EPU index can explain a substantial portion of the foreign discount, reducing it from 17.00 basis points to 5.91 basis points – a decrease of 11.09 basis points or 65%. Consequently, the discount's statistical significance diminishes, with the t-statistic falling from 3.26 to 0.99. When risk and risk premium proxies are also controlled for, the foreign discount, consistent with the final column of Table 5, is 14.83 basis points. With the inclusion of the EPU index, this discount is further reduced to 6.06 basis points with a t-statistic of 0.98. Collectively, these findings suggest that a significant part of the foreign discount can be explained away by this country-level uncertainty proxy.

In addition, I use the 2020 GDP growth forecasts from the Consensus Economics survey across various countries, reported by both global (predominantly US-based) and local institutions.[23] The number of forecasts from both global and domestic sources is comparable,

[23]Prominent global institutions such as Goldman Sachs, JP Morgan, Bank of America - Merrill, Morgan Stanley, Citigroup, Markit, Moody's, and Barclays, Deutsche, Credit Suisse, UBS, HSBC, Nomura Securi-

as shown in Columns 2 and 3 of Table 7. Interestingly, US investors on average provide more conservative and less accurate GDP growth forecasts for foreign countries than local investors do, suggesting that US investors exhibit a greater degree of pessimism regarding foreign economies. Conversely, US investors offer more optimistic and precise GDP growth predictions for the US than non-US investors. Furthermore, the dispersion of forecasts on foreign countries among US investors, which can be viewed as the proxy for country-level uncertainty, tends to be wider than that of local investors. More importantly, the extent of that dispersion across countries aligns with the corresponding foreign discount, pointing to the possibility that US investors exhibit uncertainty aversion toward foreign countries and then ask for a higher discount on countries with larger uncertainty.[24]

4.2 Issuer-Level Evidence

Moving on to cross-issuer analysis, I examine the relationship between the foreign discount and the degree of uncertainty at the issuer level. As it is challenging to measure issuer-level uncertainty, I utilize two indirect proxies: (1) the duration of the issuer's presence in the US bond market (Age_in_US); (2) the proportion of the issuer's sales revenue generated within the US (Sales_in_US), as estimated from the Compustat Segments dataset. Intuitively, the longer a foreign issuer participates in the US bond market, the more familiar investors become, potentially leading to a reduced discount. Likewise, foreign issuers with a substantial portion of their sales in the US market are anticipated to face lower uncertainty and, consequently, a smaller foreign discount. Additionally, I study the impact of higher institutional bond holdings on the discount. Rule 144A bonds,[25] predominantly held by qualified institutional buyers (QIBs), are considered as a proxy for higher institutional involvement. Alternatively, I compute the percentage of institutional holdings from mutual funds and insurance companies using data from eMAXX (InstHoldings). The results are reported in Table 8.

Column 1 in Table 8 shows the result for the issuer's tenure in the US bond market. The

ties, Oxford Economics, and Capital Economics contribute to these forecasts, while domestic institutions, primarily large banks and financial firms, provide local perspectives. Due to the data limitation, I only obtain a snapshot of June 2020 on the 2020 GDP growth forecasts.

[24]The forecast dispersion has been widely used as a measure of uncertainty in the literature. See Zarnowitz and Lambros (1987), Bloom (2009), Ilut and Schneider (2014), Rossi and Sekhposyan (2015), Baker, Bloom, and Davis (2016), Corte and Krecetovs (2024) and many others.

[25]Rule 144A was introduced in 2012, which loosened restrictions on certain privately placed securities by allowing qualified institutional buyers (QIBs) to trade on those securities. Since then, the liquidity of the affected securities has substantially increased. Rule 144A has become more popular and provides a safe harbor on which non-US companies rely when accessing the US capital markets. It also helps facilitate faster and easier bond offerings even for US issuers.

interaction term, Foreign*X, is -1.11 with a t-statistic of -3.48. This significant negative coefficient indicates that an issuer's established presence in the US bond market can reduce the foreign discount. In extreme scenarios where the issuer's US market tenure (Age_in_US) is negligible, the foreign discount is estimated to increase to 28 basis points. For Sales_in_US, calculated as the ratio of the issuer's US revenues to their total revenues. As expected, a higher Sales_in_US, signifying a greater reliance on the US market for sales, is associated with a reduced foreign discount. The coefficient is -0.36 with a t-statistic of -2.19. Moving to Rule 144A dummy in the third column, I find the interaction term, while negative as hypothesized, does not reach significance. Lastly, the interaction of the variable InstHoldings with the Foreign dummy variable is found to be negative and significant, suggesting that bonds with a higher proportion of institutional investors tend to have a lower foreign discount. This aligns with the notion that more sophisticated investors are likely to demand a smaller discount for foreign dollar bonds, assuming everything else is equal.

4.3 Time Series Evidence

In this subsection, I study the extent to which the foreign discount can be explained by the uncertainty factor as well as a common set of US economic variables in the time series. I regress the monthly changes in the foreign discount on the following explanatory variables: (1) monthly change in the global EPU index, serving as a proxy for global economic uncertainty; (2) monthly change in the US-specific EPU index, indicating uncertainty within the US; (3) monthly change in the CBOE Volatility Index (VIX), reflecting investor risk aversion or fear; (4) monthly change in the Intermediary Capital Risk (ICR) factor from He, Kelly, and Manela (2017), proxying for the soundness of the financial intermediaries;[26] (5) monthly change in the yields of "A"-rated bonds, indicative of the general credit market conditions; (6) the monthly return of S&P 500, representing the stock market performance; (7) the monthly return of the dollar index (DXY), a gauge of macro-level US economic performance. The regression results are reported in the Panel A of Table 9.

As shown in the first column of Panel A, the global EPU index (ΔEPU) is important in explaining time-series variation in the aggregate foreign discount, with a coefficient estimate of 7.26 and a t-statistic of 4.06. This is consistent with our hypothesis that the foreign discount tends to increase amidst heightened uncertainty. Similarly, we find coherent results for the US EPU index (ΔEPU_{US}). Column 3 also indicates that there is a very strong relation between the VIX index and foreign discount. An uptick in ΔVIX corresponds to

[26] As plotted in Figure 3, the aggregate foreign discount was quite small before the 2008 financial crisis and increased significantly afterward. This trend coincides with the tightening of regulation for the primary dealers, which can be captured by the intermediary capital risk factor from He, Kelly, and Manela (2017).

greater investor fear, leading to a higher compensation demanded when investing in foreign dollar-denominated bonds. In column 4, ΔICR is negatively related to the foreign discount, suggesting that an increase in intermediary capital ratio, signals improved financial condition, and thus helps reduce the discount. The positive coefficient of 8.20 (t-stat=2.04) on ΔYield implies that investors seek higher compensation for holding foreign dollar bonds in a deteriorating credit environment. Consistently, the stock market's performance inversely correlates with the foreign discount, whereas the dollar index's return shows no significant influence on the discount. Lastly, I run a kitchen sink regression by including all these explanatory variables. Strikingly, the global EPU index has the strongest explanatory power on the foreign discount, surpassing other factors and supporting the uncertainty-based explanation.

Panel B of Table 9 further investigates the interaction effect between uncertainty and deteriorating market conditions, as captured by the aforementioned variables from (3) to (7), on the aggregate foreign discount. Consistent with our intuition, the uncertainty index exerts a more pronounced effect on the discount during worsening market conditions, as evidenced by increasing ΔVIX (0.78 with t-stat 3.78), decreasing ΔICR (-11.30 with t-stat -2.54), increasing ΔYield (8.67 with t-stat 1.32), decreasing R_{SP500} (-1.44 with t-stat -4.53) and increasing R_{DXY} (2.24 with t-stat 1.93). While the results on the first four variables are easy to understand, the intuition on the dollar index's impact is the following: a higher return on the dollar index means that the dollar strengthens against other major currencies in the global market. Hence the US issuers would benefit more from a stronger US economy, leading to an increase in the foreign discount. In summary, studying the time-series determinants of foreign discount with respect to these market-level variables, the global EPU index emerges as a particularly effective factor in explaining the aggregate foreign discount. Importantly, its explanatory power intensifies during deteriorating market conditions.

5 Implications

5.1 Foreign Squeeze During COVID-19 Pandemic

Taking COVID-19 as an event study, I closely examine investors' trading behavior on the US dollar bonds v.s. foreign dollar bonds. Prior literature has documented the "dash for cash" and "dash for dollar" phenomena during the COVID-19 pandemic,[27] where investors sold high-rated, short-maturity dollar-denominated bonds to secure liquidity amidst market

[27] Haddad, Moreira, and Muir (2021), Ma, Xiao, and Zeng (2022), O'Hara and Zhou (2021), Cesa-Bianchi and Eguren-Martin (2021), Li et al. (2021), Kargar et al. (2021).

turmoil. I further study the heterogeneous trading behavior based on the bond's ultimate country of origin. First, I construct the bond-level selling pressure proxy, defined as the fraction of sell-initiated transactions by customers within all the customer-dealer transactions for each bond each day. Then I adopt the regression framework specified in Equation (1), with the modification of substituting the daily bond-level selling pressure for the monthly credit spread. To smooth out the noise in daily observations, I use the daily regression over a rolling window of the past week. Moreover, I estimate the daily foreign discount and compare it with the selling pressure before and after the COVID-19 pandemic. All the results are reported in Figure 7.

Panel (a) plots the difference in selling pressure (left axis) and in credit spreads (right axis) between foreign and US dollar bonds during the COVID-19 pandemic. Before March 09, 2020, the selling pressure of non-US dollar bonds relative to US dollar bonds was minimal and statistically insignificant. However, as the bond market plunged in early March 2020, characterized by rising yield spreads and deteriorating liquidity, the selling pressure differential soared to the peak of 5%, which is statistically significant. Meanwhile, the foreign discount jumped from under 20 bps before the pandemic to well over 60 bps afterward. To improve the liquidity conditions in the corporate bond markets, the Fed responded by creating the Primary Dealer Credit Facility (PDCF) to enhance funding conditions for primary dealers, and the Secondary Market Corporate Credit Facility (SMCCF) to purchase corporate bonds and bond ETFs directly. These measures led to market stabilization and a subsequent decline in bond yields, with a corresponding decrease in selling pressure and the foreign discount by the end of March.

Panel (b) plots the monthly average of the fraction of sell-initiated transactions for six major countries, pre- and post-pandemic. Compared to January and February, all countries saw an uptick in selling pressure in March, with the highest pressures observed for CN, followed by JP, GB, EU, and CA. This order roughly aligns with the foreign discount magnitudes at that time. In summary, I show that it is the foreign dollar bonds that suffer more selling pressure and more severe discounts relative to US dollar bonds during market distress. This insight provides a novel economic mechanism – the foreign squeeze on foreign dollar bonds during market turmoil – which has important implications for the classical home bias literature. While economic globalization accelerates and international cross-border investment and financing become increasingly prevalent, the world has also become more volatile than ever before. Different kinds of bad shocks happen more frequently, including geopolitical conflicts, trade wars, viruses, climate issues, and so on. Given these trends, the foreign discount and foreign squeeze effects highlighted in this paper are likely to remain pertinent and significant in the evolving landscape of international finance.

5.2 Comparison with Dollar Safety Premium

In this subsection, I compare the foreign discount with the safe dollar premium to further show its importance. Theoretically, the pricing of the foreign dollar bond is influenced by the tradeoff between the dollar safety premium (USD effect) and the foreign discount (USA effect). On the one hand, the USD effect benefits the non-US issuer by reducing their borrowing cost due to the perceived safety of the dollar. On the other hand, the USA effect may cost non-US issuers higher credit spreads arising from higher uncertainty. In this paper, I estimate the foreign discount effect or the USA effect by fixing the currency to be the dollar. For the USD effect, I use the "corporate bases" from Liao (2020).

