Dollar Reserves and U.S. Yields: Identifying the Price Impact of Official Flows

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[1]The views expressed are those of the authors and do not necessarily represent those of the OCC or U.S. Department of the Treasury.

Motivation

Large literature on price impact of foreign official (FO) demand for USTs

- e.g., Warnock and Warnock (2009), Bertaut et al. (2012, 2013), Wolcott (2020), among several others

Some FO demand components may be price-inelastic

- Precautionary and Mercantilist demand for reserves in particular

But others are price-elastic, giving rise to simultaneity:

- Reserve diversification purposes
  - Arslanalp, Eichengreen, and Simpson-Bell (2022)
  - BIS actively manages a portion of EM's reserves in Asia and LatAm
- Sovereign wealth funds portfolios

There may also be an omitted variable bias as literature does not control for foreign factors

Paper's contribution

- Discusses these challenges and illustrate scope for omitted variable bias
- Proposees to identify a FO flow shock via heteroskedasticity in an SVAR for FO flows and U.S. yields
  - Rigobon (2003), Brunnermeier et al. (2021), Lewis (2021), among others

Main Results

Impact effect of a FO flow shock seemingly larger than previously estimated:

- 88-100 bps per $100B of FO flows on 5 and 10-year yields, compared to 13-68 bps typically estimated in the literature (using 2017 marketable debt as a common scaler)
- Impact effect consistent with high-frequency impact of Japan's intervention in 2022
- But no conclusive evidence on comparison with domestic QE
- Impact converges to the range of estimates in the literature within half a year
- Quite small and imprecisely estimated permanent effects, possibly consistent with estimated QE announcement effects

Classic Endogeneity Problem

- Bias can be signed only in simple settings. Consider the most basic one:

$$y_t = aFO_t + e_1 \text{ with } FO_t = by_t + e_2$$

- Assume $FO \rightarrow y_{us,t}$ is *negative* $\mathbf{(a < 0)}$
- Assume further, as reasonable, that $y_{us,t} \rightarrow FO$ is *positive* $\mathbf{(b > 0)}$
- With $a < 0$ and $b > 0$, sign of bias is positive $(b\sigma_1^2/(1 - ba) > 0) \rightarrow$ OLS estimate of a is *less negative* than the true one

Even if FOs are price inelastic, there is an endogeneity problem if other flows components are elastic

- Simultaneity bias can arise even if FO demand is *inelastic* (i.e., b=0) but other market segments have elastic demand. Consider the following example, where PR is private flows:

$$y_t = aFO_t + cPR_t + e_1 \text{ with } PR_t = dy_t + e_2, \tag{1}$$

which gives

$$y_t = \frac{a}{1 - cd} FO_t + \frac{ce_2 + e_1}{1 - cd}, \tag{2}$$

- If $a < 0$, $c < 0$ and $d > 0$, then $\frac{a}{1-cd}$ can be less negative than true a

Simultaneity can also be induced by omitted variables

- Literature controls for typical domestic drivers of U.S. yields but does not control for global drivers, e.g. foreign yields
  - After 2008, one also needs to control for Fed asset purchases and forward guidance
- Denote an omitted factor F_t, then the sign of bias depends on $cov(F_t, \Delta FO_t)$ and $cov(F_t, y_t)$
  - Omitting foreign yields ($\mathcal{Y}_{g,t}$): $cov(\mathcal{Y}_{g,t}, y_{us,t}) > 0$ and $cov(\mathcal{Y}_{g,t}, \Delta FO_t) > 0$
  - Omitting QE purchases (Fed_t): $cov(Fed_t, y_{us,t}) < 0$ and $cov(Fed_t, \Delta FO_t) < 0$
- Both cases $\rightarrow$ positive bias, estimate is less negative than true effect

Estimates from OLS Benchmark

Table 1: Benchmark OLS Estimates

	Dependent Variable: 10Y U.S. Yield	
3M U.S. Yield	0.372***	(0.033)
1Y GDP Forecast	0.488***	(0.100)
10Y Inflation Forecast	0.347	(0.608)
1Y Inflation Forecast	-0.057	(0.065)
VIX	0.009	(0.006)
Federal Budget Surplus	-0.054	(0.039)
FO ($I = 0$)	-0.156	(0.166)
FO	-0.348*	(0.199)
FO (Controlling for Foreign Yields)	-1.108***	(0.145)
FO (Controlling for Fed Shocks)	-0.983***	(0.169)
Adj. R^2	0.916	
T	240	
ADF Statistic	-5.282***	

