

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

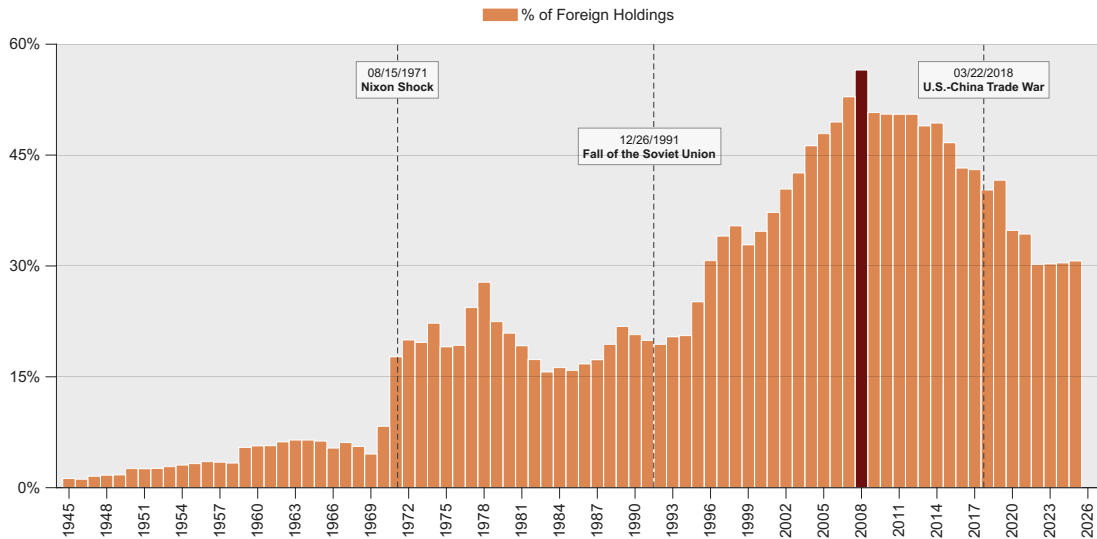
Jun Pan

**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)

Foreign Holdings of U.S. Treasuries (%)



The Unique Importance of UST

- The U.S. Treasury (UST) bond market is the single most important market in the world, totaling \$29tn by July 2025 with average trading over \$1tn per day.
- 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 also lies at the center of geopolitics:
 - ▶ 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 safety destination
 - ▶ 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](#)).
- Recent concerns over UST's resilience and US debt sustainability call for a better surveillance of UST riskiness.
- Our paper: A measure to capture UST safety and, more importantly, its riskiness.

An Illustrative Model: Two Sources of Uncertainties

- The joint dynamics of stock price S_t and short rate r_t ,

$$\begin{aligned}\frac{dS_t}{S_{t-}} &= [\mu_S - \lambda E(e^{J_S} - 1)] dt + \boxed{\sigma_S dW_t^S} + \boxed{(e^{J_S} - 1) dN_t} \\ dr_t &= [\kappa(\theta - r_t) - \lambda E(J_r)] dt + \boxed{\sigma_r dW_t^r} + \boxed{J_r dN_t}\end{aligned}$$

- Bond as a destination of safety:
 - ▶ Equity-market driven shocks governed by Poisson arrival N_t with intensity λ .
 - ▶ Upon arrival, the jump sizes J_S and J_r are joint normal with correlation ρ_J .
 - ▶ As bond prices move inversely to r , we capture flights-to-safety via $\rho_J > 0$.
- Bond as a source of risk:
 - ▶ Bond-market driven shocks governed by Brownians W_t^r and W_t^S , with an instantaneous correlation of ρ_W .
 - ▶ To capture the feature of co-movement, we set $\rho_W < 0$