Liao (2020) constructs the "corporate bases" for each major currency, calculated as the sum of the credit spread differential between the local-currency-denominated bond and dollar-denominated bond issued by the same issuer, plus the covered interest parity (CIP) deviation between their local currency and the dollar. Using a local-currency bond as a benchmark, he compares it with a currency-hedged dollar bond to disentangle the currency effect from the identity effect. I instead use the dollar bond issued by an ideally identical US issuer as the benchmark and compare it with the dollar bond issued by the non-US issuer to isolate the identity effect from the currency effect. The question is which effect – currency (USD) or identity (USA) – plays a more substantial role in determining the pricing of the dollar bonds issued by non-US issuers. Assuming that bonds denominated in a particular currency are predominantly issued by firms from the corresponding country, I can compare the magnitude of foreign discount (USA effect) for a given country (e.g., EU) with the safe dollar premium (USD effect) for the currency in that country (e.g., EUR).

Figure 8 plots the spreads over the US or USD for each foreign country and the respective currency. For example, the top-left panel shows the results for the EU and EUR. The blue line refers to the foreign discount for the EU, while the red line represents the safe dollar premium for EUR. In terms of magnitude, the foreign discount consistently exceeds the safe dollar premium. After 2013, the safe dollar premium for EUR turned negative, suggesting that it is cheaper to borrow in EUR-denominated bonds than USD-denominated bonds.[28] On the contrary, the foreign discount is always positive, indicating that the investors consistently ask for additional compensation for holding foreign dollar bonds. Similar patterns are observed across other panels, with the foreign discount (blue lines) generally exceeding the safe dollar premium (red lines). In this regard, the foreign discount is more robust and has a larger magnitude than the safe dollar premium.

[28] Liao (2020) links this negative corporate base with the positive debt issuance flow from the US to the EU.

A negative safe dollar premium may result from differences in the investor base for local currency-denominated bonds versus dollar-denominated bonds issued by the same entity. Local-currency bonds, primarily held by local investors familiar with the issuer, exhibit a negligible foreign discount. However, for dollar bonds held predominantly by international investors, particularly from the US, uncertainty likely plays a more significant role in bond pricing, leading to wider credit spreads and thus a negative corporate base. A subsequent study by Caramichael, Gopinath, and Liao (2021) examines a cleaner setting in which they compare the credit spreads between euro-denominated bonds and dollar-denominated bonds issued by global firms outside the EU and US. In this case, they do not find a significant dollar premium. Consistent with my explanation, due to the presence of a foreign discount effect, EU investors and US investors may ask for similar compensation for holding these bonds issued by firms outside the EU and US, leading to a negligible dollar premium.

6 Leland Model with Model Uncertainty

To rationalize the foreign discount and uncertainty-based explanation, I build a simple Leland-type model augmented with model uncertainty. The basic model setting adheres closely to that presented Leland (1994), with the extension of introducing two types of perpetual bonds: one issued by the home issuer while another issued by a foreign issuer. I first describe the basic model setup and the key ingredients in determining the price difference between home and foreign bonds. Then I derive the foreign discount and discuss the main mechanism delivered by the model. Lastly, I calibrate the model to match the observed empirical results.

6.1 Preferences

Consider an economy with two aggregate output processes: one for the home country Y_t^H and another for the foreign country Y_t^F. Both follow the simple geometric Brownian motion,

$$\frac{dY_t^H}{Y_t^H} = \mu^H dt + \sigma^H dB_t^H, \quad \frac{dY_t^F}{Y_t^F} = \mu^F dt + \sigma^F dB_t^F, \tag{2}$$

where μ^H (μ^F) and σ^H (σ^F) are the expected growth rate and volatility of aggregate output for the home (foreign) country, respectively. Both the mean and volatility are assumed to be constant. B_t^H and B_t^F are the mutually independent standard Brownian motions.

Assuming that the representative home investor knows exactly about the true process of home aggregate output while is uncertainty regarding the true expected growth rate of the foreign aggregate output process. Following Anderson, Hansen, and Sargent (2003), Uppal and Wang (2003), Maenhout (2004, 2006), Liu, Pan, and Wang (2005), I adopt the similar form of the expected utility by allowing model misspecification about the expected growth rate in foreign aggregate output as follows,

$$U_t = \inf_{P^\zeta} \left\{ E_t^\zeta \left[\int_t^T e^{-\rho(s-t)} \left\{ \psi\left(U_s\right) \frac{1}{\phi} L^F(\zeta) + \frac{c_s^{1-\gamma}}{1-\gamma} \right\} ds \right] \right\} \tag{3}$$

where $U_s = c_s^{1-\gamma}/(1-\gamma)$ is the standard CRRA utility with relative risk aversion coefficient γ. ρ is a constant discount rate. E_t^ζ is expectation under P^ζ and ζ is the density of probability distribution P^ζ with respect to P. P is the reference distribution, estimated by the investor from historical data and subjected to the misspecification error. P^ζ is the alternative model chosen by the investor in evaluating the continuation value. According to Girsanov's Theorem, there exists appropriately adapted process η^ζ satisfying $d\zeta/\zeta = \eta^\zeta dB_t^F$ and $dB_t^{F,\zeta} = dB_t^F + \eta^\zeta dt$. Under P^ζ, the aggregate output process now become,

$$\frac{dY_t^H}{Y_t^H} = \mu^H dt + \sigma^H dB_t^{H,\zeta}, \quad \frac{dY_t^F}{Y_t^F} = (\mu^F - \eta^\zeta \sigma^F)dt + \sigma^F dB_t^{F,\zeta}, \tag{4}$$

Effectively, $\eta^\zeta \sigma^F$ is the drift adjustment on the foreign output process. To evaluate the alternative model P^ζ (or η^ζ), $\frac{1}{\phi} L^F(\zeta)$ is introduced as the penalty function for rejecting P and accepting P^ζ. ϕ measures the level of model uncertainty. Lower ϕ means a larger penalty and smaller degree of model misspecification. When $\phi \to 0$, Equation (3) reduces to the standard expected utility case with no model uncertainty. $L^F(\zeta)$ is the relative entropy, measuring the distance between the reference distribution P and the alternative distribution P^ζ. The superscript F means that the penalty function is associated with the foreign aggregate output process. By assuming there is only model uncertainty about Y_t^F, effectively, I allow for the heterogeneity in the degree of ambiguity. Lastly, for analytical convenience, $\psi\left(U_s\right)$ is used as a normalization term that converts the penalty to units of utility, which is set to be $\psi(U_s) = [(1-\gamma)/\gamma] U_s$ following Uppal and Wang (2003).

To solve for the equilibrium, I first consider the standard portfolio-consumption problem. Assume the endowment is traded as stocks and the payout rate of the stock S_t^H (S_t^F) is Y_t^H (Y_t^F). Denote the portfolio weights on home stock and foreign stock are θ_t^H and θ_t^F. Then the budget constraint can be written as

$$dW_t = \left[r + \theta_t^H (\mu^H - r) + \theta_t^F (\mu^F - r) \right] W_t dt + \theta_t^H W_t \sigma^H dB_t^H + \theta_t^F W_t \sigma^F dB_t^F - c_t dt,$$

where r is the risk-free rate. Denote J_t as the indirect utility function $J(t, W) = \sup_{\{c, \theta^H, \theta^F\}} U_t$

and the HJB equation is the following,

$$\sup_{c,\theta^H,\theta^F}\left\{u(c)-\rho J(t,W)+\mathcal{A}J(t,W)+\inf_{\eta^\zeta}\left\{\theta^F W\sigma^F\eta^\zeta J_W+\frac{\psi(J)}{2\phi}{\eta^\zeta}^2\right\}\right\}. \tag{5}$$

where $\mathcal{A}J(t,W)$ is the standard infinitesimal generator for W. The solution is given by $J(t,W)=\frac{W^{1-\gamma}}{1-\gamma}f(t)^\gamma$. In equilibrium, to clear the market, $\theta_t^H=\theta_t^F=1$ and investor consumes the composite consumption goods $c_t=(Y_t^H)^\beta(Y_t^F)^{1-\beta}$ for tractability. Then we can solve for the optimal alternative measure $\eta^{\zeta*}=\frac{\phi}{1+\phi}\frac{\mu^F-r}{\sigma^F}$ and the corresponding pricing kernel as follows

$$\frac{dm_t}{m_t}=-rdt-\eta^H dB_t^H-\eta^F dB_t^F,\quad \eta^H=\gamma\sigma^H\beta,\quad \eta^F=\gamma\sigma^F(1-\beta)(1+\phi). \tag{6}$$

where η^H is the market price of risk for systematic home Brownian shock from B_t^H, which equals $\gamma\sigma^H\beta$. η^F is the market price of risk for the foreign Brownian shock B_t^F, equaling to $\gamma\sigma^F(1-\beta)(1+\phi)$. The term ϕ arises from the home investor's uncertainty aversion with respect to the foreign aggregate output process. When $\phi=0$, it reduces to the standard case. Therefore, our framework based on robust control yields a nice and simple close-form solution.

6.2 Firms

Now I specify the dynamics of the asset-generating process for the home firm and foreign firm in the economy. Each firm issues a perpetual bond with coupon rates of C^j ($j\in(H,\ F)$). Following Leland (1994) and Goldstein, Ju, and Leland (2001), I assume the home (foreign) firm's asset-in-place generates before-tax cash flows at a rate of δ_t^H (δ_t^F) as follows,

$$\frac{d\delta_t^F}{\delta_t^F}=\mu^{i,F}dt+\sigma_{i,F,H}dB_t^H+\sigma_{i,F,F}dB_t^F+\sigma^{i,F}dB_t^{i,F},\quad \frac{d\delta_t^H}{\delta_t^H}=\mu^{i,H}dt+\sigma_{i,H,H}dB_t^H+\sigma^{i,H}dB_t^{i,H}, \tag{7}$$

where $\mu^{i,F}$ ($\mu^{i,H}$) and $\sigma^{i,F}$ ($\sigma^{i,H}$) are the foreign (home) firm's constant expected growth rate and idiosyncratic volatility. $B_t^{i,F}$ ($B_t^{i,H}$) is a standard Brownian motion that generates idiosyncratic shocks specific to the foreign (home) issuer. $B_t^{i,H}$ and $B_t^{i,F}$ are mutually independent and both are independent of the systematic shock B_t^H and B_t^F. $\sigma_{i,F,H}$ ($\sigma_{i,F,F}$) denotes the foreign firm's systematic volatility of the cash flows with respect to the home (foreign) aggregate output process while $\sigma_{i,H,H}$ denotes the home firm's systematic volatility of the cash flows with respect to the home aggregate output process, as in Chen (2010).

To distinguish between foreign and domestic issuers within the model, two critical elements are incorporated. First, as shown in Equation (7), I assume the foreign firm's cash flow can be affected by both the home and foreign aggregate output shocks, whereas the home firm's cash flow is solely influenced by the home market shocks. Intuitively, for foreign firms in the US market, the US investors care about both the US market's risk and the foreign country's local risk. This additional risk exposure for the foreign firm is captured by the constant $\sigma_{i,F,F}$, measuring the degree of co-movement between the foreign firm and the foreign market. To ensure comparability between the home firm and foreign firm, I fix the total risk faced by the two firms to be the same. Specifically, for any given $\sigma_{i,H,H}$, I solve for $\sigma_{i,F,H}$ and $\sigma_{i,F,F}$ based on the following equations,

$$\sigma_{i,F,H}\gamma\sigma^H\beta + \sigma_{i,F,F}\gamma\sigma^F(1-\beta) = \sigma_{i,H,H}\gamma\sigma^H\beta, \quad \sigma^2_{i,F,H} + \sigma^2_{i,F,F} = \sigma^2_{i,H,H}. \tag{8}$$

Hence, in the absence of model uncertainty ($\phi = 0$), the foreign bond will have the same risk as the home bond, implying that there will be no foreign discount.

To generate a positive foreign discount, I introduce the second element based on home investor's uncertain aversion toward the true growth rate of the foreign market process. As a consequence, the default boundary for the foreign firm is higher than the one without model misspecification, leading to higher credit spreads. This intuition is also captured in earlier works.[29] The reason I follow the model specification from Uppal and Wang (2003) is that they provide a nice framework with a simple closed-form solution, which is easy to interpret and can capture the key intuition.