We take a Structural VAR approach with identification via heteroskedasticity

Monthly SVAR for FO flows and US Yields, 1999-2018:

$$\boldsymbol{B}_0 \mathbf{Y}_t = \sum_{l=1}^{p} \boldsymbol{B}_l \mathbf{Y}_{t-l} + \boldsymbol{\Gamma} \mathbf{X}_t + \boldsymbol{\zeta}_t,$$

where the model is expressed in structural form with the corresponding reduced form error term $\mathbf{u}_t = \boldsymbol{B}_0^{-1} \boldsymbol{\zeta}_t$.

$$\boldsymbol{Y}_t = [FO_t, y_{us,t}^{3M-FF}, y_{us,t}^{2Y-FF}, y_{us,t}^{5Y-FF}, y_{us,t}^{10Y-FF}, y_{us,t}^{30Y-FF}],$$

$$\boldsymbol{X}_t = [\Delta GDP_t^{E[t+1]}, \pi_t^{E[t+1]}, \pi_t^{E[t+10]}, VIX_t, surplus_t, \mathcal{Y}_{g,t}^{3M}, \mathcal{Y}_{g,t}^{10Y}, Fed_t, D_t],$$

Identification via Heteroskedasticity

Assume at least two regimes:

$$E(\mathbf{u}_t \mathbf{u}_t') = \begin{cases} \Sigma_1, & \text{for } t = 1, ..., t_{Sep2008} - 1 \\ \Sigma_2, & \text{for } t = t_{Sep2008}, ..., T \end{cases}$$

- Assume all shock variances except one have at least one non-proportional break $\rightarrow$ VAR is exactly point-identified (up the sign and column rotation)
  - K^2 unknowns $\rightarrow K^2 + K$
  - $(K^2 + K)/2$ equations $\rightarrow K^2 + K$
- Timing of variance changes can be misspecified, yet SVAR estimates ARE consistent under (Sims, 2021)
- However, covariances must be stable over time

There is Indeed at Least One Volatility Break Around the GFC

- Assuming a known break-point: variance test for flows and yields

	FO_t	$y_{us,t}^{3M-FF}$	$y_{us,t}^{2Y-FF}$	$y_{us,t}^{5Y-FF}$	$y_{us,t}^{10Y-FF}$	$y_{us,t}^{30Y-FF}$
Jan 1999 - Aug 2008 (R1)	0.029	0.090	0.496	1.22	1.99	3.00
Sep 2008 - Dec 2018 (R2)	0.052	0.009	0.054	0.262	0.579	0.872
F-test (R2/R1)	1.811***	0.100***	0.110***	0.216***	0.292***	0.291***

- Assume that break points are unknown (Bai and Perron, 2003). We find three breaks: April 2003, May 2008 with a conf. int. that contains Sep 2008, May 2011

- Evidence from other studies: Du et al. (2022), Forbes and Warnock (2021), Ahmed and Zlate (2014), Erik et al. (2020), Stracca (2021)

- Evidence on the absence of proportional variance changes in the paper. Also, marginal data densities rejects constant variances specification

