Anatomy of the Treasury Market: Who Moves Yields?

Manav Chaudhary (LSE), Julie Zhiyu Fu (WashU Olin), Haonan Zhou (HKU)

NBER SI Asset Pricing

Tracing Treasury Yield Changes to Factor×Investor Drivers

What moves the Treasury yields?

$$\text{Macro/Financial News} \rightarrow \text{Portfolio Allocation} \rightarrow \text{Yields}$$

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Traditional factor approach: regress yields on factors

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$\Longrightarrow$ we learn aggregate responses...but don't know who drives it

Our approach: brings back investors' portfolio allocation,

- Bridging factors and yields
- Decomposing yield movements by factors *and* investors
- Three applications to uncover the anatomy of Treasury market

Related Literature

- Drivers of yields and investor dynamics in the Treasury markets:
  - Pricing: Cochrane and Piazzesi, 2005; Ludvigson and Ng, 2009; Joslin, Priebsch, and Singleton, 2014; Moench and Soofi-Siavash, 2022; Vayanos and Vila, 2021
  - Foreign investors: Warnock and Warnock, 2009; Ahmed and Rebucci, 2024
  - The Fed and the QE: Gagnon, Raskin, Remache, and Sack, 2011; Hamilton and Wu, 2012
- Estimating demand-based asset pricing models:
  - Methodology: Koijen and Yogo, 2019; Gabaix and Koijen, 2024; Qian, 2024; Chodorow-Reich, Gabaix, Koijen, and Viviano, 2024
  - Application to government bond markets: Koijen, Koulischer, Nguyen, and Yogo, 2017; Fang, Hardy, and Lewis, 2022; Jansen, Li, and Schmid, 2024; Zhou, 2023; Eren, Schrimpf, and Xia, 2023; Jansen, Li, and Schmid, 2024; Jiang, Richmond, and Zhang, 2024

Model Framework

1. Data: Investors (***i***) are the FoF sectors; and sample periods (***t***) 2003Q4-2023Q4

- Treasury defined as market portfolio of 1yr+ Treasury securities
- Quantity data from Flow of Funds (FoF) + Call Report (banks) + TIC (foreign countries)

Model Framework

1. Data: Investors (i) are the FoF sectors; and sample periods (t) 2003Q4-2023Q4
2. Modelling portfolio choice: log-linearization of any portfolio choice,

$$\underbrace{\Delta q_{i,t}}_{\text{\% change quantity}} = - \underbrace{\zeta_i}_{\text{elasticity}} \times \underbrace{\Delta p_t}_{\text{\% change price}} + \underbrace{\nu_{i,t}}_{\text{Demand shifter}}$$

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- Demand shifters: macro-financial factors + unobserved PCs + idio. shocks
  - Observable factors η_t^{obs}: e.g, VIX, Fed funds rate, inflation, ...
  - Unobserved factors η_t^{unobs}: principal components (PCs) extracted from granular flows

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  - Observable factors η_t^{obs}: e.g, VIX, Fed funds rate, inflation, ...
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  - Idiosyncratic shocks $u_{i,t}$: e.g., private info, sector-specific regulation, ...

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3. Connecting quantities to prices: using market clearing, $\sum_i S_i \Delta q_{i,t} = 0$, where S_i is size,

$$\Delta p_t = \frac{1}{\zeta_S} \sum_{i \in sectors} S_i \left(\lambda_i \eta_t + u_{i,t} \right)$$

- Decompose the price response to factors by sector: $\lambda_S = \frac{1}{\zeta_S} \sum_i S_i \lambda_i$

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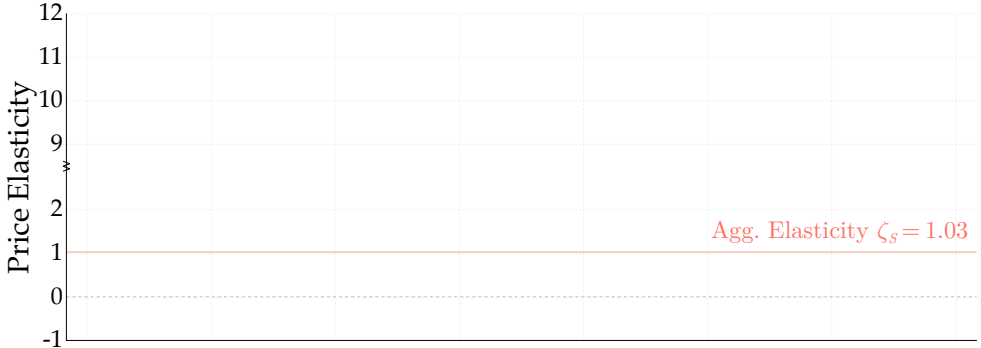
4. Identification: we assume idiosyncratic shocks are independent across investors,

$$\mathbb{E}\left[u_{i,t} u_{j,t} \right] = 0. \ \forall i \neq j$$

- Granular instrumental variable, with optimal weighting scheme for asymptotic efficiency