6.3 Foreign Discount

To price assets in this model, we define the risk-neutral probability measure Q to discount the cash flows of any asset. By specifying the density process $\xi_t = E_t\left[\frac{dQ}{dP}\right]$ from P to Q and applying the Girsanov theorem, we have

$$dB_t^{H,Q} = dB_t^H + \eta^H dt, \quad dB_t^{F,Q} = dB_t^F + \eta^F dt, \tag{9}$$

[29] Duffie and Lando (2001) assume bond investors can not perfectly observe the issuer's assets. Instead, they receive imperfect and periodic information at selected times. They find that the default barrier could be closer than the standard one, leading to a larger credit spread. Shi (2019) assume that the investors can not observe the drift of the consumption growth process. The model can generate large credit spreads matched with the empirical data.

Thus, under Q, the firm j's ($j \in (H,\ F)$) cash flows process becomes $d\delta_t^j/\delta_t^j = \mu_j^Q dt + \sigma_j^Q dB_t^{j,Q}$, where

$$\mu_F^Q = \mu - \sigma_{i,F,H}\gamma\sigma^H\beta - \sigma_{i,F,F}\gamma\sigma^F(1-\beta)(1+\phi), \quad \mu_H^Q = \mu - \sigma_{i,H,H}\gamma\sigma^H\beta,$$
$$\sigma_F^Q = \sqrt{\sigma_{i,F,H}^2 + \sigma_{i,F,F}^2 + \sigma^2}, \quad \sigma_H^Q = \sqrt{\sigma_{i,H,H}^2 + \sigma^2}. \tag{10}$$

Following Leland (1994), we can solve for the debt value, credit spread, and equity value in a closed form. According to the classical trade-off between debt tax shield and bankruptcy cost, the debt interest expenses are tax-deductible at the tax rate of τ and debt holders only recover a fraction α of first-best firm value at bankruptcy. After paying out the coupon C to the debt holders, the taxable earning of the firm is $\delta_t - C$, implying that the after-tax cash flow to equity holders is $(1-\tau)(\delta_t - C)$. Because the default decision is made by equity holders, the endogenous default boundary δ_B is then chosen to satisfy the valuing matching condition $E(\delta_B) = 0$ and the smooth pasting condition $E'(\delta_B) = 0$.[30] In the event of default, all the remaining value of the firm will go to debt holders and the equity holders get nothing. To solve the model: (1) given some default boundary δ_B, I solve the debt price and equity price; (2) I use the smooth pasting condition to get the optimal default boundary; (3) by maximizing the total levered firm value at time 0 $(E(\delta_0) + D(\delta_0))$, I derive the optimal capital structure for the firm. As the home issuer and foreign issuer only differ in μ_j^Q and σ_j^Q ($j \in (H,\ F)$), I will price each firm separately. The solutions are the following,

Proposition 1 *The foreign discount (FD) is given by given by*

$$FD(\phi) = \frac{C^F}{\left[\frac{(1-\alpha)(1-\tau)\delta_B^F}{r-\mu_F^Q} - \frac{C^F}{r}\right](\delta/\delta_B^F)^{-\kappa_F} + \frac{C^F}{r}} - \frac{C^H}{\left[\frac{(1-\alpha)(1-\tau)\delta_B^H}{r-\mu_H^Q} - \frac{C^H}{r}\right](\delta/\delta_B^H)^{-\kappa_H} + \frac{C^H}{r}}, \tag{11}$$

where optimal default boundary, coupon rate and constant coefficients κ_j for the j-firm, $j \in (F,\ H)$, are given by

$$\delta_B^j = A * C^j, \quad C^j = \left(1 + \kappa_j + \frac{\alpha\kappa_j(1-\tau)}{\tau}\right)^{-\frac{1}{\kappa_j}} \frac{\delta_0}{A},$$
$$A = \frac{(r-\mu_i^Q)\kappa_j}{r(1+\kappa_j)}, \quad \kappa_j = \frac{\mu_i^Q - \frac{1}{2}\sigma_i^{Q^2} + \sqrt{(\mu_i^Q - \frac{1}{2}\sigma_i^{Q^2})^2 + 2\sigma_i^{Q^2} r}}{\sigma_i^{Q^2}}.$$

From Proposition 1, the key determinant of the foreign discount is the degree of uncer-

[30]The idea is that when δ goes to 0, the firm value also converges to 0. In that case, the equity holders will walk away without further servicing the debt due to the limited liability. The smooth pasting condition states that in determining the default boundary δ_B, it is indifferent to the equity holders to default right at δ_B or wait a little longer.

tainty ϕ. When there is no model uncertainty ($\phi = 0$), from Equation (8) and Equation (10), we have $\mu_F^Q = \mu_H^Q$ and $\sigma_F^Q = \sigma_H^Q$. Thus the foreign discount reduces to 0. When $\phi > 0$, an increase in ϕ implies an increase in the degree of uncertainty. This increased uncertainty, through the foreign issuer's exposure to the foreign market, leads to a lower growth rate on the foreign bond. It can be viewed as if the home investor uses a lower expected growth rate due to uncertainty aversion. Since there is no uncertainty about the home output process, the home bond's growth rate remains the same. Therefore, the foreign discount is increasing in the degree of uncertainty ϕ. Moreover, the model can also generate important interaction effects between uncertainty and risk aversion. Referring to Equation (10), an increase in risk aversion γ is associated with a decrease in the expected growth rate for both the foreign bond and home bond. However, this reduction is more pronounced for the foreign bond than for the home bond due to the additional effect from the uncertainty item ϕ. Notably, the sensitivity of the foreign discount to uncertainty will be further amplified when risk aversion rises, particularly in worsening market conditions.

6.4 Model Calibration

I calibrate the model by adopting the standard calibration parameters from the literature. For the general environment, I set the benchmark risk aversion coefficient γ to 2, the risk-free rate r to 4%, the tax rate τ to 25%, the bond recovery rate α to 50%, the initial cash flow level δ_0 to 1 and the consumption elasticity β to 0.75. For the market volatility, I set σ^H and σ^F to be 20%. The expected growth rate of a firm's asset μ^i and the idiosyncratic volatility σ^i are calibrated to be 11% and 25%, respectively, for both the foreign and home firms. I set the home firm's systematic volatility to the home market volatility $\sigma_{i,H,H} = 20\%$. From Equation (8), the foreign firm's systematic volatility to the home market volatility $\sigma_{i,F,H}$ and the foreign firm's systematic volatility to the foreign market volatility $\sigma_{i,F,F}$ are solved to be 16% and 12%, respectively. While the previous literature mainly focuses on resolving the credit spread puzzle,[31] the main objective of my model is to compare the bond pricing between the foreign bond and the home bond, and to assess whether the model-implied credit spread difference can match the observed foreign discount in the data.

To illustrate numerically to what extent the model uncertainty affects bond credit spread and the foreign discount, I vary the degree of uncertainty ϕ from 0 to 4 and present the calibration results in the top panel of Table 10. For comparisons, in the first column, I also report the average credit spread for investment-grade bonds issued by US firms (139 bps) and foreign firms (160 bps) from 2005 to 2023 in the data. Thus the credit spread difference

[31]See Chen, Collin-Dufresne, and Goldstein (2008), Chen (2010), Shi (2019) and others,

between the two groups is 21 bps, which resembles the estimated foreign discount (20 bps) in Panel B of Table 3. Moving to the “Model” panel, when $\phi = 0$, the credit spread for both home (US) bond and foreign (non-US) bond are 140 bps, resulting in a zero discount. As ϕ increases to 1, the credit spread of the home bond remains at 140 bps by construction while the foreign bond’s credit spread rises to 161 bps. Therefore, the difference and the discount become 21 bps, matching the data quite well.[32] As depicted in Figure 3, the discount fluctuates significantly over time, peaking at over 100 basis points during the 2008 financial crisis. Consistently, when ϕ increases to 4, the model-implied discount also increases to 102 bps, mirroring the observed peak. This suggests that with reasonable parameters, the model can replicate the foreign discount under both normal with $\phi = 1$ and extreme conditions with $\phi = 4$.

To further explore how the interaction between uncertainty ϕ and risk aversion γ affect the foreign discount, I change the risk aversion coefficient from 2 to 4 and repeat the calibration. Accordingly, I compute the empirical credit spread from 2008 to 2009 to provide a better reference in the “Data” column. During this crisis period, the average credit spread is 289 for US bonds and 357 for non-US bonds, yielding a difference of 68 basis points. Meanwhile, the estimated foreign discount through regression is 75 bps. As shown in the bottom panel of Table 10, the model-implied discount is 0 bps for $\phi = 0$, 67 bps for $\phi = 1$, 212 bps for $\phi = 2$, and 289 bps for $\phi = 4$. Compared to the top panel, the uncertainty has a more substantial effect on the foreign discount when the risk aversion is higher. This model implication is consistent with the interaction results in Table 9, where we use the VIX index and other market-level variables to proxy for the worsening market conditions.

7 Conclusions

In this paper, I investigate the foreign discount effect within the international corporate bond market. By analyzing the credit spread differential between dollar-denominated bonds issued by non-US firms and those issued by US firms, I quantify the foreign discount as an important pricing factor in international bond pricing, controlling for various bond-level characteristics and liquidity. Furthermore, the foreign discount is not limited to dollar-denominated corporate bonds. Similar patterns are observed for euro-denominated corporate bonds and dollar-denominated sovereign bonds. Contrary to the common view, the standard risk measures can not explain away the persistent foreign discount.

After documenting the robustness of the foreign discount, I then turn to a potential

[32] In the model, the foreign discount equals the credit spread difference by definition, whereas in the data, the foreign discount is estimated using regressions, which may differ from the simple credit spread difference.

explanation based on uncertainty. Since the major business of foreign issuers happens outside the US, it can be challenging for US investors to collect accurate and timely information about the foreign asset-generating process. As a result, investors ask for higher compensation on the bonds issued by foreign firms, especially during deteriorating market conditions. Empirically, the country-level uncertainty proxy – Economic Policy Uncertainty (EPU) index from Baker, Bloom, and Davis (2016) can explain a substantial portion (65%) of the foreign discount. At the issuer level, I find that firms with a lower degree of uncertainty, indicated by a longer duration of the issuer's presence in the US bond market and a higher proportion of the issuer's sales revenue generated within the US, face a smaller discount. In the time series, I show that the global EPU index has the strongest explanatory power on the aggregate foreign discount. Importantly, its explanatory power intensifies during deteriorating market conditions.

To rationalize these empirical findings, I build a simple Leland-type model augmented with model uncertainty. Within the model, the pricing difference between the foreign and home bonds is determined by the degree of uncertainty, giving rise to the foreign discount. If there is no model uncertainty, the discount reduces to zero. When the uncertainty is present, the foreign discount is increasing in the degree of uncertainty. Notably, the sensitivity of the foreign discount to uncertainty will be further amplified when risk aversion rises, particularly in worsening market conditions. The model calibration results are consistent with those model implications. More importantly, with reasonable parameters, the model can match the empirical evidence quite well in both normal and stressful times, further supporting the uncertainty-based explanation.

As an implication, I further document the foreign squeeze effect during the COVID-19 pandemic. By examining investors' trading behavior on the US dollar bonds v.s. foreign dollar bonds, I find that foreign dollar bonds suffer more selling pressure and more severe discounts relative to US dollar bonds during market distress. The discount jumps from below 20 bps before the pandemic to well over 60 bps afterward. This insight provides a novel economic mechanism – the foreign squeeze on foreign dollar bonds during market turmoil – which has important implications for the classical home bias literature.

Lastly, I explore a second implication of the foreign discount by comparing it with the safe dollar premium in the literature. For dollar-denominated bonds issued by foreign firms, their prices depend on the tradeoff between the foreign discount (USA effect) and the dollar safety premium (USD effect). I show that the foreign discount tends to outweigh the dollar safety premium, especially for the EU and GB in market turmoil like the global financial crisis and the European debt crisis. In other words, the full benefits of the safe dollar premium can only be enjoyed by US issuers.

To summarize, the escalating prevalence of international financing, coupled with a concurrent surge in economic instability characterized by deglobalization, geopolitical conflicts, and other challenges, underscores the critical importance of understanding the foreign discount. For investors, financial intermediaries, and policymakers, it provides a novel perspective for assessing country-level relationships and the evolving risk appetite of investors, which can, in turn, influence capital flows and market conditions across different countries.