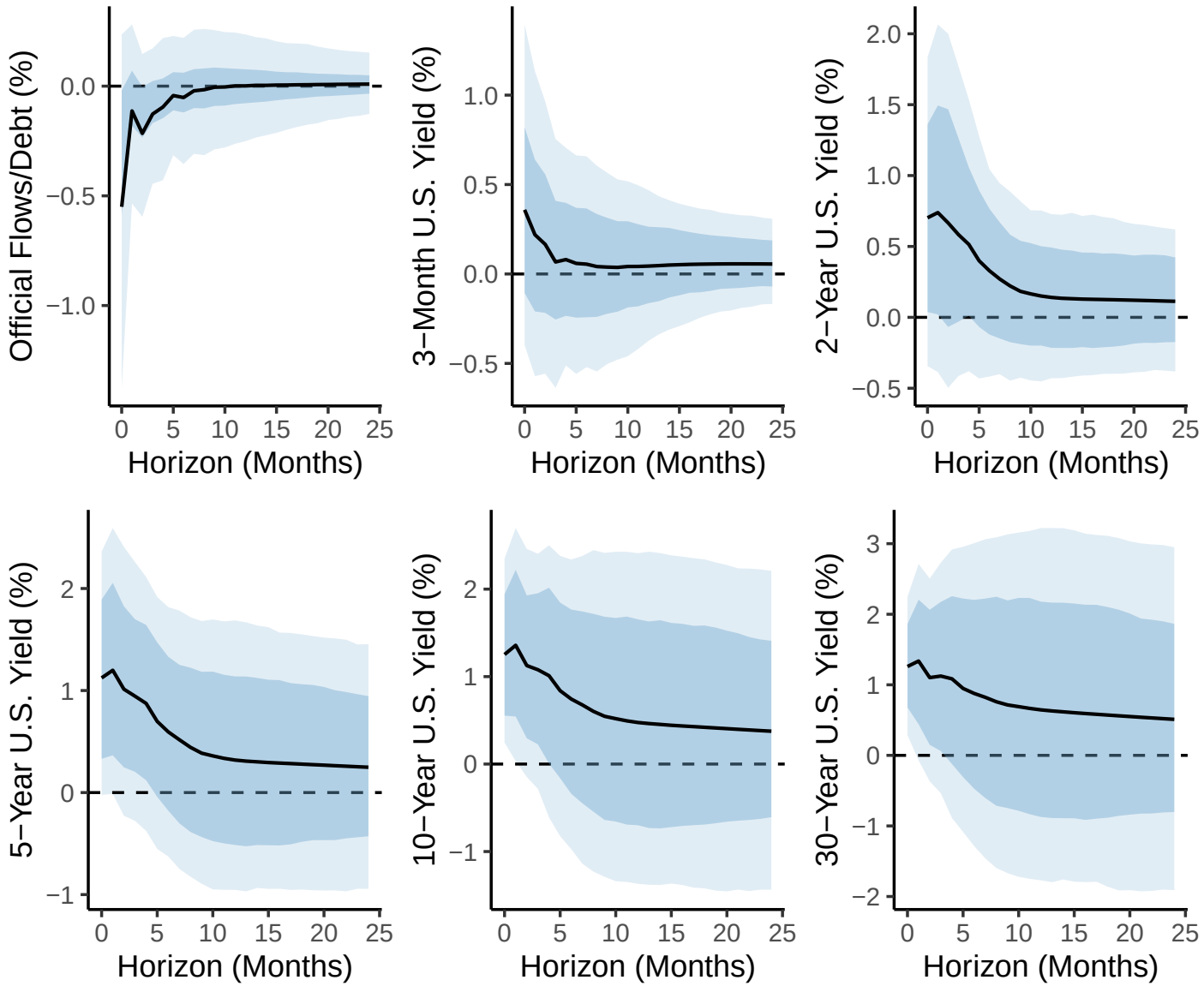
Testing VAR Parameter Stability

- CUSUM tests on VAR residuals (Ploberger and Kramer, 1992)
- Marginal Data Densities (Brunnermeier et al., 2021)

Table 2: Marginal Data Densities

Two Regimes (2008)	
VAR Specification	MDD
Static	445
Heteroskedasticity	517
TVP and Heteroskedasticity	99

Impact of a $100B FO Sale Shock (Scaled by 2017 Marketable Debt Outstanding)



What do these Impacts Imply? Example: A Shift in the Composition of China's Reserves

	China
Assume all reserves held in Treasuries	
FX Reserves ($\$B$, Mar 2022)	3,250
Assume % USD	60%
1% Outflow ($\$B$)	-19.5
5Y yield elasticity per $\$1B$	1.12bps
Contemporaneous impact on 5Y yield	**+21.84bps**

