The Stock-Bond Correlation: A Tale of Two Days in the Treasury Bond Market

Jun Pan

Shanghai Advanced Institute of Finance (SAIF)
Shanghai Jiao Tong University

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Joint work with Grace Xing Hu (PBCSF) and Zhao Jin (CUFE)

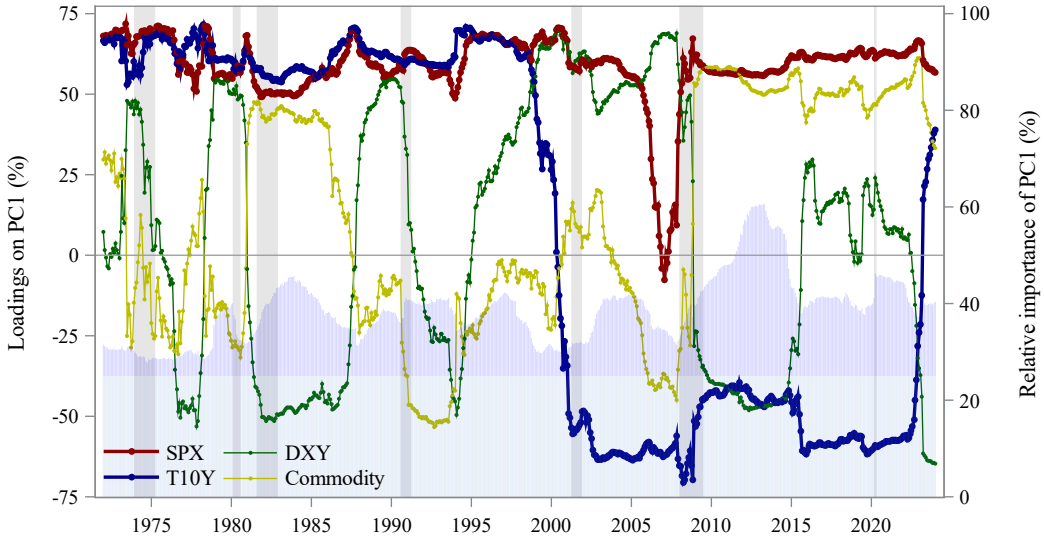
The Unique Importance of UST

- The US Treasury (UST) bond market is the single most important market in the world, totaling $28tn by Oct 2024 with average daily trading of near $1tn.
- The pricing of UST provides:
  - The reference curve for cost of funds at different borrowing horizons.
  - Price discovery about inflation and macroeconomic fundamentals.
  - Information on US monetary policy.
- UST has also become politically charged:
  - Three rounds of quantitative easing after 2008 and the 2020 QE infinite.
  - Large foreign holdings because of the reserve currency status of US dollar.
  - Financing the large and ever growing deficits of the US government.
- A well functioning UST: important for global markets, and essential for USA.

The Dual Role of U.S. Treasury in Global Markets

- **As a destination of safety**
  - Flights to safety (Baele, Bekaert, Inghelbrecht, and Wei 2019).
  - Global safety demand for UST (Jiang, Krishnamurthy, and Lustig 2023).
- **As a source of risk**
  - Interest rate risk – 2013 taper tantrum and FOMC rate hikes.
  - Inflation risk – 2021 inflation surge.
  - Dealer capacity risk – 2020 dash for cash (Duffie, Jackson Hole 2023).
- While the notion of UST as the primary safe haven is widely accepted, the concern over UST's resilience and US debt sustainability has only begun in recent years.
  - The Trump election has further hastened and deepened the concern.
  - Such heightened concerns call for better surveillance of UST riskiness.
- **Our paper:** A measure to capture UST safety and, more importantly, its riskiness.

The Stock-Bond Combo: A Robust Anchor to the Global Comovement



A Measure for Dual UST: Stock-Bond Correlation

- We use high-frequency SPX E-mini (SPX) and 10-Year T-Note (UST) futures to construct a daily stock-bond correlation measure. For day t,

$$\rho_t^{\text{UST}} = \text{corr}\left(R_{i,t}^{\text{SPX}}, R_{i,t}^{\text{UST}} \middle| \, i \in t\right),$$

