

Foreign Discount in International Corporate Bonds

Zhe Geng

School of Management, Fudan University

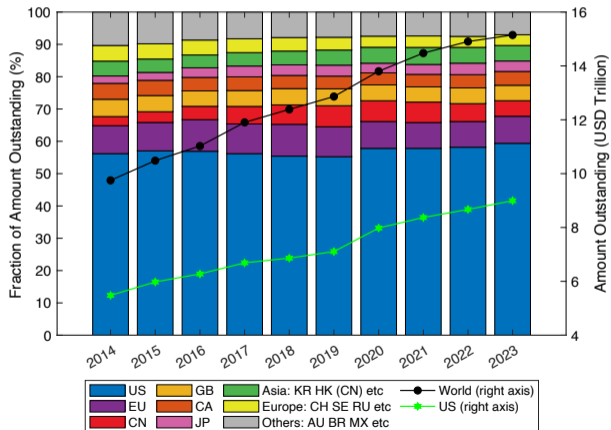
ABFER 2024

Motivation

- Well documented: dollar debt dominance.
- Maybe less well-known: 41% of dollar corp bonds (6.2 Trillion USD) are issued by non-US firms. [Plots](#)

Motivation

- Well documented: dollar debt dominance.
- Maybe less well-known: 41% of dollar corp bonds (6.2 Trillion USD) are issued by non-US firms. Plots



Motivation

- Well documented: dollar debt dominance.
- Maybe less well-known: 41% of dollar corp bonds (6.2 Trillion USD) are issued by non-US firms. Plots
- This paper: how to price dollar bonds issued by non-US firms?
 - ▶ Dollar bond examples: AstraZeneca (UK) v.s. Pfizer (US).
 - ▶ Is there any pricing diff btw dollar bonds issued by non-US and US firms?
 - ▶ What kind of risks? What are the implications?

Motivation

- Well documented: dollar debt dominance.
- Maybe less well-known: 41% of dollar corp bonds (6.2 Trillion USD) are issued by non-US firms. Plots
- **This paper: how to price dollar bonds issued by non-US firms?**
 - ▶ Dollar bond examples: AstraZeneca (UK) v.s. Pfizer (US).
 - ▶ Is there any pricing diff btw dollar bonds issued by non-US and US firms?
 - ▶ What kind of risks? What are the implications?
- Why issue?
 - ▶ AstraZeneca: dollar bonds v.s. local currency bonds.
 - ▶ Currency hedging, dollar safety premium, dollar bias, dollar carry trade, signaling...
 - ▶ See Nance, Smith and Smithson (1993), Krishnamurthy and Vissing-Jorgensen (2012), Caballero, Farhi, and Gourinchas (2017), Bruno and Shin (2017), Jiang, Krishnamurthy, and Lustig (2018, 2020, 2023), Liao (2020), Maggiori, Neiman, and Schreger (2020), Caramichael, Gopinath, and Liao (2021), Eren and Malamud (2022), Eren, Malamud, and Zhou (2023), Huang, Panizza and Portes (2024)...

Main Findings

- Document and quantify the foreign discount:
 - ▶ Foreign issuers pay 20 bps higher credit spreads than US counterparts.

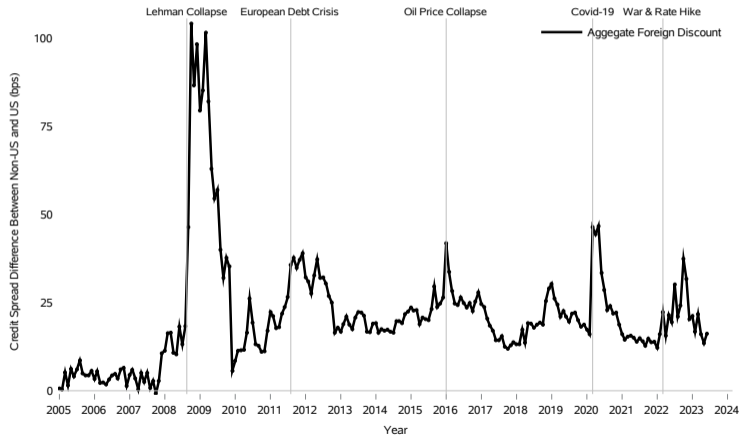
Discount

Main Findings

- Document and quantify the foreign discount:

- Foreign issuers pay 20 bps higher credit spreads than US counterparts.