An Illustrative Model: Stock and Bond Correlation

- The price of a zero-coupon bond maturing at year T ,

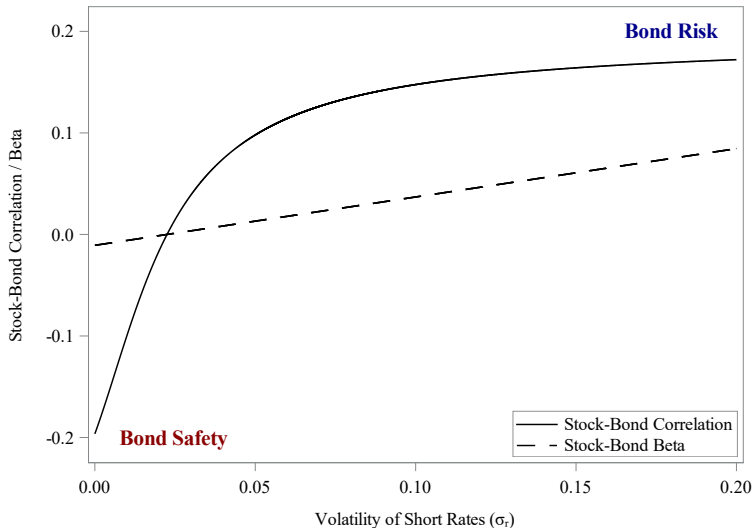
$$P(t, T) = E_t^Q \left[\exp \left(- \int_t^T r_s ds \right) \right] = \exp [A(\tau) - B(\tau) r_t], \quad \tau = T - t.$$

- The instantaneous correlation between stock and bond returns,

$$\text{Corr} (d \ln S_t, d \ln P_t) = - \frac{\sigma_S \sigma_r \rho_W + \lambda \rho_J \sigma_J^S \sigma_J^r}{\sqrt{(\sigma_S^2 + \lambda(\sigma_J^S)^2) (\sigma_r^2 + \lambda(\sigma_J^r)^2)}}$$

- “Bond Safety” days are when λ is large and σ_r approaches zero, and the correlation dominated by ρ_J . While on “Bond Risk” days, the correlation is primarily driven by the diffusion shocks via ρ_W .

A Tale of Two Days According to σ_r



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 ,

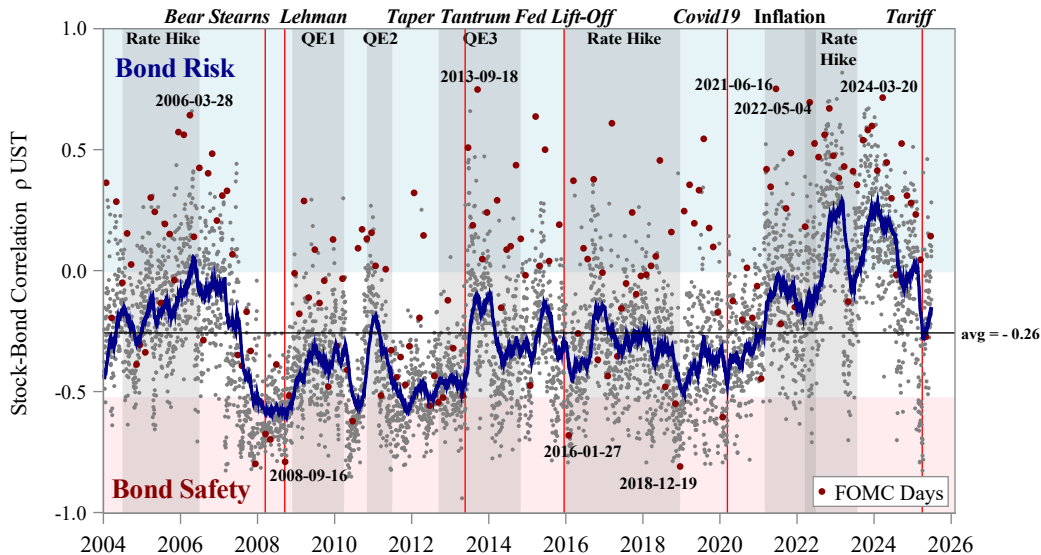
$$\rho_t^{\text{UST}} = \text{corr} (R_{i,t}^{\text{SPX}}, R_{i,t}^{\text{UST}} \mid i \in t),$$