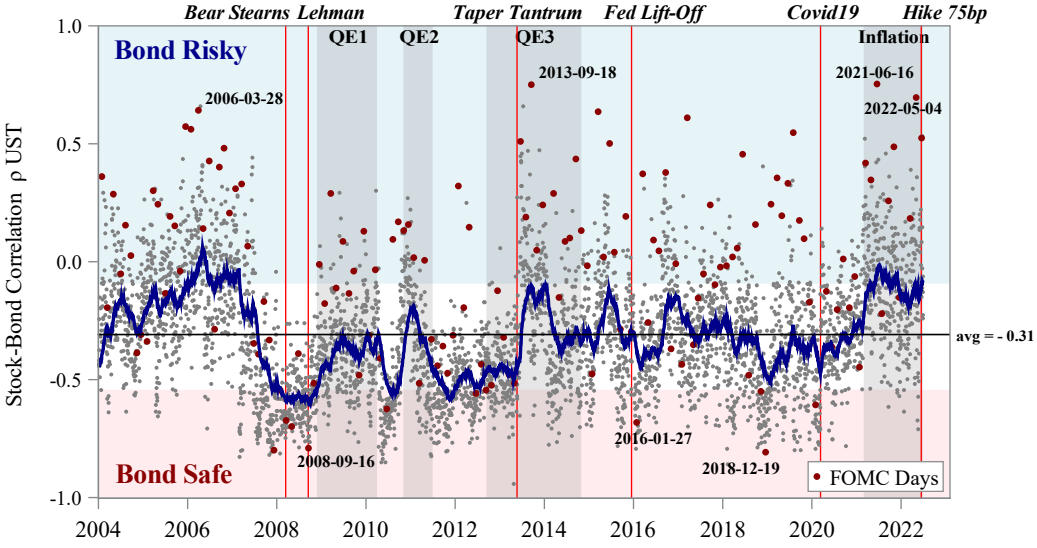
  where $R_{i,t}^{\text{SPX}}$ and $R_{i,t}^{\text{UST}}$ are 5-minute SPX and UST returns realized on day t.

- Use ρ_t^{UST} to sort days into bond safety (lower 20%) and bond risky (upper 20%).

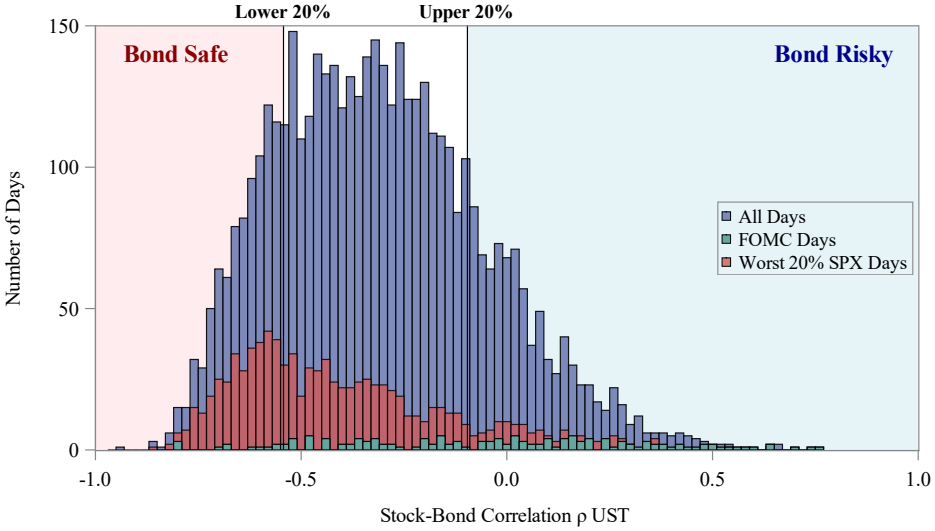
	mean	std	min	20%	median	80%	max
ρ_t^{UST}	-0.31	0.26	-0.94	-0.54	-0.33	-0.10	0.75
			UST Safety			UST Risky	
ρ_t^{USD}	-0.06	0.28	-0.77	-0.33	-0.04	0.18	0.75
			USD Safety			USD Risky	

- We further construct ρ_t^{USD}, ρ_t^{UST2Y}, and ρ_t^{UST3M} as alternative measures.

