Foreign Discount in International Corporate Bonds

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Abstract

In the dollar-denominated corporate bond market, 42% of bonds with an amount outstanding of USD 5.9 Trillion are issued by non-US firms. Despite the increasing importance of cross-border financing, foreign issuers are paying an extra premium of 23 bps, compared with their US counterparts. A similar foreign discount exists in the euro-denominated corporate bond and dollar-denominated sovereign bond market. Contrary to the common view, the standard risk and risk aversion cannot explain the discount. I propose a theoretical explanation based on uncertainty aversion. The model can generate the uncertainty effect in the cross-section and the volatility effect in the time series, both are supported by the data. Taking Covid-19 as an event study, I further document a foreign squeeze effect by showing that foreign dollar bonds suffer higher selling pressure relative to US dollar bonds during market turmoil. Such foreign discount (USA effect) dominates the dollar safety premium (USD effect). My results highlight the foreign discount and foreign squeeze effects in the international cross-border investment and financing.

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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 March 2021, a large fraction (42%) of the dollar-denominated corporate bonds is issued by non-US entities, with an amount outstanding of USD 5.9 Trillion.[2] The presence of these non-US issuers could pose a non-trivial risk for global investors with such exposure. While the literature mainly focuses on the determinants of credit spreads among US corporate bonds, the pricing of dollar bonds issued by non-US firms is not well understood, which depends on the currency (USD) effect and the foreign (USA) effect. While the USD effect benefits the non-US issuer by reducing its borrowing cost due to safe dollar premium, the USA effect could induce higher financing cost due to higher uncertainty. In this paper, I study the foreign effect by fixing the currency to be the dollar. In the absence of the USD effect, the paper can also shed light on the home bias literature by providing new evidence in the pricing level, complementary to the existing holding level evidence.

In aggregate, I find a positive and significant foreign discount in the dollar-denominated corporate bonds in TRACE.[3] The discount is measured as the credit spreads difference between dollar-denominated bonds issued by non-US firms and US firms, controlling for rating, bond-level characteristics and liquidity, as well as industry fixed effects and year fixed effects. The aggregate discount is 22.9 bps, implying that non-US issuers have 22.9 bps higher borrowing cost than their US counterparts. Across countries, I show 20.1 bps discount for developed countries like Eurozone (EU), United Kingdom (GB), Japan (JP), Canada (CA) compared to 65.1 bps for developing countries like China (CN) and Mexico (MX). As over 90% of 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. In the time series, the discount becomes more prominent in stressful times like the global financial crisis, European debt crisis and Covid-19 pandemic.

Moreover, I show that the foreign discount is not unique to dollar-denominated corporate bonds, it also exists within euro-denominated corporate bonds. In this case, the EU issuers

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[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 literature documents why and when non-US firms issue dollar bonds, including the special role of the dollar, dollar bias, the safe dollar premium and timing 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, 2020, 2021), Liao (2020), Maggiori, Neiman, and Schreger (2020), Caramichael, Gopinath, and Liao (2021) and others.

[3] The total amount outstanding reported by TRACE is about 9.4 trillion USD by March 2021, accounting for 67% of the global dollar-denominated corporate bonds.

will be viewed as home issuers, while non-EU issuers like US issuers will be regarded as foreign issuers. Along with the US, I also include the United Kingdom (GB), Switzerland (CH), Sweden (SE) and Norway (NO) based on the amount outstanding of euro-denominated corporate bonds. Symmetrically, these non-EU issuers also pay an extra of 22.6 bps relative to their EU counterparts. Furthermore, such foreign discount also prevails in dollar-denominated government bonds. Even after adjusting by the sovereign CDS spreads, the discounts are 7.2 bps, 12.9 bps and 22.5 bps for the top three countries based on the amount outstanding, Germany, Canada and Japan, respectively. To sum up, the foreign discount is a much more general and symmetric effect.

I then examine the potential drivers underlying the foreign discount. 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.[4] In the context of cross-border investment, this uncertainty effect could be quite relevant. Since the major business of the foreign issuer happens outside the US, the US investors may find it more difficult to collect accurate and timely information about the asset generating process. Thereby they are more uncertainty averse about the foreign firm relative to the US firm. Next, I will first examine whether the risk and risk aversion can explain the foreign discount and then explore the uncertainty channel afterward.

Focusing first on risk channels, I consider both issuer-specific risks and country-specific risks. The issuer-level risks typically consist of 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. Although the credit risk is important in credit pricing, it can not explain away the discount. 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. Overall, non-US issuers are more likely to have better credit quality than US issuers. Nonetheless, 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) and find almost no effects on the foreign discount.

As for country-level risks, I consider currency risk, sovereign risk and local market risk. Specifically, I use country-level currency volatility to proxy for currency risk, sovereign CDS spread to proxy for sovereign risk, and country-level aggregate credit market and equity market movements to proxy for local market risk. Although CDS spread and local market movement have some explanatory power in the time series for countries like EU and CA,

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

the panel regression shows that about 70% of the variations in foreign discount is left unexplained, indicating that these country-level risks fail to explain the variations in the discount across countries. Indeed, the cross-sectional analysis among seven developed countries even suggests a reverse relation between country-level risk and discount. For example, Canada with the lowest discount actually has a relatively high CDS spread.

Moving next to the risk aversion, I investigate to what extent the foreign discount is driven by the variations of the US risk premia, which are the critical inputs in investors' pricing kernel. 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. While these risk premia are essential in the credit pricing, they have no significant effects on the discount. In addition to the risk and risk premium channels, the institutional differences including tax treatment, default and bankruptcy treatment, collateral and covenants considerations also fail to explain the pricing difference between foreign dollar bonds and US dollar bonds.

After documenting the persistence of the foreign discount, I now turn to explore a potential explanation based on uncertainty aversion. To provide a theoretical underpinning, I build a Leland-type model augmented with model uncertainty. There is one representative home investor and two perpetual bonds, one issued by a home firm while the other issued by a foreign firm. In order to differentiate the two firms, I first assume that the foreign firm's cash flow can be affected by both the home aggregate shock and foreign aggregate shock, while the home firm's cash flow is only related to the home market shock. To make it comparable, I fix the total risk faced by the two firms to be the same. Secondly, I assume that the investor knows precisely about the true process of the home aggregate process but is uncertain about the true growth rate of the foreign aggregate process. Thus the pricing of the two bonds depends on the degree of uncertainty, giving rise to the foreign discount.

While the model is relatively simple and mainly serves as a framework, the key is to illustrate the basic mechanics in driving the foreign discount. In the model, the foreign discount $FD = f(\phi, \rho_i, \gamma, \sigma)$ is increasing in country-level uncertainty (ϕ), investor's risk aversion (γ) and volatility (σ), and is decreasing in issuer-level correlation with US (ρ_i). If there is no model uncertainty ($\phi = 0$), the discount will reduce to zero. When $\phi > 0$, the model can generate the uncertainty effect in the cross-section and the volatility effect in the time series. Next, I will show supporting evidence across countries (ϕ), across issuers and investors (ρ_i), and over time (γ, σ).

Firstly, to examine whether countries have heterogeneous degrees of uncertainty (ϕ), I use the GDP growth forecasts on foreign countries reported by the large institutions in the US from the Consensus Economics survey.[5] Interestingly, for each foreign country, the average of forecasts among US investors tends to be smaller and less precise than that in local investors. When it comes to forecasting the US, the reverse effect is found. More importantly, the dispersion of forecasts among US investors tends to be larger than that of local investors. The extent of that dispersion across countries also aligns with the corresponding foreign discount, indicating that US investors exhibit uncertainty aversion toward foreign countries and then ask for a higher discount on countries with higher uncertainty.

Secondly, I explore different investors' heterogeneous degrees of uncertainty across foreign issuers (ρ_i). As it is challenging to measure the issuer-level uncertainty directly, I provide some suggestive evidence along different dimensions: (1) the age of the issuer in the US bond market; (2) the fraction of sales in the US; (3) bond issued under Rule 144A or not; (4) bond-level holdings percentage by large institutions. Intuitively, the longer the foreign issuers stay in the US bond market, the more likely the investors are to build up familiarity and ask for a lower discount. Likewise, for foreign issuers with a higher fraction of sales in the US market, we should expect the uncertainty to be smaller, so is the foreign discount. As Rule 144A bonds are mainly held by qualified institutional buyers (QIBs) who are more sophisticated, the discount should be smaller. Similarly, bonds with higher institutional holdings should have a lower discount. I find consistent results in the data.

Thirdly, in time series, I document that the foreign discount can be predicted by model parameters – risk aversion (γ) and volatility (σ), proxied by VIX index, home and foreign market movements. Since the higher the VIX Index is, the higher the degree of risk aversion or fear among investors is. As they are more concerned about the market, they will require a higher discount to hold less safe foreign dollar bonds. Moreover, as the investment-grade bond yields proxying for the overall credit situation increases, the investors are more likely to demand high compensation on foreign dollar bonds in a worsening credit environment. Lastly, when the foreign market becomes stressful, the investors will be more concerned about these foreign issuers, contributing to the higher foreign discount.

Taking Covid-19 as an event study, I closely look at the investors' trading behavior on the US dollar bonds v.s. foreign dollar bonds. The current literature documents the dash for cash and dash for dollar effects during Covid-19 pandemic,[6] I further show that it is the foreign dollar bonds that suffer higher selling pressure and more severe discount relative to

[5]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 et al. (2021).

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

US dollar bonds.[7] The discount jumps from below 20 bps before pandemic to well over 60 bps afterward. Across countries, the selling pressure is highest for CN, followed by JP, GB, UK and CA. In addition to the foreign discount, this quantity level evidence further provides a new economic channel, foreign squeeze during market turmoil, as an important implication of the classical home bias literature.

Lastly, I study the comparison between the foreign discount and the currency premium (from Liao (2020)). In principle, the pricing of the foreign dollar bond depends on the tradeoff between the dollar safety premium (USD effect) and the foreign discount (USA effect). Examining the time variations, I find that the foreign discount tends to dominate the dollar safety premium, especially for EU and GB in bad states like the global financial crisis and European debt crisis. In other words, the dollar safety premium can only be fully enjoyed by US issuers.

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). Moreover, Longstaff et al. (2011) study the sovereign credit risk for 26 countries and find the sovereign credit spreads are more related to US factors than local factors. Recently, Huang et al. (2020) show the global credit spread puzzle within G7 countries' corporate bonds and how it co-moves with the US and affects the economic growth. Unlike these studies either focusing on the US corporate bonds or non-US local corporate bonds, I look at the dollar bonds issued by non-US firms and examine the underlying drivers behind the pricing difference 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 premium.

Secondly, my paper contributes to the home-bias literature as the first comprehensive study on the foreign discount or the home-country effect in the pricing space rather than in the holding level documented in previous papers.[8] The most related paper is Maggiori, Neiman, and Schreger (2020) who show that the investors' bond portfolios exhibit strong dollar or home-currency bias in the international cross-border investment. Unlike their evidence in the holding level, I examine the pricing implication given that the investors have

[7]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.

[8]See French and Poterba (1991), Coval and Moskowitz (1999), Obstfeld and Rogoff (2001), Coeurdacier and Rey (2013), Cooper, Sercu, and Vanpée (2013), Burger, Warnock, and Warnock (2018).

already held those foreign dollar bonds in their portfolio. Controlling for the currency effect, I find that the home-country effect is still important in pricing the foreign dollar bonds. With the rapid development of the international cross-border investment, the home-bias effect in terms of quantities could be less pervasive as Coeurdacier and Rey (2013) shows. However, even if the investors become more willing to hold foreign assets and expand their investment frontier, it is still not clear what price they are willing to offer. Hence, examining the home-bias effect in the pricing level should yield useful insights and additional evidence to this classical puzzle. Moreover, I show that foreign dollar bonds suffer higher selling pressure than US dollar bonds, highlighting a new 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, outweighed the wealth share of the US in the world.[9] Besides, there are many papers studying why and when non-US entities issue dollar-denominated bonds,[10] which is not the focus of this paper. I mainly explore the pricing implications for foreign dollar bonds. The pricing of the dollar bond issued by non-US firms could depend on both the currency (USD) effect and the foreign (USA) effect. While the literature has so far been focused on the benefits of issuance of dollar-denominated bonds due to the USD premium[11], this paper is more about the potential cost side of the dollar bonds issuance arising from the non-USA effect. I find that the foreign discount tends to dominate the dollar safety premium, especially for the EU and GB in stressful times like 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 generality and robustness. Section 4 provides a simple theoretical framework based on uncertainty aversion to illustrate the basic mechanics. Section 5 provides supporting evidence on model implications. Section 6 studies the foreign squeeze effect on foreign dollar bonds during the Covid-19 pandemic, as well as the comparison between foreign discount and safe dollar premium. Section 7 concludes.

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[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, Jiang, Krishnamurthy, and Lustig (2018, 2021, 2020) for safe dollar premium in the international treasury market, Liao (2020) and Caramichael, Gopinath, and Liao (2021) for safe dollar premium in the international corporate bond market.

2 Data

This section summarizes the sample of international corporate bonds employed in this paper. First, I present an overview of international corporate bonds distribution across countries and currencies from Bloomberg. Then I show the summary statistics for the main sample of this paper, dollar-denominated corporate bonds in the US bond market, taking advantage of the detailed pricing and description information from TRACE and Mergent FISD. Next, I discuss the data on Bloomberg's euro-denominated corporate bonds and dollar-denominated sovereign bonds. The last subsection is a summary of market-level variables in the US and other countries from various data resources. Firm-level equity and financial data are from standard CRSP and Compustat datasets.

2.1 Overview of International Corporate Bonds

From Bloomberg, I can calculate the total amount outstanding of all the bonds around the world by countries or currencies. In total, the amount outstanding is 103 trillion USD by the end of 2019, consistent with 106 trillion USD reported by BIS. Unlike the BIS classification, Bloomberg can trace back the ultimate country of origin for each issuer. I will use this information to better reflect the country-level bond financing in later analysis.[12] By March 2021, corporate bonds account for 32% of all the bonds, with an amount outstanding of 37 trillion USD. Figure 1 plots the corporate bond amount outstanding distribution across countries or currencies from 2014 to 2021Q1. I choose 2014 as the starting year as the Bloomberg BQL function and the underlying dataset is only available after 2014. Later on, I will provide summary statistics for a longer period from 2002 to 2021Q1 from TRACE.

The top-left panel shows that the left axis is the fraction of the amount outstanding by countries and the right axis is the total amount outstanding in trillion USD. The corporate bonds are categorized into nine groups based on their ultimate country of origin, namely 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 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, the bond amount outstanding issued by US issuers takes the most significant proportion of the total (24.8%) by the end of 2021Q1, up from 22.6% in 2014. The amount outstanding increases from 6.3 trillion USD in 2014 to 9.2 trillion USD in 2021Q1. Moreover, the amount outstanding issued by EU issuers is 7.7 trillion USD in 2014, accounting for

[12] A similar point made by Coppola et al. (2021) on the international cross-border financing.