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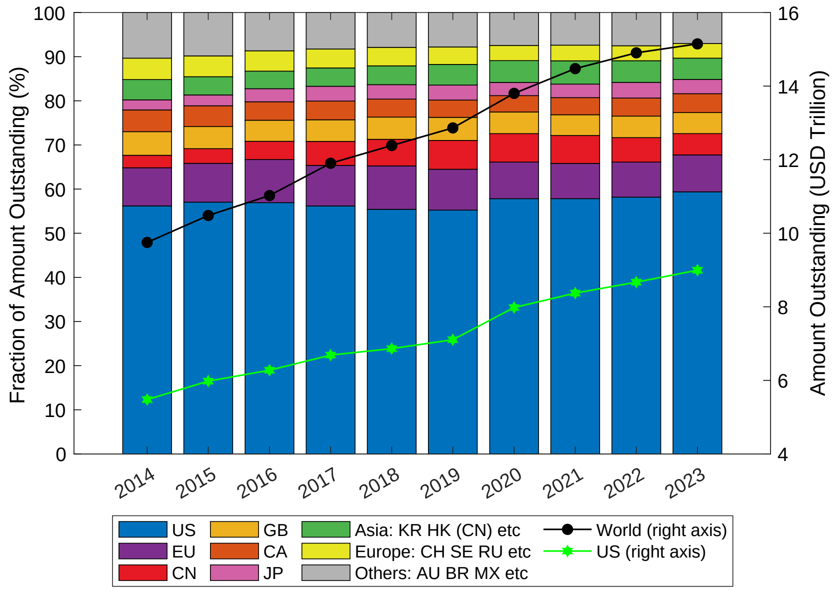
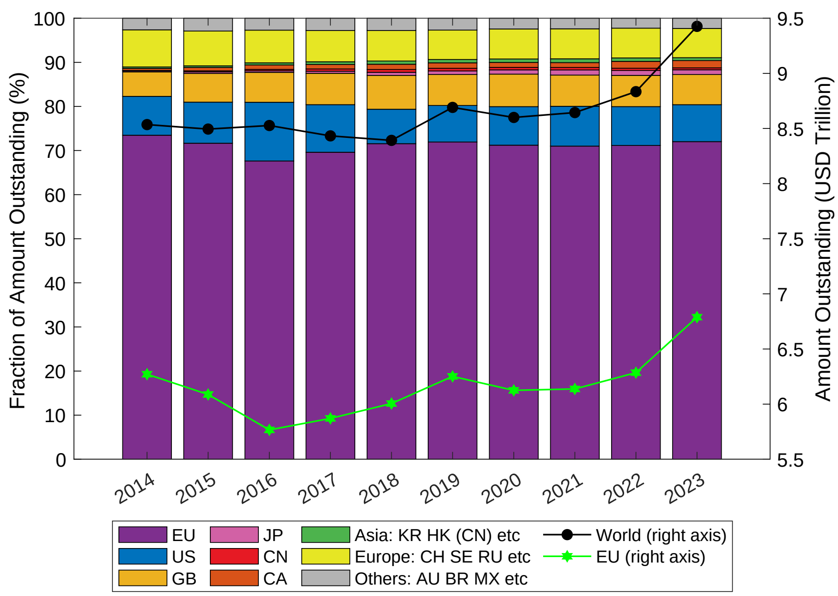


(a) **Dollar Corp Bonds: Across Countries**



(b) **Euro Corp Bonds: Across Countries**

Figure 1: This figure plots the distribution of corporate bond amount outstanding across countries for dollar-denominated bonds in Panel (a) and euro-denominated bonds in Panel (b). The left axis is the fraction of the amount outstanding, and the right axis is the total amount outstanding in trillions of USD. Bonds are grouped by their origin country into nine categories: the United States (US), Eurozone (EU), China Mainland (CN), United Kingdom (GB), Canada (CA), Japan (JP), Asia excluding China Mainland and Japan, Europe excluding Eurozone and the United Kingdom, and an aggregate for the rest of the world. The black line is the total amount outstanding for the world, and the green line refers to the amount outstanding for the US in Panel (a) or the EU in Panel (b). All the data are obtained from Bloomberg.

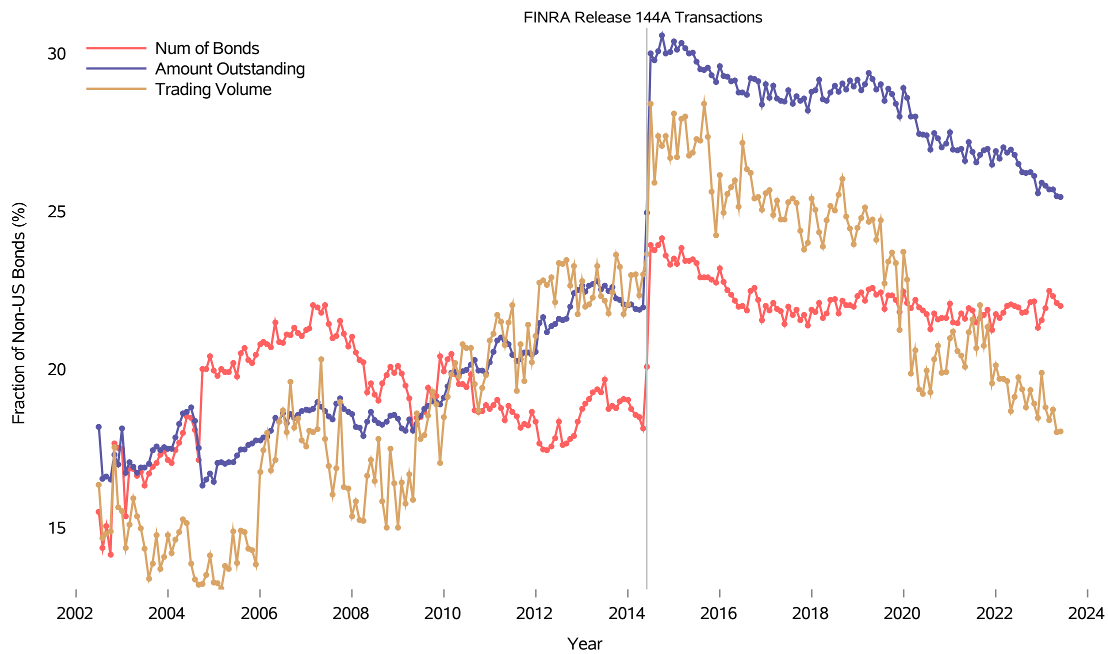
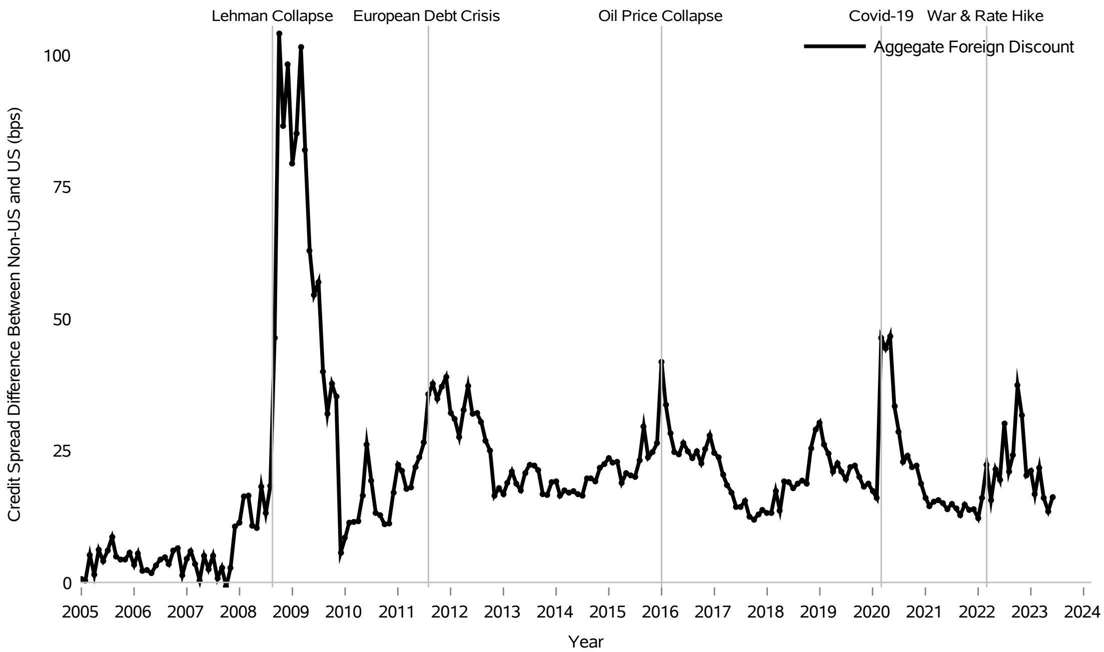
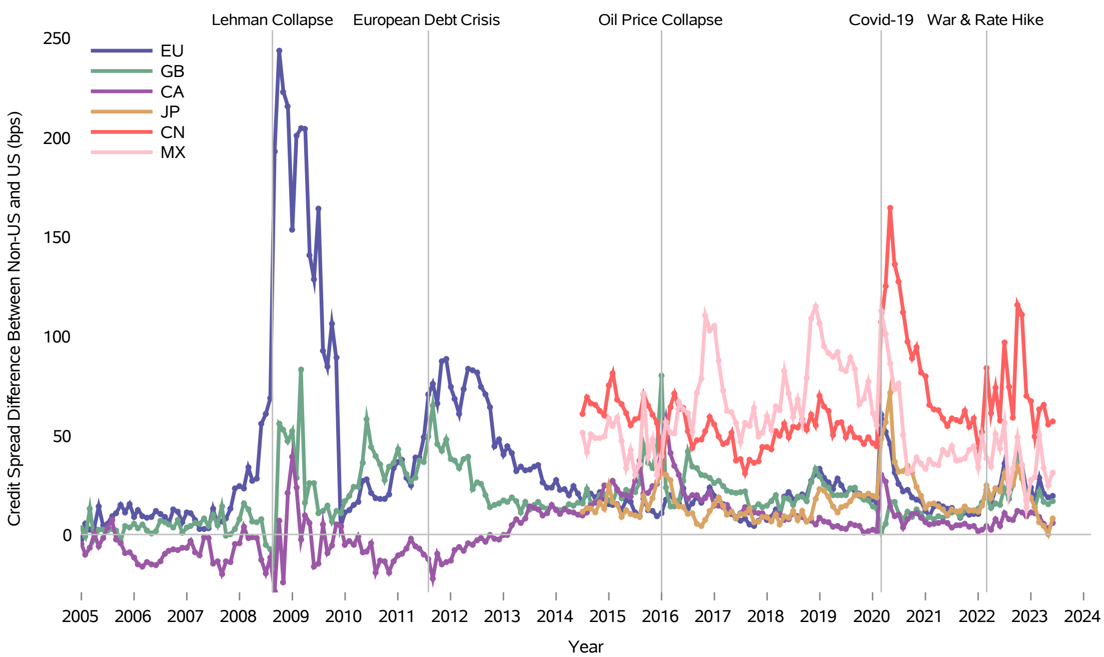


Figure 2: This figure plots the fraction of dollar bonds issued by non-US firms to the total dollar bonds in TRACE along three dimensions: the number of bonds (red line), the amount outstanding (blue line), and trading volume (orange line). The vertical grey line refers to the date of June 30, 2014, when FINRA brought 144A corporate debt transactions into the TRACE system. To identify the ultimate country of origin for each issuer, I first use the ISIN code information in the TRACE to merge with the Bloomberg and then further trace back the ultimate parent country of domicile for each issuer.



(a) **Foreign Discount: Aggregate**



(b) **Foreign Discount: Across Countries**

Figure 3: This figure plots the credit spreads difference between dollar-denominated bonds issued by non-US and those issued by the US, estimated using monthly regressions of credit spreads on a dummy variable *Foreign*, controlling for bond characteristics and liquidity. *Foreign* equals one if the bond is issued by non-US issuers and zero otherwise. Panel (a) is the foreign discount at the aggregate level and Panel (b) is the country-level foreign discount for six major economies, including the EU, GB, CA, JP, CN, and MX. The sample period is from January 2005 to June 2023.