High-Frequency Stock-Bond Correlation ρ_t^{UST}

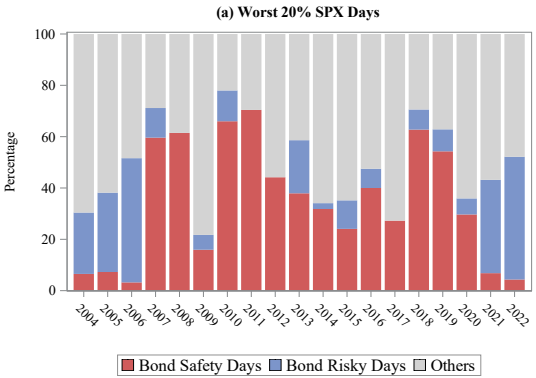


Distribution of Stock-Bond Correlation ρ_t^{UST}

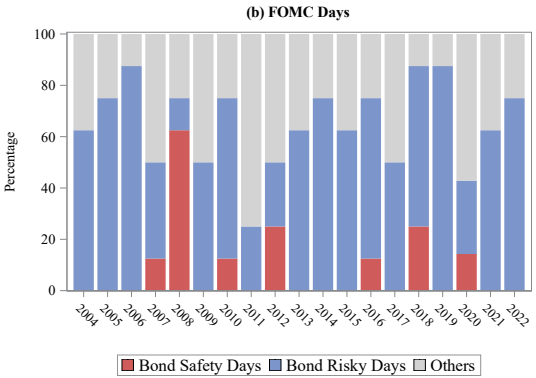


Diverging Sources of Risk as Captured by Stock-Bond Correlation ρ^{UST}

Source of Risk: SPX

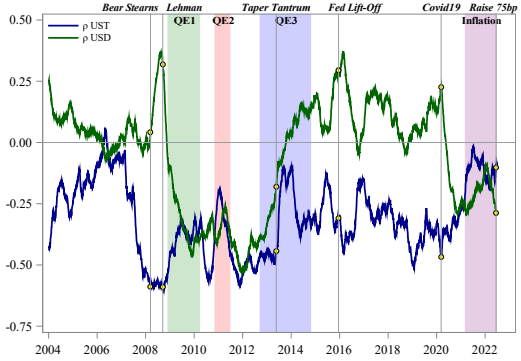


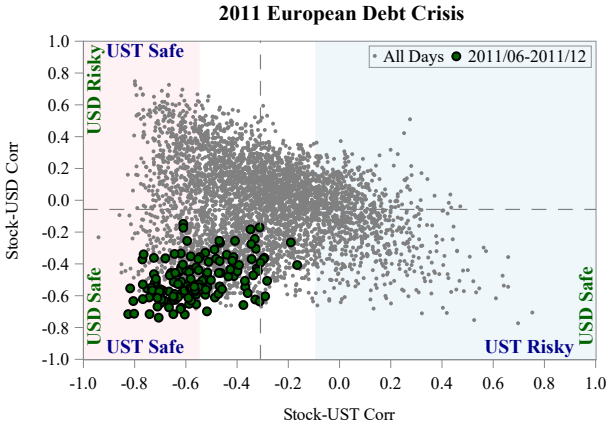
Source of Risk: UST



- On bond safety days, SPX is the main source of risk and UST is the safe haven asset.
- On bond risky days, UST becomes a source of risk (interest-rate, inflation, and liquidity).

The Safety of UST vs. USD





Summary of Main Results: A Tale of Two Days

- On bond safety days, safety matters the most:
  - Global asset returns are determined by their relative safety, not fundamentals.
  - Treasury convenience yield widens, indicating increased demand for UST safety.
  - Significant reduction in UST term premium, driven by flights-to-safety.
  - The otherwise positive linkage between USD and UST breaks down – the decrease in UST yield not accompanied by USD depreciation.
- On bond risky days, UST risk takes center stage:
  - Significant increase in UST term premium, driven by increased duration risk.
  - The positive linkage between USD and UST strengthens – the increase in UST yield accompanied by double the appreciation of USD.
  - A stock+bond model outperforms the CAPM in explaining global asset returns.
  - UST is the source of risk: intraday UST return can predict SPX.

Summary of Main Results: A Unique Measure of UST Riskiness

- We document significantly higher stock-bond correlation ρ_t^{UST} under
  - Higher interest-rate risk: releases of FOMC decisions and minutes.
  - Higher stress on dealers' balance sheet capacity: quarter ends and increased UST10Y issuance.
- Our stock-bond correlation measure can further identify the prominent episodes when UST becomes a source of risk:
  - 2013 taper tantrum – interest rate risk.
  - 2020 dash for cash – lack of UST resilience.
  - 2021 inflation surge – inflation risk.
  - 2022 rate hikes – interest rate risk.
- By contrast, existing measures of market risk (e.g., VIX, MOVE, and HPW Noise) are not designed specifically to capture the UST riskiness.