27.9% of the total corporate bonds. Afterward, the share of EU-issued bonds keeps shrinking and decreases to 21.6% in 2021Q1. On the contrary, China's corporate bonds have the most impressive growth during this short period, climbing from 3.2 trillion USD in 2014 to 8.1 trillion USD in 2021Q1. Meanwhile, its global share has a sharp increase from 11.5% in 2014 to 21.7% in 2021Q1, surpassing EU and becoming second only to the US. These three economies account for 68.2% of the global corporate bonds.

Moving to the top-right panel of Figure 1, the left axis is the fraction of the amount outstanding by currencies, and the right axis is the total amount outstanding in trillion USD. Now I classify the corporate bonds into seven groups based on denominated currencies, including USD, EUR, CNY, GBP, CAD, JPY, and the rest. The black line is the total amount outstanding for all countries while the green line refers to the amount outstanding for the US. Interestingly, the dollar-denominated bonds as a percentage of all corporate bonds are 37.8% by March 2021, a slight increase from 35.2% in 2014, but is much higher than the relative size of US-issued bonds (24.8%). The difference between 37.8% for dollar-denominated bonds and 24.8% for US-issued bonds implies that non-US firms issue a large quantity of dollar-denominated bonds. Similarly, there is a weak decreasing pattern for EUR-denominated bonds and a modestly increasing trend for CNY-denominated bonds.

Next, I examine the distribution within two major currencies across countries, dollar-denominated bonds as shown in the bottom-left panel and euro-denominated bonds in the bottom-right panel. Focusing on the dollar-denominated bonds, US-issued bonds account for the majority of the dollar bonds, with the share rising from 56.2% in 2014 to 57.9% in 2021Q1. In other words, 42% of the dollar-denominated corporate bonds are issued by non-US issuers, with an amount outstanding of 5.9 trillion USD. The main focus of this paper is to try to compare the pricing of the foreigner-issued dollar bonds to the rest of US dollar bonds. Besides the US, other countries or economies have a large portion of dollar corporate bonds, like EU, CN, GB, CA and JP. Turning to the bottom-right panel for euro-denominated bonds, the overwhelming majority are EU-issuers (71.4%), followed by US-issuers (8.8%) and then GB-issuers (7.1%) by March 2021. In section 3.2, I will also investigate the pricing difference between home bonds (in this case, 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 pricing and characteristics information of the corporate bonds from TRACE and Mergent FISD, I can uncover the most important piece of the dollar-denominated bonds in the world. As shown in the top panel of Figure 2 and Table 1, the total amount outstanding of corporate bonds in TRACE is 9.4 trillion USD by 2021Q1, accounting for 67% of the global dollar-denominated corporate bonds.[13] To further identify the ultimate country of origin for each issuer in TRACE, I first use the ISIN code information in TRACE to merge with the Bloomberg and then use the variable "ult_parent_cntry_domicile" in Bloomberg to trace back the ultimate parent country 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, US firms issue 7.0 trillion USD bonds, and the rest 2.4 trillion USD bonds are issued by non-US firms. Although the market share of foreign bonds in TRACE (26%) is smaller than that of share in the global market (42%), 2.4 trillion USD is still significant and sizable. I focus on the TRACE sample because TRACE has been widely used in the US corporate bond literature due to its comprehensive information about secondary market pricing. Meantime, the Mergent FISD dataset also provides detailed bond descriptions to facilitate the analysis. Moreover, any result found in this most transparent sample could also be applied to the more general setting, including offshore dollar-denominated corporate bonds and other currency-denominated corporate bonds.

The bottom panel of Figure 2 outlines the dynamics of foreign bonds as a fraction of all bonds in TRACE along three dimensions, including the number of bonds (red line), amount outstanding (blue line) and trading volume (orange line). Starting from 2002Q4 when TRACE became available, the three measures are around 17%. Over time, we can see a gradually increasing trend for foreign bonds in the amount outstanding. The percentage rises to about 23% by the end of June 2014. Then there is a sudden jump for all three measures. The amount outstanding sharply increases to over 30%. This is because FINRA brings 144A corporate debt transactions into the TRACE system.[15] Since most of the 144A corporate bonds are issued by foreign firms, a steep increase should be expected. Based on this observation, I will consider both the short and more complete period from June 2014 to March 2021 and the more extended period from January 2005 to March 2021. After the inclusion of 144A corporate bonds, the fraction of non-US bonds stays comparatively stable

[13] This number is slightly smaller than the number reported by SIFMA (10.7 trillion USD). See https://www.sifma.org/resources/research/fixed-income-chart/. The discrepancy primarily arises because some bonds may not be recorded into the Mergent FISD dataset, even if their pricing information is available. However, without bond characteristics information like issue date and maturity date, it is infeasible to add the bond into calculating the amount outstanding.

[14] In Mergent FISD, the variables related to country information are "Country Domicile (country_domicile)" and "Country (country)", which 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

and slightly declines post-Covid-19 pandemic. Meantime, the trading volume experiences a more significant drop to around 20% in 2021Q1. As for the number of bonds (red line), the pattern is relatively stable from June 2014 to March 2021.

Based on the amount outstanding of dollar corporate bonds across countries, I choose EU, GB, CA and JP as the main sample. I also include the CN and MX to shed light on developing countries. Some other countries like Australia (AU), Korea (KR), Switzerland (CH) and Brazil (BR) with a modest portion of dollar corporate bonds will also be added into analysis when necessary. 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 2 summarizes more detailed statistics before and after June 2014. For each bond and during each month, we consider its yield to maturity using the last trading-day price of this bond in that month. Following the convention, we use the Treasury Constant Maturity Rate (CMT) released by St. Louis Fed as the base rates and adopt the interpolation method to expand the full yield curve for the calculation of credit spreads.[16] Specifically, credit spread is measured as the difference between the corporate bond yield and CMT yield of the same maturity. To be included in the empirical analysis, I apply the following standard filters to the TRACE corporate bonds 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, as most foreign bonds are issued by relatively large corporations with high ratings, I only include the investment-grade (IG) bonds. Thus any results found within the IG sample would suggest even more significant effects for the high-yield bonds sample.

Panel A reports the summary statistics for the sample period from June 2014 to March 2021. Overall, there are 1312 US issuers with 11021 bonds, 161 EU issuers with 780 bonds, 90 GB issuers with 582 bonds, 83 CA issuers with 516 bonds, 38 JP issuers with 285 bonds, 51 CN issuers with 181 bonds. Panel B reports the summary statistics for the sample period from July 2002 to May 2014. Compared to the more recent and complete sample, the number of issuers and bonds is similar for the US. For EU, GB and CA, the numbers are relatively smaller but are still non-trivial. However, for JP and CN, the numbers are too small to conduct any meaningful statistical references. In addition to the number of issuers and bonds, the bond-level variables reported in the summary tables include bond characteristics 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

[16]https://fred.stlouisfed.org/categories/115

(TradeSize), and the monthly liquidity measure gamma from Bao, Pan, and Wang (2011). In addition, we also control for issuers' industry in our analysis using two-digit industry categorization from SIC industry code.

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 2, 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 except for CA. Comparing the US and non-US samples further, we see that US-issued bonds on average have longer maturity, smaller issuance size, higher coupon rate 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. Furthermore, the bond trading variables give us a sense of the overall liquidity condition across countries. Interestingly, different measurements of 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. So is NumTrades, which is measured as the average number of trades per month. 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, 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 bond prices following Bao, Pan, and Wang (2011), US-issued bonds have smaller trade size and higher gamma thus less liquid compared to the rest countries. The negative correlation between trade size and gamma is consistent with Bao, Pan, and Wang (2011)'s findings.

2.3 Corporate and Sovereign Bonds in Bloomberg

In addition to dollar-denominated bonds recorded in TRACE (onshore dollar bonds), I also collect data for euro-denominated bonds and dollar-denominated bonds in the eurodollar (offshore) market 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 as in the previous subsection also apply. Taking advantage of Bloomberg's self-developed algorithm (BQL and BQL.Query), I can download a large amount of data. As I mentioned before, the critical variable to identify the ultimate country of origin of the parent firm for each issuer is the "ult_parent_cntry_domicile". To pick up bonds issued in the eurodollar (offshore) market, I use the variable "exch_code" to exclude the bonds recorded in TRACE or New York. As for the industry classification, I choose the BICS level one industry categorization ("BICS_level_1_sector_name"). Lastly, I choose January 2015 as the starting date as Bloomberg's BQL algorithm only applies to data after 2014. This selection also coincides with the starting date in TRACE and makes the results easy to compare with each other.

As shown in Panel A of Table 3, from January 2015 to March 2021, 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. Panel B reports the summary statistics for the sample period from July 2000 to December 2014, which are too few to study. So I will neglect this sample period and only focus on the period after 2015. Comparing the EU and US samples further, we observe that EU-issued bonds on average have lower ratings (high numerical value), shorter maturity, a slightly larger issuance size, higher coupon rate 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 essential bond characteristics would be necessary, provided in the next section.

2.4 Market-Level Variables

This subsection is briefly describes the market-level variables in the US and other countries from various data resources. First, I download the CBOE VIX from St. Louis Fed. The second variable is the country-level corporate yield from "A"-rated firms, which measures the overall credit market condition in that country. The selection of "A"-rated issuers is based on the overall liquidity and data availability from Bloomberg Barclays Index. I also collect the country-level stock market major index from DataStream.[17] Moreover, I download country-level major policy rate and country-level exchange rate in foreign currency per U.S. dollar from CEIC for the period from January 1980 to March 2021. In the case of the US, the major policy rate is the fed fund rate and the key exchange rate variable is the dollar index. All the frequencies are monthly, consistent with the credit spreads. These data series will be useful in predictability tests conducted in Section 5.2.

[17] including "S&P 500 COMPOSITE", "FTSE ALL SHARE", "DAX 30 PERFORMANCE", "FRANCE CAC 40", "SHANGHAI SE A SHARE", "TOPIX" and "S&P/TSX COMPOSITE INDEX" for US, GB, DE, FR, CN, JP and CA, respectively.

3 Empirical Results: Foreign Discount

In this section, I estimate the foreign discount based on the credit spreads difference between bonds issued by US issuers v.s. foreign issuers from the panel regression as follows,

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

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. Moreover, I control for credit rating and other bond characteristics including maturity, issuance size, age, and liquidity. The panel regressions further include year and industry fixed effects to control for potential market-wide fluctuations and industry differences in credit spreads. The main results are reported in Table 4. The reported t-stat's 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. Hence, the coefficient b captures the credit spread difference between bonds issued by non-US firms and US firms. The first column is for all countries, aiming to quantify the extent of the foreign discount at the aggregate level.

In order to estimate the tension between a specific country and US, I run the regression for each foreign country within the sample including all the bonds issued by that foreign country's issuers and the bonds issued by US firms. For example, if the foreign country is GB, by focusing on the sample consisting of only US dollar bonds and GB dollar bonds, I can estimate the foreign discount for GB relative to the US. Here I choose four largest developed economies, including EU, GB, CA, JP, and two developing countries, including CN and MX, based on the amount outstanding of dollar bonds. Furthermore, to better capture the dynamic variations of the foreign discount, I estimate the time-series of coefficient b_t by performing the cross-sectional regression each month for each foreign country and plot the results in Figure 3.

3.1 Foreign Discount in Dollar-Denominated Corporate Bonds

Focusing first on the dollar-denominated bonds in TRACE, Panel A of Table 4 reports the regression results for the sample period from June 2014 to March 2021. The aggregate discount shown in the first column ("All") is 22.91 bps with t-statistics 6.09. This suggests that the bonds issued by US firms in general enjoy a premium of about 23 bps over their foreign counterparts after controlling for credit rating, other bond characteristics and liquidity. In other words, the borrowing cost in the bond market for foreign issuers is on average 23 bps higher than their US counterparts of the same credit rating, characteristics and liquidity. And this difference is significant both economically and statistically. Moreover, column 2-7 in Panel A shows the foreign discounts for each chosen country, which are 19.90 bps (t-stat=4.29) for EU, 21.60 bps (t-stat=3.73) for GB, 14.50 bps (t-stat=2.16) for CA, 18.66 bps (t-stat=2.62) for JP, 64.88 bps (t-stat=6.01) for CN, and 65.28 bps (t-stat=4.25) for MX, respectively. Not surprisingly, developing countries like CN and MX have considerably higher discounts compared to 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 exposed to higher risk than firms in developed countries, the lower discount in developed countries is to be expected. Panel B of Table 4 shows the estimation of foreign discount for a longer period sample from January 2005 to March 2021. The aggregate foreign discount is 20.10 bps with t-statistics 4.56, similar in magnitude as in the more recent sample period in Panel A. The country-level discounts are 28.38 bps (t-stat=3.29) for EU, 18.16 bps (t-stat=2.91) for GB, and 5.03 bps (t-stat=0.71) for CA. The increase in EU discount is mainly driven by the European debt crisis.

Next, I take a close look at the foreign discount over time. Panel A in Figure 3 plots the aggregate discount from January 2005 to June 2014. Every time when there is a crisis, we see a significant increase in the foreign discount. The first peak happens in the global financial crisis and the discount rises to 100 bps. The second one coincides with the European debt crisis and the third spike happens at the end of 2015 when the Fed starts a new round of raising interest rate after the global financial crisis. In the recent Covid-19 pandemic, we also find a steep increase in the discount to around 50 bps. Panel B in Figure 3 further plots the country-level discount over time. The discounts are all positive for the six countries most of the time after June 2014. Before that, EU and GB are almost positive from January 2005 to June 2014, while CA has a very small or even negative discount for most of the time. In the global financial crisis, the discounts in all the three countries (EU, GB and CA) have substantial increase. Interestingly, when it comes to the European debt crisis, the discount for EU and GB both spike up and stay at a high level. At the same time, we do not see such a pattern for CA, implying that the European debt crisis should be more relevant for European countries. More recently, during the Covid-19 pandemic, we also find a steep increase for most countries except GB. To sum up, when there is a bad shock to the global economy, the US investors will become more worried about the future economic situation. Therefore, the investors are more likely to demand high compensation for holding foreign bonds in worsening economic conditions. When the bad shock happens particularly to a specific country or region, everything else being equal, the investor would require higher credit spreads to hold bonds issued in that country or region, as we observed for the European debt crisis. For control variables, the credit rating and maturity are informative in explaining the credit spreads, so are issuance size, age and liquidity.

3.2 Foreign Discount in Euro-Denominated Corporate Bonds

In this subsection, I show that the foreign discount is not unique to dollar-denominated corporate bonds. Such discount also exists within euro-denominated corporate bonds. In this case, EU firms will be considered as the home issuers, while firms in the US, as well as in other countries, will be viewed as foreign issuers. The Panel A of Table 5 reports the estimates of coefficient b for a set of countries chosen based on the amount outstanding of euro-denominated corporate bonds, including US, GB, CH, SE, NO and CN. The coefficients for dummy variable $Foreign$ are positive and statistically significant: 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. This implies that EU-issued bonds overall enjoy a premium of 23 bps compared to bonds issued by other countries after controlling for credit rating and other bond characteristics and firm size.