Discount



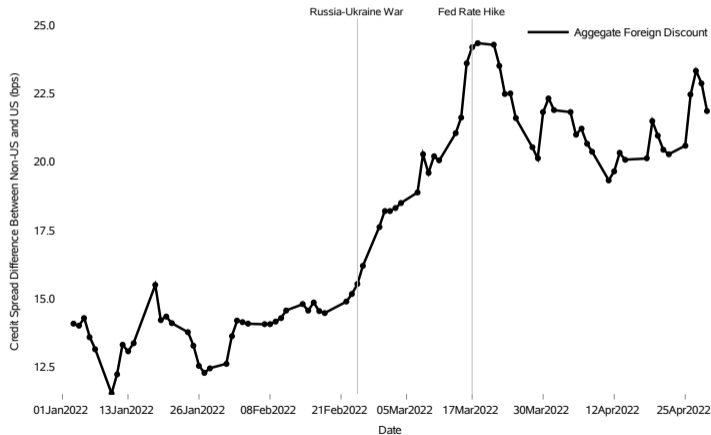
- $\text{CreditSpread}_{i,t} = a_t + b_t \text{Foreign}_{i,t} + c_t \text{Rating}_{i,t} + \sum_k \text{Controls}_{i,t}^k + \epsilon_{i,t}$. (TRACE IG dollar bonds)

Main Findings

- Document and quantify the foreign discount:

- Foreign issuers pay 20 bps higher credit spreads than US counterparts.

Discount



- $\text{CreditSpread}_{i,t} = a_t + b_t \text{Foreign}_{i,t} + c_t \text{Rating}_{i,t} + \sum_k \text{Controls}_{i,t}^k + \epsilon_{i,t}$. (TRACE IG dollar bonds)

Main Findings

- Document and quantify the foreign discount:
 - ▶ Foreign issuers pay 20 bps higher credit spreads than US counterparts. Discount
 - ▶ Not unique to the dollar, it also exists within euro-denominated corporate bonds.

Main Findings

- Document and quantify the foreign discount:
 - ▶ Foreign issuers pay 20 bps higher credit spreads than US counterparts. Discount
 - ▶ Not unique to the dollar, it also exists within euro-denominated corporate bonds.
- What kind of risks?
 - ▶ Issuer-level risk, country-level risk, US risk premium, institutional diff, and investor clientele.
 - ▶ Standard risks and institutional factors fail to account for the discount.

Main Findings

- Document and quantify the foreign discount:
 - ▶ Foreign issuers pay 20 bps higher credit spreads than US counterparts. Discount
 - ▶ Not unique to the dollar, it also exists within euro-denominated corporate bonds.
- What kind of risks?
 - ▶ Issuer-level risk, country-level risk, US risk premium, institutional diff, and investor clientele.
 - ▶ Standard risks and institutional factors fail to account for the discount.
- An uncertainty-based explanation:
 - ▶ The uncertainty index from Baker, Bloom, and Davis (2016) can explain a substantial portion of the discount.
 - ▶ The uncertainty-based model calibrations can match the empirical data quite well.

Main Findings

- Document and quantify the foreign discount:
 - ▶ Foreign issuers pay 20 bps higher credit spreads than US counterparts. Discount
 - ▶ Not unique to the dollar, it also exists within euro-denominated corporate bonds.
- What kind of risks?
 - ▶ Issuer-level risk, country-level risk, US risk premium, institutional diff, and investor clientele.
 - ▶ Standard risks and institutional factors fail to account for the discount.
- An uncertainty-based explanation:
 - ▶ The uncertainty index from Baker, Bloom, and Davis (2016) can explain a substantial portion of the discount.
 - ▶ The uncertainty-based model calibrations can match the empirical data quite well.
- Implications:
 - ▶ Foreign Squeeze: foreign dollar bonds suffer from high selling pressure during COVID-19.
 - ▶ The foreign discount (USA effect) dominates the dollar safety premium (USD effect).