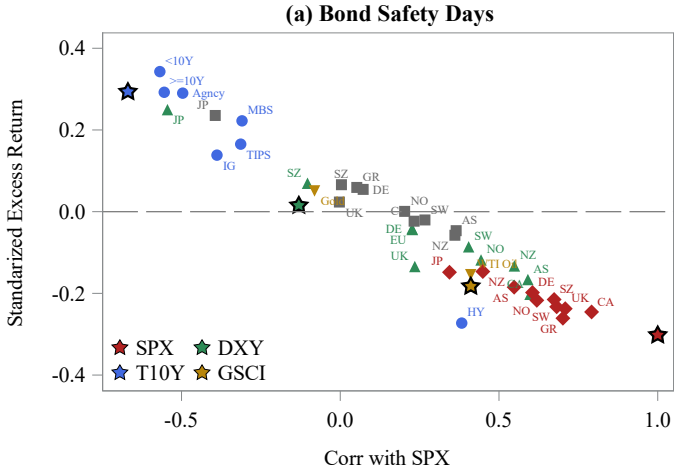
Related Literature

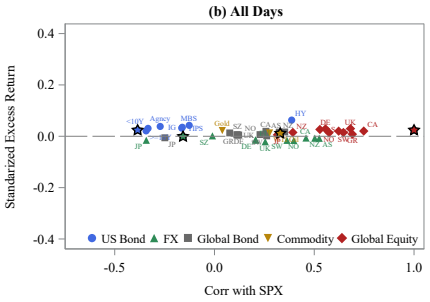
- The U.S. Treasury bond market
  - Liquidity and arbitrage capital: Hu, Pan, and Wang (2013).
  - Dealer capacity and UST resilience: Duffie (2023), Duffie et. al (2023).
  - Term premium: Adrian, Crump, and Moench (2013), Kim and Wright (2005).
- Flights to safety: Baele, Bekaert, Inghelbrecht, and Wei (2020).
- Treasury convenience:
  - Treasury basis: Du, Im, and Schreger (2018).
  - Demand for dollar safe asset: Jiang, Krishnamurthy, and Lustig (2021).
- Stock-bond correlation:
  - Non-monetary news in Fed communication: Cieslak and Schrimpf (2019).
  - UST convenience yield: Acharya and Laarits (2023).

Part I: UST Safety – Performance of Key Assets

UST Safety Days	SPX	UST	DXY	EUR/USD	YEN/USD
Mean Return (bps)	-36.20***	13.60***	1.20	-2.08	15.83***
	[-8.04]	[9.57]	[0.63]	[-0.90]	[6.72]
CAPM α (bps)		5.03***	-0.89	0.96	6.11***
		[4.42]	[-0.49]	[0.44]	[3.13]
ΔImplied Vol (%)	0.51***	0.79***	0.07***	0.07***	0.14***
	[6.48]	[4.68]	[3.75]	[3.42]	[4.28]
ΔVolatility (%)	1.11***	-0.02			
	[4.22]	[-0.21]			
ΔVolume (std)	0.25***	0.15***			
	[7.29]	[5.22]			
All Days	SPX	UST	DXY	EUR/USD	YEN/USD
Mean Return (bps)	3.37**	1.52**	0.40	-0.39	-0.51
	[2.23]	[2.50]	[0.56]	[-0.47]	[-0.59]
std (bps)	121.40	44.75	48.54	58.07	61.57

Part I: UST Safety – Alignment of Global Asset Returns





Part I: UST Safety – Widening of UST Convenience Yield

- UST basis is y_t^{UST} minus a currency-hedged synthetic government bond yield.
- Negative basis indicates UST convenience: lower funding cost for US government.
- Our result: it is the safety of UST, not USD, that drives the UST convenience.

	1-Year			5-Year		
	ΔUST Basis	ΔUST Basis (CIP Adj.)	ΔSwap Spread	ΔUST Basis	ΔUST Basis (CIP Adj.)	ΔSwap Spread
UST Safety Days	-0.66***	-0.45***	-0.43***	-0.51***	-0.36***	-0.26***
	[-3.51]	[-3.07]	[-3.01]	[-4.04]	[-3.36]	[-2.76]
UST Risky Days	0.1	0.03	-0.06	-0.07	-0.05	-0.08
	[0.93]	[0.35]	[-0.80]	[-0.74]	[-0.62]	[-1.26]
USD Safety Days	0.23	0.21*	0.14	0.07	0.13	0.14*
	[1.58]	[1.73]	[1.32]	[0.64]	[1.34]	[1.68]
USD Risky Days	0.05	0.12	0.14	-0.03	0.05	0.09
	[0.37]	[1.24]	[1.56]	[-0.24]	[0.57]	[1.23]
Intercept	0.07	0.02	0.04	0.11*	0.05	0.03
	[0.85]	[0.38]	[0.71]	[1.87]	[1.10]	[0.87]
NOBS	4423	4423	4423	4428	4428	4428
R2 (%)	0.55	0.37	0.4	0.47	0.29	0.31

Part I: UST Safety – UST Basis Widening Unique to UST Safety

$$\Delta\text{UST Basis} = \overbrace{\Delta y^{\text{US}} - \underbrace{\Delta(y^{\text{FX}} - (f-s))}_{\text{Synthetic Treasury Yield}}}^{\text{Decomposition \#1}} = \overbrace{\Delta(y^{\text{US}} - y^{\text{FX}}) + \underbrace{\Delta(f-s)}_{\text{Hedging Cost}}}^{\text{Decomposition \#2}}$$