To better capture how the foreign discount evolves over time and across countries, the top panels of Figure 4 outlines the time-series variation of the slope coefficient b using the cross-sectional regression by month and by country. Post 2014, the premium is essentially positive for all countries. More strikingly, we see the premium rising in two periods. The first one is from mid-2015 to the beginning of 2016, which could be related to the tightening regulation on the banking sectors in 2015 summer and the rising interest rates at the end of 2015. The second period is on March 2020, which is due to the coronavirus outbreak. The sharp increases in crisis periods confirm that the home (EU) investors tend to price foreign-issued bonds more negatively in bad states. Bonds issued by foreign firms are perceived to be less secure compared to the treasuries or investment grades bonds issued by home firms. In particular, EU investors also care about whether the bond issuer is an EU firm or not. This observation coincides with the model calibration result in Jiang, Krishnamurthy, and Lustig (2021). In their argument, around 90% of the convenience yield on US treasury is attributable to the dollar exposure rather than the safety/liquidity of the treasury department. In other words, if the treasury department issue euro-denominated bonds, it should not be able to explore the advantage of the convenience yield but rather pay the discount. This is also an indication of the home-country bias. And this discount, while staying at a modest level during normal times, tends to break open rapidly amid market turmoil.

3.3 Foreign Discount in Dollar-Denominated Sovereign Bonds

Next, I consider the foreign discount in dollar-denominated government bonds. Instead of using the regression setting to estimate the magnitude of foreign discount, I directly compute the sovereign credit spread by subtracting the US treasury yield from the sovereign dollar bond yield with the same maturity. To control for the sovereign credit risk, I download the sovereign CDS spread from Bloomberg and subtract sovereign CDS spread from the sovereign credit spread, denoted as the adjusted sovereign credit spread. As the most liquid sovereign CDS spread is 5 years, I choose all the foreign sovereign dollar bonds with maturity from 3 years to 7 years and calculate the average of adjusted sovereign credit spread each month as the measure of foreign discount in the sovereign bond market. Since the majority (90%) of the dollar-denominated government bonds are issued by the US government, I only choose CA, DE and JP as the main countries to study based on their amount outstanding and number of bonds.

On average, the sovereign credit 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 adjusted sovereign credit 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 shown in Panel B of Figure 4, the foreign discounts for the three countries are positive most of the time. These results indicate that the foreign discount is not unique to dollar-denominated corporate bonds, it also prevails in dollar-denominated government bonds. To sum up, the foreign discount is a much more general effect in the international bond market.

3.4 Foreign Discount: Risk and Risk Aversion

After documenting the generality 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 drivers. Theoretically, the equilibrium asset returns are driven by risk and risk aversion. Hence, I examine whether the standard risk and risk aversion can explain away the foreign discount, including issuer-specific risk, country-specific risk and US risk premium. Compared to US issuers, the foreign issuers could have higher firm-specific risk like credit risk and liquidity risk, or have additional country-specific risk exposures like currency risk, sovereign risk and local market risk, or co-move more with US risk premium embedded in investors' pricing kernel, leading to the foreign discount. Next, I will go through issuer-specific risk, country-specific risk and US risk premium one by one.

3.4.1 Issuer-Level Risk

First is the issuer-specific risk, I mainly look at issuer-level credit and liquidity risks. Specifically, to control the credit risk beyond ratings, I consider three dimensions: model-estimated default probability, ex-post real default probability and recovery rate. For the model-estimated default probability, I focus on the non-US issuers with listed equity in the US market. 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 measure – gamma from Bao, Pan, and Wang (2011). All the results are reported in Table 6.

Column 1 shows that aggregate discount without controlling for model-estimated credit risk or liquidity risk, similar in magnitude (21 bps) as in the whole sample (23 bps). After adding the two liquidity proxies (column 2), although the two liquidity proxies are significant in pricing the credit spreads, the discount remains around 21 bps. While high turnovers are associated with high credit spreads, the illiquidity measure gamma is positively correlated with the credit spread. The former suggests the reaching for yield story and the latter is better to reflect the liquidity risk. Column 3 further reports the discount after controlling for the leverage, asset growth and equity volatility, three critical inputs in constructing Merton's distance-to-default. Consistent with our intuition, I find that leverage and equity volatility are both positively and significantly correlated with the credit spreads, while asset growth (Mu) has a negative relation with credit spreads. Indeed, these fundamental variables can help explain some portion of the discount. The discount reduces from 21 bps to 17 bps. To better measure the credit risk, I estimate the distance-to-default following Merton (1974). In the absence of Moody's EDF data, I simply use the logarithm or the inverse of the distance-to-default to account for the fat tail issue with the normal distribution, denoted as the "DefaultRisk". While this credit risk proxy is essential in the credit pricing, negatively correlated with the credit spreads at the 1% significance, it cannot explain away the discount. If I add all the liquidity and default proxies, the discount becomes 17 bps, which is still sizable and highly significant.

Moreover, I manually collect ex-post bond default and recovery data from Moody's Annual Default Study. The default amount information across regions is from 2014 to 2020 and the recovery information is based on their trading prices in 2020. On the one hand, the fraction of defaults by non-US issuers is on average 26.4%. Compared with the fraction of total amount outstanding by non-US issuers (28.3%), it suggests that non-US issuers actually have a similar or even lower default probability than US issuers. On the other hand, the recovery rate across countries shows that the US issuers in general have a lower recovery rate

(19.5%) relative to CA (29.5%), EU (19.8%), CN (59.3%), and MX (32.1%), and higher than GB (7.1%). Documented by Maggiori, Neiman, and Schreger (2020), only large foreign firms can be able to issue bonds denominated in multi-currencies, which could potentially explain why these foreign firms on average have lower default probability and higher recovery rate than US issuers. Overall, these pieces of evidence on model-estimated default probability, ex-post actual default probability and recovery rate suggest that non-US issuers are more likely to have similar or better credit quality than US issuers. Nonetheless, they still need to pay a non-trivial discount to investors for being foreigners.

3.4.2 Country-Level Risk

Secondly, I examine whether the country-level risks can explain the foreign discount across countries, including currency risk, sovereign risk and local market risk. As different bonds face different levels of country-specific risks, it is not suitable to control these risks in the bond-level regression. Instead, I use the monthly change of country-level foreign discount obtained from Section 3.1 to regress on the monthly change of the country-level risks. Basically, it is a monthly time-series regression for any given country. In choosing the proxies of country-level risks, I use country-level currency volatility to proxy for currency risk, sovereign CDS spread to proxy for sovereign risk, and country-level aggregate credit market and equity market movements to proxy for local market risk. The aggregate credit market index is proxied by the yield of "A"-rated corporate bond for each country from Bloomberg. The aggregate equity market index is chosen as described in Section 2.4 from DataStream. The results are reported in Table 7.

Column 1-6 in Table 7 reports the results for each country. We can see that the sovereign CDS spread and aggregate local credit market movement have some explanatory power on the foreign discount in the time series, especially for EU, CA and MX. An increase in sovereign CDS spread is associated with an increase in foreign discount, both economically and statistically significant. Similarly, the aggregate credit market yield change is also positively correlated with the foreign discount. As the "A"-rated bond yields proxying for the overall credit situation increases, the investors are more likely to demand high compensation for holding foreign bonds in a worsening credit environment. Moreover, the adjusted R^2s are 0.66 for EU, 0.53 for CA and 0.44 for MX. While for GB, JP and CN, the explanatory power is rather weak, indicating that a large portion of the variations in country-level foreign discount is not attributed to these country-level risks.

Column Pool in Table 7 further shows the results for the panel regression in which I pool all the six countries together. Only the country-level interest rate has a marginal explanatory power on the foreign discount. Other country-level risk measures fail to explain the variations in the foreign discount. The adjusted R^2 shows that about 70% of the variations in foreign discount is left unexplained. Given that sovereign CDS spread and local credit market movement can explain some of the foreign discount in the time series. The failure to explain the variations in the panel regression is mostly driven by the disconnection between foreign discount and country-level risks in the cross-section. Then I further perform an additional cross-sectional analysis between the foreign discounts and country-level risk proxies. To increase the number of observations, I choose GB, CA, DE, FR, NL, JP, AU and plot their foreign discount against the average of sovereign CDS spread, the currency volatility and the equity volatility from June 2014 to March 2021. As shown in Figure 5, this simple exercise even suggests a reverse relation between country-level risk and the corresponding foreign discount. For example, CA with the lowest discount has a relatively high sovereign CDS spread. DE with the largest equity volatility turns out to have a relatively smaller discount. For currency risk, DE, FR, NL, JP and CA has relatively similar currency volatility but have different levels of foreign discount. These pieces of evidence suggest that the main challenge for the standard country-level risks is to explain the variations in the foreign discount across countries.

3.4.3 US Risk Premium

Thirdly, I investigate whether the foreign discount is driven by the variations of the US risk premia. From US investors' perspective, the key US market risks will enter into their pricing kernel. If foreign bonds and US bonds have different correlations with these US risk premia, it could potentially explain the foreign discount. To conduct a rigorous analysis, 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. Then I directly include these proxies into the regression setting in Equation (1) and report the results in Table 6. Consistent with the common view, the increases in the equity risk premium and variance risk premium are associated with the increase in credit spreads. While these risk premia are important in the credit pricing by themselves, they have no significant effects on the discount. The magnitude of foreign discount barely changes after the inclusion of these risk premium proxies, remaining at 17 bps.

3.4.4 Institutional Differences

In addition to the standard risk and risk premium dimensions considered above, the pricing difference between foreign and US dollar bonds could also be driven by institutional differences. In principle, the bonds issued by non-US and US issuers could have different treatments for tax, bankruptcy, collateral or investor clientele. To address this concern, I look into the institutional knowledge and go over these dimensions one by one. In general, there are three ways of issuing dollar-denominated bonds for a non-US firm. The foreigner can choose to register the bond under the SEC, which has the most stringent disclosure requirement and takes longer. Alternatively, the foreign firm can choose to register the bond under Rule 144A, which has less strict disclosure requirements and is held by qualified institutional buyers (QIBs). Lastly, the bond can also be registered under Reg S, which is open to global investors in the euro-dollar market. The issuer can also decide to register the bond under multiple regulations to access more investors.

For tax treatment, foreign firms need to pay corporate income tax, branch profits tax and withholding tax in the US. Moreover, since GB, JP, CA and most EU countries like DE and FR adopt territorial international taxation. Firms from these countries effectively pay similar tax rates as US firms. For the bankruptcy, if the foreign firms run into trouble, it is actually attractive for them to file for Chapter 11 as the US has the most flexible legal system in terms of reorganization and restructuring. Even in the event of liquidation, the US court can apply for the international law and get approved in the local court to freeze assets. Since most of my samples are from developed countries, it should be less of a concern. Moreover, from Moody's default and recovery data, non-US issuers tend to have lower default probability and higher recovery rates than US firms, which could be driven by higher quality or reputation concerns. In terms of collateral, most of the bonds in TRACE are in the DTC. Thus they share the same hair cut as US bonds, 20% to 30% for investment-grade bonds. Furthermore, the covenants are also light for investment-grade bonds issued by foreign firms. Usually, it only includes a negative pledge.

As for investor clientele, I obtain the bondholders' information from eMAXX from 2018Q2 to 2021Q1 and merge it with corporate bonds in TRACE. On average, the eMAXX uncovers 48% holdings by investors like mutual funds, insurance companies and pension funds. Among the 48% holdings, 94% of the investors are from the US and 59% of the investors are insurance companies. Across countries, I find EU, GB and CA have very similar holding structures as in the US in terms of coverage, the fraction of US investors and fraction of insurance companies. Nonetheless, foreign issuers from these three countries also have a sizable discount as shown before. To sum up, these institutional considerations also fail to explain the pricing difference between foreigner-issued bonds and home-issued bonds.

4 Model

After documenting the persistence and robustness of the foreign discount, I now turn to explore the potential explanation, especially in explaining the variations in the cross-section. On top of risk and risk aversion, the investors could also exhibit uncertainty aversion towards assets that are difficult to estimate the true distribution. In the context of cross-border investment, this uncertainty effect could be quite relevant. Since the major business, cash flows, and operating headquarters of the foreign issuer are outside the US, and investors may find it more challenging to collect accurate and timely information about the asset-generating process. Thereby they are more uncertainty averse about the foreign firm relative to the US firm. To provide a theoretical underpinning, I build a simple Leland-type model augmented with model uncertainty. The basic model setting is the same as in Leland (1994) except that there are two perpetual bonds, one issued by home issuer while another issued by 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 characterize its properties with respect to the key parameters. Lastly, I discuss the main mechanism delivered by the model.

4.1 Preferences

First I introduce the aggregate output process for home country Y_t^H and foreign country Y_t^F, which follows 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 uncertain about 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 only 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. ζ is the density of probability distribution $P^\zeta \in P(\zeta)$ 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 some 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 ambiguity. 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^ζ and the alternative distribution P. The superscript F refers to the penalty function 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 as in Uppal and Wang (2003). Lastly, for analytical convenience, $\psi(U_s)$ 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 are 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 risk price for systematic Brownian shock from B_t^H, which equals to $\gamma\sigma^H\beta$. 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 consideration over model uncertainty with respect to the foreign aggregate output process. When $\phi = 0$, it reduces to the standard case. The robust control framework yields a nice and simple close-form solution to illustrate the basic mechanism later on.

4.2 Firms

Next I specify the dynamics of the asset generating process for home firm and foreign firm, respectively. There are two perpetual bonds with coupon rate of C^H and C^F, respectively, one issued by home firm while another issued by foreign firm. 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,

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

where μ and σ are the firm's expected growth rate and idiosyncratic volatility, which are both constant over time. $B_t^{i,H}$ ($B_t^{i,F}$) is a standard Brownian motion that generates idiosyncratic shocks specific to the home (foreign) 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. To make the model as simple as possible, I make the assumption that both home issuer and foreign issuer have the same μ and σ.

In order to differentiate the foreign issuer from the home issuer, two key ingredients are integrated into the model. First, as shown in Equation (7), I assume the foreign firm's cash flow can be affected by both the home aggregate output shock and foreign aggregate output shock while the home firm's cash flow is only related to the home market shock. Intuitively, for foreign firms listed in the US market, the US investors care about both the overall market risk in the US 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 firm and the foreign market. To make it comparable, I fix the total risk faced by two firms to be the same by choosing $\sigma_{i,F,H}$ and $\sigma_{i,F,F}$ to satisfy the conditions below for any given $\sigma_{i,H,H}$,

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

Hence, in the absence of model uncertainty, the foreign bond will have the same credit spreads as the home bond. There is no foreign discount.

To generate the foreign discount, I introduce the second distinction based on uncertain aversion toward the foreign process. As shown in Equation (3), I assume that the home investor is only concerned about gauging the true growth rate of the foreign market process. As a consequence, the default boundary for the foreign firm could be closer than the one without model misspecification. Thus the investors would require higher credit spreads. This intuition is also captured in earlier works.[18] 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.