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

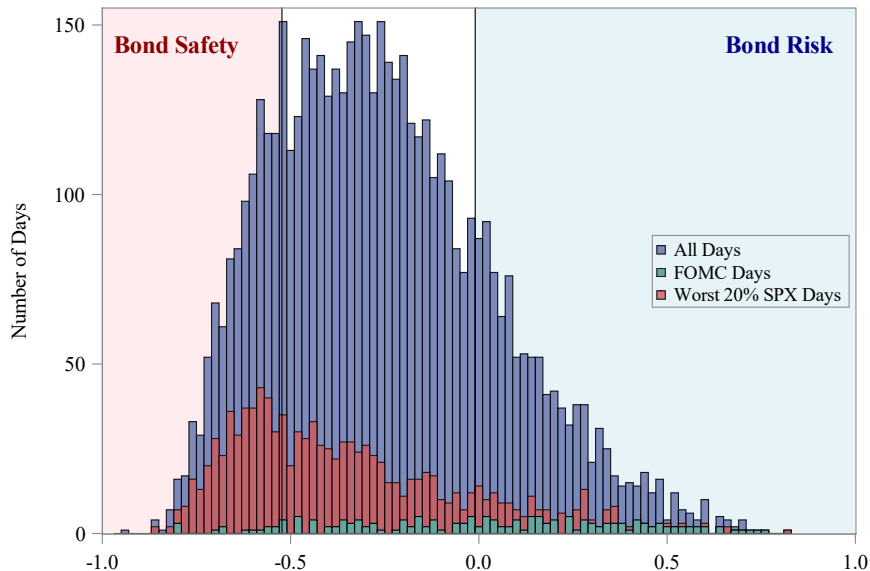
- A parallel measure for U.S. dollar, ρ_t^{USD} , is constructed with the same approach, using currency futures on USD/EUR and USD/YEN.

	mean	std	min	20%	50%	80%	max
	Safety				Risk		
ρ_t^{UST}	-0.26	0.29	-0.94	-0.52	-0.29	-0.01	0.82
ρ_t^{USD}	-0.09	0.28	-0.79	-0.36	-0.08	0.16	0.75

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



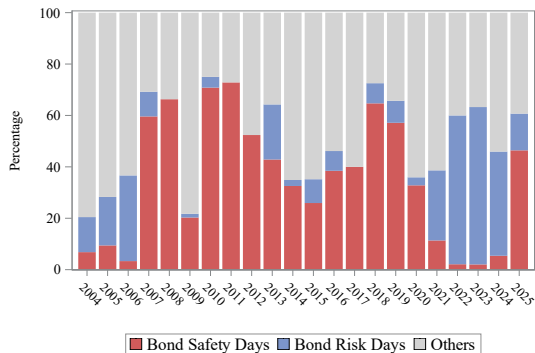
Distribution of Stock-Bond Correlation ρ_t^{UST}