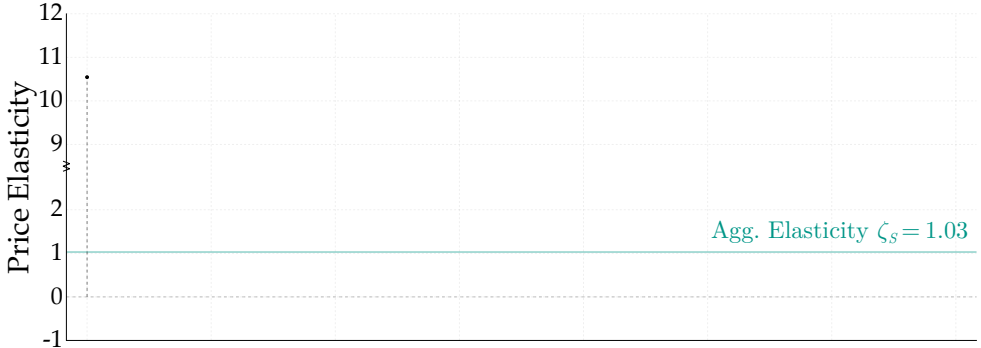
1. Quantifying Sensitivities: Aggregate & Sectoral Price Elasticities

Agg. elasticity $\zeta_S = \mathbf{1.03}$: a $\frac{1}{\zeta_S} = \mathbf{97}$bps $\uparrow$ prices to a 1% demand shock



1. Quantifying Sensitivities: Aggregate & Sectoral Price Elasticities

Who contribute a lot to aggregate elasticities?



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Coef.	10.54
(s.e.)	(2.66)

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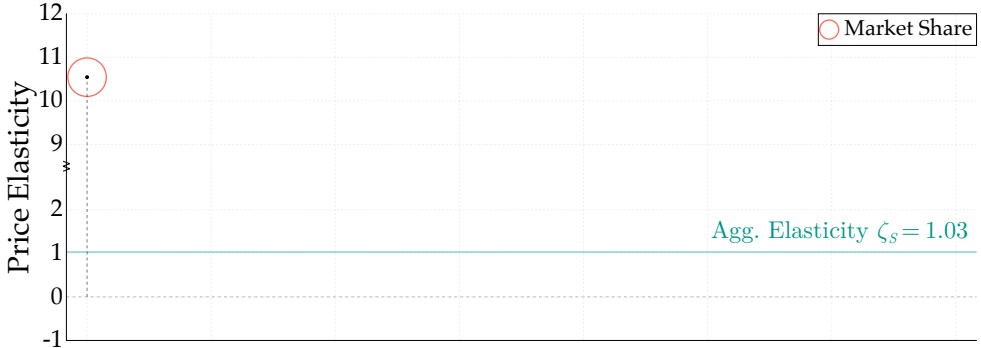

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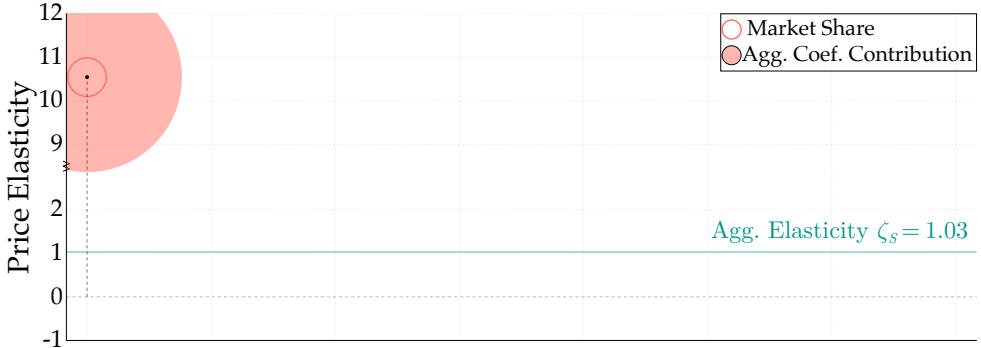

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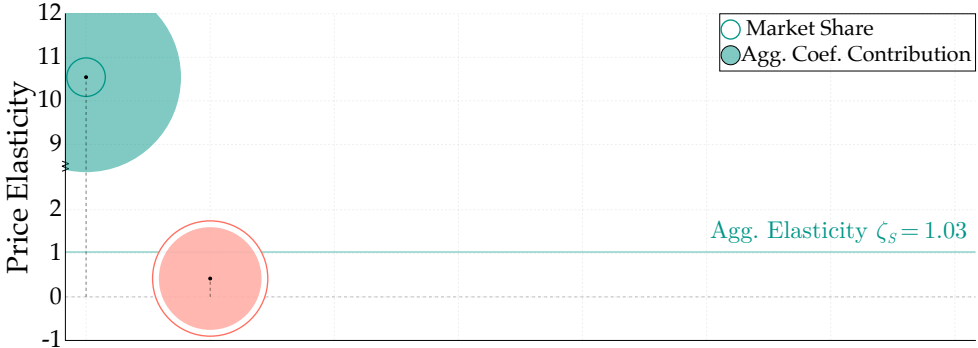

	Households (residual)	Foreign
Coef.	10.54	0.42
(s.e.)	(2.66)	(0.1)