Contributions

- Corporate and Sovereign Bond Pricing:

- ▶ Credit Pricing: Collin-Dufresne, Goldstein, and Martin (2001), Campbell and Taksler (2003), Edwards, Harris, and Piwowar (2007), Bao, Pan, and Wang (2011), Longstaff et al. (2011), Kuehn and Schmid (2014), Culp, Nozawa, and Veronesi (2018), Huang, Nozawa, and Shi (2024), Wang (2024)...
- ▶ This paper focuses on “non-US over US”, rather than US, and document the foreign discount effect.

- Home Bias and Currency Bias:

- ▶ Home Bias: French and Poterba (1991), Coval and Moskowitz (1999), Obstfeld and Rogoff (2000), Coeurdacier and Rey (2013), Cooper, Sercu and Vanpée (2013), Burger et al. (2018), Maggiori, Neiman and Schreger (2020)...
- ▶ This paper focuses on the pricing, rather than holdings, and document the foreign squeeze effect.

- Dollar Debt Dominance and Dollar Safety Premium:

- ▶ Krishnamurthy and Vissing-Jørgensen (2012), Ivashina, Scharfstein, and Stein (2015), Bruno and Shin (2014, 2017), Caballero and Farhi (2018), Du, Tepper, and Verdelhan (2018), Cenedese et al. (2021), Jiang, Krishnamurthy and Lustig (2018, 2020, 2023), Maggiori, Neiman and Schreger (2020), Liao (2020), Caramichael, Gopinath and Liao (2021), Shi, Viswanath-Natraj and Wang (2022), Hu et al. (2022)...
- ▶ This paper focuses on the cost, rather than benefit, associated with dollar bond issuance.

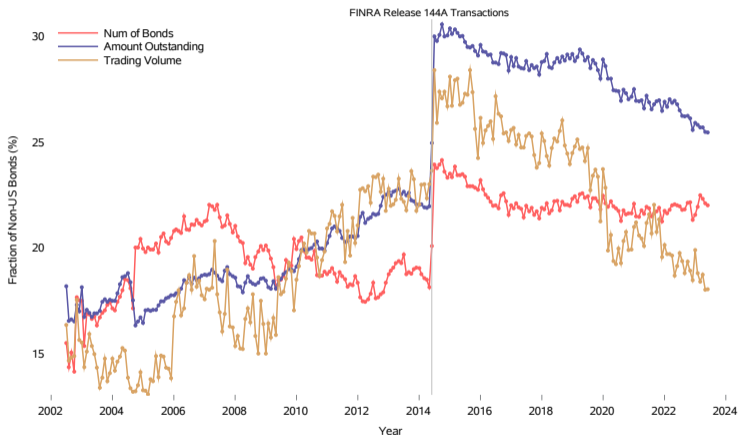
Roadmap

- Data Summary
- Quantify the Foreign Discount
 - ▶ Cross-Country and Cross-Currency
 - ▶ Risk and Institutional Factors
- Uncertainty-Based Explanation
 - ▶ Supporting Empirical Evidences
 - ▶ Model Calibrations
- Implications
 - ▶ Foreign Squeeze
 - ▶ Comparison with Safe Dollar Premium

Roadmap

- Data Summary
- Quantify the Foreign Discount
 - ▶ Cross-Country and Cross-Currency
 - ▶ Risk and Institutional Factors
- Uncertainty-Based Explanation
 - ▶ Supporting Empirical Evidences
 - ▶ Model Calibrations
- Implications
 - ▶ Foreign Squeeze
 - ▶ Comparison with Safe Dollar Premium