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

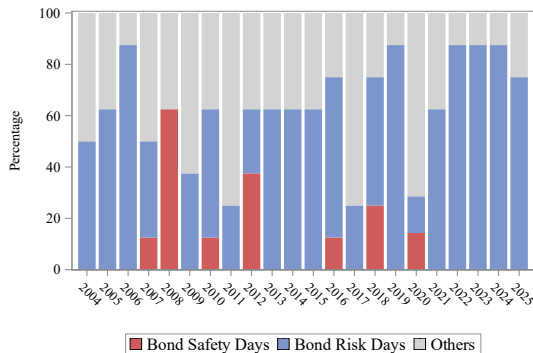
Source of Risk: SPX

(a) Worst 20% SPX Days



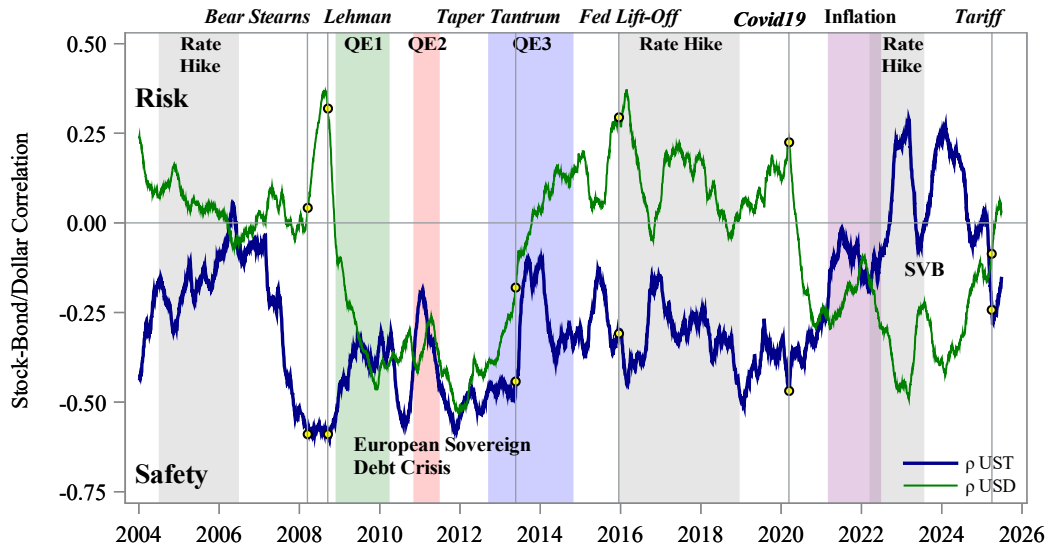
Source of Risk: UST

(b) FOMC Days



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

The Safety of UST vs. USD



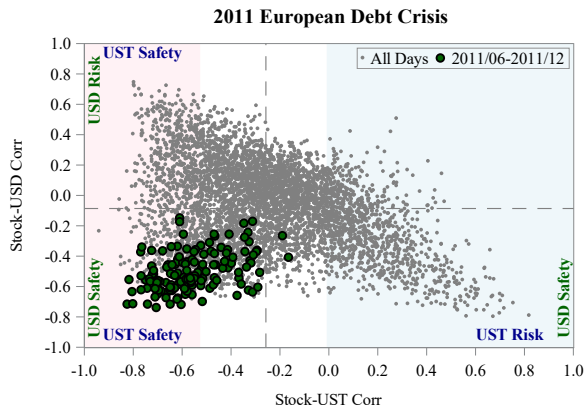
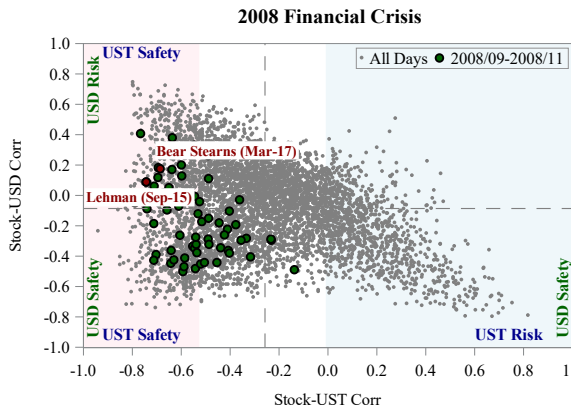
Related Literature

- 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

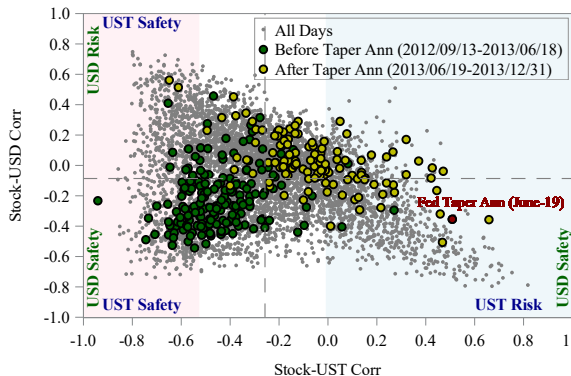
UST Safety Days	SPX	UST	DXY	EUR/USD	YEN/USD
Mean Return (bps)	-32.41*** [-7.88]	11.83*** [9.11]	0.83 [0.49]	-1.67 [-0.81]	14.30*** [6.86]
CAPM α (bps)		4.80*** [4.54]	-0.52 [-0.32]	0.01 [0.01]	9.09*** [4.82]
Δ Implied Vol (%)	0.46*** [6.26]	0.70*** [4.61]	0.06*** [3.57]	0.06*** [3.20]	0.11*** [4.33]
Δ Volatility (%)	0.96*** [4.03]	-0.02 [-0.24]			
Δ Volume (std)	0.14*** [6.80]	0.09*** [4.81]			
All Days	SPX	UST	DXY	EUR/USD	YEN/USD
Mean Return (bps)	3.90*** [2.81]	1.37** [2.34]	0.20 [0.31]	-0.12 [-0.16]	-0.54 [-0.66]
std (bps)	119.73	46.20	48.50	56.27	62.61