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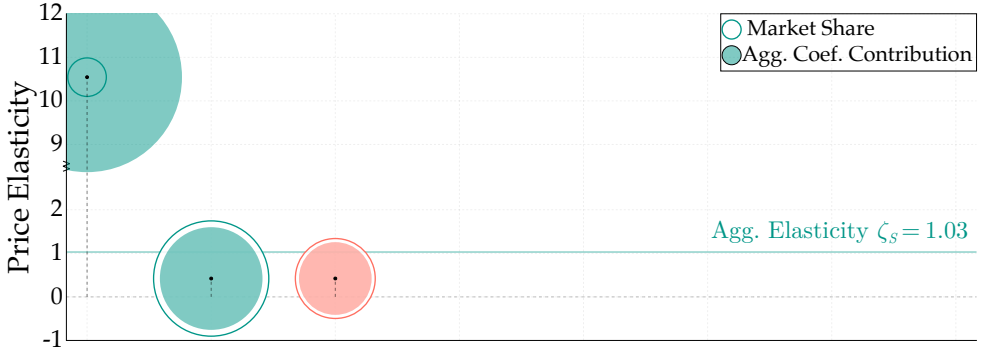

	Households (residual)	Foreign	Fed
Coef.	10.54	0.42	0.42
(s.e.)	(2.66)	(0.1)	(0.16)

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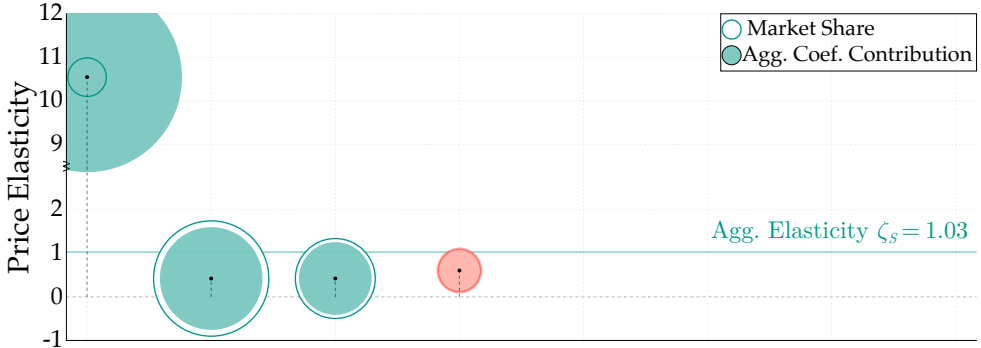

	Households (residual)	Foreign	Fed	Mutual Funds
Coef.	10.54	0.42	0.42	0.61
(s.e.)	(2.66)	(0.1)	(0.16)	(0.24)

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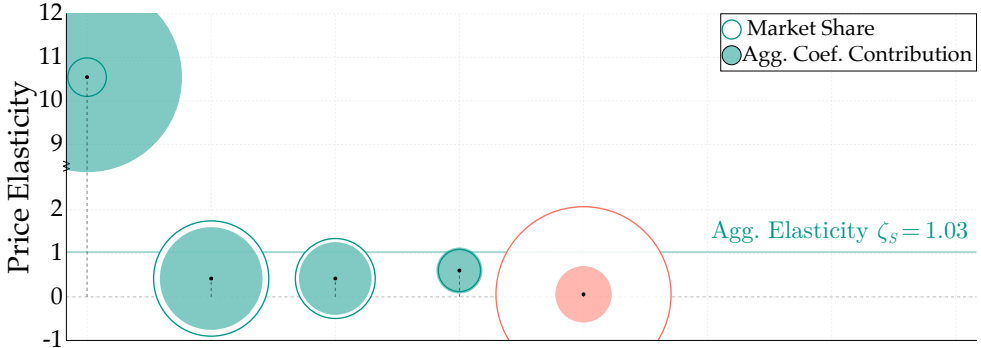

	Households (residual)	Foreign	Fed	Mutual Funds	Supply	Broker dealers	Pension	ETF
Coef.	10.54	0.42	0.42	0.61	0.06			
(s.e.)	(2.66)	(0.1)	(0.16)	(0.24)	(0.04)			

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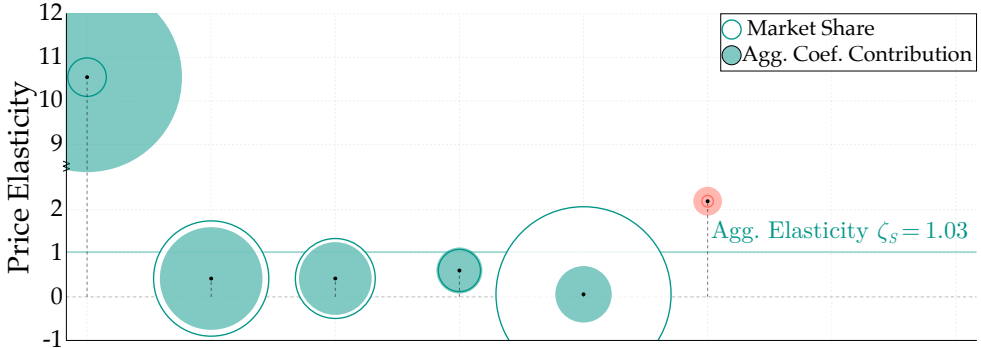