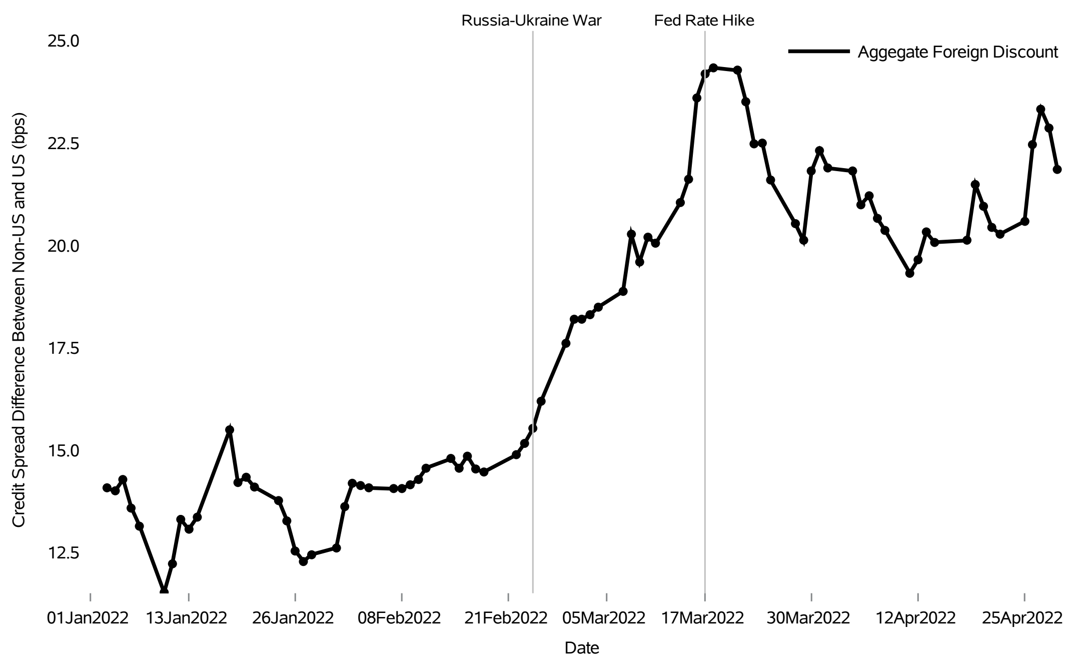
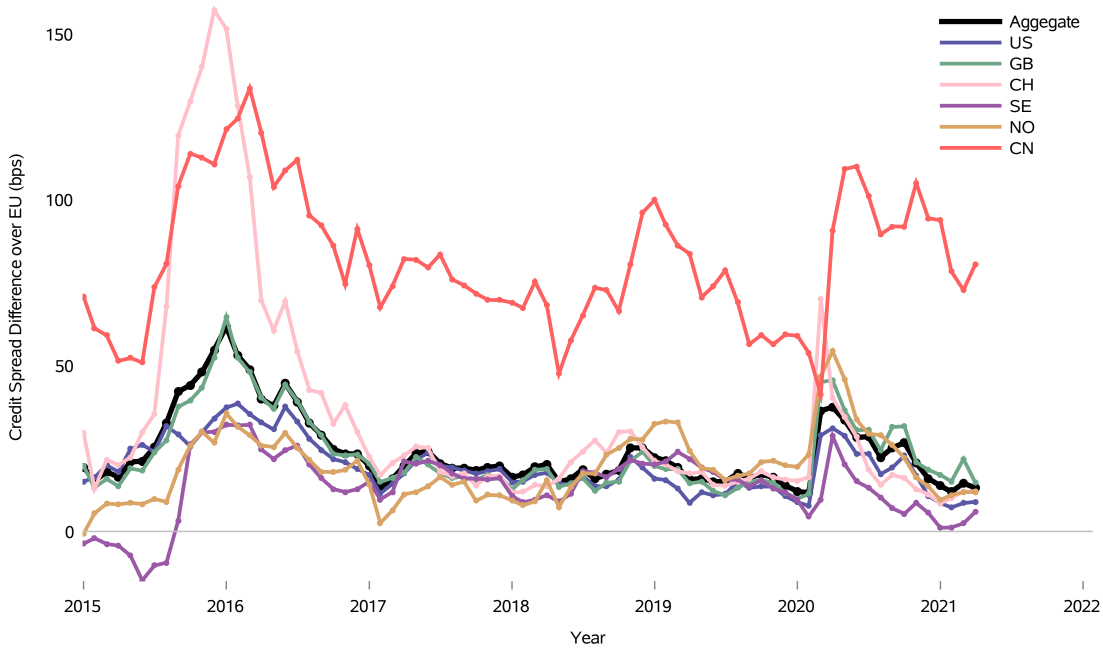
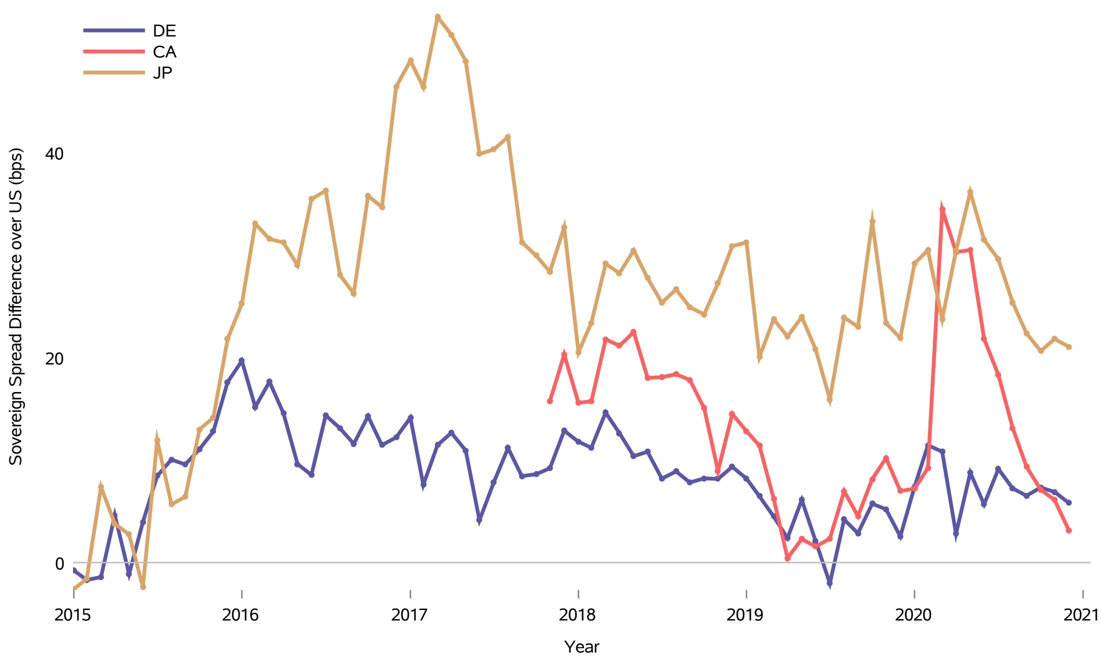


Figure 4: This figure plots the credit spreads difference between dollar-denominated bonds issued by non-US and those issued by the US, estimated using daily regressions of credit spreads on a dummy variable *Foreign* over a rolling window of the past week, controlling for bond characteristics and liquidity. *Foreign* equals one if the bond is issued by non-US issuers and zero otherwise. The sample period is from January 2022 to April 2022.



(a) **EUR-denominated Corporate Bonds: Spread Over EU**



(b) **USD-denominated Sovereign Bonds: Spread Over US**

Figure 5: The top panel plots the credit spreads difference between euro-denominated bonds issued by non-EU and those issued by the EU, estimated using monthly regressions of credit spreads on a dummy variable *Foreign*, controlling for bond characteristics. *Foreign* equals one if the bond is issued by non-EU issuers and zero otherwise. The sample period is from January 2015 to March 2021. The bottom panel plots the sovereign spread difference between dollar-denominated sovereign bonds issued by non-US and those issued by the US after adjusting the sovereign Credit Default Swap (CDS) spread. The sample period is from January 2015 to December 2020.

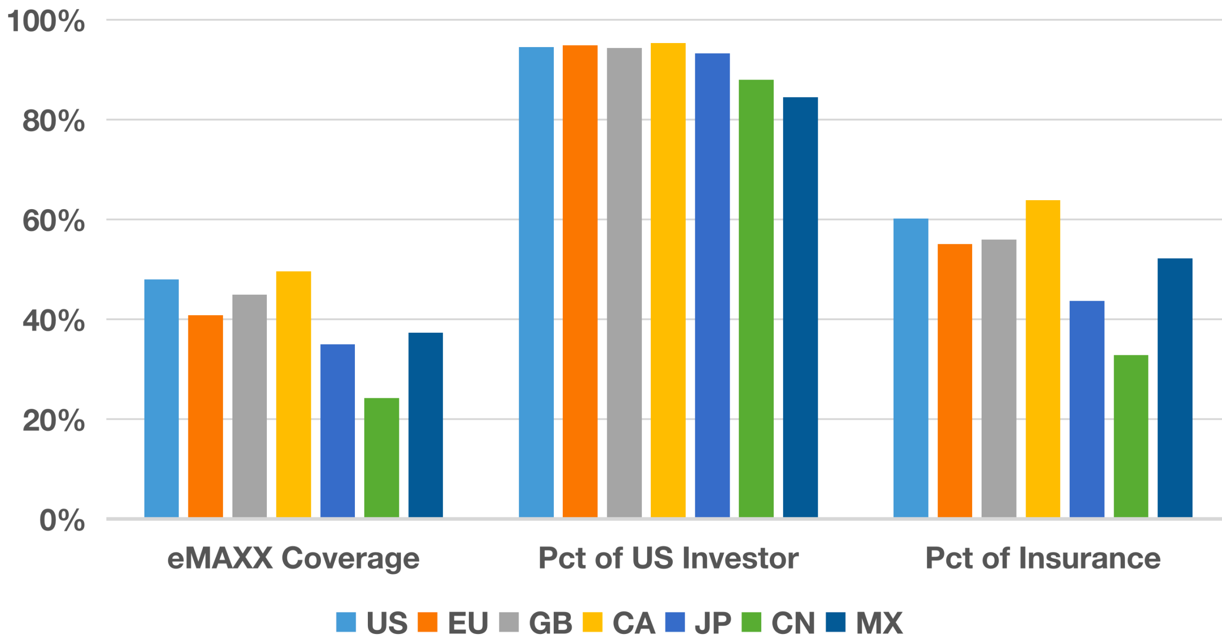
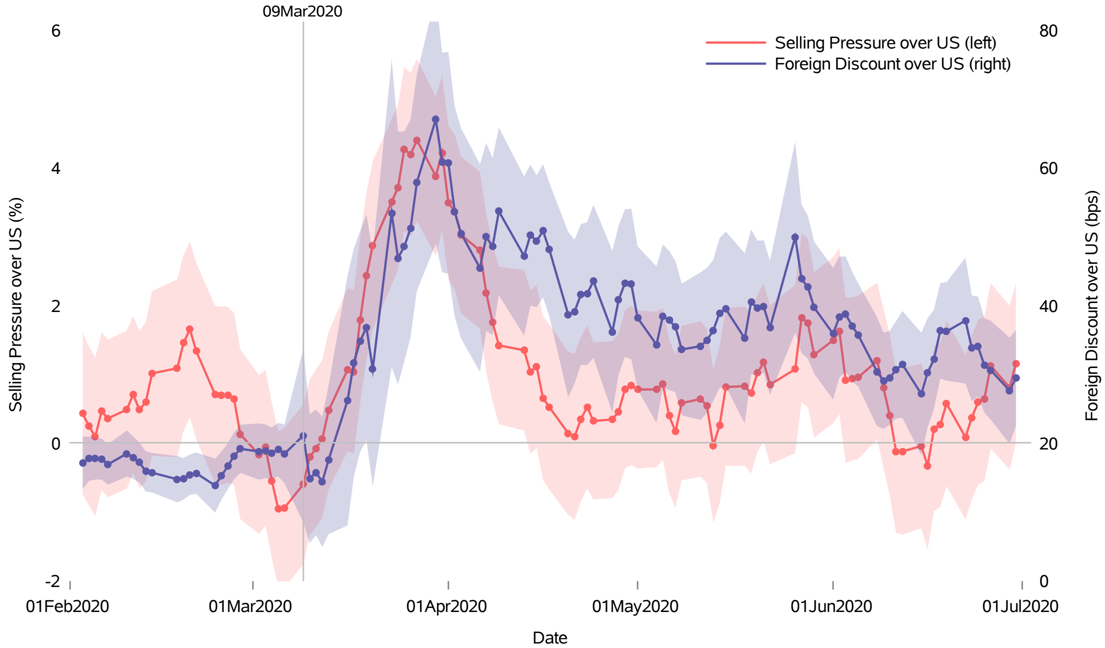
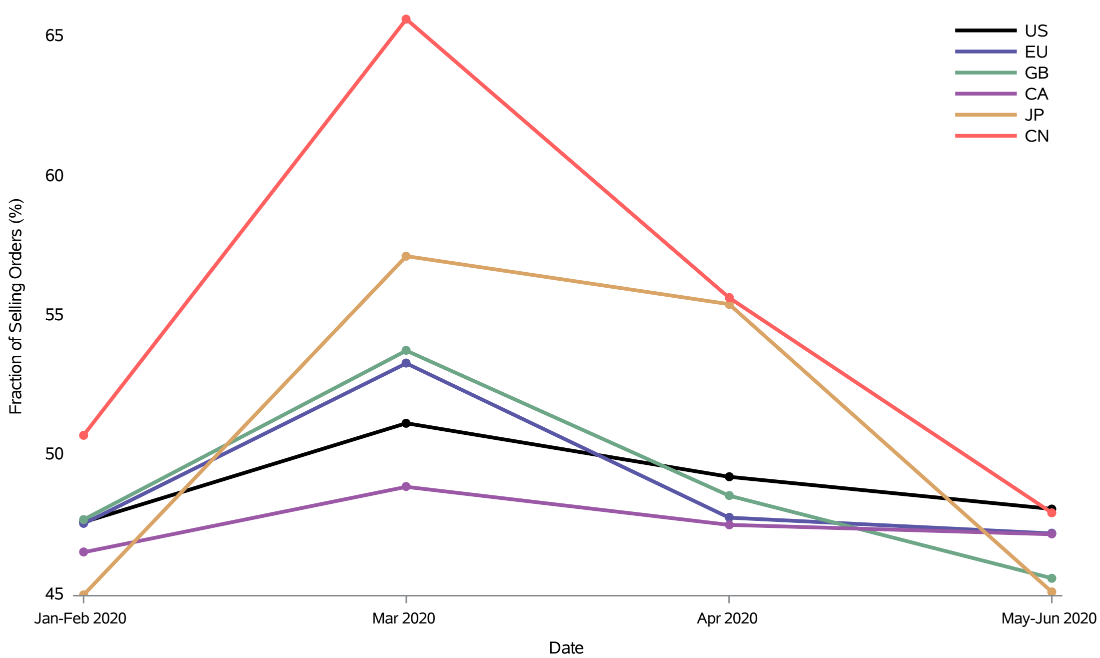