Maturity: 1-Year		Decomposition #1		Decomposition #2	
	ΔUST Basis	Δy^{UST}	$\Delta(y^{\text{FX}} - (f-s))$	$\Delta(y^{\text{UST}} - y^{\text{FX}})$	$\Delta(f-s)$
UST Safety Days	-0.51***	-1.02***	-0.51***	-0.95***	0.44**
	[-3.16]	[-5.97]	[-2.62]	[-5.77]	[2.33]
Matched Days (without bond safety features)					
Matching Criterion	ΔUST Basis	Δy^{UST}	$\Delta(y^{\text{FX}} - (f-s))$	$\Delta(y^{\text{UST}} - y^{\text{FX}})$	$\Delta(f-s)$
(1) by Δy^{UST}	-0.14	-1.02***	-0.88***	-0.95***	0.81***
	[-0.93]	[-6.17]	[-4.75]	[-6.07]	[4.69]
(2) by UST10Y Ret	0.23*	-0.09	-0.33**	-0.11	0.34**
	[1.81]	[-0.88]	[-2.37]	[-0.97]	[2.53]
(3) by SPX Ret	-0.08	-0.34**	-0.25*	-0.29**	0.21
	[-0.59]	[-2.57]	[-1.87]	[-2.20]	[1.55]
(4) by ΔVIX	-0.07	-0.04	0.03	-0.06	-0.01
	[-0.57]	[-0.40]	[0.22]	[-0.55]	[-0.09]

Part II: Dual UST – Performance of Key Assets

UST Safety Days

	SPX	UST	DXY	EUR/USD	YEN/USD
Mean Return (bps)	-36.20***	13.60***	1.20	-2.08	15.83***
	[-8.04]	[9.57]	[0.63]	[-0.90]	[6.72]
CAPM α (bps)		5.03***	-0.89	0.96	6.11***
		[4.42]	[-0.49]	[0.44]	[3.13]
ΔImplied Vol (%)	0.51***	0.79***	0.07***	0.07***	0.14***
	[6.48]	[4.68]	[3.75]	[3.42]	[4.28]
ΔVolatility (%)	1.11***	-0.02			
	[4.22]	[-0.21]			
ΔVolume (std)	0.25***	0.15***			
	[7.29]	[5.22]			
Daily ETF Flow ($m)	-162.85**	13.09***			
	[-2.04]	[2.61]			
ΔNet Position (std)		0.40**			
Primary Dealers		[2.07]			

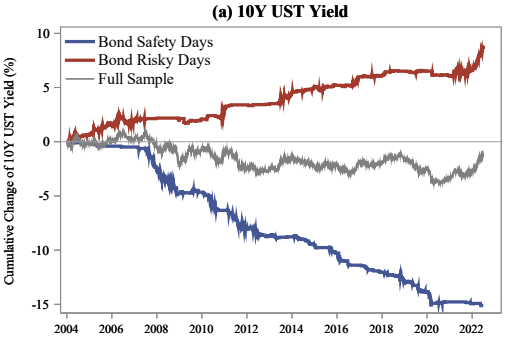
UST Risky Days

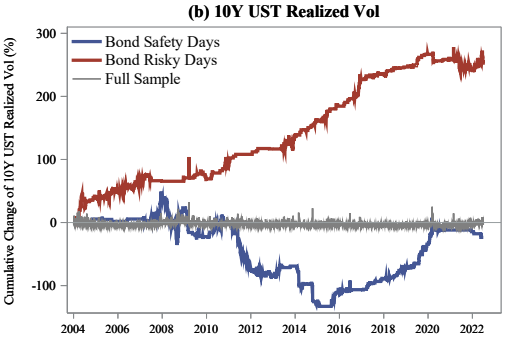
SPX	UST	DXY	EUR/USD	YEN/USD
13.75***	-6.05***	2.14	-1.93	-8.29***
[4.76]	[-3.92]	[1.22]	[-0.98]	[-4.16]
	-7.96***	3.61**	-4.99**	-9.97***
	[-4.92]	[2.06]	[-2.53]	[-5.06]
-0.16***	-0.11	-0.03***	-0.03**	-0.04***
[-4.12]	[-0.96]	[-3.13]	[-2.47]	[-3.04]
-0.25**	0.28***			
[-2.12]	[3.64]			
-0.00	0.12***			
[-0.12]	[3.97]			
10.02	-6.26			
[0.11]	[-1.03]			
	-0.60***			
	[-3.88]			

- Sharp decline in SPX; significant rally in UST.
- Large spikes in implied vol across the board.
- Significant SPX outflow and UST inflow.
- Primary dealers increase net UST position.