Fraction of Non-US Corporate Bonds in TRACE



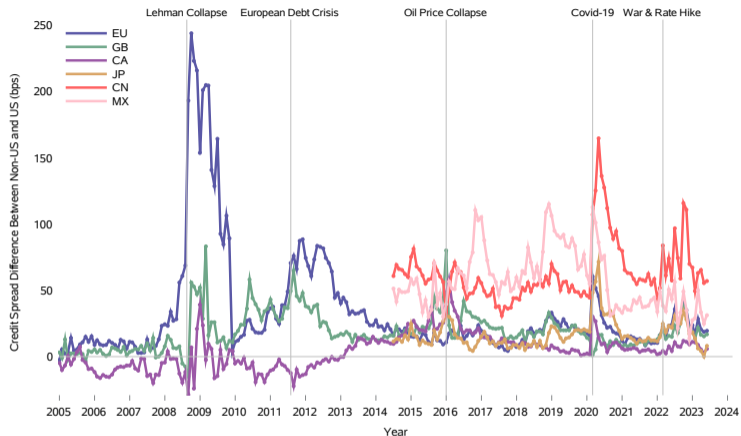
Country	US	Non-US
Default	0.71%	0.65%
Recovery	29.96%	31.42%
RatingNum	7.37	7.13

- Moody's Default and Recovery data from 2014 to 2023: 1160 observations.
- Non-US includes EU, GB, CA, and JP.
- Recovery rate is measured by post-default trading prices.

Roadmap

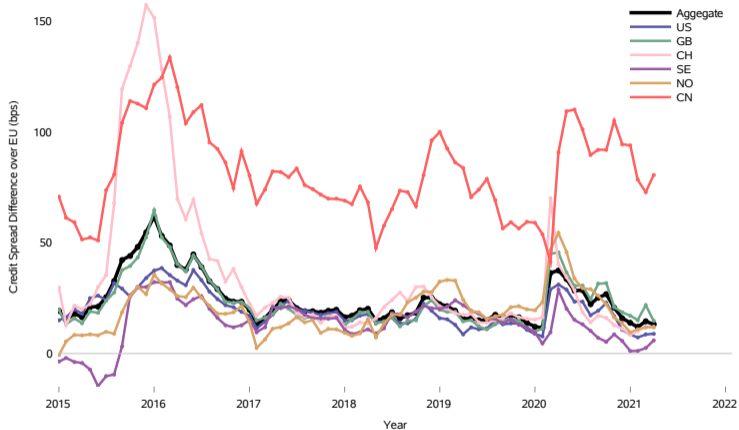
- Data Summary
- Quantify the Foreign Discount
 - ▶ Cross-Country and Cross-Currency
 - ▶ Risk and Institutional Factors
- Uncertainty-Based Explanation
 - ▶ Supporting Empirical Evidences
 - ▶ Model Calibrations
- Implications
 - ▶ Foreign Squeeze
 - ▶ Comparison with Safe Dollar Premium

Foreign Discount Across Countries



	Panel A: 2014/07 - 2023/06						Panel B: 2005/01 - 2023/06				
	All	EU	GB	CA	JP	CN	MX	All	EU	GB	CA
Foreign	22.06***	19.44***	20.70***	12.65**	18.17***	65.70***	60.24***	19.69***	25.67***	18.80***	5.03
	[6.57]	[5.17]	[3.80]	[2.21]	[2.67]	[8.06]	[3.77]	[5.10]	[3.54]	[3.38]	[0.83]

EUR-denominated Corporate Bonds



	Panel A: 2015/01 - 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]

Roadmap

- Data Summary
- Quantify the Foreign Discount
 - ▶ Cross-Country and Cross-Currency
 - ▶ Risk and Institutional Factors
- Uncertainty-Based Explanation
 - ▶ Supporting Empirical Evidences
 - ▶ Model Calibrations
- Implications
 - ▶ Foreign Squeeze
 - ▶ Comparison with Safe Dollar Premium

Risk and Risk Premia

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

● Issuer-Level Risk:

- ▶ Liquidity risk: turnover, illiquidity.
- ▶ Credit risk: Merton's Model.
 - ★ Inputs: leverage, asset growth, and equity volatility.
 - ★ Output: Distance-to-Default and default risk measure.