Part I: UST Safety – Compared with Dollar Safety

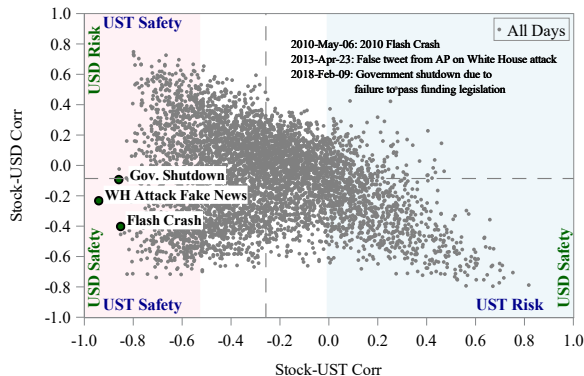


Part I: UST Safety – Compared with Dollar Safety

2013 QE3 and Taper Tantrum



Panic Events

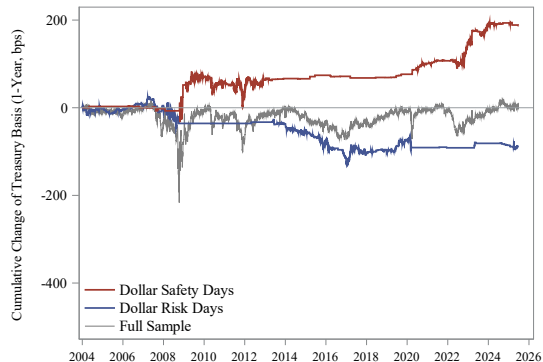
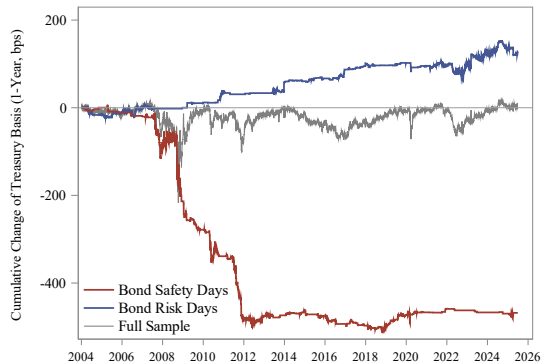


Part I: UST Safety – Widening of UST Convenience Yield

- 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.
- It is the safety of UST, not USD, that drives the changes in UST convenience yield.

$y = \Delta\text{UST Basis}$	1-Year			5-Year		
	(1)	(2)	(3)	(1)	(2)	(3)
UST Safety Days	-0.55*** [-3.55]		-0.58*** [-3.60]	-0.50*** [-4.44]		-0.51*** [-4.47]
UST Risk Days	-0.01 [-0.07]		-0.05 [-0.50]	-0.14 [-1.53]		-0.16 [-1.64]
USD Safety Days		0.18 [1.31]	0.27* [1.93]		0.04 [0.36]	0.13 [1.28]
USD Risk Days		-0.07 [-0.65]	0.05 [0.45]		-0.05 [-0.57]	0.03 [0.26]
Intercept	0.11* [1.95]	-0.02 [-0.31]	0.07 [1.02]	0.12*** [3.00]	0.00 [-0.08]	0.10* [1.96]
NOBS	5221	5212	5190	5226	5216	5195
R2 (%)	0.37	0.05	0.44	0.43	0.01	0.45