- UST: decline in price and increase in volatility.
- Increase in SPX and reduction in VIX.
- Increased trading volume in UST, but not in SPX.
- Primary dealers reduce net UST position.

Part II: Dual UST – Cumulative Changes in UST Yield and Volatility





Part II: Dual UST – UST Term Premium

	Panel A: Adrian, Crump, and Moench (2013)					Panel B: Kim and Wright (2005)				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
UST Safety Days	-0.99***	-0.82***	-0.99***	-0.59***	-0.63***	-0.84***	-0.63***	-0.84***	-0.58***	-0.51***
	[-4.71]	[-3.78]	[-4.72]	[-2.91]	[-2.94]	[-8.06]	[-5.52]	[-8.05]	[-5.64]	[-4.74]
UST Risky Days	0.45**	0.44**	0.50**	0.45**	0.53***	0.37***	0.35***	0.41***	0.36***	0.42***
	[2.31]	[2.22]	[2.55]	[2.28]	[2.74]	[3.40]	[3.20]	[3.74]	[3.17]	[3.79]
FTS by Baele et al. (2019)		-1.97*			-0.81		-2.38***			-1.64***
		[-1.82]			[-0.82]		[-7.52]			[-5.18]
FOMC			-0.61		-0.90*			-0.46		-0.51*
			[-1.11]		[-1.67]			[-1.53]		[-1.74]
SPX worst 20%				-1.60***	-1.70***				-1.13***	-1.05***
				[-5.60]	[-6.50]				[-8.90]	[-8.46]
SPX best 20%				1.97***	1.88***				0.86***	0.80***
				[8.57]	[8.11]				[8.02]	[7.73]
VIX top 20%					0.32					0.14
					[1.11]					[0.89]
VIX bottom 20%					-0.30**					-0.21**
					[-2.03]					[-2.33]
ΔNoise					1.63***					0.14
					[2.99]					[0.59]
ΔTYF Vol					0.00					-0.01
					[0.09]					[-0.48]
Intercept	0.06	0.08	0.07	-0.10	-0.02	0.07	0.09	0.07	0.07	0.11
	[0.60]	[0.77]	[0.71]	[-1.00]	[-0.19]	[1.22]	[1.59]	[1.38]	[1.26]	[1.64]
NOBS	4570	4570	4570	4570	4557	4570	4570	4570	4570	4557
R2 (%)	0.81	1.13	0.86	5.3	5.99	2.42	4.36	2.51	8.23	9.23

Part II: Dual UST – Transmission of UST to USD

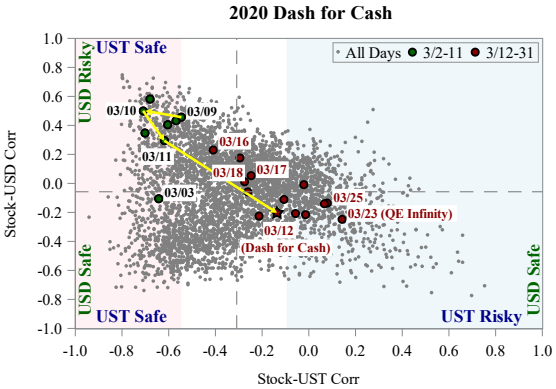
	USD Return (bps)	
$\Delta y^{\text{UST}} \times$ UST Safety		-1.39***
		[-2.79]
$\Delta y^{\text{UST}} \times$ UST Risky		1.89***
		[4.36]
Δy^{UST} (bps)	1.52***	1.16***
	[6.96]	[4.43]
$R^{\text{SPX}} \times$ UST Safety		0.04*
		[1.68]
$R^{\text{SPX}} \times$ UST Risky		-0.04
		[-1.57]
R^{SPX} (bps)	-0.09***	-0.08***
	[-7.65]	[-5.26]
UST Safety	-0.11	-0.83
	[-0.06]	[-0.41]
UST Risky	1.63	0.75
	[0.85]	[0.38]
Intercept	0.36	0.27
	[0.42]	[0.31]
NOBS	4604	4604
R2 (%)	4.97	6.46

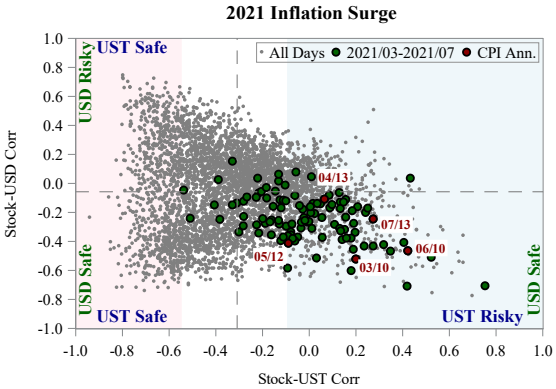
- USD appreciates when UST yield increases.
  - 1 bps increase in y^{UST} leads to 1.52 bps increase in USD return.
- On UST safety days, this transmission breaks down.
  - Reductions in UST yield due to flights-to-safety do not translate to USD depreciation.
- On UST risky days, this transmission more than doubles.
  - Increase in UST yield due to heightened risk in UST leads to amplified USD appreciation.