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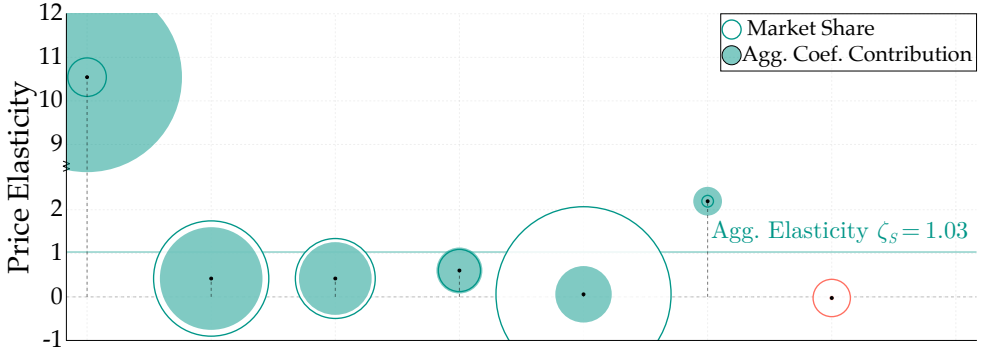

	Households (residual)	Foreign	Fed	Mutual Funds	Supply	Broker dealers	Pension
Coef.	10.54	0.42	0.42	0.61	0.06	2.2	-0.03
(s.e.)	(2.66)	(0.1)	(0.16)	(0.24)	(0.04)	(4.42)	(0.08)

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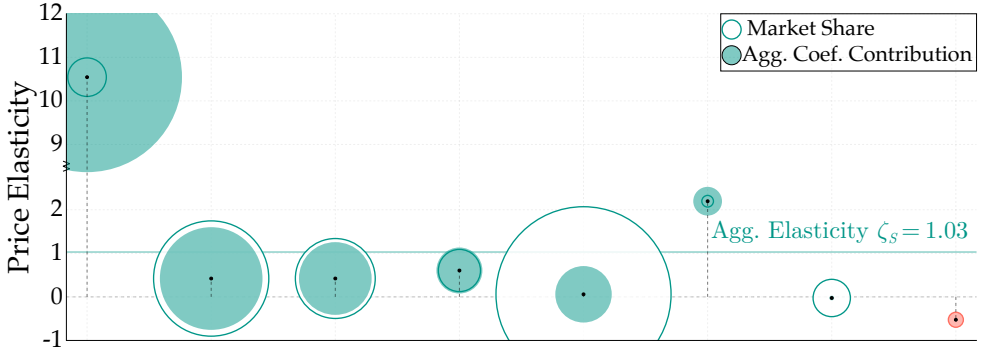

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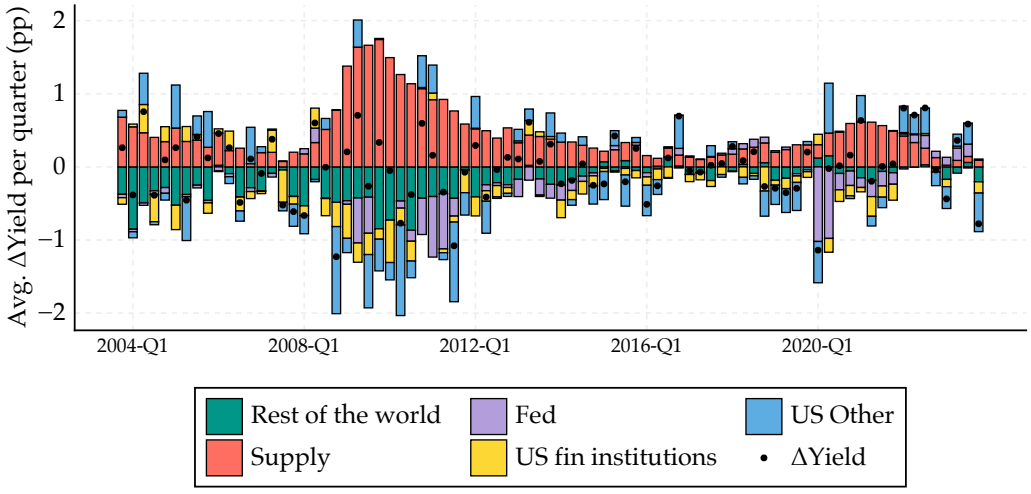
Coef.	10.54	0.42	0.42	0.61	0.06	2.2	-0.03	-0.52
(s.e.)	(2.66)	(0.1)	(0.16)	(0.24)	(0.04)	(4.42)	(0.08)	(0.18)

2. Decomposing Yields: Sectoral Contributions



▸ Latent shocks by sector

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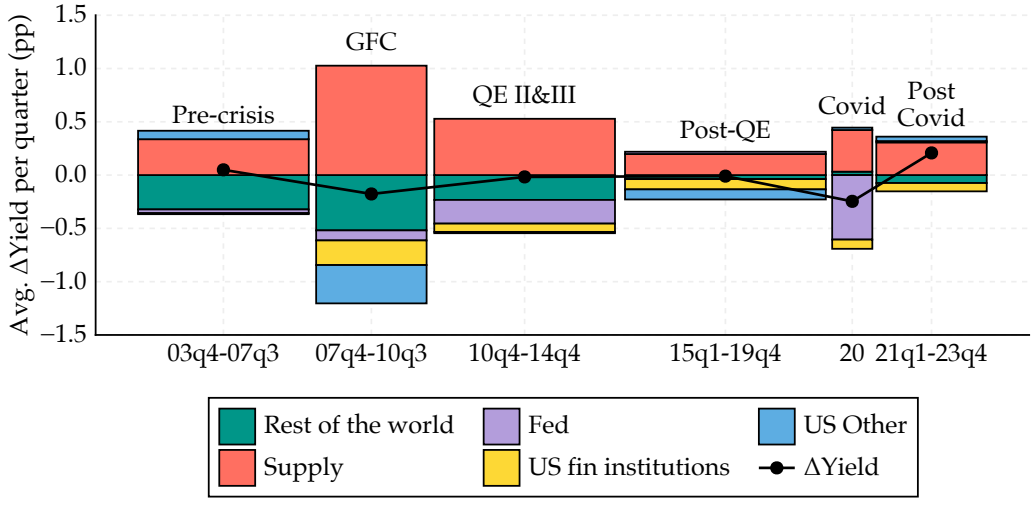