4.3 Foreign Discount

In order to price the assets in the model, we need to define the risk-neutral probability measure Q to discount the cash flows of any asset with risk-free rate. 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

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

Thus, under Q, the firm j's ($j \in (H,\ F)$) cash flows process can be converted to the standard form as in Leland (1994), $d\delta_t^j/\delta_t^j = \mu_j^Q dt + \sigma_j^Q dB_t^{j,Q}$, where

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

Next, we consider the debt pricing and equity pricing in the model. According to the

[18] Duffie and Lando (2001) assume bond investors cannot perfectly observe the issuer's assets. Instead, they receive imperfect and periodic information at selected times. After deriving the conditional distribution of the assets, given accounting data and survivorship, 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. She parameterizes an ambiguity belief set by an interval centered around the long-run mean of the growth rate. The larger the set of beliefs is, the less confidence the agent has in her probability assessment of the growth rate. The model can generate large credit spreads matched with the empirical data.

classical trade-off between debt tax shield and bankruptcy cost in the original model, 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, which is the unlevered asset value $\frac{\delta_t}{r-\mu^Q}$. After paying out the coupon C to the debt holders, the taxable earnings 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 $E'(\delta_B) = 0$. 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. In the event of default, all the remaining value of the firm will go to debt holders and the equity holders get nothing. 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. Then we are ready to solve for the debt price $D(\delta)$ and equity price $E(\delta)$ in a closed-form following the standard procedure. First, given some default boundary δ_B, I solve the debt price and equity price. Then I use the smooth pasting condition to get the optimal default boundary. Finally, 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 as if the investors independently price the two issuers. The solutions are the following,

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

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

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

$$\delta_B^j = AC^j, \quad C^j = \left(1 + \kappa_j + \frac{\alpha\kappa_j(1-\tau)}{\tau}\right)^{-\frac{1}{\kappa_j}} \frac{\delta_0}{A},$$

$$A = \frac{(r-\mu_i^Q)\kappa_j}{r(1+\kappa_j)}, \quad \kappa_j = \frac{\mu_i^Q - \frac{1}{2}\sigma_i^{Q^2} + \sqrt{(\mu_i^Q - \frac{1}{2}\sigma_i^{Q^2})^2 + 2\sigma_i^{Q^2} r}}{\sigma_i^{Q^2}}.$$

Thus the pricing of the foreign bond v.s. home bond depends on the degree of uncertainty ϕ, giving rise to the foreign discount. I now move to the quantitative performance of the model.[19] I borrow the standard calibration parameters from the literature, including risk

[19]Note that the model is not designed to match the credit spreads puzzle as many other papers are targeted at in the literature. (See Chen, Collin-Dufresne, and Goldstein (2008), Chen (2010) and Shi (2019)). Instead,

aversion coefficient, moments of the asset market, moments of the firm-level performance, bond recovery rate, tax rate, correlation with the home and foreign market, and the degree of uncertainty. Table 8 summarizes the basic parameters used in the calibration exercise. I set the risk aversion coefficient γ to be 2, risk-free rate r to be 4%, the tax rate τ to be 25% and the bond recovery rate α to be 50%. As for the expected growth rate and volatility of the market, I choose μ^H and μ^F to be 10%, and σ^H and σ^F to be 20%. The expected growth rate of a firm's asset μ and the idiosyncratic volatility σ are calibrated to be 4% and 40%, respectively. The correlation between home firm and home market movement is set to be 40%. The degree of uncertainty aversion ϕ is 2.

The model calibration result is reported in Figure 6. The top-left panel shows the result for debt pricing, while the top-right panel shows the result for the credit spread. We can see that the foreign bond (blue line) has a lower bond price and higher credit spread than the home bond (red line), which is driven by the uncertainty effect in the model. The bottom-left panel shows the result for the default boundary, while the bottom-right panel shows the result for the leverage. The foreign issuer has a lower default boundary but lower leverage than the home issuer. After showing the existence of foreign discount in the model, I then characterize its properties with respect to the key parameters in the model.

4.4 Model Mechanics

While the model is relatively simple and mainly serves as a framework, the key is to illustrate the basic mechanics in driving the foreign discount. To understand what gives rise to the foreign discount and how does it respond to the variations in model parameters, I derive the following proposition,

Proposition 2 *The foreign discount (FD) has the following properties: (a) When there is no uncertainty $\phi = 0$, there is no foreign discount (FD=0). (b) FD is increasing in the level of uncertainty ϕ, risk aversion coefficient γ, the foreign market volatility σ^F, the home market volatility σ^H, and is decreasing in the correlation with US market $\sigma_{i,F,H}$.*

Note that both the foreign and home bond have the same solution structure with different expected growth rates μ_j^Q and volatility σ_j^Q ($j \in (H,\ F)$). From the insights in the Leland model, we know that the bond price is increasing in the expected growth rate and decreasing in volatility. When the growth rate increases, the present value of future dividend payments goes up. Thus the probability of default decreases (cash flow channel). When the volatility

the main objective of the model is to compare the difference in bond pricing between the foreign issuer and the home issuer.

drops, the present value of future dividend payment rises due to a decline in risk premia (discount rate channel). Although there is an additional option-related volatility effect in which a decrease in volatility makes it less attractive for the firm to stay longer as the option value falls, the cash flow effect and discount rate effect dominate the volatility effect. That is to say, in a state with a high growth rate or low volatility, the firm is willing to wait longer as the probability of default decreases. Besides, there is also a concavity effect. The slope of bond price is larger for low growth rate and high volatility, meaning that following the same magnitude reduction in growth rate, the bond price will drop more dramatically in low growth rate state compared to high growth rate state. A similar effect applies to volatility as well.

Armed with this intuition in determining the endogenous default boundary and bond price, let me walk through the results in the Proposition (2). When there is no uncertainty $\phi = 0$, from Equation (10) and Equation (8), we have $\mu_F^Q = \mu_H^Q$ and $\sigma_F^Q = \sigma_H^Q$. Thus the foreign discount equals zero. For the second part of the Proposition (2), I consider the response from the model parameters on the growth rate μ^Q and volatility σ^Q one by one. From Equation (10), (b.1) an increase in ϕ implies an increase in the degree of uncertainty. Through foreign issuer's exposure to the foreign market, the growth rate on the foreign bond decreases. 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 by assumption, we do not see any adjustment on the home bond's growth rate. Therefore, the foreign discount responds negatively to the increase in uncertainty; (b.2) an increase in risk aversion coefficient γ is associated with a decrease in expected growth rate for both the foreign bond and home bond. However, the extent of that decrease is larger for the foreign bond as opposed to the home bond due to the additional effect from the uncertainty item ϕ. Hence, we should expect the foreign discount will rise accordingly; (b.3) if the home aggregate volatility σ^H increases, signaling a volatile and shaky market. It will negatively affect the expected growth rate for foreign and home issuers with the same magnitude, given that the total risk should be the same. Note that the growth rate of the foreign issuer is already smaller than that of the home issuer because of the uncertainty item ϕ. Due to the concavity effect, the bond price will drop more dramatically for the foreign issuer relative to the home issuer. As a result, the foreign-country premium will ascend along; (b.4) when the foreign market experiences turmoil, proxied by an increase in the foreign aggregate volatility σ^F, the expected growth rate of the foreign firm decreases due to the additional uncertainty item ϕ. Consequently, we see a rise in foreign discount; (b.5) when the correlation with US market $\sigma_{i,F,H}$ increases, $\sigma_{i,F,F}$ has to decrease to satisfy Equation (8). The reduction in $\sigma_{i,F,F}$ has a large impact than the increase in $\sigma_{i,F,H}$ due to the uncertainty item ϕ. Hence, the expected growth rate of the foreign firm increases, leading to a drop in the foreign discount.

To sum up, from Proposition (2), when $\phi > 0$, the model can generate the uncertainty effect in the cross-section and the volatility effect in the time-series. For the uncertainty effect, the investor will require a higher discount for the country with higher uncertainty (ϕ), or for the foreign issuer with lower correlation with the home market ($\sigma_{i,F,H}$). For the volatility effect, the investor will ask for more compensation in bad states when the risk aversion (γ) increases or the home or foreign market volatility (σ^F or σ^H) spikes up. Next I will show supporting evidence across countries (ϕ), across issuers and investors ($\sigma_{i,F,H}$) and over time (γ, σ^F, σ^H) in next section.

5 Foreign Discount and Uncertainty

5.1 Foreign Discount: Cross Section

Firstly, across countries (ϕ), I use the 2020 GDP growth forecasts on foreign countries reported by the large global institutions, as well as forecasts by the domestic investors from the Consensus Economics survey and report the results in Table 9. The typical global institutions include Goldman Sachs, JP Morgan, Bank of America - Merrill, Morgan Stanley, Citigroup, Markit, Moody's from the US, and Barclays, Deutsche, Credit Suisse, UBS, HSBC, Nomura Securities, Oxford Economics and Capital Economics from other countries. The domestic institutions are mainly large banks, insurance companies and security firms. The number of forecasts by global and domestic institutions are more or less comparable, as shown in Columns 2 and 3 from Table 9. Due to the data limitation, I only obtain a snapshot of June 2020 on the 2020 GDP growth forecasts.

Interestingly, for each foreign country, the average forecasts among US investors are all smaller than the average forecasts made by local investors in that country. Moreover, the realized GDP growth implies that the precision of the forecast by local investors is higher than that of US investors, suggesting that US investors behave as if they are relatively more "pessimistic" about other countries economies. When forecasting the US, the reverse and symmetrical effect is found. The US investors predict a better and more accurate GDP growth than non-US investors. Besides, the dispersion of forecasts among US investors tends to be larger than that of local investors. More importantly, the extent of that dispersion across countries lines up 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.

Next moving to the cross-issuers ($\rho_{i,F,H}$), I explore different investors' heterogeneous degrees of uncertainty across foreign issuers. As it is challenging to measure the issuer-level uncertainty directly, I provide some suggestive evidence along different dimensions: (1) the age of the issuer in the US bond market; (2) the fraction of sales in the US; (3) bond issued under Rule 144A or not; (4) bond-level holding percentage by large institutions. Intuitively, the longer the foreign issuers stay in the US bond market, the more likely the investors are to build up familiarity and ask for a lower discount. Likewise, for foreign issuers with a higher fraction of sales in the US market, we should expect the uncertainty to be smaller, so is the foreign discount. As Rule 144A bonds are mainly held by qualified institutional buyers (QIBs) who are more sophisticated, the discount should be smaller. Similarly, bonds with higher institutional holdings constructed from eMAXX should also have a lower discount. I report the results in Table 10.

Column 1 in Table 10 shows the result for the age of the issuer in the US bond market. The interaction term Foreign*Age_in_US is -1.11 with t-stats -3.48. The negative and significant coefficient implies that the age effect does mitigate the foreign discount to some extent. In the extreme case where Age_in_US equals 0, the foreign discount increases to 28 bps. For Sales_in_US, which is computed as the fraction of the issuer's revenues (REVTS) in the US among total revenues, using data from Compustat Segments Dataset. Higher Sales_in_US means that the issuer has a higher fraction of sales in the US market, which is also found to have a negative effect on the foreign discount, consistent with the intuition. The coefficient estimate is -0.36 with t-stats -2.19. In other words, for issuers with no sales in the US market, the foreign discount is around 27 bps.

Next, I study the sophistication of investors along two dimensions. First, I consider whether bonds are issued under Rule 144A sample or not.[20] As Rule 144A bonds are mainly held by qualified institutional buyers (QIBs) who are more sophisticated, I find that for bonds under Rule 144A, the interaction term is negative as expected but not significant. To further study the sophistication effect, I construct the bond-level holdings percentage by large institutions from eMAXX. For each bond, I calculate the holdings percentage from mutual funds and insurance companies. Then I use the holdings variable to interact with the dummy variable Foreign and find the interaction term negative and significant. It suggests that if more institutional investors hold the bond, the foreign discount is smaller, which is consistent with the intuition that more sophisticated investors demand a lower discount on

[20]Note that most of the foreign bonds are actually issued under Rule 144A, which was introduced in 2012 and loosened restrictions on certain privately placed securities by allowing qualified institutional buyers (QIBs) to trade on those securities amongst themselves. 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.

the foreign dollar bonds, everything else being equal.

5.2 Foreign Discount: Time Series

In this subsection, I perform the predictability test for a set of state variables suggested by the model on the foreign discount, i.e., risk aversion (γ) and volatility (σ). Specifically, the aggregate foreign discount in month $t + 1$ is regressed on a set of US market-level variables in month t. In addition, the lag of discount in month t is also added into the regression to control for the auto-correlation of the discount. As for the set of market-level variables, I first choose the CBOE VIX index as a proxy for US investors' level of fear or risk aversion about the market. Moreover, the overall credit market condition, measured by the yields of "A"-rated bonds, is included in the analysis. I also include the stock market index – S&P 500 index into the test. Then I use the dollar index to proxy for the macro-level economic performance. Either in the times when the US trade balance improves or in crisis when the demand for safe dollar fuels, the dollar index tends to rise. Along with this set of US macro variables, I add a similar set of variables for each country to see whether foreign-wide information has any predictive power on the foreign discount for that country. The foreign set of variables consists of country-level "A-rated" corporate yield and country-level primary stock market index, as detailed in Section 2.4. The results are reported in Table 11.

Panel A shows the results for the recent sample from June 2014 to March 2021 and Panel B shows the results for the more extended sample from January 2005 to March 2021. All the market-level variables, proxying for risk aversion (γ) and volatility (σ), can predict the future foreign discount after controlling for the current foreign discount. To be more specific, one standard deviation of increase in VIX can predict an increase in the aggregate foreign discount of 4.1 bps. Since the higher the VIX Index is, the higher the degree of fear among investors is. Consequently, the investors would become more worried about the future economic situation and tend to shift their investment towards safer assets like US treasury or investment-grade bonds issued by US firms, asking for a higher premium on foreign dollar bonds. The next variable – corporate yield can positively predict the discount. I find that one standard deviation of increase in investment-grade credit spreads can predict an increase in the aggregate foreign discount of 4.9 bps. Intuitively, an increase in the yield of the investment-grade bond is a sign of a worsening credit environment. Thus the investors are more likely to demand high compensation for holding foreign bonds than home bonds. The US stock index also exhibits predictive power in forecasting the foreign discount. The intuition is that if the stock market has a bad performance, which could also lead to the flight-to-quality or flight-to-liquidity effects. Moving next to the dollar index, one standard deviation of increase in the dollar index can predict an increase in the foreign discount of 3.5 bps. When the dollar index rises, the dollar strengthens against other major currencies in the global market. Hence the US issuers would benefit more from the relatively stronger economy, leading to an increase in the foreign discount.

Overall, studying the predictability of foreign discount with respect to home market-level variables and foreign market-level variables, we find that VIX and the US credit market yield have better ability to forecast the discount. Consistent with our intuition and model, these are the key state variables the home investors are paying attention to. Across countries, we can also see that US market-level variables can explain a large portion of the discount. The adjusted R-squares are all above 60% in the best scenario. In terms of statistical significance, the premium in EU, CA, JP and MX are all sensitive to VIX, and investment-grade yield. As for economic significance, MX has the largest magnitude, followed by CA, EU and JP. Note that this economic significance is also related to the relative size of the foreign discount. To sum up, both the statistical and economic significance of VIX and investment-grade yield with respect to the foreign discount are sizable and significant, consistent with the volatility channel generated by the model.