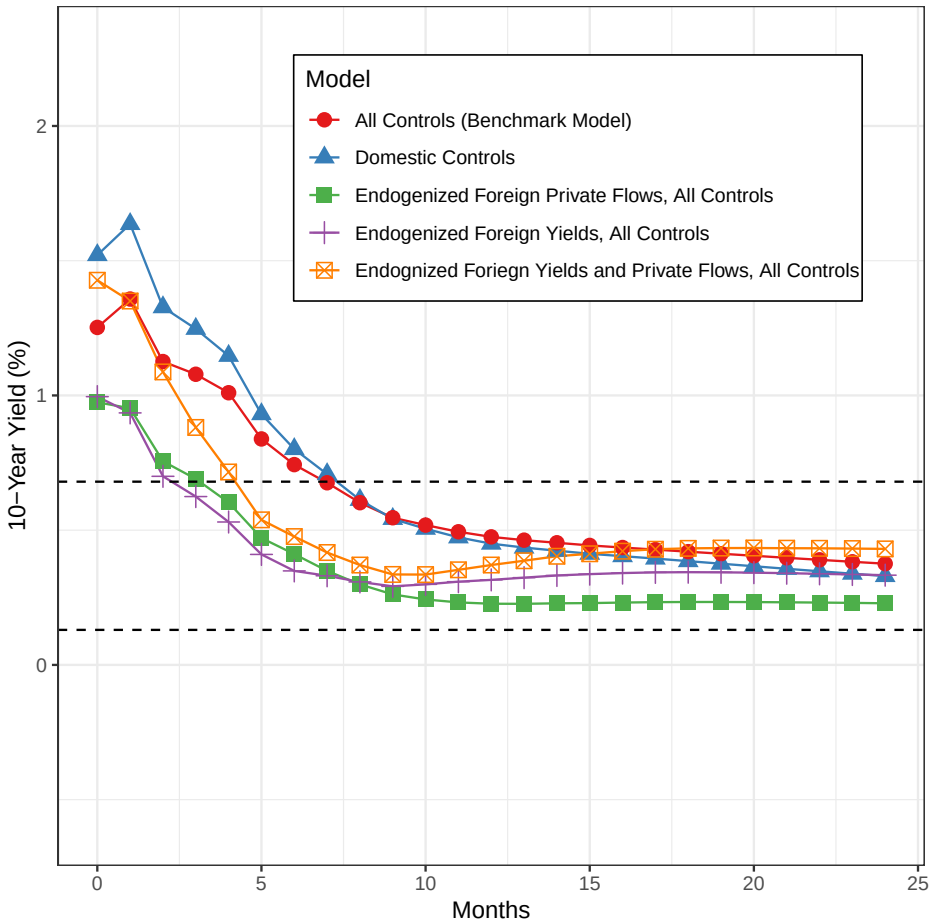
Robustness

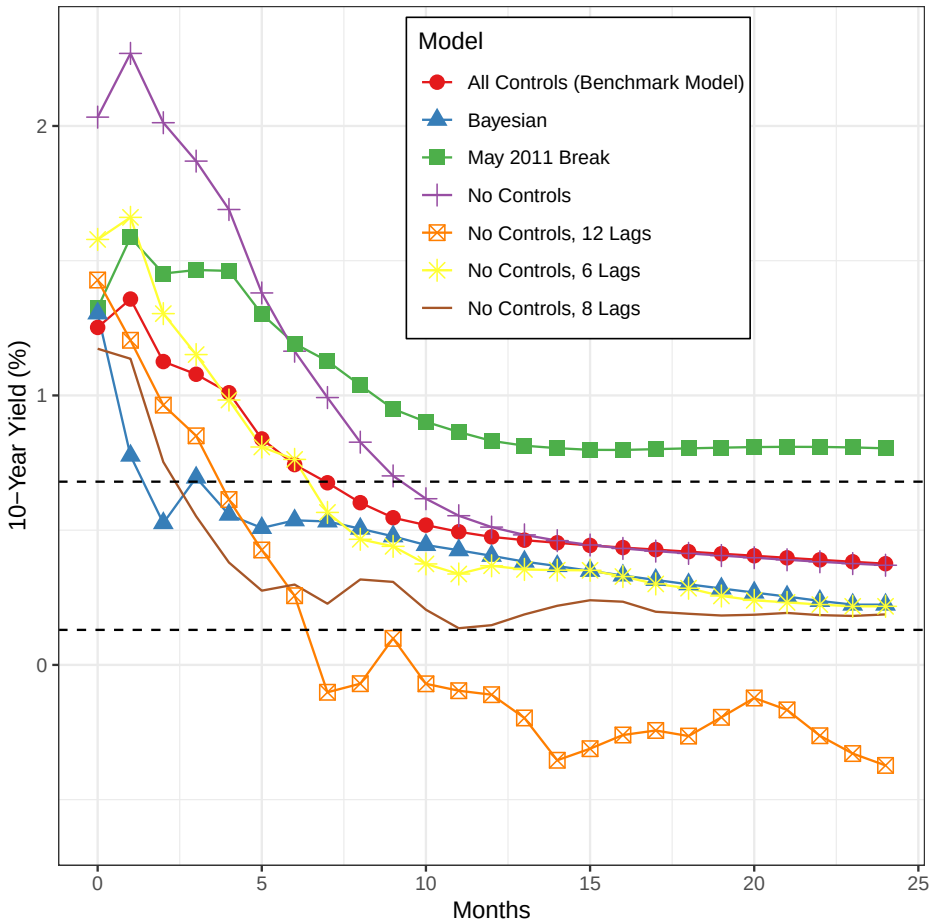
Comparable impacts under a broad set of alternative model specifications:

- Endogenous private flows, foreign yields
- Excluding controls
- Dropping short and long rates
- Using different regime break dates
- Bayesian estimation with mutliple breaks (Brunnermeier et al., 2021)

Robustness (cont.)