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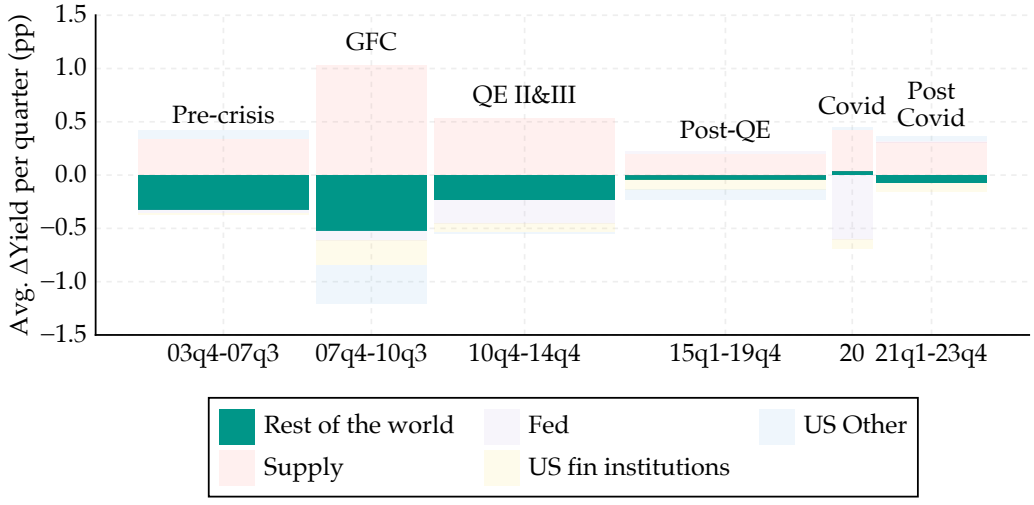
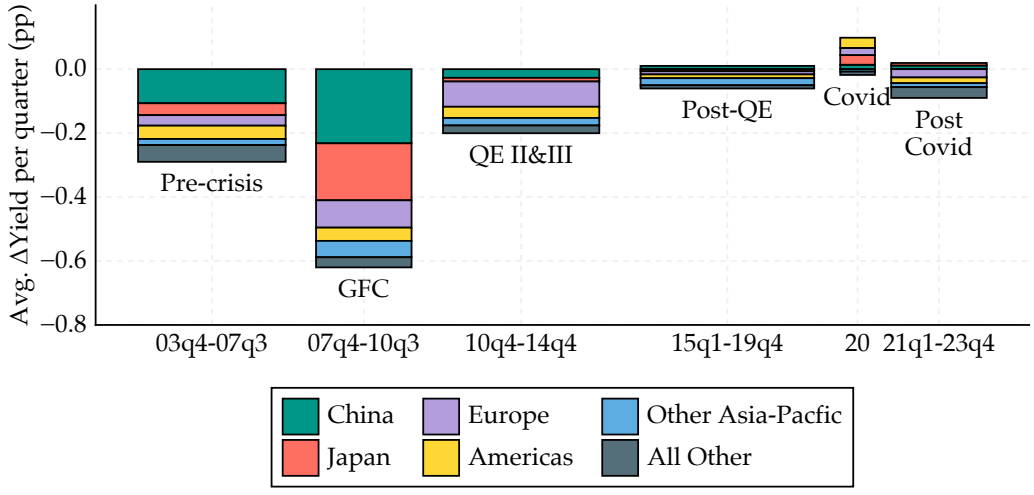
2. Decomposing Yields: Post-GFC Diminishing Role of Foreign Investors



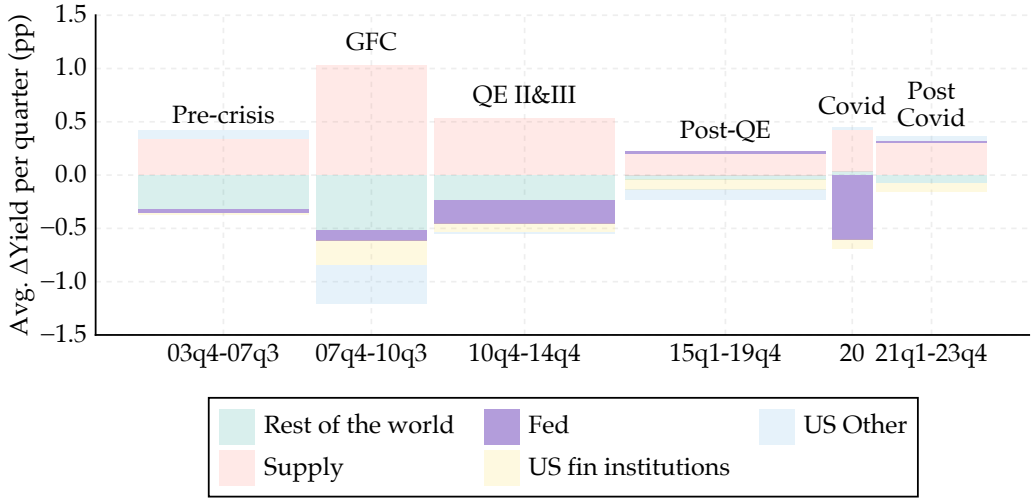
$\Longrightarrow$ Pre-GFC consistent with "saving glut" compressing yields...but no longer