Figure 6: This figure plots the distribution of bond investors at the country level, as sourced from eMAXX, across three dimensions, including overall coverage, the percentage of US investors, and the percentage of insurance companies. The bondholders' information from eMAXX is from 2018Q2 to 2021Q1.



(a) **Aggregate Foreign Discount and Selling Pressure**



(b) **Selling Pressure Across Acountries**

Figure 7: Panel (a) plots the difference in selling pressure (left axis) and in credit spreads (right axis) between dollar-denominated bonds issued by non-US and those issued by the US during the COVID-19 pandemic, estimated using daily regressions specified in equation (1) over a rolling window of the past week. The selling pressure is defined as the fraction of sell-initiated transactions by customers within all the customer-dealer transactions for each bond each day. Panel (b) plots the monthly average of the fraction of sell-initiated transactions for six major economies before and after the COVID-19 pandemic.

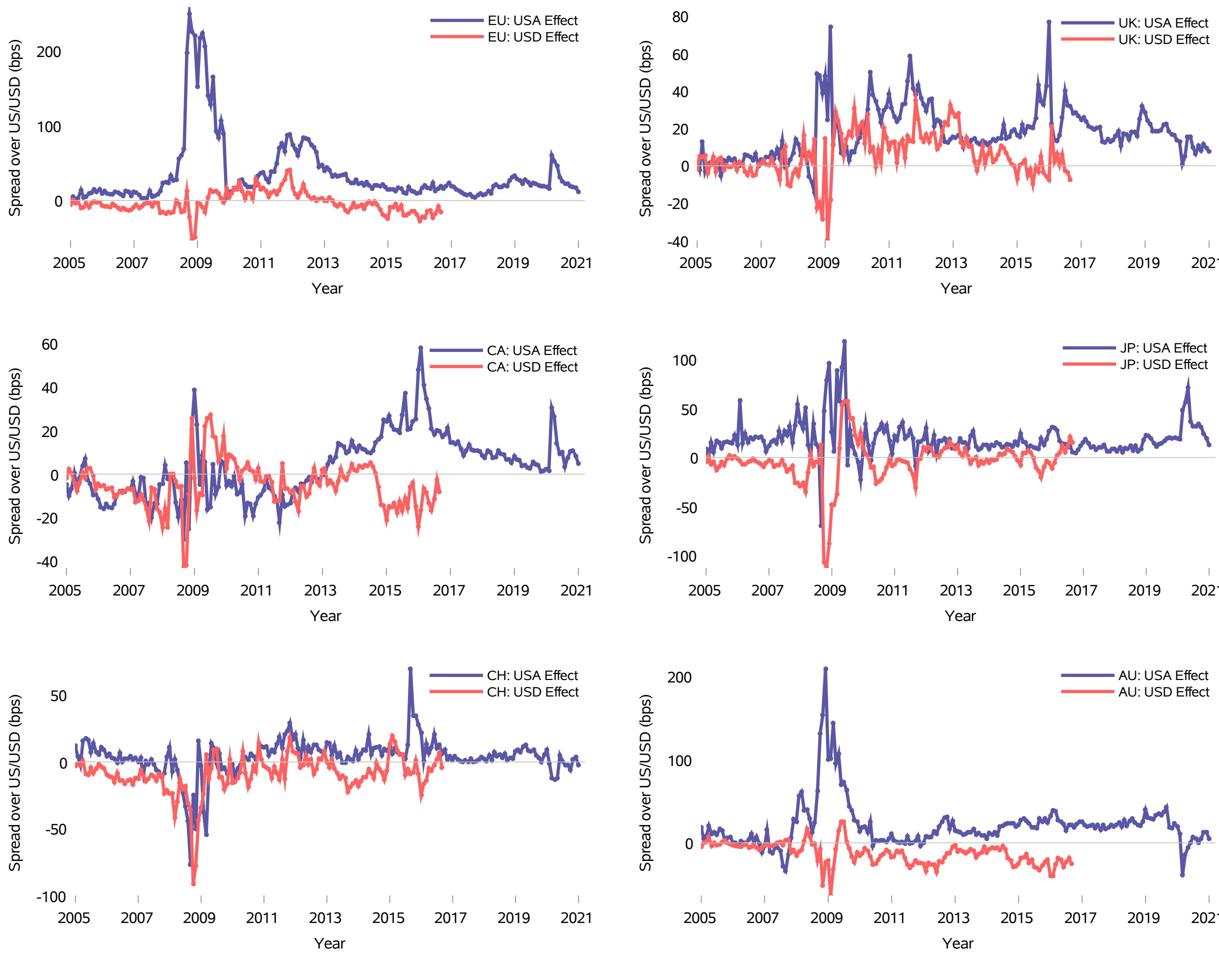


Figure 8: This figure plots the comparison between foreign discount (USA effect) and the safe dollar premium (USD effect). The red line refers to the safe dollar premium or corporate base for the six major currencies in Liao (2020), including EUR, GBP, CAD, CHF, AUD, and JPY. The blue line refers to the foreign discount for the six corresponding major economies, including EU, GB, CA, CH, AU, and JP.

Table 1: **Summary Statistics: USD-Denominated Bonds**

	Panel A: 2014/07 - 2023/06																	
	Mean						Median						STD					
Variable	US	EU	GB	CA	JP	CN	US	EU	GB	CA	JP	CN	US	EU	GB	CA	JP	CN
NumIssuers	1,448	192	114	99	54	56	1,448	192	114	99	54	56	1,448	192	114	99	54	56
NumBonds	13,179	1,028	729	710	515	214	13,179	1,028	729	710	515	214	13,179	1,028	729	710	515	214
CreditSpread	1.26	1.29	1.35	1.47	0.98	1.55	1.12	1.10	1.18	1.30	0.84	1.37	0.81	0.82	0.93	1.01	0.76	0.93
Yield	3.36	3.24	3.34	3.58	2.82	3.48	3.32	3.11	3.24	3.58	2.61	3.35	1.42	1.47	1.53	1.57	1.49	1.44
Rating	7.37	7.20	7.33	7.39	6.36	6.21	8.00	8.00	7.00	8.00	6.00	5.00	1.99	2.10	1.75	2.09	1.64	1.90
Maturity	11.02	8.15	9.05	10.92	4.98	8.82	7.38	5.04	6.01	7.30	3.84	5.92	8.99	7.79	8.06	9.01	4.28	7.97
Age	5.21	4.41	4.97	5.98	2.77	3.57	3.75	3.15	3.47	4.12	2.04	2.53	4.93	4.43	4.91	5.66	2.83	3.67
IssueSize	13.24	13.61	13.55	13.21	13.50	13.63	13.12	13.74	13.53	13.12	13.53	13.53	0.67	0.60	0.68	0.61	0.58	0.58
Coupon	4.23	4.02	4.27	4.45	3.10	3.87	4.00	3.88	4.13	4.38	2.93	3.75	1.57	1.61	1.62	1.86	1.35	1.28
Turnover	3.67	3.27	3.47	3.16	3.06	2.12	2.56	2.27	2.44	2.06	2.09	1.10	4.06	3.62	3.84	3.73	3.35	3.01
NumTrades	102.13	54.36	73.54	59.96	59.65	21.91	49.00	24.00	37.00	30.00	33.00	9.00	138.88	85.14	99.62	86.13	77.17	39.22
NumTradingDays	13.97	14.31	14.98	12.16	14.71	9.92	16.00	16.00	17.00	13.00	16.00	9.00	6.46	6.19	6.04	6.48	5.88	5.95
TradeSize	0.42	0.94	0.71	0.53	0.75	1.08	0.26	0.73	0.50	0.35	0.50	0.85	0.48	0.76	0.66	0.57	0.72	0.83
Gamma	0.39	0.25	0.29	0.50	0.17	0.36	0.09	0.03	0.05	0.07	0.02	0.05	1.37	1.13	1.17	1.82	0.97	1.61
	Panel B: 2005/01 - 2014/06																	
NumIssuers	1,242	132	86	70	26	13	1,242	132	86	70	26	13	1,242	132	86	70	26	13
NumBonds	8,683	497	414	397	138	31	8,683	497	414	397	138	31	8,683	497	414	397	138	31
CreditSpread	1.73	2.13	1.70	1.78	1.73	2.02	1.33	1.48	1.34	1.48	1.28	1.83	1.61	2.43	1.41	1.36	1.57	1.02
Yield	4.53	4.78	4.38	4.47	4.18	5.10	4.78	4.92	4.71	4.81	4.38	5.31	2.15	2.72	1.99	2.06	2.21	1.67
Rating	7.11	6.78	6.35	7.89	6.26	8.36	7.00	7.00	7.00	8.00	7.00	10.00	2.10	2.24	2.03	1.62	2.87	2.34
Maturity	9.96	8.80	9.06	11.56	6.99	15.65	6.78	5.48	6.08	7.49	4.47	14.84	8.61	8.10	8.10	9.55	6.91	9.42
Age	4.83	4.39	4.90	4.90	3.32	4.17	3.63	3.21	3.56	3.80	2.36	3.06	4.21	3.89	4.43	4.24	3.07	3.91
IssueSize	12.96	13.32	13.31	12.89	12.99	13.08	12.90	13.30	13.30	12.90	12.72	13.12	0.74	0.76	0.83	0.60	0.80	0.61
Coupon	5.73	5.75	5.69	5.84	4.83	5.73	5.80	5.75	5.65	6.00	5.00	5.88	1.58	1.80	1.72	1.68	1.94	1.61
Turnover	4.09	4.37	3.96	3.38	3.62	5.36	2.51	2.83	2.66	1.98	1.77	3.00	5.07	5.01	4.61	4.38	5.04	6.61
NumTrades	84.27	81.01	85.72	30.47	65.05	35.52	30.00	40.00	39.00	13.00	28.00	18.00	137.40	121.73	123.09	55.47	100.85	57.57
NumTradingDays	11.65	12.61	12.77	8.31	10.69	9.24	12.00	14.00	14.00	7.00	10.00	8.00	6.87	6.63	6.85	5.96	6.77	6.06
TradeSize	0.54	0.69	0.60	0.80	0.52	1.10	0.28	0.44	0.39	0.53	0.24	0.96	0.65	0.70	0.63	0.80	0.69	0.91
Gamma	1.36	1.30	1.13	1.23	1.23	1.11	0.34	0.24	0.24	0.23	0.28	0.33	3.29	3.54	3.05	3.22	3.14	2.87