Part III: UST Riskiness – Stock-Bond Correlation as a Unique Measure

- Our high-frequency ρ_t^{UST} is unique and effective in capturing UST riskiness
  - Because it can capture the dual role of UST with distinct signals. Specifically, ρ^{UST} is negative when UST is safe and positive when risky.
  - Since 2000, the overall level the stock-bond correlation is negative.
  - Against this backdrop, a sudden increase in ρ^{UST} signals UST riskiness. A temporary relinquishment of UST as the safe asset.
- By contrast, other well known measures not uniquely designed for UST riskiness:
  - HPW Noise Measure: spikes up amid both flights-to-safety and UST turmoils.
  - VIX: fear gauge for the equity market.
  - MOVE: "VIX of bonds" but largely influenced by VIX.
  - UST volatility: can be influenced by equity market volatility.
- The potential drivers of UST riskiness: interest-rate risks, inflation risk, and intermediary risk.

Part III: UST Riskiness – Prominent Episodes Captured by ρ_t^{UST}





Part III: UST Riskiness – Interest Rate Risk

	N	$\Delta\rho^{\text{UST}}$	ΔVIX	ΔMOVE	ΔNoise	ΔUST Vol	ΔEmini Vol
FOMC Announcement Days	147	0.30***	-0.52***	-2.30***	0.07***	2.19***	2.66***
		[10.18]	[-3.26]	[-6.63]	[2.92]	[6.53]	[5.60]
rate hike	29	0.30***	-0.66**	-2.26***	0.10*	2.43***	2.94***
		[5.63]	[-2.13]	[-3.83]	[1.72]	[6.75]	[2.72]
rate unchanged	107	0.31***	-0.42**	-1.83***	0.06**	2.09***	2.17***
		[9.64]	[-2.28]	[-5.35]	[2.26]	[5.01]	[3.95]
rate cut	11	0.18*	-1.19	-6.91***	0.11**	2.57***	6.66***
		[1.74]	[-1.31]	[-2.89]	[2.16]	[5.08]	[4.15]
FOMC Minutes Release	146	0.10***	-0.09	0.18	-0.03	0.44**	0.07
		[3.39]	[-0.99]	[0.78]	[-1.34]	[2.24]	[0.15]
rate hike	28	0.06	-0.17	0.45	-0.06	0.79**	0.33
		[1.14]	[-1.33]	[0.90]	[-0.94]	[2.25]	[0.38]
rate unchanged	107	0.13***	-0.09	0.18	-0.02	0.42*	-0.14
		[3.90]	[-0.86]	[0.75]	[-1.07]	[1.76]	[-0.21]
rate cut	11	-0.12***	0.06	-0.42	0.00	-0.27	1.55
		[-4.68]	[0.08]	[-0.25]	[0.09]	[-0.25]	[1.40]