Part I: UST Safety – Widening of UST Convenience Yield



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

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

Synthetic Treasury Yield
Hedging Cost

Maturity: 1-Year		Decomposition #1		Decomposition #2	
	$\Delta \text{UST Basis}$	Δy^{UST}	$\Delta(y^{\text{FX}} - (f - s))$	$\Delta(y^{\text{UST}} - y^{\text{FX}})$	$\Delta(f - s)$
UST Safety Days	-0.44*** [-3.10]	-0.83*** [-5.47]	-0.39** [-2.21]	-0.74*** [-5.03]	0.29* [1.72]

Matched Days (without bond safety features)

Matching Criterion	$\Delta \text{UST Basis}$	Δy^{UST}	$\Delta(y^{\text{FX}} - (f - s))$	$\Delta(y^{\text{UST}} - y^{\text{FX}})$	$\Delta(f - s)$
(1) by $\Delta y^{\text{UST}(1y)}$	0.02 [0.17]	-0.83*** [-5.60]	-0.86*** [-4.89]	-0.86*** [-5.87]	0.88*** [5.16]
(2) by $R^{\text{UST}(10y)}$	0.18* [1.65]	-0.09 [-0.83]	-0.27** [-2.05]	-0.12 [-1.15]	0.30** [2.39]
(3) by R^{SPX}	0.08 [0.61]	0.06 [0.45]	-0.02 [-0.13]	0.06 [0.46]	0.02 [0.11]
(4) by ΔVIX	-0.10 [-0.89]	0.08 [0.63]	0.18 [1.16]	0.07 [0.55]	-0.17 [-1.14]

Part II: Dual UST – Performance of Key Assets

	UST Safety Days				
	SPX	UST	DXY	EUR/USD	YEN/USD
Mean Return (bps)	-32.41*** [-7.88]	11.83*** [9.11]	0.83 [0.49]	-1.67 [-0.81]	14.30*** [6.86]
CAPM α (bps)		4.80*** [4.54]	-0.52 [-0.32]	0.01 [0.01]	9.09*** [4.82]
Δ Implied Vol (%)	0.46*** [6.26]	0.70*** [4.61]	0.06*** [3.57]	0.06*** [3.20]	0.11*** [4.33]
Δ Volatility (%)	0.96*** [4.03]	-0.02 [-0.24]			
Δ Kurtosis	0.19** [2.00]	0.16 [1.09]			
Δ Volume (std)	0.14*** [6.80]	0.09*** [4.81]			

- Sharp decline in SPX; significant rally in UST.
- Implied vol spikes up across the board.
- Large increase in SPX intraday vol, but not UST.

	UST Risk Days				
	SPX	UST	DXY	EUR/USD	YEN/USD
	12.60*** [4.60]	-5.81*** [-3.57]	1.45 [0.97]	-0.92 [-0.60]	-6.93*** [-3.51]
		-7.82*** [-5.09]	3.73*** [2.63]	-2.78* [-1.84]	-8.18*** [-4.22]
	-0.14*** [-3.82]	-0.13 [-1.04]	-0.03*** [-3.07]	-0.03*** [-2.71]	-0.03** [-2.33]
	-0.19 [-1.46]	0.39*** [4.80]			
	0.21** [2.36]	1.44*** [6.18]			
	0.02 [1.26]	0.13*** [6.16]			

- Large decline in UST prices, but not SPX.
- Significant increase in UST vol.
- Increased trading volume in UST, but not in SPX.