This table reports the summary statistics for the dollar-denominated investment-grade corporate bonds issued by six major economies in the TRACE database, including the US, EU, GB, CA, JP, and CN. Panel A covers the sample period from July 2014 to June 2023 and Panel B covers the earlier period from January 2005 to June 2014. The separation arose from the event that the FINRA brought 144A corporate debt transactions into the Trace system on June 30, 2014. *Creditspread* is measured as the difference between the corporate bond yield and Treasury Constant Maturity Rate of the same maturity in percent. *Rating* is a numerical translation of Moody's rating: 1=Aaa, 2=Aa+ and so on until 21 to C. *Maturity* is the bond's time-to-maturity in years. *Age* is the time since issuance in years. *IssueSize* is the log of bond issuance size. *Coupon* is the bond's coupon payment in percent. *Turnover* is the average monthly trading volume as a percentage of its amount outstanding. *NumTrades* is the total number of transactions in a month. *NumTradingDays* counts the number of trading days per month. *TradeSize* is the average trade size of the bond in millions of dollars. *Gamma* measures the negative auto-correlation between daily bond prices following Bao, Pan, and Wang (2011).

Table 2: **Summary Statistics: EUR-Denominated Bonds**

	Mean						Median						STD					
Variable	EU	US	GB	CH	SE	CN	EU	US	GB	CH	SE	CN	EU	US	GB	CH	SE	CN
NumIssuers	75	40	22	15	10	10	75	40	22	15	10	10	75	40	22	15	10	10
NumBonds	752	401	221	62	36	25	752	401	221	62	36	25	752	401	221	62	36	25
CreditSpread	0.92	1.09	1.12	0.97	0.98	1.45	0.81	0.95	0.95	0.72	0.90	1.36	0.52	0.56	0.69	0.77	0.33	0.42
Yield	0.72	0.92	0.90	0.71	0.81	1.05	0.61	0.82	0.78	0.52	0.73	0.98	0.73	0.78	0.87	0.92	0.66	0.56
Rating	7.39	7.19	7.90	6.37	7.71	6.28	8.00	8.00	8.00	7.00	8.00	6.00	1.90	2.22	1.58	2.02	0.98	1.46
Maturity	7.32	7.93	6.90	6.71	7.16	4.86	6.68	7.01	6.33	6.13	6.40	4.56	3.99	4.29	3.62	3.50	4.05	2.49
Age	3.42	2.60	2.89	2.48	4.17	2.24	2.48	2.15	2.37	2.21	3.42	1.93	3.24	2.08	2.42	1.81	3.45	1.63
IssueSize	20.41	20.39	20.30	20.30	20.00	20.13	20.44	20.37	20.29	20.21	20.03	20.03	0.47	0.41	0.35	0.29	0.33	0.34
Coupon	1.99	1.69	1.75	1.36	2.29	1.61	1.50	1.63	1.60	1.35	1.88	1.63	1.48	0.86	1.00	0.82	1.51	0.41

This table reports the summary statistics for the euro-denominated investment-grade corporate bonds issued by six economies in the Bloomberg database, including the EU, US, GB, CH, SE, and CN. The sample period is from January 2015 to March 2021. *Creditspread* is measured as the difference between the corporate bond yield and the European Central Bank Yield Curve Rate of the same maturity in percent. *Rating* is a numerical translation of Moody's rating: 1=Aaa, 2=Aa+ and so on until 21 to C. *Maturity* is the bond's time-to-maturity in years. *Age* is the time since issuance in years. *IssueSize* is the log of bond issuance size. *Coupon* is the bond's coupon payment in percent.

Table 3: **Foreign Discount in USD-Denominated Corporate Bonds**

	Panel A: 2014/07 - 2023/06							Panel B: 2005/01 - 2023/06			
	All	EU	GB	CA	JP	CN	MX	All	EU	GB	CA
Foreign	22.06***	19.44***	20.70***	12.65**	18.17***	65.70***	60.24***	19.69***	25.67***	18.80***	5.03
	[6.57]	[5.17]	[3.80]	[2.21]	[2.67]	[8.06]	[3.77]	[5.10]	[3.54]	[3.38]	[0.83]
Rating	18.40***	18.19***	18.07***	18.19***	18.19***	18.31***	18.20***	20.24***	20.24***	20.09***	20.27***
	[10.58]	[10.75]	[10.51]	[10.39]	[10.35]	[10.36]	[10.45]	[12.47]	[12.31]	[12.59]	[12.45]
Maturity	3.68***	3.64***	3.65***	3.65***	3.65***	3.63***	3.66***	3.00***	2.97***	3.00***	2.99***
	[18.52]	[18.84]	[18.55]	[18.29]	[18.41]	[18.52]	[18.18]	[6.61]	[6.38]	[6.56]	[6.60]
IssueSize	-5.19**	-5.57**	-5.26**	-5.55**	-5.41**	-5.32**	-5.36**	-4.63	-4.74	-4.67	-4.81
	[-2.32]	[-2.45]	[-2.37]	[-2.49]	[-2.38]	[-2.37]	[-2.33]	[-0.72]	[-0.73]	[-0.73]	[-0.74]
Age	2.92***	3.03***	3.04***	3.02***	3.05***	3.05***	3.05***	3.36***	3.42***	3.39***	3.42***
	[7.89]	[7.92]	[7.89]	[7.68]	[7.80]	[7.82]	[7.74]	[6.39]	[6.32]	[6.35]	[6.21]
Turnover	1.71***	1.78***	1.80***	1.77***	1.75***	1.77***	1.81***	1.53***	1.58***	1.53***	1.49***
	[4.47]	[4.72]	[4.85]	[4.58]	[4.55]	[4.68]	[4.71]	[2.71]	[2.72]	[2.75]	[2.69]
Constant	30.43	36.6	31.51	36.05	32.82	30.3	31.33	12.97	12.9	11.91	15.05
	[1.05]	[1.23]	[1.08]	[1.23]	[1.11]	[1.03]	[1.04]	[0.14]	[0.13]	[0.13]	[0.16]
Obs	700476	612396	604455	602414	590928	581290	579428	1105040	976310	968247	966561
Adj R^2	0.35	0.36	0.35	0.36	0.36	0.36	0.37	0.15	0.15	0.15	0.15

This table reports the foreign discount within USD-denominated corporate bonds, estimated using panel regressions of credit spreads on a dummy variable $Foreign$, which equals one if the bond is issued by non-US issuers and zero otherwise, controlling for bond characteristics and liquidity, as well as industry and year fixed effect. Panel A shows the regression results for seven groups: a combined category labeled All, which includes all foreign issuers from the six specified countries, and separate categories for the EU, GB, CA, JP, CN, and MX from July 2014 to June 2023. Panel B shows the results for EU, GB, and CA in an extended period from January 2005 to June 2023. Reported in square brackets are tstat's using standard errors clustered by issuer and year. See Table 1 for bond-level variable definitions.

Table 4: **Foreign Discount in EUR-Denominated Corporate Bonds**

	Panel A: 2014/06 - 2021/03							Panel B: 2005/01 - 2021/03			
	All	US	GB	CH	SE	NO	CN	All	US	GB	CH
Foreign	22.59***	18.54***	22.22***	26.7	13.98***	20.79***	80.34***	20.89***	18.68***	20.41***	27.51*
	[4.07]	[3.66]	[4.83]	[1.59]	[2.89]	[2.76]	[10.92]	[4.00]	[3.66]	[4.55]	[1.68]
Rating	12.07***	11.82***	14.65***	12.98***	13.22***	13.14***	13.13***	12.52***	12.43***	15.00***	13.72***
	[8.27]	[9.21]	[8.86]	[9.16]	[8.96]	[8.56]	[8.61]	[8.13]	[8.73]	[8.48]	[8.68]
Maturity	2.71***	2.84***	3.66***	3.09***	3.43***	3.34***	3.37***	2.41***	2.42***	3.02***	2.50***
	[5.85]	[7.74]	[7.55]	[6.51]	[8.85]	[8.84]	[8.20]	[4.20]	[5.41]	[4.87]	[5.19]
IssueSize	1.82	2.55	-0.56	0.08	-1.52	-0.67	-0.62	1.17	1.28	-1.46	-1.12
	[0.71]	[1.21]	[-0.22]	[0.03]	[-0.60]	[-0.26]	[-0.23]	[0.43]	[0.50]	[-0.57]	[-0.39]
Age	-5.96***	-5.69***	-4.85***	-5.56***	-5.13***	-5.17***	-5.26***	-6.02***	-5.84***	-5.39***	-5.94***
	[-4.67]	[-5.15]	[-4.44]	[-5.39]	[-4.82]	[-4.80]	[-4.85]	[-5.43]	[-7.55]	[-6.14]	[-7.97]
Coupon	16.09***	15.34***	14.20***	15.25***	14.04***	14.24***	14.42***	17.19***	16.81***	16.44***	17.39***
	[5.07]	[5.66]	[5.09]	[5.42]	[4.93]	[4.99]	[5.05]	[5.72]	[7.81]	[6.64]	[8.02]
Constant	-84.3	-100.25**	-68.37	-61.2	-32.11	-47.93	-49.1	-71.29	-75.67	-46.86	-38.59
	[-1.48]	[-2.44]	[-1.18]	[-1.23]	[-0.67]	[-1.00]	[-0.94]	[-1.21]	[-1.58]	[-0.81]	[-0.68]
Obs	59686	44853	38271	31188	30421	29805	29878	66719	50618	43998	36270
Adj R^2	0.26	0.28	0.25	0.24	0.24	0.24	0.26	0.23	0.25	0.22	0.22

This table reports the foreign discount within euro-denominated corporate bonds, estimated using panel regressions of credit spreads on a dummy variable *Foreign*, which equals one if the bond is issued by non-EU issuers and zero otherwise, controlling for bond characteristics and liquidity, as well as industry and year fixed effect. Panel A shows the regression results for seven groups: a combined category labeled All, which includes all foreign issuers from the six specified countries, and separate categories for the US, GB, CH, SE, NO, and CN from January 2015 to March 2021. Panel B shows the results for US, GB, and CH in an extended period from January 2005 to March 2021. Reported in square brackets are tstat's using standard errors clustered by issuer and year. See Table 2 for bond-level variable definitions.