2. Decomposing Yields: China and Japan role particularly diminished



▸ Quarter-by-quarter ▸ IIP ▸ Bilateral: China ▸ Bilateral: Japan ▸ China sell-off

2. Decomposing Yields: GFC and Covid, and the Fed

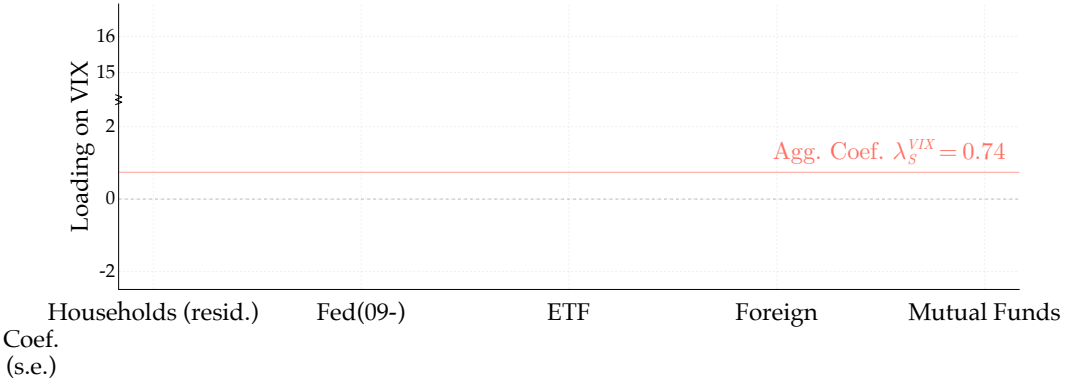


The post-GFC Fed acts as a state-contigent liquidity provider

3. Anatomy of Episodes: Dissecting Flight-to-Safety

Treasury prices rise in bad times:

$$\Delta p_t = \ldots + \underbrace{\lambda_S^{VIX}}_{>0} \eta_t^{VIX} + \varepsilon_t$$



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Treasury prices rise in bad times: ...but who is "fleeing to safety"?

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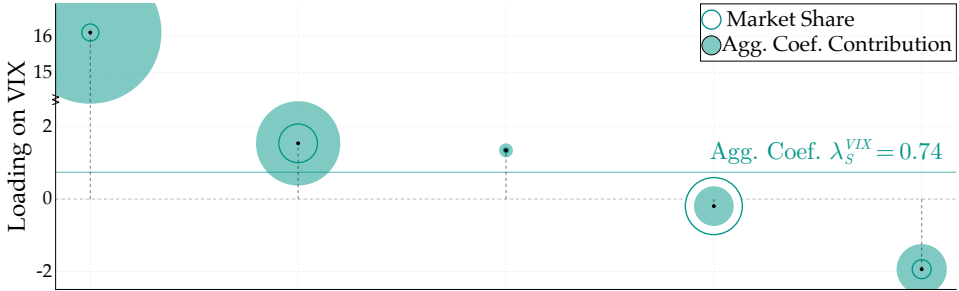
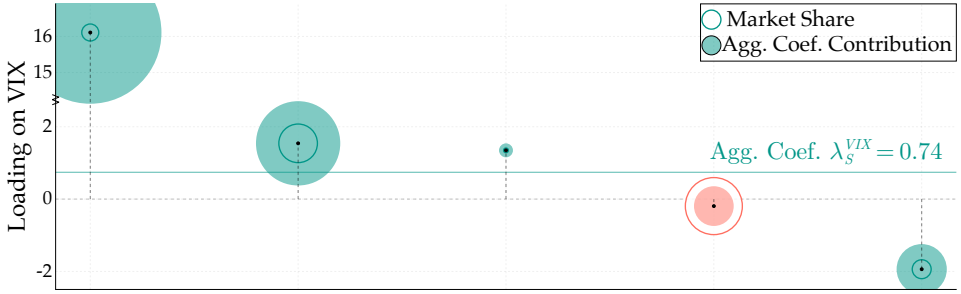


	Households (resid.)	Fed(09-)	ETF	Foreign	Mutual Funds
Coef.	16.11	1.54	1.35	-0.19	-1.94
(s.e.)	(5.1)	(0.41)	(0.6)	(0.34)	(0.8)

3. Anatomy of Episodes: Dissecting Flight-to-Safety

Two competing views on foreign demand speak to dollar exorbitant privilege

- **Safe-asset view**: foreigners buy Treasuries in crises
- **Precautionary-saving view**: foreigners hold Treasuries to sell in crises