● US Risk Premia:

- ▶ Equity risk premium.
- ▶ Variance risk premium.
- ▶ Term premium.
- ▶ Default premium.

● Country-Level Risk:

- ▶ Political risk (ICRG).
- ▶ Currency risk (FX rate).
- ▶ Local Credit risk.

Risk and Risk Premia

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

● Issuer-Level Risk:

- ▶ Liquidity risk: turnover, illiquidity.
- ▶ Credit risk: Merton's Model.
 - ★ Inputs: leverage, asset growth, and equity volatility.
 - ★ Output: Distance-to-Default and default risk measure.

● US Risk Premia:

- ▶ Equity risk premium.
- ▶ Variance risk premium.
- ▶ Term premium.
- ▶ Default premium.

● Country-Level Risk:

- ▶ Political risk (ICRG).
- ▶ Currency risk (FX rate).
- ▶ Local Credit risk.

Risk and Risk Premia

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

● Issuer-Level Risk:

- ▶ Liquidity risk: turnover, illiquidity.
- ▶ Credit risk: Merton's Model.
 - ★ Inputs: leverage, asset growth, and equity volatility.
 - ★ Output: Distance-to-Default and default risk measure.

● US Risk Premia:

- ▶ Equity risk premium.
- ▶ Variance risk premium.
- ▶ Term premium.
- ▶ Default premium.

● Country-Level Risk:

- ▶ Political risk (ICRG).
- ▶ Currency risk (FX rate).
- ▶ Local Credit risk.

Risk and Risk Premia

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

● Issuer-Level Risk:

- ▶ Liquidity risk: turnover, illiquidity.
- ▶ Credit risk: Merton's Model.
 - ★ Inputs: leverage, asset growth, and equity volatility.
 - ★ Output: Distance-to-Default and default risk measure.

● US Risk Premia:

- ▶ Equity risk premium.
- ▶ Variance risk premium.
- ▶ Term premium.
- ▶ Default premium.

● Country-Level Risk:

- ▶ Political risk (ICRG).
- ▶ Currency risk (FX rate).
- ▶ Local Credit risk.

Institutional Difference

- How can non-US firms issue dollar-denominated bonds?
 - ▶ Registration under SEC (stringent disclosure), Rule 144A (QIBs), Reg S (Eurodollar).
- Tax treatment:
 - ▶ Foreign firms pay corporate income tax, branch profits tax, and withholding tax.
 - ▶ International taxation: territorial (UK, DE, FR, CA, JP) v.s. worldwide (US, CN, MX).
- Default and Bankruptcy:
 - ▶ Out-of-court restructuring, Chapter 11 reorganization or liquidation.
 - ▶ Similar default probability but higher recovery rate.
- Payment in Dollar:
 - ▶ Fed Swap Line: provide foreign central banks with dollar funding to institutions in their jurisdictions.
- Collateral and covenants:
 - ▶ DTC (20%-30% haircut for IG) in US.
 - ▶ Covenants are light for IG. (negative pledge)
- Investor Clientele: Bond Holders
 - ▶ Use eMAXX to merge with TRACE.
 - ▶ Reversely identify investor type by using trade size.

Roadmap

- Data Summary
- Quantify the Foreign Discount
 - ▶ Cross-Country and Cross-Currency
 - ▶ Risk and Institutional Factors
- Uncertainty-Based Explanation
 - ▶ Supporting Empirical Evidences
 - ▶ Model Calibrations
- Implications
 - ▶ Foreign Squeeze
 - ▶ Comparison with Safe Dollar Premium

1. Country-Level Uncertainty

- Economic Policy Uncertainty (EPU) Index from Baker, Bloom, and Davis (2016).
 - ▶ own-country newspaper coverage of policy-related economic uncertainty.
 - ▶ the number of federal tax code provisions set to expire from CBO.
 - ▶ dispersion among economic forecasters from Survey of Professional Forecasters.