6 Implications

6.1 Covid-19 Pandemic and foreign squeeze

Using Covid-19 as an event study, I closely look at the investors' trading behavior on the US dollar bonds v.s. foreign dollar bonds. The previous literature documents the dash for cash and dash for dollar effects during Covid-19 pandemic,[21] they show that investors tend to sell bonds with high rating, short maturity and denominated in dollar to obtain liquidity during market turmoil. I further study the heterogeneity effect from the angle of 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 similar regression framework specified in Equation (1) except replacing the monthly bond-level credit spread with the daily bond-level selling pressure. To smooth out the noise in daily observations, I use the panel regression over a rolling window of the past seven days. Moreover, I estimate the daily foreign discount before and after the Covid-19 pandemic and compare it with the selling pressure. All the results are reported in Figure 7.

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

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 2020, the selling pressure of non-US dollar bonds relative to US dollar bonds is fairly small, which is not statistically different from 0. Beginning in early March 2020, the bond market plunged, with climbing yield spreads and worsening liquidity conditions. The difference in selling pressure between non-US bonds and US bonds also soared to the peak of 5%, which is statistically significant. Meanwhile, the foreign discount jumped from below 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. Then we see the bond market stabilized and bond yield fell back. Consistently, I find both the selling pressure and foreign discount relative to the US dropped at the end of March.

Panel (b) plots the monthly average of the fraction of sell-initiated transactions for six major countries before and after the Covid-19 pandemic. Compared with the monthly average of selling pressure in January and February, all the countries experienced an increase in selling pressure in March. Across countries, the selling pressure is highest for CN, followed by JP, GB, EU and CA, consistent with the corresponding magnitude of foreign discount at that time except for GB. In summary, I show that it is the foreign dollar bonds that suffer more selling pressure and more severe discount relative to US dollar bonds during market turmoil. The trading level evidence also provides a new economic channel, foreign squeeze on foreign dollar bonds during market turmoil, as an important implication of the classical home bias literature. With the rapid development of economic globalization, international cross-border investment and financing could become more and more pervasive. Meanwhile, we also see the world has become more volatile than ever before. All kinds of bad shocks happen more frequently, including geopolitical conflicts, trade wars, viruses, climate issues, and so on. In light of the increasing trend for international finance and the more volatile environment, the foreign discount and foreign squeeze effects identified in this paper could be relevant and important going forward.

6.2 Comparison with Dollar Safety Premium

In this subsection, to further show the importance of the foreign discount, I study the comparison between foreign discount and the safe dollar premium, particularly in terms of magnitude. As documented in Figure 7 from Liao (2020), he constructs the "corporate bases" for each major currency, which is calculated from the sum of the credit spread differential between the local-currency-denominated bond and dollar-denominated bond issued by the same multi-currency issuer and the CIP deviation between that local currency and USD. Unlike Liao (2020) who uses local-currency bond as the benchmark and compares it with currency-hedged dollar bond to disentangle the currency effect from the entity 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. Then, the question is which effect plays a bigger role in determining the pricing of the dollar bonds issued by non-US issuers. With the assumption that most of the bonds denominated in one currency (e.g., GBP) are issued by firms in that country (e.g., GB), I can compare the magnitude of foreign discount (USA effect) for any given country (e.g., EU) with the safe dollar premium (USD effect) for the currency in that country (e.g., EUR). The results are reported in Figure 8.

As Liao (2020) mainly focuses on the six currencies, namely euro (EUR), UK sterling (GBP), Canadian dollar (CAD), Swiss franc (CHF), Australian dollar (AUD) and Japanese yen (JPY), Figure 8 plots the spreads over US or USD for each foreign discount and corresponding safe dollar premium. The top-left panel is for EU/EUR. The blue line refers to the foreign discount for the EU, while the red line refers to the corporate base or safe dollar premium for EUR. The foreign discount has a larger magnitude than that of the safe dollar premium. Moreover, after 2013, the corporate base for EUR turns negative, implying that it is cheaper to borrow in EUR-denominated bonds than USD-denominated bonds. Liao (2020) links this negative corporate base with the positive debt issuance flow from the US to the EU. On the contrary, the foreign discount is always positive, even after 2013, suggesting that the investors always ask for compensation for holding foreign dollar bonds. Moving to other panels, the results are very similar. The blue lines are almost all above the red lines at all times. In this regard, the foreign discount is more robust and has a larger magnitude than the safe dollar premium.

The negative corporate base could arise from the fact that the home bias effect or the foreign discount is different for the local-currency-denominated bond and dollar-denominated bond issued by the same issuer. As the local-currency bonds are mainly held by local investors who are more familiar with the issuer's business, the home-country bias effect is negligible. However, for dollar bonds mainly held by international investors (US investors), the uncertainty aversion effect should be more relevant in bond pricing, giving rise to larger credit spreads in dollar bonds. Hence, we may observe a negative corporate base. A more recent paper by Caramichael, Gopinath, and Liao (2021) further study 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 story, due to the presence of a foreign discount effect, EU investors and US investors may ask for similar compensation for holding those bonds issued by firms outside the EU and US, generating a negligible dollar premium.

7 Conclusions

In this paper, I study the foreign discount effect in the international corporate bond market. Examining the credit spreads difference between the dollar-denominated bonds issued by non-US firms and US firms after controlling for ratings and other bond-level characteristics and liquidity, I quantify the foreign discount or home-country premium as an important pricing factor in the context of international bond pricing. Moreover, the foreign discount is not specific to dollar-denominated corporate bonds. I also find a similar result in the euro-denominated bonds and dollar-denominated sovereign bonds. To understand the potential drivers underlying the foreign discount, I first consider whether the standard risk and risk aversion can explain the foreign discount, including issuer-specific risk, country-specific risk and US risk premium. For the firm-specific risk, I look at issuer-level credit risk and liquidity risk. For country-specific risk, I consider currency risk, sovereign risk and local market risk. For US risk premium, I choose three risk premium proxies, including equity risk premium, variance risk premium and term premium following Longstaff et al. (2011). Contrary to the common view, these standard risk and risk premia can not explain away the discount.

After documenting the generality and persistence of the foreign discount, I then turn to the potential explanation based on uncertainty aversion. On top of risk and risk aversion, the investors could also exhibit uncertainty aversion towards assets that are difficult to estimate the true distribution, which could be quite relevant in the cross-border investment. To provide a theoretical underpinning, I build a simple Leland-type model augmented with model uncertainty. While the model is relatively simple and mainly serves as a framework, the key is to illustrate the basic mechanics in driving the foreign discount. The model can generate the uncertainty effect in the cross-section and the volatility effect in the time series and I find supporting evidence in the data.

To further study investors' trading behavior on the US dollar bonds v.s. foreign dollar bonds, I choose Covid-19 as an event study and show that it is the foreigner-issued bonds that suffer more selling pressure and more severe discount relative to US-issued bonds. The discount jumps from below 20 bps before pandemic to over 60 bps afterward. Across countries, the selling pressure is highest for CN, followed by JP, GB, UK and CA. In addition to the foreign discount, this trading level evidence further provides a new economic channel, foreign squeeze during market turmoil, as an important implication of the classical home-bias literature.

Lastly, I explore the implication of the foreign discount (USA effect) by comparing it with the safe dollar premium (USD effect) in the literature. For dollar-denominated bonds issued by foreign firms, its price depends on the tradeoff between the foreign discount and the dollar safety premium. I show that the foreign discount is more robust and larger than the safe dollar premium, especially in bad times like the global financial crisis or the Covid-19 pandemic.

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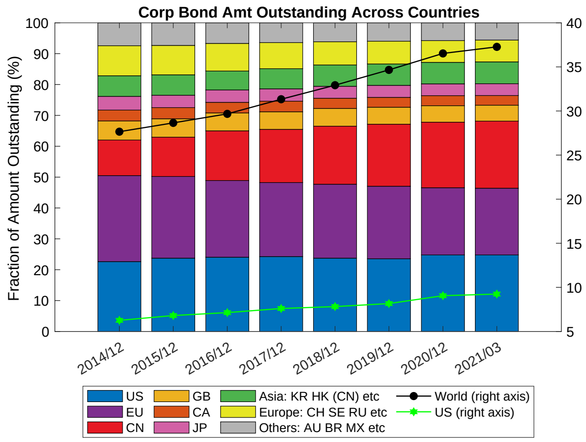
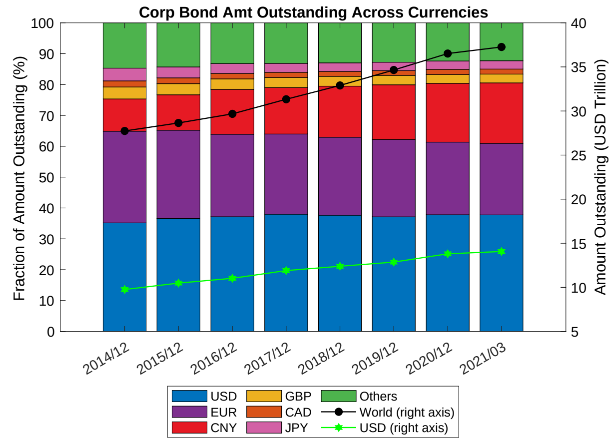
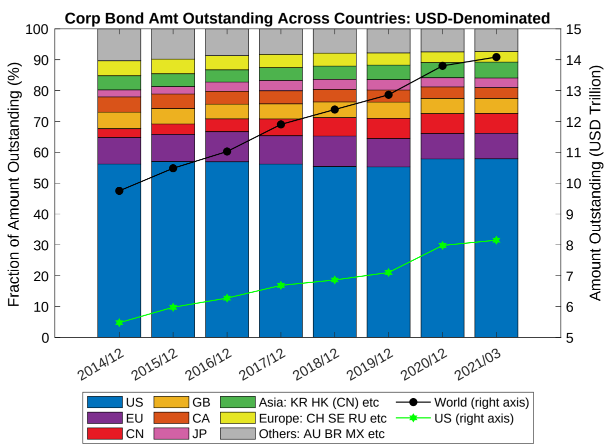


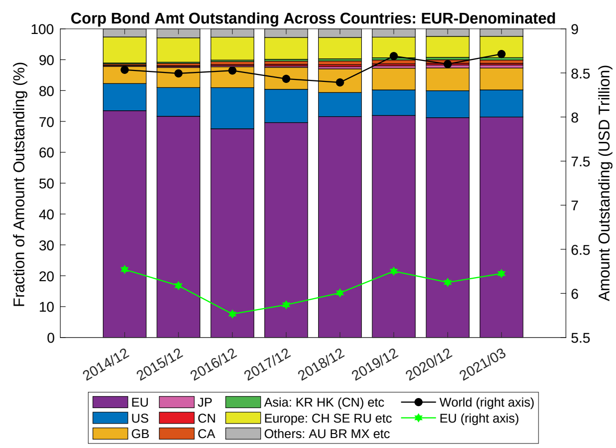
(a) **All Corp Bonds: Across Countries**



(b) **All Corp Bonds: Across Currencies**

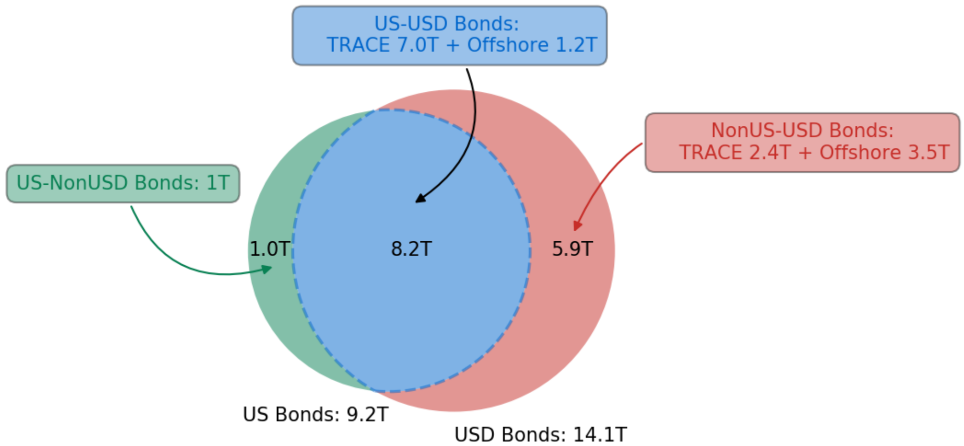


(c) **Dollar Corp Bonds: Across Countries**

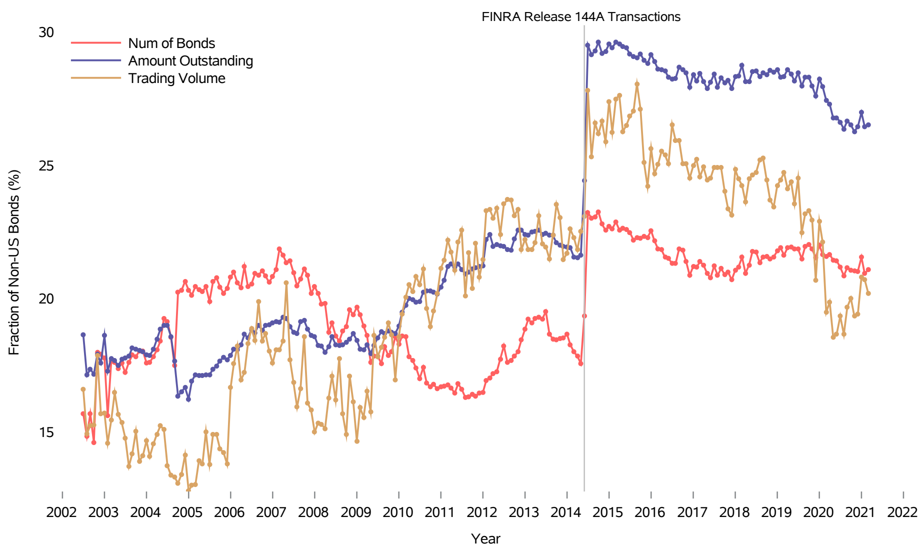


(d) **Euro Corp Bonds: Across Countries**

Figure 1: This figure plots the amount outstanding distribution across countries (panel a), across currencies (panel b) for all corporate bonds, and the amount outstanding distribution across countries within dollar-denominated bonds (panel c) and within euro-denominated bonds (panel d), respectively. The left axis is the fraction of the amount outstanding by countries or currencies, and the right axis is the total amount outstanding in trillions USD. Based on bonds' ultimate country of origin, I categorize the corporate bonds into nine groups, including 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 United Kingdom, and the rest of the world in panel a, c and d. The black line is the total amount outstanding for the world, and the green line refers to the amount outstanding for the US. Based on bonds' denominated currencies (panel b), I classify corporate bonds into seven groups: USD, EUR, CNY, GBP, CAD, JPY and the rest. The black line is the total amount outstanding for the world, and the green line refers to the amount outstanding for the EU. All the data are from Bloomberg.