Part III: UST Riskiness – Dealer Capacity

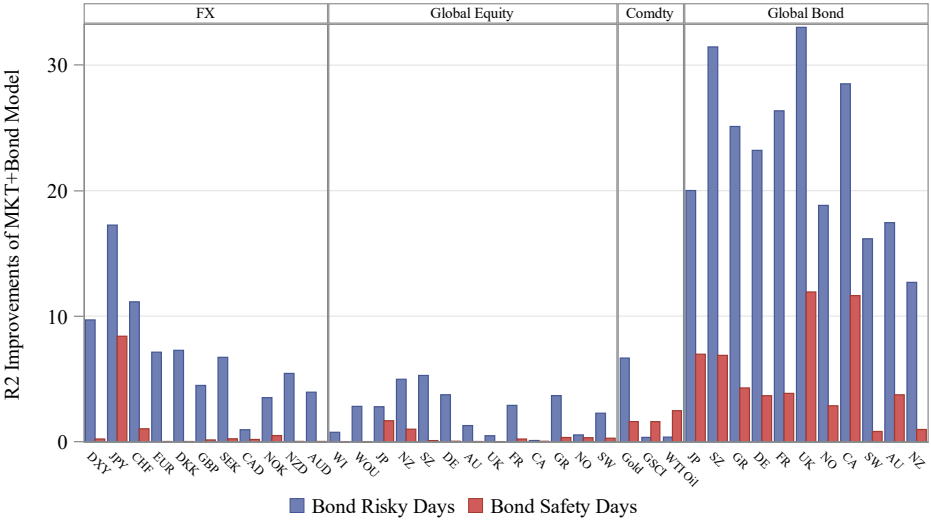
	N	$\Delta\rho^{UST}$	ΔVIX	ΔMOVE	ΔNoise	ΔUST Vol	ΔEmini Vol
Quarter End	74	0.04**	-0.17	0.27	0.04	0.10	-0.96
		[1.97]	[-0.83]	[1.11]	[0.98]	[0.30]	[-1.10]
post Volcker Rule	28	0.09***	-0.50**	-0.09	0.08	-0.08	0.49
		[2.98]	[-1.98]	[-0.19]	[1.13]	[-0.28]	[0.56]
Month End (ex. Qtr End)	148	0.03*	0.40***	0.59**	0.05**	1.92***	0.42
		[1.84]	[3.77]	[2.28]	[2.46]	[3.63]	[0.64]
post Volcker Rule	56	0.06*	0.50***	0.87**	0.03	0.15	0.60
		[1.89]	[2.68]	[2.12]	[1.23]	[0.22]	[0.93]
10Y UST Auctions	74	0.00	0.32	-0.12	-0.03	0.32	-0.53
		[0.22]	[1.19]	[-0.27]	[-0.88]	[1.05]	[-0.58]
with Increased Off. Amt.	14	0.13***	0.06	-1.37	-0.16	-0.75	-6.18*
		[2.64]	[0.11]	[-1.09]	[-1.62]	[-1.40]	[-1.86]
post Volcker Rule	7	0.22**	-0.13	-0.69	0.02	-0.87	-9.59
		[2.56]	[-0.14]	[-1.27]	[0.88]	[-1.00]	[-1.60]
5Y UST Auctions	222	0.02	-0.02	0.50*	0.01	0.41***	-0.44
		[1.25]	[-0.21]	[1.68]	[0.37]	[2.68]	[-1.13]
with Increased Off. Amt.	37	0.06	0.2	0.7	-0.02	1.07**	0.38
		[1.51]	[0.53]	[0.67]	[-0.38]	[2.43]	[0.35]
post Volcker Rule	17	0.02	0.32	0.26	0.04	0.03	0.98
		[0.39]	[0.47]	[0.62]	[1.44]	[0.08]	[0.46]

Part III: UST Riskiness – UST Leading SPX in Intraday Pricing

	UST Risky Days		Non-UST Risky Days		Full Sample	
	$R^{SPX}_{i+1,t}$	$R^{UST}_{i+1,t}$	$R^{SPX}_{i+1,t}$	$R^{UST}_{i+1,t}$	$R^{SPX}_{i+1,t}$	$R^{UST}_{i+1,t}$
$R^{SPX}_{i,t}$	-0.03**	0.01	-0.02**	-0.01***	-0.02**	-0.01***
	[-2.58]	[1.63]	[-2.29]	[-7.91]	[-2.38]	[-4.26]
$R^{UST}_{i,t}$	0.15***	-0.03**	-0.01	-0.08***	0.03	-0.06***
	[2.65]	[-2.05]	[-0.40]	[-11.54]	[1.46]	[-7.56]
Intercept	0.08**	-0.03**	-0.01	0.02***	0.01	0.01*
	[2.51]	[-2.33]	[-0.42]	[2.87]	[0.29]	[1.84]
NOBS	70,147	69,992	283,174	282,891	353,331	352,893
R2 (%)	0.39	0.11	0.04	0.50	0.05	0.34

- On UST risky days, UST is the source of risk:
  - UST can positively predict SPX, but not vice versa.
- On other days, SPX is the source of risk:
  - SPX can negatively predict UST, but not vice versa.

Part III: UST Riskiness – A Two-Factor Model of Stock and Bond



Conclusions

- Reliable risk measures for UST are needed amid increasing concern over its safety:
  - Steady decline of dealer capacity to UST outstanding since 2007.
  - Persistent fiscal deficits leading to further growth of UST outstanding.
  - Trump's campaign promises that are inflationary: taxes, tariffs, labor, the Fed.
- Our stock-bond correlation measure is effective in capturing not only UST safety, but, more importantly, its riskiness, and with *opposite signals*.
- **UST Safety – days with highly negative stock-bond correlation**
  - Alignment of global asset returns by their relative safety, not fundamentals.
  - Widening of UST convenience yield due to UST (not USD) safety.
- **UST Riskiness – days with high stock-bond correlation**
  - Captured by our measure are days when UST is dominated by interest rate risk, inflation risk, and dealer capacity risk.
- By contrast, other liquidity and uncertainty measures for UST spike up in both scenarios (e.g., 2008-09 financial crisis vs 2020 dash for cash.)