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

1. Country-Level Uncertainty

- Economic Policy Uncertainty (EPU) Index from Baker, Bloom, and Davis (2016).
 - ▶ own-country newspaper coverage of policy-related economic uncertainty.
 - ▶ the number of federal tax code provisions set to expire from CBO.
 - ▶ dispersion among economic forecasters from Survey of Professional Forecasters.

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

2. Issuer-Level Uncertainty

• $\text{CreditSpread}_{i,t} = a + \mathbf{b} \text{Foreign}_{i,t} + \mathbf{c} X_{i,t} + \mathbf{d} \text{Foreign} \cdot X_{i,t} + \epsilon_{i,t}$.

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

- Age_in_US: time since entering to US.
- Sales_in_US: fraction of sales from US.
- Rule144A: Issued under Rule 144A.
- InstHoldings: holding pct by institutions.

3. Time-Series Uncertainty

Panel A: Reg Aggregate Foreign Discount on Uncertainty and US Variables

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

- ΔEPU : global EPU index.
- ΔEPU_{US} : US-specific EPU index.
- ΔICR : Intermediary Capital Risk from He, Kelly, and Manela (2017).
- The global EPU index has the strongest explanatory power on the foreign discount, surpassing other factors.

3. Time-Series Uncertainty

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

- The uncertainty index exerts a more pronounced effect on the discount during worsening market conditions, as evidenced by increasing ΔVIX , decreasing ΔICR , decreasing R_{SP500} and increasing R_{DXY} .

Roadmap

- Data Summary
- Quantify the Foreign Discount
 - ▶ Cross-Country and Cross-Currency
 - ▶ Risk and Institutional Factors
- Uncertainty-Based Explanation
 - ▶ Supporting Empirical Evidences
 - ▶ Model Calibrations
- Implications
 - ▶ Foreign Squeeze
 - ▶ Comparison with Safe Dollar Premium

Uncertainty-Based Model

- Step 1: Solve for pricing kernel.
 - ▶ Two-country (two trees) and one representative investor (US).
 - ▶ US investor exhibits **uncertainty aversion ϕ in the expected growth rate of foreign tree**. (Robust Control)
 - ▶ Pricing kernel: $\frac{dm_t}{m_t} = -r dt - \eta^H dB_t^H - \eta^F dB_t^F$, $\eta^H = \gamma \sigma^H \beta$, $\eta^F = \gamma \sigma^F (1 - \beta)(1 + \phi)$.
- Step 2: Apply to Leland framework and price bonds.
 - ▶ Two bonds issued by the US firm and foreign firm separately.
 - ▶ The foreign firm has risk exposure from its local market while the total risk is the same as the US firm .
 - ▶ Foreign Discount: ❶ $FD(\phi, \gamma)_{\phi=0} = 0$; ❷ FD is increasing in ϕ ; ❸ $\frac{\partial FD}{\partial \phi}$ is increasing in γ .
- Key Intuition:
 - ▶ Investors ask for high compensation for bearing the uncertainty on foreign bonds, especially in volatile states when risk aversion γ and market volatility σ increase.

Uncertainty-Based Model Calibration

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

- ϕ : The degree of uncertainty.
- The model can replicate the foreign discount under both normal and extreme conditions.
- The uncertainty has a larger effect on the foreign discount during worsening market conditions when the risk aversion is higher.

Uncertainty-Based Model Calibration

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

- ϕ : The degree of uncertainty.
- The model can replicate the foreign discount under both normal and extreme conditions.
- The uncertainty has a larger effect on the foreign discount during worsening market conditions when the risk aversion is higher.

Uncertainty-Based Model Calibration

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

- ϕ : The degree of uncertainty.
- The model can replicate the foreign discount under both normal and extreme conditions.
- The uncertainty has a larger effect on the foreign discount during worsening market conditions when the risk aversion is higher.