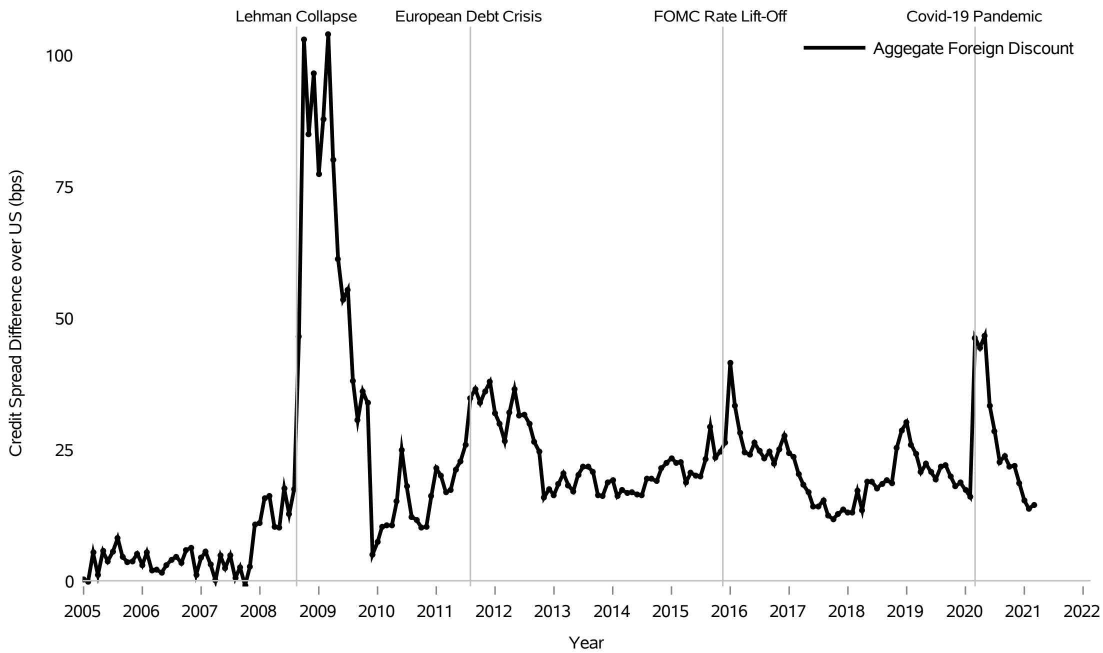


(a) **US-Issued Corp Bonds and USD-Denominated Corp Bonds: 2021Q1**

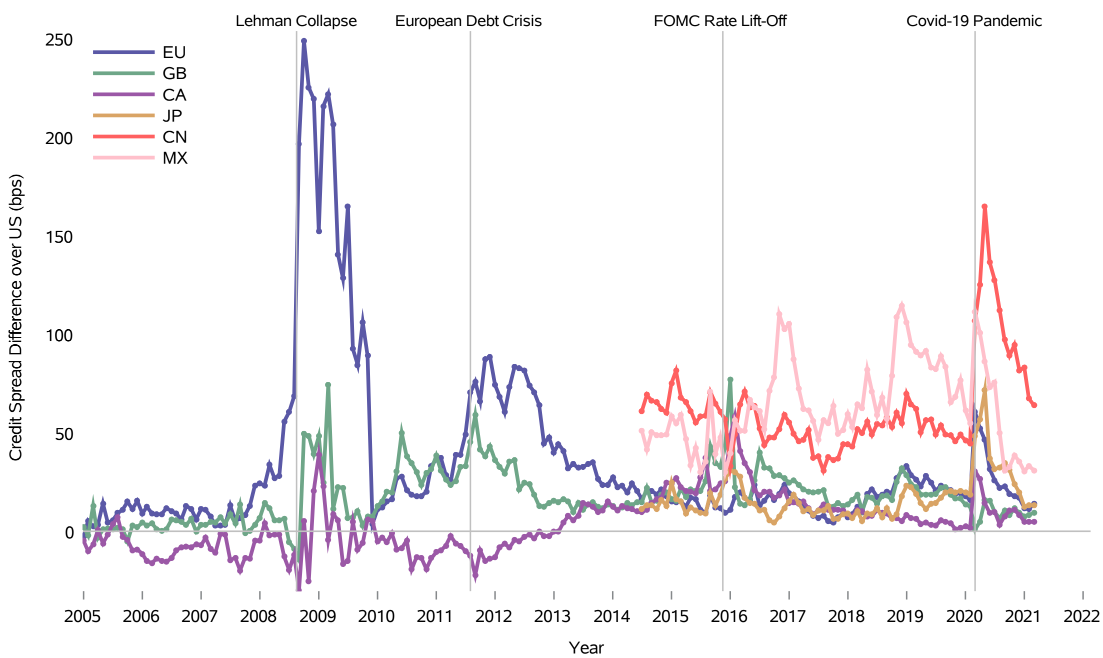


(b) **Fraction of Corp Bonds Issued by Non-US Firms in TRACE**

Figure 2: The top panel plots the snapshot of US-issued corporate bonds and USD-denominated corporate bonds by March 2021. The eurodollar (offshore) dollar data are from Bloomberg. The bottom panel outlines the dynamics of foreign dollar bonds as a fraction of all dollar bonds in TRACE along three dimensions: the number of bonds (red line), amount outstanding (blue line) and trading volume (orange line). The vertical grey line refers to the event that FINRA brings 144A corporate debt transactions into the TRACE system on June 30, 2014. 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 use the variable "ult_parent_cntry_domicile" in Bloomberg to trace back the ultimate parent country of domicile for each issuer.

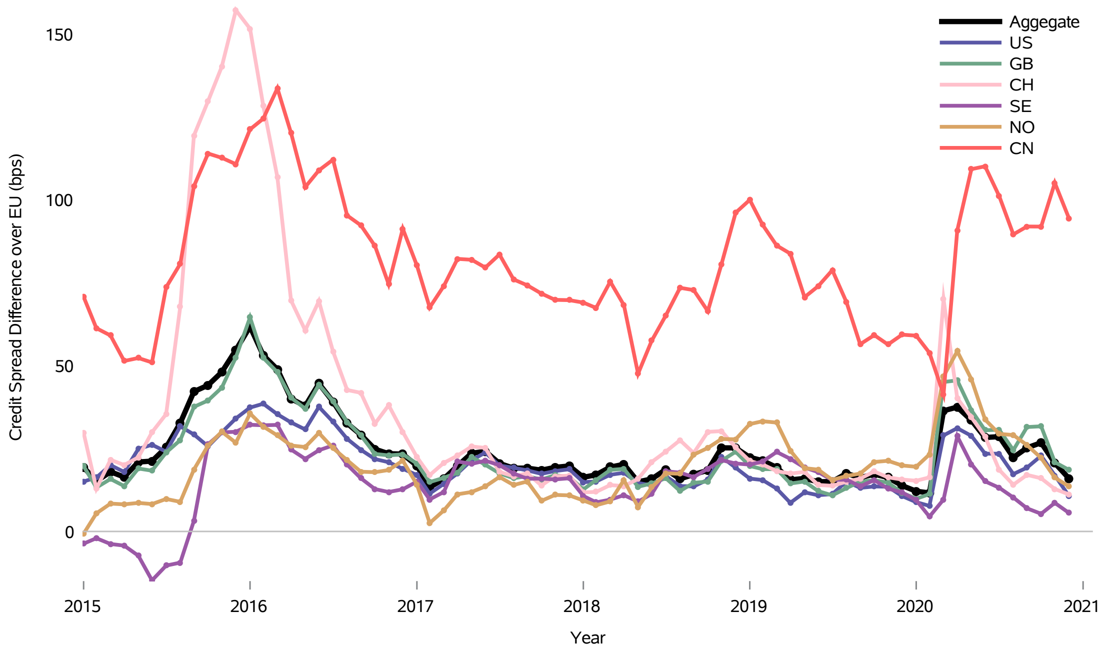


(a) **Foreign Discount: Aggregate**

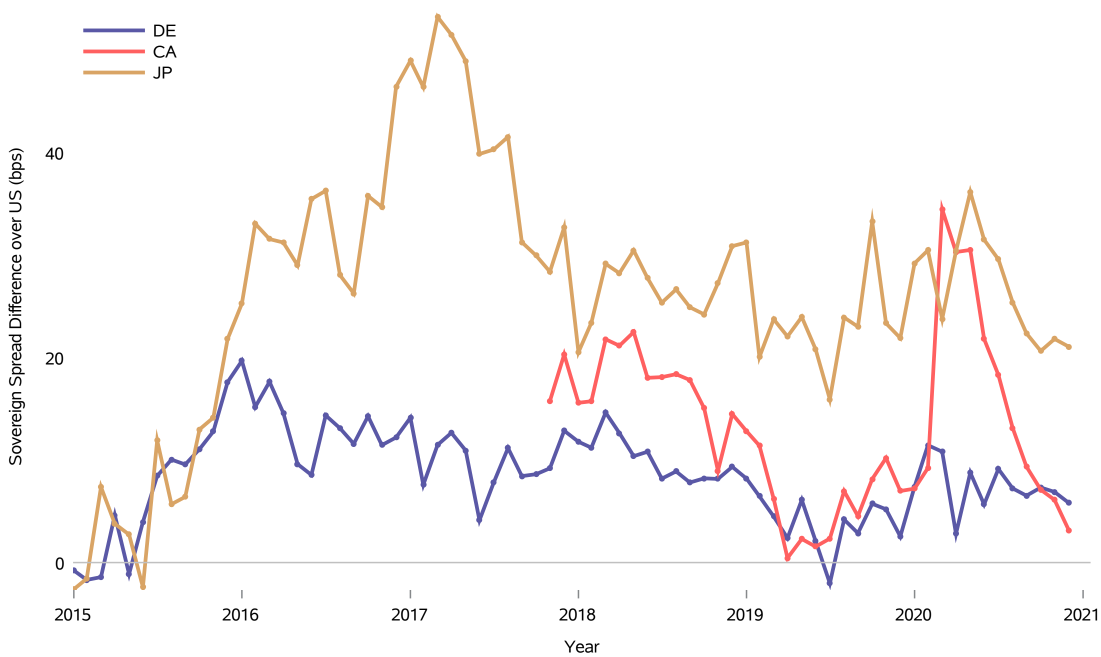


(b) **Foreign Discount: Across Countries**

Figure 3: This figure plots the credit spreads difference between non-US-issued bonds and US-issued bonds within dollar-denominated corporate bonds, estimated using monthly 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 credit ratings, bond characteristics and liquidity. The sample period is from June 2014 to March 2021.



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



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

Figure 4: The top panel plots the credit spreads difference between non-EU-issued bonds and EU-issued bonds within euro-denominated corporate bonds, estimated using monthly 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 credit ratings, bond characteristics and liquidity. The bottom panel plots the credit spread difference between non-US-issued bonds and US-issued bonds within USD-denominated sovereign bonds under the same regression setting. The sample period is from January 2015 to December 2020.

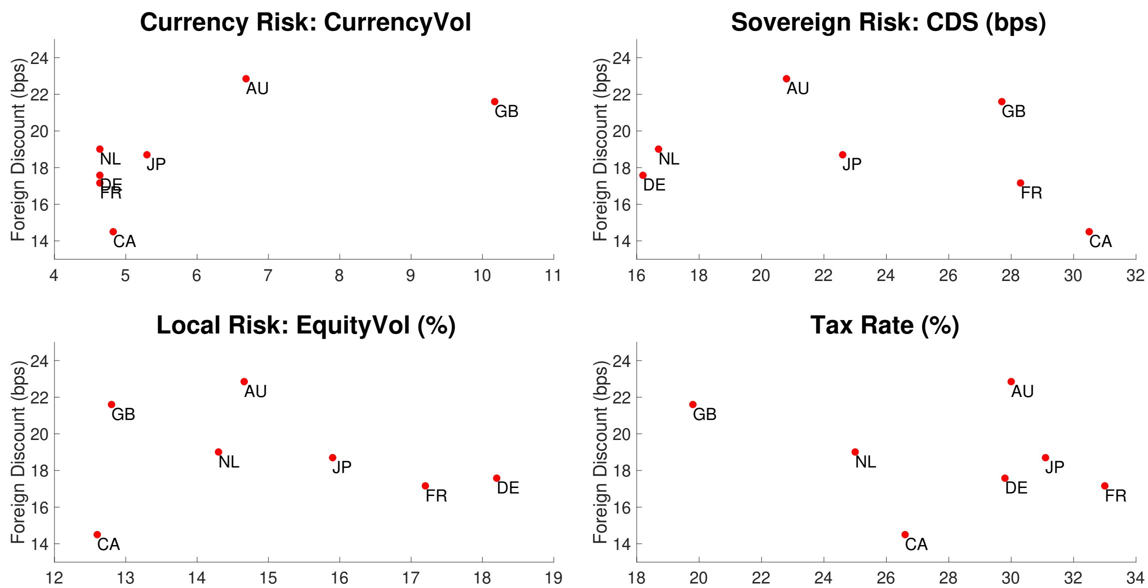


Figure 5: This figure plots the country-level foreign discount against the average of sovereign CDS spread, the currency volatility, the equity volatility and the tax rate from June 2014 to March 2021.