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	-0.82*** [-4.19]	-0.71*** [-3.48]	-0.82*** [-4.21]	-0.55*** [-2.90]	-0.64*** [-3.31]	-0.67*** [-8.07]	-0.50*** [-5.47]	-0.67*** [-8.10]	-0.50*** [-6.07]	-0.52*** [-6.01]
UST Risk Days	0.56*** [2.71]	0.60** [2.48]	0.61*** [2.91]	0.56*** [2.62]	0.63*** [2.98]	0.32*** [3.08]	0.36*** [3.23]	0.36*** [3.49]	0.31*** [2.97]	0.37*** [3.57]
FTS by Baele et al. (2019)		-1.94* [-1.82]					-2.23*** [-8.67]			
FOMC			-0.69 [-1.38]		-0.85* [-1.72]			-0.64*** [-2.64]		-0.64*** [-2.65]
SPX Worst 20%				-1.23*** [-4.61]	-1.38*** [-5.38]				-0.81*** [-7.50]	-0.82*** [-7.78]
SPX Best 20%				1.26*** [5.45]	1.18*** [5.07]				0.51*** [5.26]	0.50*** [5.26]
VIX Top 20%					0.31 [1.21]					0.01 [0.08]
VIX Bottom 20%					-0.27* [-1.86]					-0.15** [-1.96]
Δ Noise					1.42*** [3.04]					0.03 [0.16]
Δ TYF Vol					-0.02 [-0.47]					-0.02 [-1.09]
Intercept	0.02 [0.27]	0.06 [0.63]	0.04 [0.42]	-0.04 [-0.38]	0.03 [0.31]	0.06 [1.26]	0.08* [1.80]	0.07 [1.54]	0.08* [1.83]	0.13** [2.30]
NOBS	5303	4886	5303	5303	5291	5308	4886	5308	5308	5296
R2 (%)	0.65	0.98	0.70	2.66	3.20	1.94	4.18	2.17	5.16	5.46

Part II: Dual UST – Transmission of UST to USD

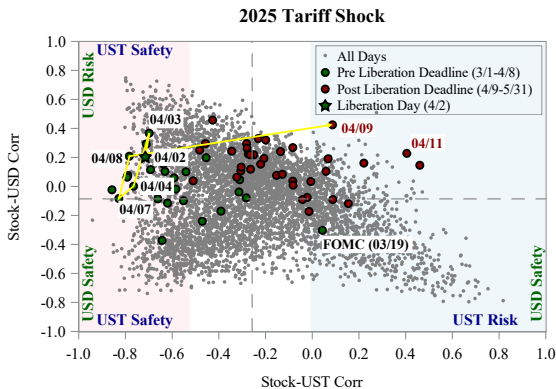
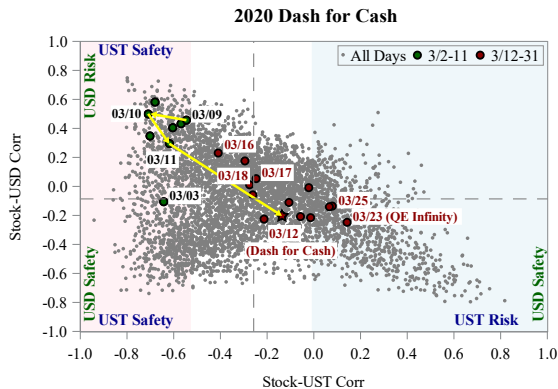
	USD Return (bps)	
$\Delta y^{\text{UST}} \times \text{UST Safety}$		-1.72*** [-3.56]
$\Delta y^{\text{UST}} \times \text{UST Risk}$		1.81*** [5.35]
Δy^{UST} (bps)	1.85*** [10.04]	1.48*** [5.94]
$R^{\text{SPX}} \times \text{UST Safety}$		0.04** [1.98]
$R^{\text{SPX}} \times \text{UST Risk}$		-0.05** [-2.17]
R^{SPX} (bps)	-0.09*** [-7.85]	-0.07*** [-5.26]
UST Safety	0.07 [0.04]	-0.94 [-0.52]
UST Risk	0.73 [0.46]	0.03 [0.02]
Intercept	0.27 [0.33]	0.14 [0.17]
NOBS	5309	5309
R2 (%)	6.89	8.81

- USD appreciates when UST yield increases.
 - ▶ 1 bps increase in y^{UST} leads to 1.85 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 risk days, this transmission nearly doubles.
 - ▶ Increase in UST yield due to heightened risk in UST leads to amplified USD appreciation.