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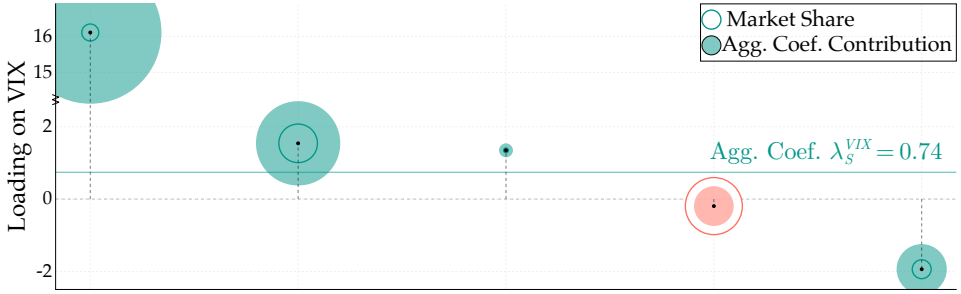

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Conclusion

This paper: Develop a flexible framework to quantify what and who drives Treasury prices:

1. **Quantify market & investor sensitivities:** Inelastic market & large investor differences
2. **Decompose yields to factor x investor drivers:** Post-GFC significant changes in drivers
3. **Zoom into specific episodes:** Foreigners do not flee-to-safety

This framework can be applied to study other markets

OptimalGIV package available in Julia & Python

References

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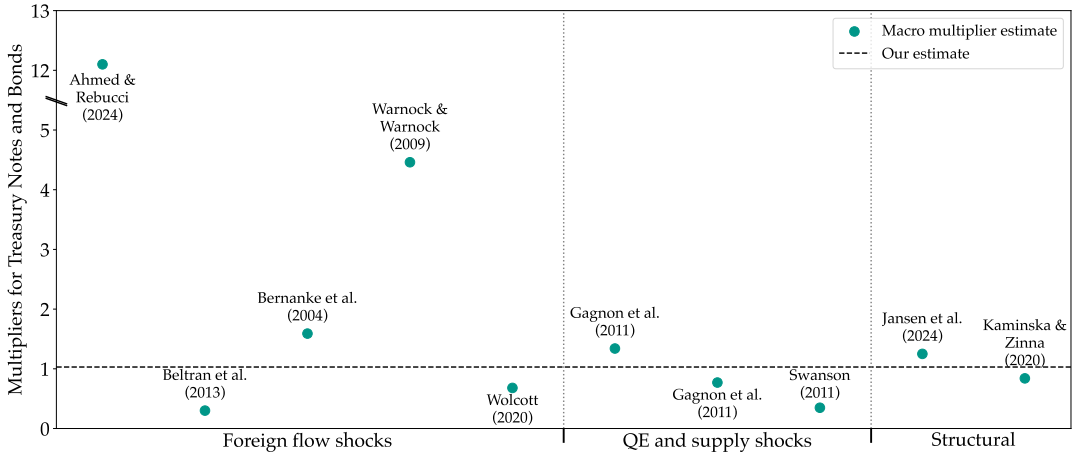
- Fang, Xiang, Bryan Hardy, and Karen K. Lewis (May 2022). ***Who Holds Sovereign Debt and Why It Matters.*** DOI: 10.3386/w30087. National Bureau of Economic Research: 30087. URL: https://www.nber.org/papers/w30087 (visited on 11/11/2023). Pre-published.

Treasury Macro Multipliers Implied by the Literature

We map literatures' price impact estimates to macro multipliers:



Quantifying Sensitivities: Identification Robustness

Key concern: there are still some residual correlations across $u_{i,t}$

$\Longrightarrow$ downward bias: $\hat{\zeta}_S \approx \zeta_S \sqrt{1 - R^2 \text{ of } \Delta p \text{ explained by resid. correlation.}}$,

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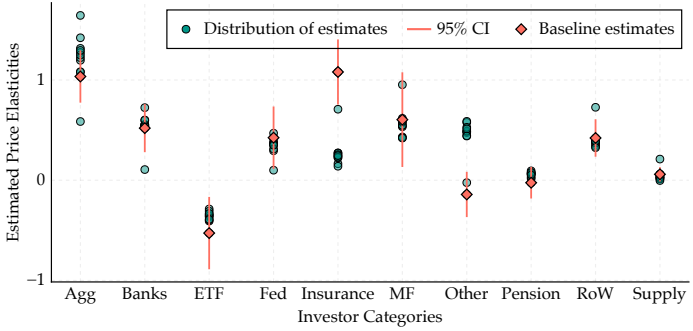
Residual correlation appears limited, as $\hat{\zeta}_S$ remain stable even when

1. Controlling for more common variation using more macro & PCA factors ▸ Robustness
2. Leaving-out one-sector at a time in estimation:



Robustness: Price Elasticities

Back

Sector	Baseline	More factors	1970-2023	Including Bills
Aggregate	1.04	1.08	1.3	2.09
	(0.81, 1.27)	(0.83, 1.34)	(1.11, 1.5)	(1.26, 2.91)
Other	-0.24	-0.11	0.19	0.56
	(-0.46, -0.01)	(-0.34, 0.11)	(0.02, 0.36)	(0.26, 0.87)
Households	10.07	11.09	10.5	4.34
	(5.26, 14.88)	(5.71, 16.46)	(7.29, 13.7)	(0.78, 7.9)
Pension	0.2	0.2	-0.23	0.17
	(0.04, 0.36)	(0.04, 0.36)	(-0.39, -0.07)	(-0.07, 0.4)
Insurance	0.51	0.38	-0.67	-0.01
	(0.21, 0.81)	(0.09, 0.66)	(-0.93, -0.41)	(-0.51, 0.49)
Mutual Funds	0.58	0.51	0.47	0.55
	(0.11, 1.05)	(0.03, 1.0)	(0.23, 0.72)	(-0.11, 1.21)
ETF	-0.1	-0.2	0.23	-0.33
	(-0.46, 0.26)	(-0.56, 0.17)	(0.04, 0.42)	(-0.83, 0.17)
Dealers	7.42	7.94	-1.47	1.11
	(-1.49, 16.32)	(-1.22, 17.1)	(-8.37, 5.43)	(-10.11, 12.33)
Fed	0.44	0.49	0.03	0.24
	(0.15, 0.72)	(0.2, 0.79)	(-0.06, 0.13)	(-0.13, 0.6)
Banks	0.53	0.43	1.0	0.63
	(0.35, 0.7)	(0.26, 0.6)	(0.51, 1.49)	(0.42, 0.85)
RoW	0.44	0.39	0.39	0.57
	(0.3, 0.58)	(0.25, 0.53)	(0.27, 0.52)	(0.36, 0.79)
Supply	0.05	0.04	0.26	1.33
	(-0.02, 0.12)	(-0.03, 0.11)	(0.18, 0.33)	(0.32, 2.34)
MMF				2.4
				(0.33, 4.47)

Figure 1: Raw Dollar Flows

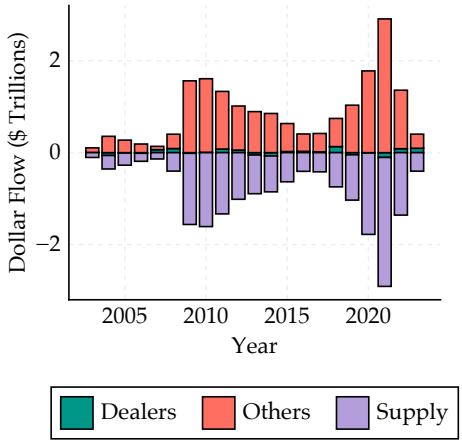
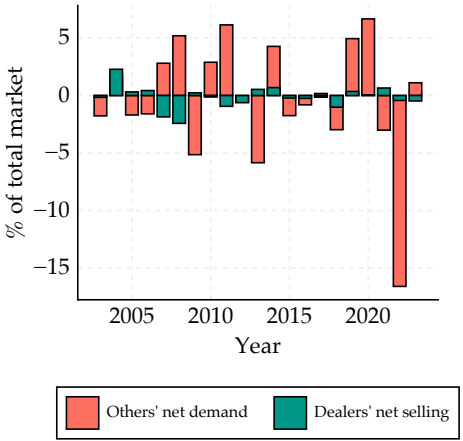
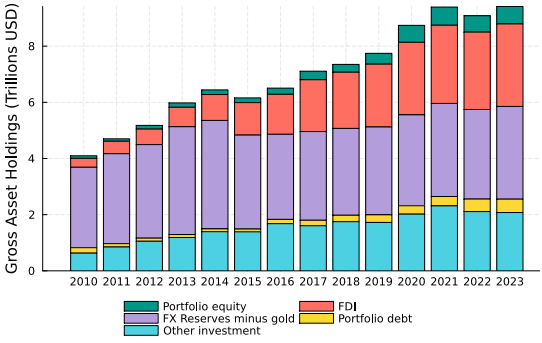


Figure 2: BD Flows vs Net Demand by Others

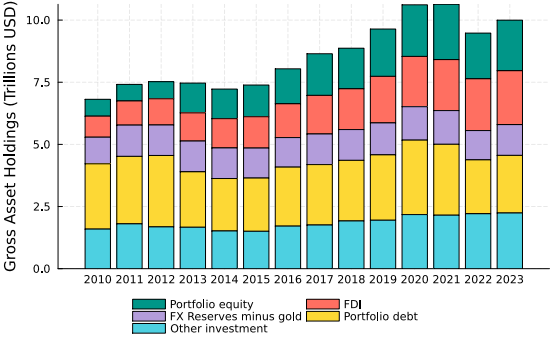


Back

Gross external assets of China and Japan: 2010-2023



China



Japan

Back

This Time is Different? Foreigners Selloff in bad times

Figure 3: 2003-2023 Quarterly

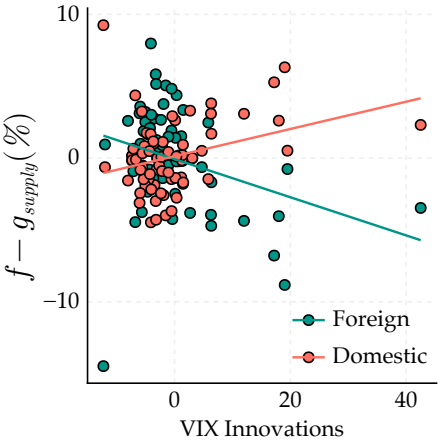


Figure 4: GFC (07-09 Monthly)