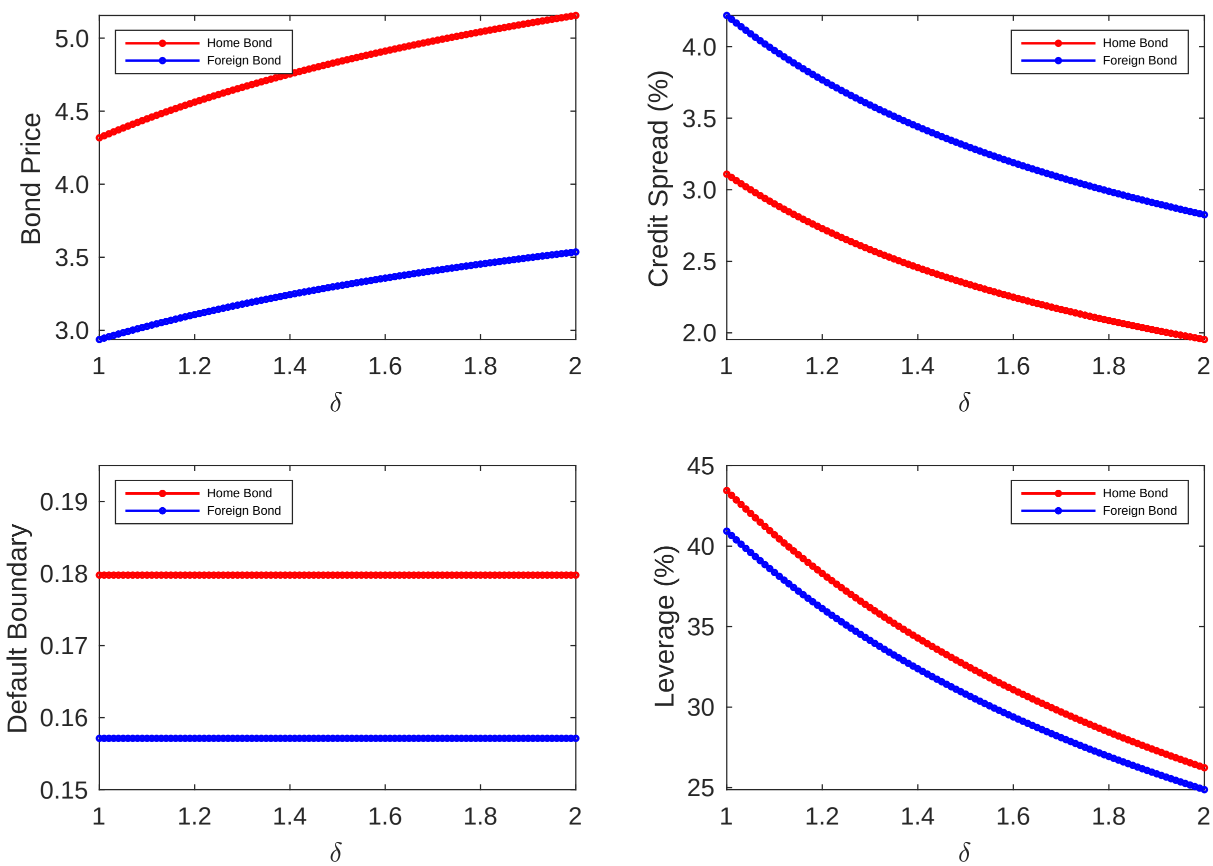
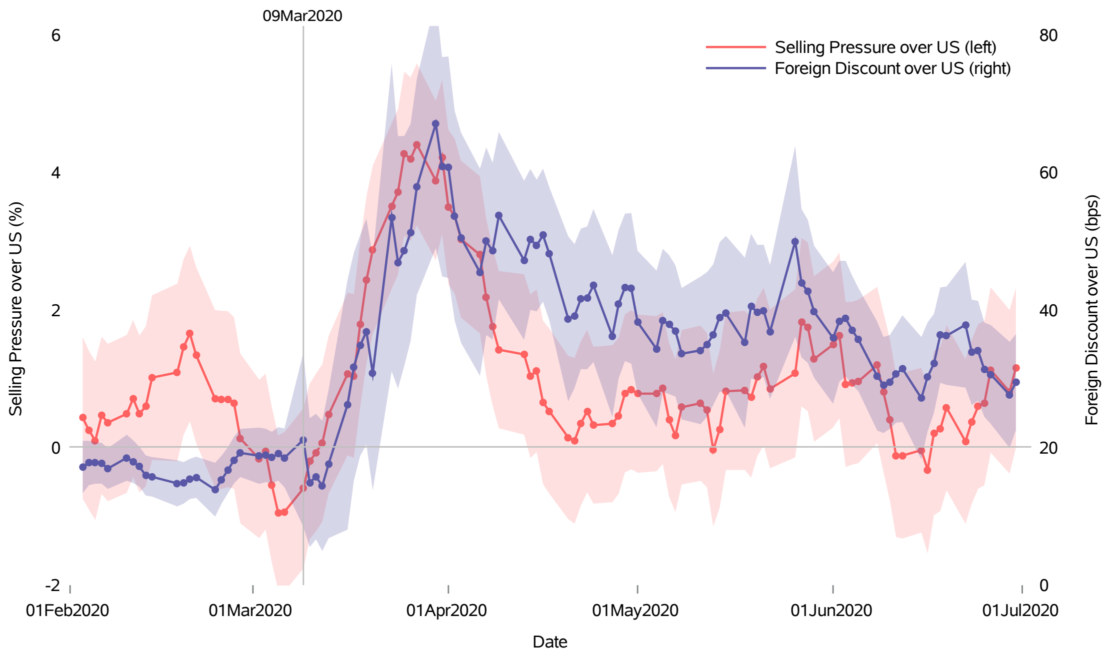
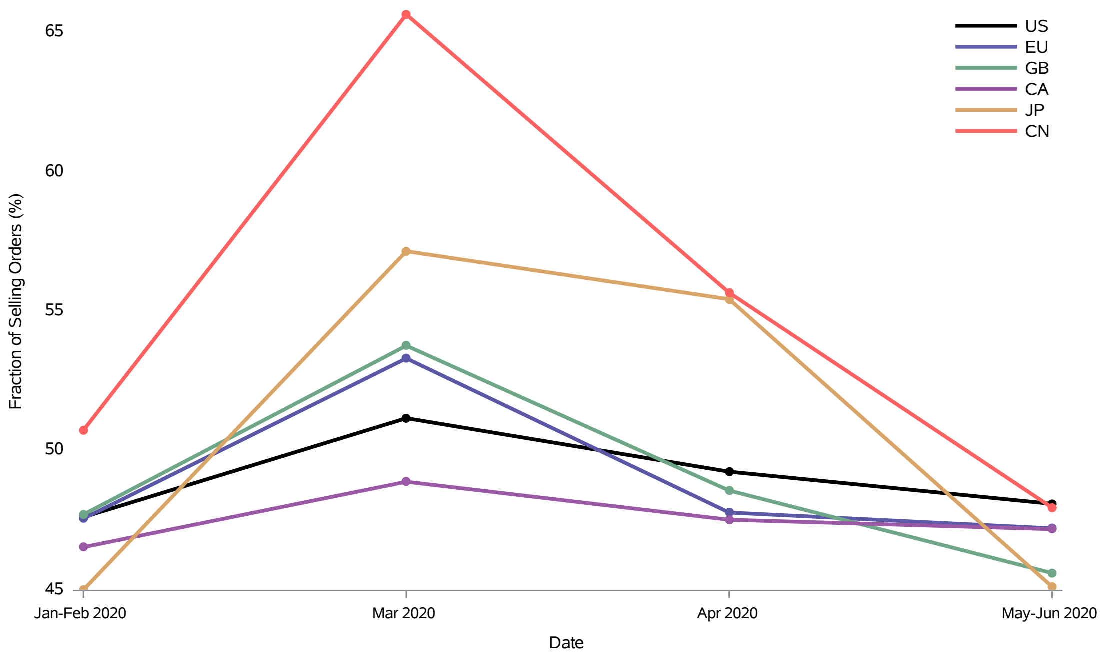


Figure 6: This figure plots the model calibration results, including the bond pricing (top-left panel), the credit spread (top-right panel), the default boundary (bottom-left panel) and the leverage (bottom-right panel).



(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 non-US-issued bonds and US-issued bonds within dollar-denominated corporate bonds during Covid-19 pandemic, estimated using panel 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 countries before and after the Covid-19 pandemic.

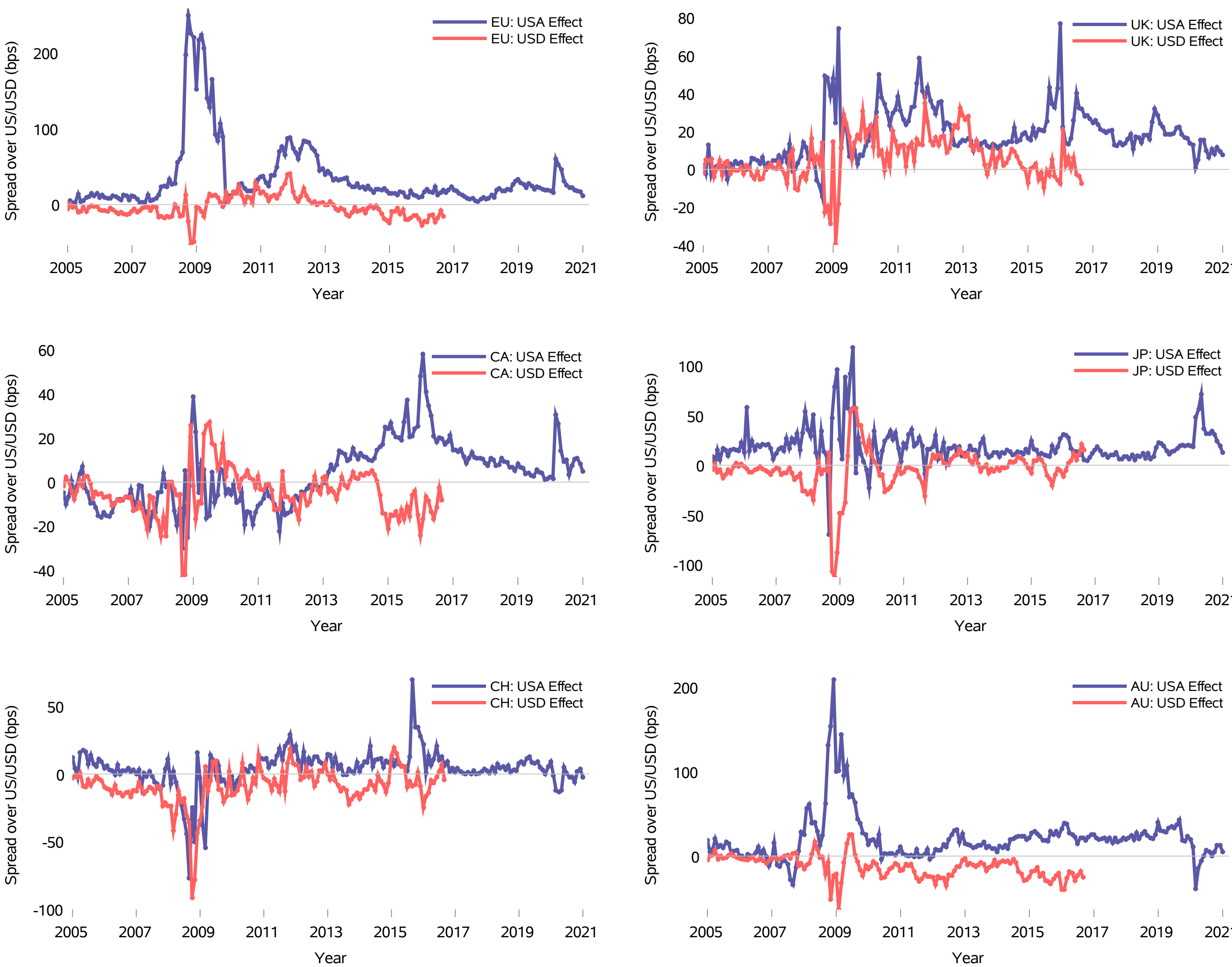


Figure 8: This figure plots the comparison between foreign discount (USA effect) and the safe dollar premium (USD effect). The red line refers to the corporate base or safe dollar premium for six major currencies in Liao (2020), including EUR, GBP, CAD, CHF, AUD and JPY. The blue line refers to the foreign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

Table 1: **Amount Outstanding (Trillions USD) on 2021Q1**

		US	Non-US	All Countries
USD	TRACE	7.0	2.4	9.4
	Offshore	1.2	3.5	4.7
	Sum	8.2	5.9	14.1
EUR		0.8	7.9	8.7
Other Currencies		0.2	12.1	14.5
All Currencies		9.2	28.1	37.3

This table reports the snapshot of all international corporate bonds across currencies and issuers' ultimate country of origin on March 2021. Across currencies, I consider USD-denominated bonds, including both TRACE (onshore) bonds and Eurodollar (offshore) bonds, EUR-denominated bonds and other-currency-denominated bonds. Across issuers' ultimate country of origin, I consider US issuers and non-US issuers for simplicity. To identify the ultimate country of origin for each issuer in Trace, we use the ISIN code information in TRACE to merge with Bloomberg.

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

Variable	Mean						Median						STD					
	US	EU	GB	CA	JP	CN	US	EU	GB	CA	JP	CN	US	EU	GB	CA	JP	CN
Panel A: 2014/06 - 2021/03																		
NumIssuers	1,312	161	90	83	38	51												
NumBonds	11,021	780	582	516	285	181												
CreditSpread	1.31	1.26	1.33	1.67	0.95	1.54	1.15	1.06	1.13	1.44	0.85	1.34	0.86	0.80	0.95	1.22	0.68	1.00
Yield	3.13	2.97	3.04	3.54	2.43	3.16	3.14	2.91	2.97	3.54	2.41	3.10	1.26	1.23	1.34	1.56	1.08	1.20
Rating	7.35	6.94	7.15	7.60	6.10	6.17	8.00	7.00	7.00	8.00	6.00	5.00	1.97	2.15	1.85	2.08	1.61	1.89
Maturity	10.82	8.18	8.30	11.61	5.07	8.08	7.13	5.03	5.45	8.10	4.02	5.32	9.00	7.88	7.73	9.05	4.18	7.69
Age	5.05	4.04	4.32	6.28	2.44	2.80	3.68	2.90	3.20	4.67	1.89	2.18	4.76	3.97	4.07	5.48	2.21	2.74
IssueSize	13.22	13.68	13.60	13.16	13.63	13.66	13.12	13.82	13.60	13.12	13.59	13.59	0.68	0.58	0.67	0.61	0.56	0.59
Coupon	4.36	4.02	4.14	4.81	3.13	3.74	4.13	3.80	3.95	4.75	2.95	3.63	1.59	1.64	1.62	1.82	1.12	1.04
Turnover	3.55	3.26	3.58	3.01	2.97	2.27	2.39	2.28	2.50	1.81	1.96	1.18	4.06	3.59	3.98	3.71	3.34	3.21
NumTrades	92.60	50.96	75.87	48.40	56.89	24.56	43.00	24.00	39.00	26.00	32.00	9.00	129.36	73.33	100.49	64.41	68.08	45.58
NumTradingDays	13.50	14.34	15.04	11.32	14.39	11.14	15.00	16.00	17.00	11.00	16.00	11.00	6.53	6.10	5.83	6.34	6.02	5.96
TradeSize	0.45	1.01	0.77	0.54	0.85	1.15	0.27	0.79	0.54	0.36	0.55	0.93	0.52	0.81	0.71	0.58	0.80	0.86
Gamma	0.45	0.24	0.29	0.68	0.16	0.29	0.10	0.03	0.05	0.11	0.02	0.04	1.55	1.15	1.13	2.32	0.97	1.38
Panel B: 2002/07 - 2014/05																		
NumIssuers	1,291	102	67	70	19	8												
NumBonds	9,432	426	352	409	98	17												
CreditSpread	1.64	2.09	1.44	1.78	1.54	1.78	1.25	1.42	1.10	1.47	1.07	1.60	1.59	2.52	1.19	1.35	1.55	0.82
Yield	4.54	4.75	4.02	4.61	3.95	4.31	4.75	4.80	4.19	4.97	4.00	4.31	2.08	2.76	1.92	2.01	2.21	1.70
Rating	6.94	6.80	6.23	7.92	5.51	7.43	7.00	7.00	6.00	8.00	6.00	7.00	2.14	2.25	2.02	1.56	3.10	2.47
Maturity	9.79	8.58	8.70	12.14	6.30	13.12	6.63	5.26	5.81	7.88	4.35	9.59	8.53	8.07	7.95	9.69	6.11	8.72
Age	4.84	3.92	4.09	4.92	2.93	4.44	3.66	2.90	2.99	3.94	2.05	1.42	4.16	3.45	3.73	4.08	2.62	5.34
IssueSize	12.94	13.41	13.40	12.89	13.18	12.80	12.90	13.39	13.30	12.90	13.53	12.61	0.76	0.71	0.75	0.59	0.86	0.67
Coupon	5.82	5.73	5.48	5.94	4.81	5.00	5.88	5.75	5.40	6.10	5.00	5.00	1.57	1.76	1.80	1.58	2.13	2.05
Turnover	4.27	4.85	4.24	3.52	3.54	3.88	2.58	3.23	2.87	2.00	1.73	1.76	5.29	5.32	4.77	4.66	4.95	5.44
NumTrades	85.24	88.31	77.09	26.79	53.92	49.16	31.00	45.00	38.00	12.00	29.00	18.00	136.20	124.78	108.47	48.51	70.75	84.46
NumTradingDays	11.74	13.24	13.01	7.81	10.61	9.21	12.00	15.00	14.00	6.00	10.00	7.50	6.89	6.52	6.44	5.74	6.76	6.64
TradeSize	0.54	0.72	0.67	0.88	0.62	0.60	0.28	0.48	0.47	0.60	0.30	0.28	0.66	0.70	0.65	0.85	0.75	0.72
Gamma	1.40	1.29	0.96	1.25	0.96	1.24	0.36	0.24	0.20	0.22	0.21	0.36	3.43	3.70	2.75	3.51	2.90	3.26

This table reports the summary statistics for the USD-denominated investment-grade corporate bonds issued by six major countries in the TRACE sample, including US, EU, GB, CA, JP and CN. Panel A reports the sample period from June 2014 to March 2021 and Panel B reports the sample period from July 2002 to May 2014. The separation arise from the event that the FINRA brings 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 issuance. *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 million of dollars. *Gamma* measures the negative auto-correlation between daily bond prices following Bao, Pan and Wang (2011).