10Y Yield response under different model specifications



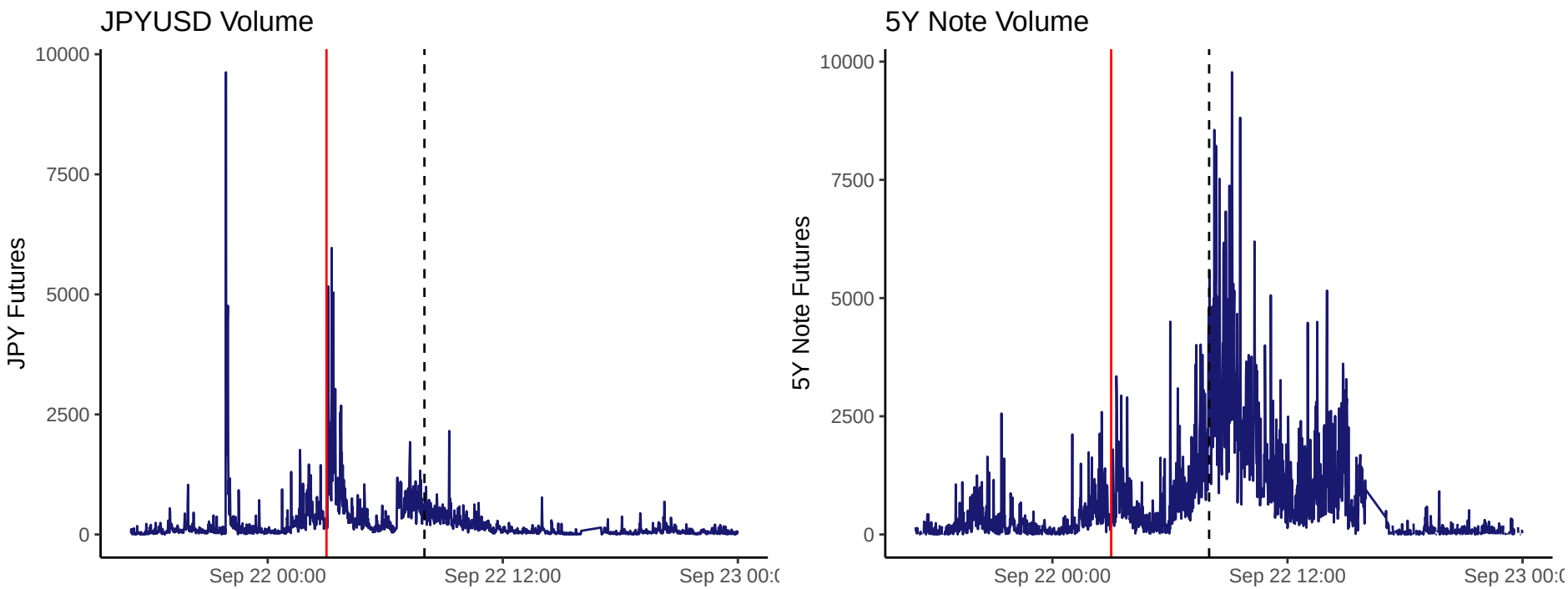


Is difficult to compare price impacts across type of flows

We take a two-pronged approach

- High-Frequency Identification of the Impact of Recent Japan FX Intervention is Very Close to our Estimate
- Bayesian estimation of a 10-variable VAR with FO, FP, DO, and DP flows.