Uncertainty-Based Model Calibration

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

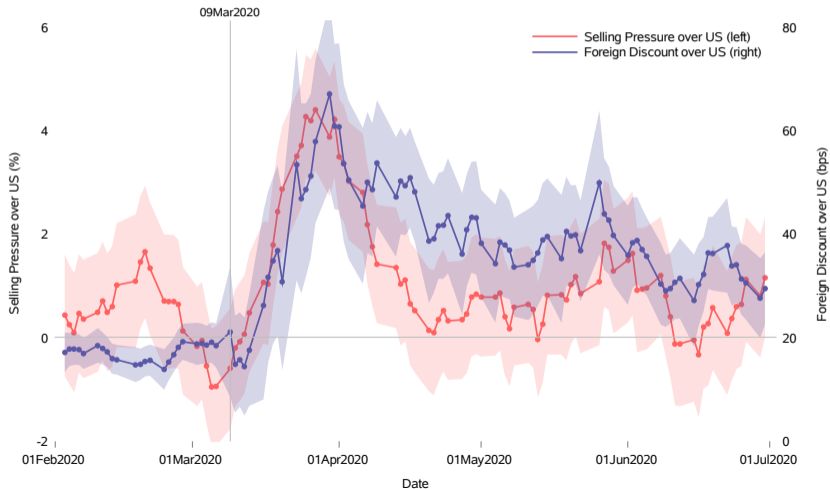
- ϕ : The degree of uncertainty.
- The model can replicate the foreign discount under both normal and extreme conditions.
- The uncertainty has a larger effect on the foreign discount during worsening market conditions when the risk aversion is higher.

Roadmap

- Data Summary
- Quantify the Foreign Discount
 - ▶ Cross-Country and Cross-Currency
 - ▶ Risk and Institutional Factors
- Uncertainty-Based Explanation
 - ▶ Supporting Empirical Evidences
 - ▶ Model Calibrations
- Implications
 - ▶ Foreign Squeeze
 - ▶ Comparison with Safe Dollar Premium

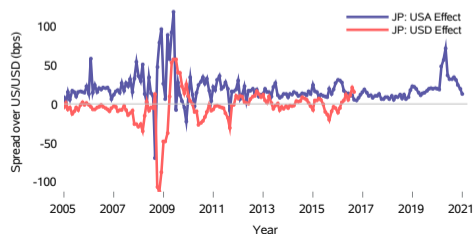
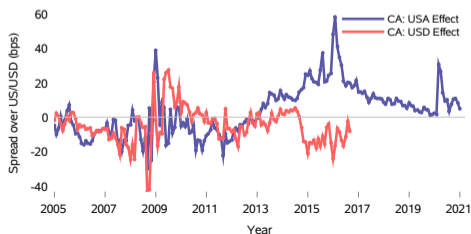
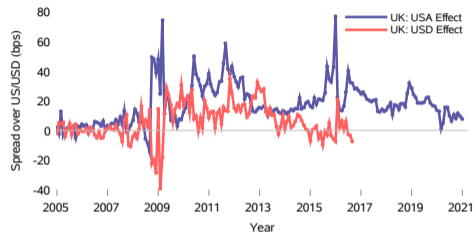
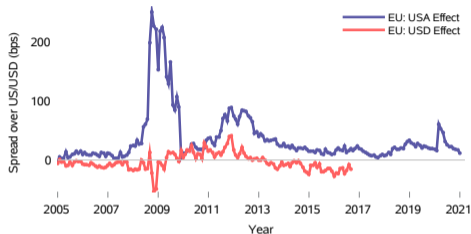
Foreign Squeeze in COVID-19

- $\text{SellingPressure}_{i,t} = a_t + \mathbf{b}_t \text{Foreign}_{i,t} + c_t \text{Rating}_{i,t} + \sum_k \text{Controls}_{i,t}^k + \epsilon_{i,t}$.
- SellingPressure: fraction of sell transactions by customers within all the customer-dealer transactions.