Table 3: **Summary Statistics: EUR-Denominated Bonds**

	Panel A: 2015/01 - 2021/03																	
	Mean						Median						STD					
Variable	EU	US	GB	CH	SE	CN	EU	US	GB	CH	SE	CN	EU	US	GB	CH	SE	CN
NumIssuers	752	401	221	62	36	25												
NumBonds	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
	Panel B: 2000/01 - 2014/12																	
NumIssuers	126	38	27	4	9	0												
NumBonds	126	38	27	4	9	0												
CreditSpread	0.90	0.79	0.74	0.43	0.64		0.76	0.60	0.67	0.29	0.63		0.82	0.65	0.42	0.38	0.18	
Yield	3.85	3.86	3.42	2.12	3.42		3.85	3.46	3.11	1.98	3.09		1.35	1.50	1.14	0.51	1.04	
Rating	7.02	6.68	7.72	4.97	7.86		8.00	6.00	8.00	4.00	8.00		2.15	2.68	1.35	1.92	0.63	
Maturity	13.15	11.75	10.20	9.08	12.62		12.36	11.63	9.77	9.08	11.87		4.71	6.50	3.78	1.19	3.29	
Age	3.21	2.17	2.35	0.61	2.75		2.32	1.44	1.54	0.46	1.85		2.84	2.05	2.21	0.51	2.62	
IssueSize	20.58	20.46	20.31	20.32	20.21		20.56	20.44	20.44	20.56	20.04		0.68	0.52	0.32	0.27	0.21	
Coupon	4.58	4.21	3.99	2.16	4.37		4.63	4.13	4.00	1.75	4.75		1.37	1.37	0.97	0.63	0.95	

This table reports the summary statistics for the EUR-denominated investment-grade corporate bonds issued by six countries in the Bloomberg sample, including EU, US, GB, CH, SE and CN. Panel A reports the sample period from January 2015 to March 2021 and Panel B reports the sample period from January 2000 to December 2014. The separation arises from the fact that Bloomberg's BQL algorithm only applies to data after 2015. *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.

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

	Panel A: 2014/06 - 2021/03							Panel B: 2005/01 - 2021/03			
	All	EU	GB	CA	JP	CN	MX	All	EU	GB	CA
Foreign	22.91***	19.90***	21.60***	14.50**	18.66***	64.88***	65.28***	20.10***	28.38***	18.16***	5.03
	[6.09]	[4.29]	[3.73]	[2.16]	[2.62]	[6.01]	[4.25]	[4.56]	[3.29]	[2.91]	[0.71]
Rating	19.23***	18.99***	18.86***	19.08***	19.02***	19.21***	19.07***	21.32***	21.35***	21.17***	21.41***
	[9.85]	[10.17]	[9.90]	[9.69]	[9.67]	[9.70]	[9.83]	[12.03]	[11.83]	[12.31]	[12.04]
Maturity	3.94***	3.91***	3.92***	3.93***	3.93***	3.91***	3.95***	2.97***	2.95***	2.99***	2.98***
	[24.03]	[26.62]	[26.58]	[26.81]	[27.08]	[26.66]	[27.13]	[5.42]	[5.27]	[5.50]	[5.49]
IssueSize	-4.07*	-4.38*	-4.05*	-4.41*	-4.33*	-4.06*	-4.16*	-3.91	-4.03	-3.89	-4.13
	[-1.74]	[-1.80]	[-1.77]	[-1.85]	[-1.78]	[-1.71]	[-1.71]	[-0.59]	[-0.60]	[-0.60]	[-0.62]
Age	3.54***	3.69***	3.69***	3.66***	3.70***	3.70***	3.71***	3.86***	3.90***	3.88***	3.89***
	[8.93]	[9.15]	[8.85]	[8.43]	[8.77]	[8.84]	[8.91]	[7.73]	[7.69]	[7.70]	[7.40]
Turnover	2.03***	2.07***	2.11***	2.07***	2.05***	2.06***	2.10***	1.67**	1.69**	1.64**	1.59**
	[4.69]	[4.50]	[4.76]	[4.45]	[4.38]	[4.52]	[4.60]	[2.56]	[2.48]	[2.51]	[2.43]
Constant	-47.39*	-42.14	-45.20*	-40.27	-42.45	-46.98*	-45.69*	-57.14	-56.91	-56.82	-52.5
	[-1.85]	[-1.57]	[-1.79]	[-1.48]	[-1.59]	[-1.78]	[-1.67]	[-0.59]	[-0.59]	[-0.59]	[-0.54]
Obs	490531	427461	422444	419526	410590	404298	403527	890179	786016	781902	778299
Adj R^2	0.37	0.38	0.37	0.38	0.38	0.38	0.39	0.14	0.14	0.14	0.14

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 credit ratings, other bond characteristics and liquidity, as well as industry and year fixed effect. Panel A shows the results for EU, GB, CA, JP, CN, MX and All from June 2014 to March 2021. Column *All* means all the foreign issuers in the six countries above. Panel B shows the results for EU, GB and CA in a longer period from January 2005 to March 2021. Reported in square brackets are tstat's using standard errors clustered by issuer and year. See Table **??** for bond-level variable definitions.

Table 5: **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]
Turnover	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 credit ratings, other bond characteristics and liquidity, as well as industry and year fixed effect. Panel A shows the results for US, GB, CH, SE, NO, CN and All from June 2014 to March 2021. Column *All* means all the foreign issuers in the six countries above. Panel B shows the results for US, GB and CH in a longer period from January 2005 to March 2021. Reported in square brackets are tstat's using standard errors clustered by issuer and year. See Table 3 for bond-level variable definitions.

Table 6: **Issuer-level Risks and US Risk Premia**

Foreign	20.64***	20.91***	17.18***	17.14***	17.12***	17.01***
	[3.74]	[3.97]	[2.82]	[3.06]	[2.85]	[2.75]
Rating	17.42***	16.88***	15.99***	16.44***	16.00***	16.05***
	[8.55]	[9.06]	[8.61]	[9.35]	[8.50]	[8.46]
Maturity	4.06***	3.70***	3.71***	3.71***	3.71***	3.75***
	[21.63]	[21.52]	[23.24]	[23.23]	[23.37]	[25.22]
IssueSize	-0.31	1.23	0.14	0.01	0.01	-0.31
	[-0.13]	[0.56]	[0.06]	[0.00]	[0.00]	[-0.12]
Age	2.23***	2.47***	2.37***	2.32***	2.36***	2.38***
	[6.19]	[5.41]	[5.80]	[5.84]	[6.03]	[5.71]
Turnover		2.06***	1.95***	1.93***	1.94***	1.88***
		[3.61]	[3.56]	[3.74]	[3.63]	[3.88]
Illiquidity		11.26***	11.06***	11.08***	11.05***	9.69***
		[19.45]	[15.59]	[16.17]	[15.60]	[8.14]
Leverage			0.26***		0.24**	0.24**
			[2.73]		[2.46]	[2.35]
Mu			-0.19		-0.14	-0.14
			[-1.58]		[-1.32]	[-1.26]
EquityVolatility			0.90***		0.74	0.75*
			[2.96]		[1.61]	[1.69]
DefaultRisk				-22.47***	-4.74	-4.79
				[-2.60]	[-0.40]	[-0.39]
EquityPremium						-19.34***
						[-4.46]
VariancePremium						0.56***
						[5.31]
TermPremium						-1.17
						[-0.99]
Industry&Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	67.36**	32.59	23.66	99.59**	39.42	56.08
	[2.19]	[1.15]	[0.89]	[2.39]	[0.70]	[0.95]
NumObs	195725	195725	195725	195725	195725	195725
Adjusted $R2$	0.39	0.45	0.47	0.47	0.47	0.50

This table reports the regression result on foreign discount after controlling for the credit risk, liquidity risk and US risk premia. Specifically, to control for the credit risk beyond ratings, I focus on the non-US issuers with listed equity in the US market and 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 measure – gamma from Bao, Pan, and Wang (2011). To control for US risk premia, I choose three risk premium proxies following Longstaff, Pan, Pedersen and Singleton (2011), 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. The sample period is from June 2014 to March 2021.

Table 7: **Country-level Risks**

	EU	GB	CA	JP	CN	MX			Pool		
CDS	1.74***	-0.07	1.66*	0.49	0.07	0.45***	0.25				0.19
	[2.76]	[-0.16]	[1.77]	[1.06]	[0.45]	[3.86]	[1.62]				[1.27]
CorpYield	24.44***	-9.45***	13.75**	53.17*	-8.64	29.68***		8.53			4.10
	[3.68]	[-3.12]	[2.09]	[1.74]	[-1.00]	[7.27]		[0.98]			[0.62]
Stock	-0.77*	0.02	-0.74**	-0.21	-0.12	-1.54***			-0.09		-0.01
	[-1.78]	[0.06]	[-2.10]	[-1.05]	[-0.44]	[-3.12]			[-0.39]		[-0.05]
ExchangeRate	-0.01	1.00*	1.56**	-0.15	1.36	2.26***				0.73	0.38
	[-0.04]	[1.94]	[2.46]	[-0.37]	[1.18]	[3.56]				[1.34]	[0.83]
Constant	0.52	0.96	0.96	-2.11	-0.50	-2.67	-0.87	-1.86	-1.51	-1.73	-1.41
	[0.21]	[0.40]	[0.48]	[-0.60]	[-0.12]	[-0.88]	[-0.56]	[-1.57]	[-1.20]	[-1.25]	[-0.85]
Obs	80	80	80	80	80	80	480	480	480	480	480
Adj $R2$	0.66	0.05	0.53	0.07	0.05	0.44	0.284	0.236	0.214	0.232	0.288

This table reports the regression result on the change of country-level foreign discount on the change of country-level risks, including sovereign risk, local market risk and currency risk. Specifically, I use sovereign CDS spread to proxy for sovereign risk, country-level aggregate credit market and equity market movements to proxy for local market risk, and country-level currency volatility to proxy for currency risk. Columns 1-6 reports the time-series regression result for each country separately and Column "Pool" reports the pool regression result for all six countries. The sample period is from June 2014 to March 2021.

Table 8: **Calibration Parameters**

Variable	Definition	Value
γ	Risk Aversion	2
r	Riskfree Rate	4
α	Recovery Rate	50
τ	Corporate Tax Rate	25
δ_0	Initial Cash Flow Level	1
μ^H	Market Growth Rate	10
σ^H	Market Volatility	20
μ^F	Market Growth Rate	10
σ^F	Market Volatility	20
μ	Firm Asset Growth Rate	4
σ	Firm Asset Idiosyncratic Volatility	40
$\sigma_{i,H,H}$	Home Firm's Correlation with Home Market	0.40
ϕ	Uncertainty Aversion	2

This table summarizes the basic parameters used in the calibration exercise, including the risk aversion coefficient γ, risk-free rate r, the tax rate τ and the bond recovery rate α, the expected growth rate μ^H (μ^F) and volatility σ^H (σ^F) the of the market, the expected growth rate of firm's asset μ and the idiosyncratic volatility σ, the correlation variable $\sigma_{i,H,H}$ and the uncertainty aversion ϕ.

Table 9: **Foreign Discount and 2020 GDP Forecasts**

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

This table reports the results of 2020 GDP growth forecasts on foreign countries reported by the large institutions from the Consensus Economics survey on June 8, 2020, including the number of investors, mean of GDP growth forecasts and dispersion of GDP growth forecasts. Local refers to investors from local country and US means investors from the US. To examine the difference between the two groups, I report the double t-test for the mean of forecasts and the F test for the dispersion of the forecasts.

Table 10: **Foreign Discount and Cross-Issuers/Investors Evidences**

	Age_in_US	Sales_in_US	Rule144A	InstHoldings
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]
Foreign*X	-1.11***	-0.36**	-7.84	-0.51***
	[-3.48]	[-2.19]	[-1.26]	[-5.40]
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]
NumObs	504194	147429	504194	140103
R-Square	0.37	0.42	0.38	0.28

This table reports the foreign discount with respect to heterogeneous degrees of uncertainty in the cross-section. Age_in_US means the age of the issuer since existing in the US bond market. Sales_in_US means the fraction of the issuer's revenues (REVTS) in the US, using data from Compustat Segments Dataset. Rule144A is a dummy variable, which equals one if the bond is issued under Rule 144A and zero otherwise. InstHoldings refers to the bond-level holdings percentage by large institutions, including mutual funds and insurance companies from eMAXX. The sample period is from June 2014 to March 2021.

Table 11: **Foreign Discount and Time-Series Predictability**

	Panel A: 2014/06-2021/03						Panel B: 2005/01-2021/03					
Foreign	0.66***	0.45**	0.47**	0.36	0.47*	0.17	0.87***	0.70***	0.56***	0.81***	0.79***	0.42***
	(3.83)	(2.23)	(2.09)	(1.34)	(1.99)	(0.68)	(10.31)	(7.71)	(5.78)	(8.61)	(8.90)	(3.67)
VIX		0.54**				0.40**		0.50***				0.41**
		(2.32)				(2.34)		(2.64)				(2.59)
IGSpread			7.99**			3.71*			10.75***			9.64***
			(2.13)			(1.81)			(3.19)			(2.94)
S&P500				-0.23*		-0.07				-0.13*		0.03
				(-1.90)		(-0.81)				(-1.76)		(0.35)
DollarIndex					0.73*	0.64***					0.44**	0.28
					(1.86)	(2.68)					(2.09)	(1.62)
Constant	7.57**	3.54*	-10.96	46.43**	23.80**	21.54	0.74	-5.09**	-50.67***	12.52*	7.16**	-48.39**
	(2.27)	(1.79)	(-1.60)	(2.07)	(2.15)	(1.08)	(0.84)	(-2.10)	(-3.12)	(1.83)	(2.26)	(-2.32)
Obs	79	79	79	79	79	79	192	192	192	192	192	192
Adj $R2$	0.571	0.678	0.643	0.654	0.628	0.756	0.829	0.842	0.867	0.832	0.832	0.875

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 investment-grade 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 an extended period from January 2005 to March 2021.