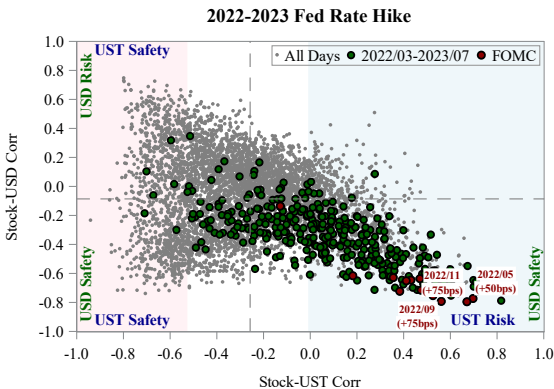
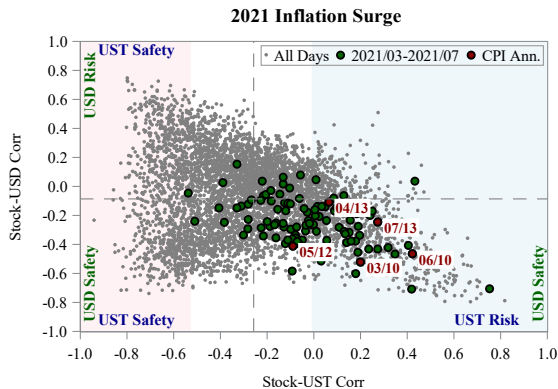
Part III: UST Riskiness – Stock-Bond Correlation as a Unique Measure

- Our measure ρ_t^{UST} is uniquely designed to differentiate the dual sources of risk:
 - ▶ Its sudden increase signals UST riskiness.
 - ▶ Its sudden reduction signals UST safety amid episodes of flight-to-safety.
- By contrast, existing risk measures are one-dimensional in nature:
 - ▶ 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 drivers of UST riskiness captured by our measure:
 - ▶ Interest-rate risks (e.g., FOMC announcements, taper tantrum from QE).
 - ▶ Inflation risk (e.g., 2021 inflation surge).
 - ▶ Intermediary risk (e.g., dash for cash).
 - ▶ More recently, political uncertainty (e.g., Liberation Day).

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



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



Part III: UST Riskiness – Interest Rate and Dealer Capacity Risk

	N	$\Delta\rho^{UST}$	ΔVIX	$\Delta MOVE$	$\Delta Noise$	$\Delta UST Vol$	$\Delta Emini Vol$
FOMC Announcement Days	171	0.30*** [11.44]	-0.44*** [-2.86]	-2.82*** [-7.47]	0.06*** [3.00]	2.01*** [6.16]	2.85*** [6.11]
FOMC Minutes Release	171	0.10*** [3.93]	-0.19 [-1.38]	-0.05 [-0.19]	-0.03 [-1.38]	0.36* [1.84]	0.05 [0.12]
Jackson Hole	19	0.15** [2.20]	-0.51 [-1.18]	-0.42 [-0.50]	0.05 [1.00]	1.83*** [3.20]	3.41*** [3.00]
Quarter End	86	0.04* [1.91]	-0.13 [-0.76]	0.21 [0.78]	0.03 [1.08]	0.05 [0.17]	-0.76 [-0.98]
<i>post Volcker Rule</i>	40	0.08** [2.14]	-0.32* [-1.68]	-0.12 [-0.26]	0.06 [1.20]	-0.13 [-0.39]	0.49 [0.74]
Month End (ex. Qtr End)	172	0.03* [1.77]	0.31*** [3.14]	0.51** [2.16]	0.05*** [2.71]	1.45*** [2.97]	0.46 [0.78]
<i>post Volcker Rule</i>	80	0.04* [1.69]	0.27* [1.76]	0.60* [1.87]	0.04* [1.70]	-0.32 [-0.61]	0.64 [1.12]
10Y UST Auctions	86	0.00 [-0.06]	0.25 [1.04]	-0.65 [-1.25]	-0.03 [-0.95]	0.32 [1.21]	0.07 [0.08]
<i>with Increased Off. Amt.</i>	17	0.13*** [3.76]	0.01 [0.03]	-1.83* [-1.80]	-0.12 [-1.29]	-0.81 [-1.52]	-5.25** [-2.13]
<i>post Volcker Rule</i>	10	0.20*** [3.25]	-0.15 [-0.24]	-1.68** [-2.40]	0.02 [1.29]	-0.93 [-1.15]	-7.00* [-1.65]

- Reliable risk measures for UST are needed amid increasing concerns 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 *distinct signals*.
- By contrast, other liquidity and uncertainty measures are one-dimensional in nature, incapable of differentiating the dual and contrasting sources of risk.