Comparison with Dollar Safety Premium

- USD effect (**benefit**): a large base of investors, high liquidity, convenience yield. (Liao (2020))
- USA effect (**cost**): US investors may ask for additional compensation due to high uncertainty.



Conclusions

- Document and quantify the foreign discount, which is symmetric.
- Standard risk and risk aversion can not explain away the foreign discount.
- Uncertainty-based explanation with supporting empirical evidence.
- Uncertainty-based model calibrations can match the data quite well.
- Foreign dollar bonds suffer high selling pressure during COVID-19.
- The USA effect dominates the USD effect, especially in deteriorating conditions.

Summary Statistics

	Mean: July 2014 - June 2023						Mean: January 2005 - June 2014					
	US	EU	GB	CA	JP	CN	US	EU	GB	CA	JP	CN
NumIssuers	1,448	192	114	99	54	56	1,242	132	86	70	26	13
NumBonds	13,179	1028	729	710	515	214	8,683	497	414	397	138	31
CreditSpread (%)	1.26	1.29	1.35	1.47	0.98	1.55	1.73	2.13	1.70	1.78	1.73	2.02
Yield (%)	3.36	3.24	3.34	3.58	2.82	3.48	4.53	4.78	4.38	4.47	4.18	5.10
Rating	7.37	7.20	7.33	7.39	6.36	6.21	7.11	6.78	6.35	7.89	6.26	8.36
Maturity (Y)	11.02	8.15	9.05	10.92	4.98	8.82	9.96	8.80	9.06	11.56	6.99	15.65
Age (Y)	5.21	4.41	4.97	5.98	2.77	3.57	4.83	4.39	4.90	4.90	3.32	4.17
IssueSize (log)	13.24	13.61	13.55	13.21	13.50	13.63	12.96	13.32	13.31	12.89	12.99	13.08
Coupon (%)	4.23	4.02	4.27	4.45	3.10	3.87	5.73	5.75	5.69	5.84	4.83	5.73
Turnover (%)	3.67	3.27	3.47	3.16	3.06	2.12	4.09	4.37	3.96	3.38	3.62	5.36
NumTrades	102.13	54.36	73.54	59.96	59.65	21.91	84.27	81.01	85.72	30.47	65.05	35.52
NumTradingDays	13.97	14.31	14.98	12.16	14.71	9.92	11.65	12.61	12.77	8.31	10.69	9.24
TradeSize (million)	0.42	0.94	0.71	0.53	0.75	1.08	0.54	0.69	0.60	0.80	0.52	1.10
Gamma	0.39	0.25	0.29	0.50	0.17	0.36	1.36	1.30	1.13	1.23	1.23	1.11

- Compared to foreign dollar bonds, US dollar bonds on average have lower ratings, longer maturity, smaller issuance size, higher coupon rates and are older, higher turnover, and higher gamma.

Country-Level Uncertainty: ϕ

- Consensus Economics survey: forecasts of 2020 GDP growth on different countries by global and local institutions.
- Global: Goldman, JPM, Citi, BOA, MS, Barclays, Deutsche, UBS, Credit Suisse, Moody's, Markit...
- Local: National Bank of Canada, Toronto Dominion Bank, BMO Capital Markets, Conf Board of Canada...

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

Country-Level Uncertainty: ϕ

- Consensus Economics survey: forecasts of 2020 GDP growth on different countries by global and local institutions.
- Global: Goldman, JPM, Citi, BOA, MS, Barclays, Deutsche, UBS, Credit Suisse, Moody's, Markit...
- Local: National Bank of Canada, Toronto Dominion Bank, BMO Capital Markets, Conf Board of Canada...

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

Country-Level Uncertainty: ϕ

- Consensus Economics survey: forecasts of 2020 GDP growth on different countries by global and local institutions.
- Global: Goldman, JPM, Citi, BOA, MS, Barclays, Deutsche, UBS, Credit Suisse, Moody's, Markit...
- Local: National Bank of Canada, Toronto Dominion Bank, BMO Capital Markets, Conf Board of Canada...

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