High-Frequency Impact of Recent Japan FX Intervention Very Close to our Estimate

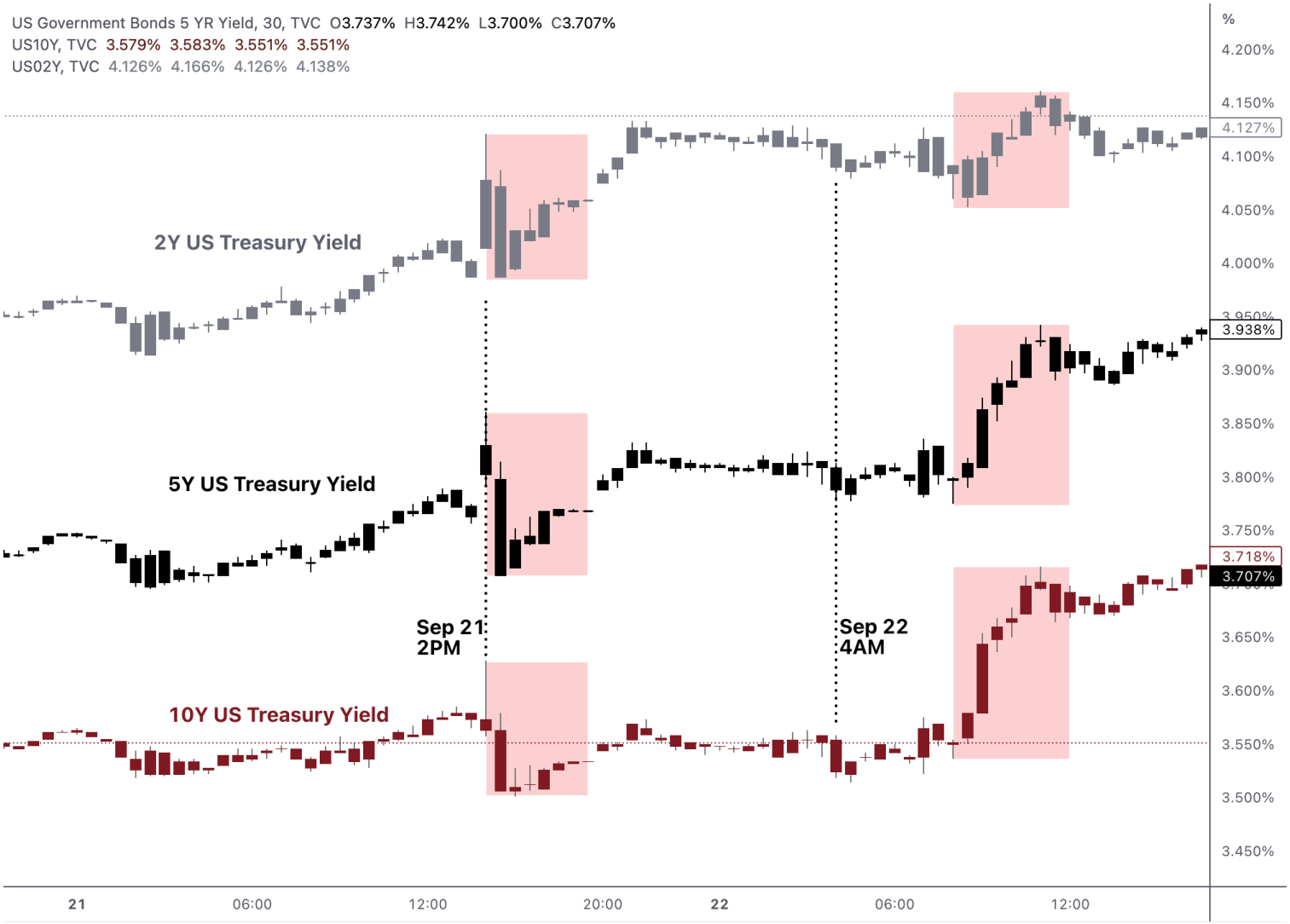


Futures Volume

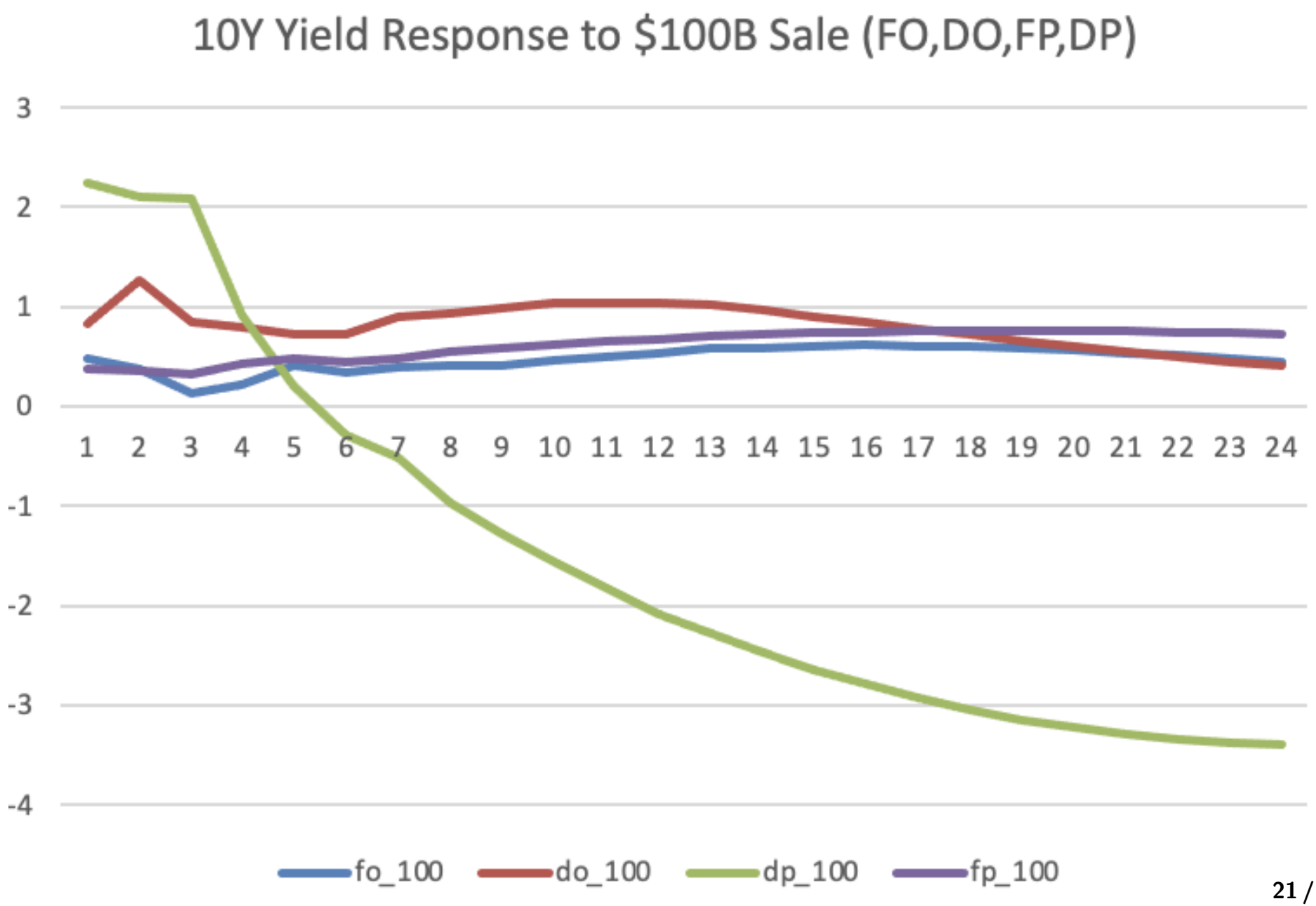
2022 Japan FX Intervention

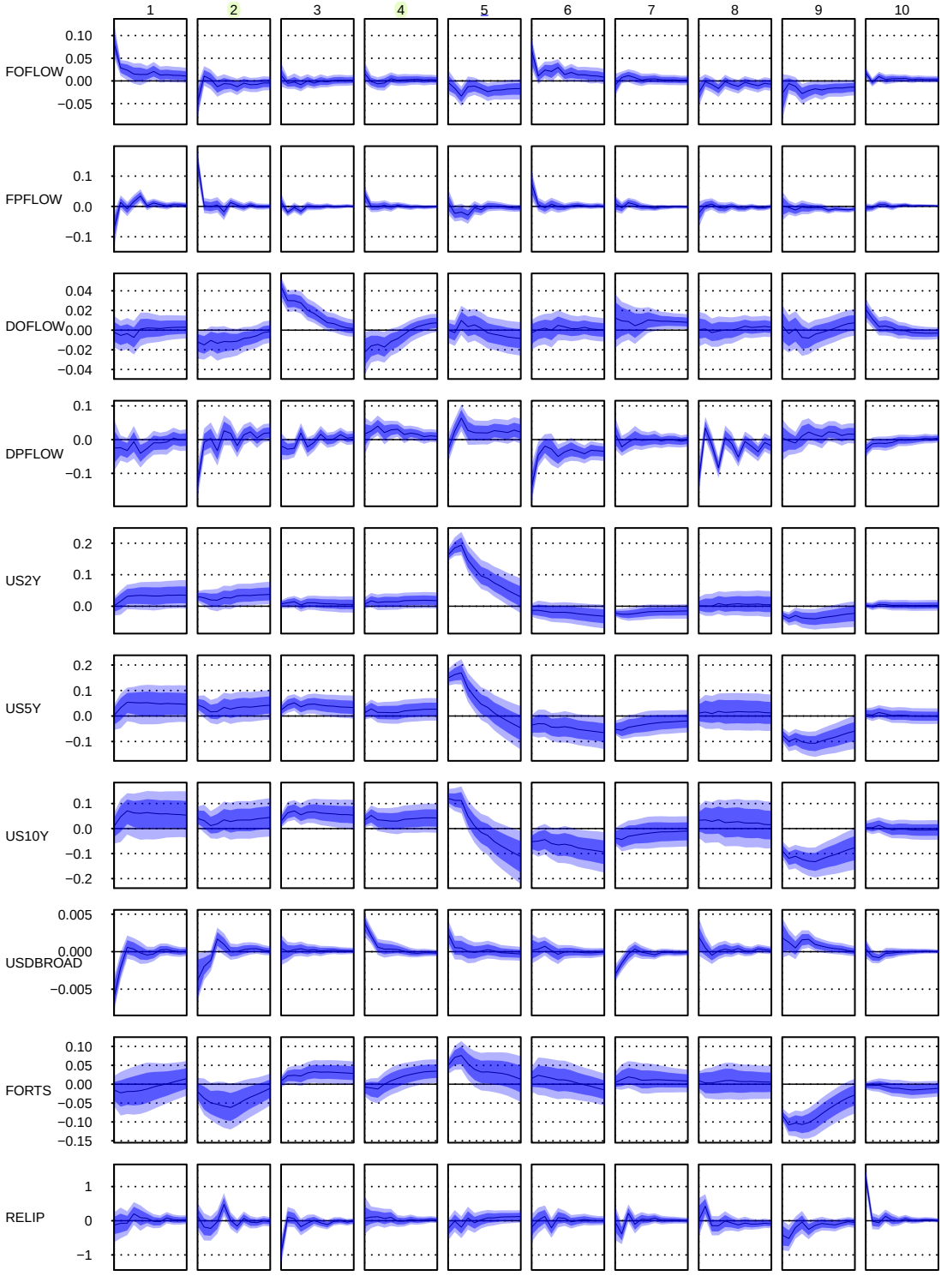
- USD/JPY appreciated 3.5% on the news

2022 Japan FX Intervention



Comparing with other flows with the same model




1
2
3
4
5
6
7
8
9
10
FOFLOW
0.10
0.05
0.00
−0.05
FPFLOW
0.1
0.0
−0.1
DOFLOW
0.04
0.02
0.00
−0.02
−0.04
DPFLOW
0.1