Table 5: **Foreign Discount After Controlling for Risk and Risk Premia**

Foreign	17.00***	17.86***	16.38***	17.01***	16.96***	14.83***
	[3.26]	[3.79]	[3.66]	[3.44]	[3.45]	[2.56]
Rating	19.03***	18.23***	16.21***	16.23***	16.28***	16.36***
	[10.10]	[10.88]	[10.13]	[10.38]	[10.59]	[10.84]
Maturity	3.32***	2.73***	2.76***	2.75***	2.77***	2.78***
	[12.78]	[6.49]	[6.89]	[6.90]	[6.89]	[7.10]
IssueSize	-0.03	3.45	1.85	0.42	0.21	0.09
	[-0.01]	[1.10]	[0.66]	[0.16]	[0.08]	[0.03]
Age	2.23***	2.13***	1.93***	1.84***	1.86***	1.84***
	[5.44]	[5.34]	[5.72]	[5.44]	[5.41]	[5.96]
Turnover		1.73***	1.48***	1.42***	1.41***	1.40***
		[3.12]	[2.93]	[2.86]	[2.82]	[2.88]
Gamma		17.22***	16.46***	16.31***	15.58***	15.52***
		[3.42]	[3.77]	[3.79]	[3.51]	[3.72]
Leverage			0.44***	0.46***	0.46***	0.46***
			[4.38]	[4.84]	[4.79]	[5.01]
AssetGrowth			-0.34***	-0.08	-0.08	-0.09
			[-2.82]	[-0.94]	[-0.95]	[-1.09]
EquityVolatility			1.37***	0.65**	0.65***	0.64***
			[6.83]	[2.51]	[2.61]	[2.56]
DefaultRisk				1.00***	1.01***	1.00***
				[2.65]	[2.65]	[2.68]
EquityPremium					-14.49**	-15.78***
					[-2.36]	[-3.11]
VariancePremium					0.52	0.54
					[1.19]	[1.33]
TermPremium					0.72	-0.91
					[0.51]	[-0.57]
DefaultPremium					-1.05	-0.32
					[-1.47]	[-0.71]
PoliticalRisk						-0.99
						[-0.85]
CurrencyRisk						-0.68
						[-1.07]
CreditRisk						1.73
						[1.37]
Constant	8.06	-41.63	-55.36	-38.17	-47.07	33.53
	[0.12]	[-0.92]	[-1.40]	[-1.00]	[-1.25]	[0.33]
Obs	425866	425866	425866	425866	424948	424948
Adj R^2	0.23	0.37	0.43	0.44	0.45	0.46

This table reports the foreign discount after controlling for the issuer-level risks, US risk premia, and country-level risks. Issuer-level risks include firms' default risk, estimated on Merton's distance-to-default with three key inputs: equity volatility, leverage, and asset growth; and firms' liquidity risk, proxied by turnover and gamma from Bao, Pan, and Wang (2011). US risk premia are captured through four proxies: the equity risk premium, variance risk premium, term premium, and default premium. Country-level risks include political risk, currency risk, and credit risk. *Foreign* equals one if the bond is issued by non-US issuers and zero otherwise. Reported in square brackets are tstat's using standard errors clustered by issuer and year. The sample period is from January 2005 to June 2023.

Table 6: **Foreign Discount and Country Level Uncertainty**

Foreign	17.00***	5.91	17.01***	7.48	14.83***	6.06
	[3.26]	[0.99]	[3.44]	[1.40]	[2.56]	[0.98]
EPU		1.98***		1.71***		1.47***
		[4.66]		[7.03]		[5.66]
Rating	19.03***	18.95***	16.23***	16.14***	16.36***	16.31***
	[10.10]	[10.19]	[10.38]	[10.26]	[10.84]	[10.79]
Maturity	3.32***	3.31***	2.75***	2.76***	2.78***	2.78***
	[12.78]	[12.78]	[6.90]	[6.93]	[7.10]	[7.12]
IssueSize	-0.03	-0.14	0.42	0.21	0.09	-0.10
	[-0.01]	[-0.03]	[0.16]	[0.08]	[0.03]	[-0.04]
Age	2.23***	2.19***	1.84***	1.82***	1.84***	1.82***
	[5.44]	[5.92]	[5.44]	[5.69]	[5.96]	[6.11]
IssuerRisk	No	No	Yes	Yes	Yes	Yes
USRiskPremium	No	No	No	No	Yes	Yes
CountryRisk	No	No	No	No	Yes	Yes
Industry&Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs	425866	425866	425866	425866	424948	425866
Adj R^2	0.23	0.24	0.44	0.44	0.46	0.46

This table reports the foreign discount after controlling for country-level uncertainty, proxied by the Economic Policy Uncertainty (EPU) index from Baker, Bloom, and Davis (2016). *Foreign* equals one if the bond is issued by non-US issuers and zero otherwise. Reported in square brackets are tstat's using standard errors clustered by issuer and year. The sample period is from January 2005 to June 2023. See Table 5 for variable definitions on issuer-level risk, US risk premia, and country-level risk.

Table 7: **Foreign Discount and 2020 GDP Forecasts**

	Num of Investors		Dispersion of GDP Forecast (%)				Mean of GDP Forecast (%)				
Country	Local	US	Local	US	FValue	Pvalue	Local	US	Diff	tValue	Realized
CA	11	8	0.79	1.60	4.11**	0.04	-6.12	-7.26	-1.14*	-1.87	-5.40
DE	17	13	1.47	1.70	1.34	0.57	-6.09	-7.05	-0.97*	-1.67	-4.90
FR	9	13	0.90	1.78	3.92*	0.06	-10.06	-9.41	0.65	1.12	-8.10
JP	12	13	0.71	1.18	2.73*	0.10	-5.18	-5.36	-0.19	-0.48	-4.80
UK	17	14	2.02	2.35	1.35	0.56	-8.39	-9.68	-1.29*	-1.65	-9.80
US	10	14	1.20	1.32	1.21	0.80	-6.28	-5.18	1.10**	2.09	-3.50

This table reports 2020 GDP growth forecast results across various countries, reported by both global (predominantly US-based) and local institutions from the Consensus Economics survey conducted on June 2020, including the number of investors, the dispersion of GDP growth forecasts and the mean of GDP growth forecasts. Local refers to investors from the local country and the US means global investors. To examine the difference between the two groups, I report the F-test for the dispersion of the forecasts and the double t-test for the mean of forecasts.

Table 8: **Foreign Discount and Issuer Level Uncertainty**

	X=Age_in_US	X=Sales_in_US	X=Rule144A	X=InstHoldings
Foreign*X	-1.11***	-0.36**	-7.84	-0.51***
	[-3.48]	[-2.19]	[-1.26]	[-5.40]
Foreign	28.01***	27.25**	18.35***	46.95***
	[6.59]	[2.42]	[4.60]	[4.73]
X	-6.20***	-0.06	27.78***	0.03
	[-4.10]	[-0.99]	[5.78]	[0.38]
Rating	19.04***	17.82***	19.01***	20.97***
	[9.83]	[7.59]	[9.97]	[5.35]
Maturity	3.90***	4.15***	3.94***	3.69***
	[24.20]	[22.49]	[24.60]	[16.75]
IssueSize	-4.51*	-6.08*	-4.19*	-11.33***
	[-1.92]	[-1.77]	[-1.77]	[-2.67]
Age	10.17***	2.91***	3.68***	3.76***
	[6.62]	[6.69]	[8.67]	[6.76]
Turnover	2.08***	1.88***	2.11***	2.53***
	[4.70]	[4.52]	[4.60]	[4.07]
Industry&Year FE	Yes	Yes	Yes	Yes
Constant	-43.57*	124.15***	-54.93**	46.71
	[-1.65]	[2.67]	[-2.10]	[1.11]
Obs	504194	147429	504194	140103
Adj R^2	0.37	0.42	0.38	0.28

This table examines the link between the foreign discount and the degree of uncertainty at the issuer level. To measure this uncertainty, several indirect proxies are utilized: (1) Age_in_US is the duration of the issuer's presence in the US bond market; (2) Sales_in_US is the proportion of the issuer's sales revenue generated within the US, as estimated from the Compustat Segments dataset; (3) Rule144A is a dummy variable, which equals one if the bond is issued under Rule 144A and zero otherwise; (4) InstHoldings refers to the percentage of the institutional holdings from mutual funds and insurance companies using data from eMAXX. *Foreign* equals one if the bond is issued by non-US issuers and zero otherwise. Reported in square brackets are tstat's using standard errors clustered by issuer and year.

Table 9: **Aggregate Foreign Discount and Time-Series Drivers**

	Panel A: Reg Aggregate Foreign Discount on Uncertainty and US Variables							
ΔEPU	7.26***							7.22***
	[4.06]							[3.12]
ΔEPU$_{US}$		4.06***						-0.46
		[3.34]						[-0.30]
ΔVIX			0.34**					0.35
			[2.01]					[1.61]
ΔICR				-4.42**				-2.07
				[-2.01]				[-1.07]
ΔYield					8.20**			5.48*
					[2.04]			[1.77]
R_{SP500}						-0.34*		0.28
						[-1.67]		[0.93]
R_{DXY}							0.41	-0.05
							[1.20]	[-0.18]
Constant	0.42	0.43	0.47	0.71	-0.16	0.63	0.11	0.06
	[0.40]	[0.41]	[0.52]	[0.85]	[-0.15]	[0.65]	[0.12]	[0.05]
Obs	221	221	221	221	221	221	221	221
Adj R^2	0.180	0.132	0.125	0.097	0.135	0.095	0.070	0.262

	Panel B: Reg Aggregate Foreign Discount on Interactions				
	X=ΔVIX	X=ΔICR	X=ΔYield	X=R_{SP500}	X=R_{DXY}
ΔEPU*X	0.78***	-11.30**	8.67	-1.44***	2.24*
	[3.78]	[-2.54]	[1.32]	[-4.53]	[1.93]
ΔEPU	6.98***	5.94***	6.02***	7.20***	6.20***
	[5.54]	[4.08]	[4.31]	[6.61]	[3.74]
X	0.21	-1.56	6.00	-0.11	0.29
	[1.60]	[-0.87]	[1.63]	[-0.72]	[1.00]
Constant	0.52	0.60	0.00	0.51	0.04
	[0.49]	[0.62]	[0.00]	[0.47]	[0.04]
Obs	221	221	221	221	221
Adj R^2	0.297	0.250	0.253	0.325	0.228

This table reports the predictability results for the aggregate foreign discount on a set of important macro-level variables. Specifically, the aggregate foreign discount in month $t+1$ is regressed on the lag of discount in month t and the set of US market-level variables in month t, including CBOE VIX index, the yields of "A"-rated bonds (CorpYield), and the S&P 500 index, the dollar index. Panel A shows that results from June 2014 to March 2021 and Panel B shows the results for a longer period from January 2005 to June 2023.

Table 10: **Model Calibrations**

	Data (bps)	Model (bps)			
		Risk Aversion γ=2			
	2005-2023	ϕ=0	ϕ=1	ϕ=2	ϕ=4
CS_{US}	139	140	140	140	140
CS_{Non-US}	160	140	161	186	242
CS_{Diff}	21	0	21	46	102
Discount	20	0	21	46	102
		Risk Aversion γ=4			
	2008-2009	ϕ=0	ϕ=1	ϕ=2	ϕ=4
CS_{US}	289	272	272	272	272
CS_{Non-US}	357	272	339	484	561
CS_{Diff}	68	0	67	212	289
Discount	75	0	67	212	289

The top panel reports the calibration results on how the degree of model uncertainty ($\phi \in \{0, 1, 2, 4\}$) affects bond credit spread (CS) and the foreign discount (Discount) in normal times, as indicated by the risk aversion coefficient $\gamma = 2$. The bottom panel reports the results in stressful times, as indicated by the risk aversion coefficient $\gamma = 4$. For the general environment, I set the benchmark risk aversion coefficient γ to 2, the risk-free rate r to 4%, the tax rate τ to 25%, the bond recovery rate α to 50%, the initial cash flow level δ_0 to 1 and the consumption elasticity β to 0.75. For the market volatility, I set σ^H and σ^F to be 20%. The expected growth rate of a firm's asset μ^i and the idiosyncratic volatility σ^i are calibrated to be 11% and 25%, respectively, for both the foreign and home firms. I set the home firm's systematic volatility to the home market volatility $\sigma_{i,H,H} = 20\%$. From Equation (8), the foreign firm's systematic volatility to the home market volatility $\sigma_{i,F,H}$ and the foreign firm's systematic volatility to the foreign market volatility $\sigma_{i,F,F}$ are solved to be 16% and 12%, respectively.