0.0
−0.1
US2Y
0.2
0.1
0.0
US5Y
0.2
0.1
0.0
−0.1
US10Y
0.1
0.0
−0.1
−0.2
USDBROAD
0.005
0.000
−0.005
FORTS
0.10
0.05
0.00
−0.05
−0.10
−0.15
RELIP
1
0
−1

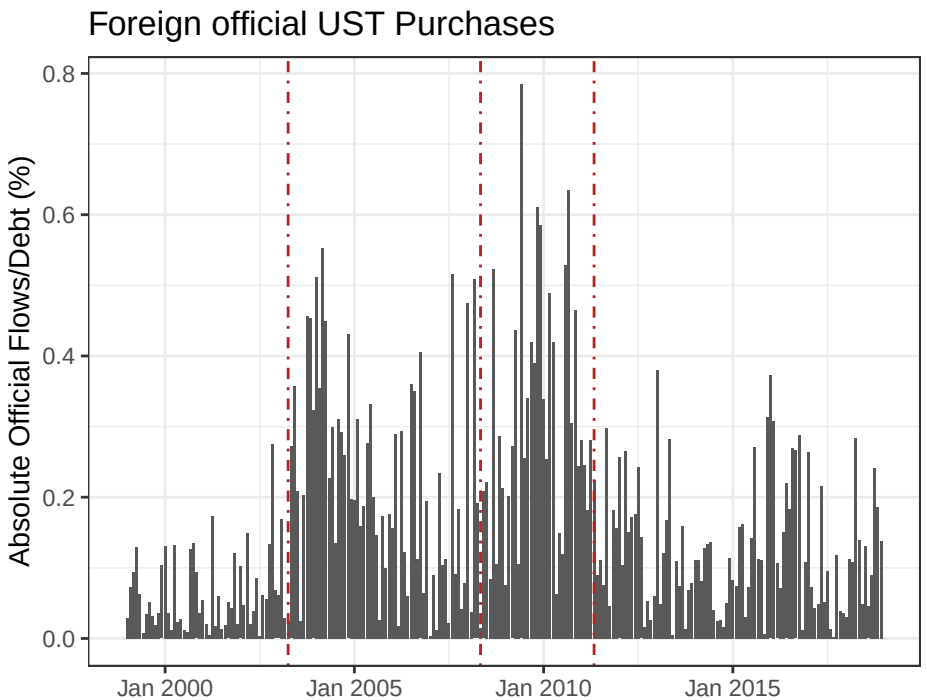
Concluding Remarks

- Identifying the price impact of financial flows is a challenging task
- We present new estimates of the effect of FO flows on US yields identified via heteroskedasticity
- A $100B flow shock may raise U.S. yields more than previously estimated on impact, consistent with high-frequency evidence on Japan's intervention
- Estimates align with prevailing consensus at 5-6 months horizon
- Small and imprecisely estimated long-run effects consistent with some of the findings in the QE literature
- Result is important in the context of the ongoing global monetary policy tightening cycle, the diminished attractiveness of US Dollar Reserves after the freezing of Russia holdings, and ongoing efforts to promote other international currencies

Thank You

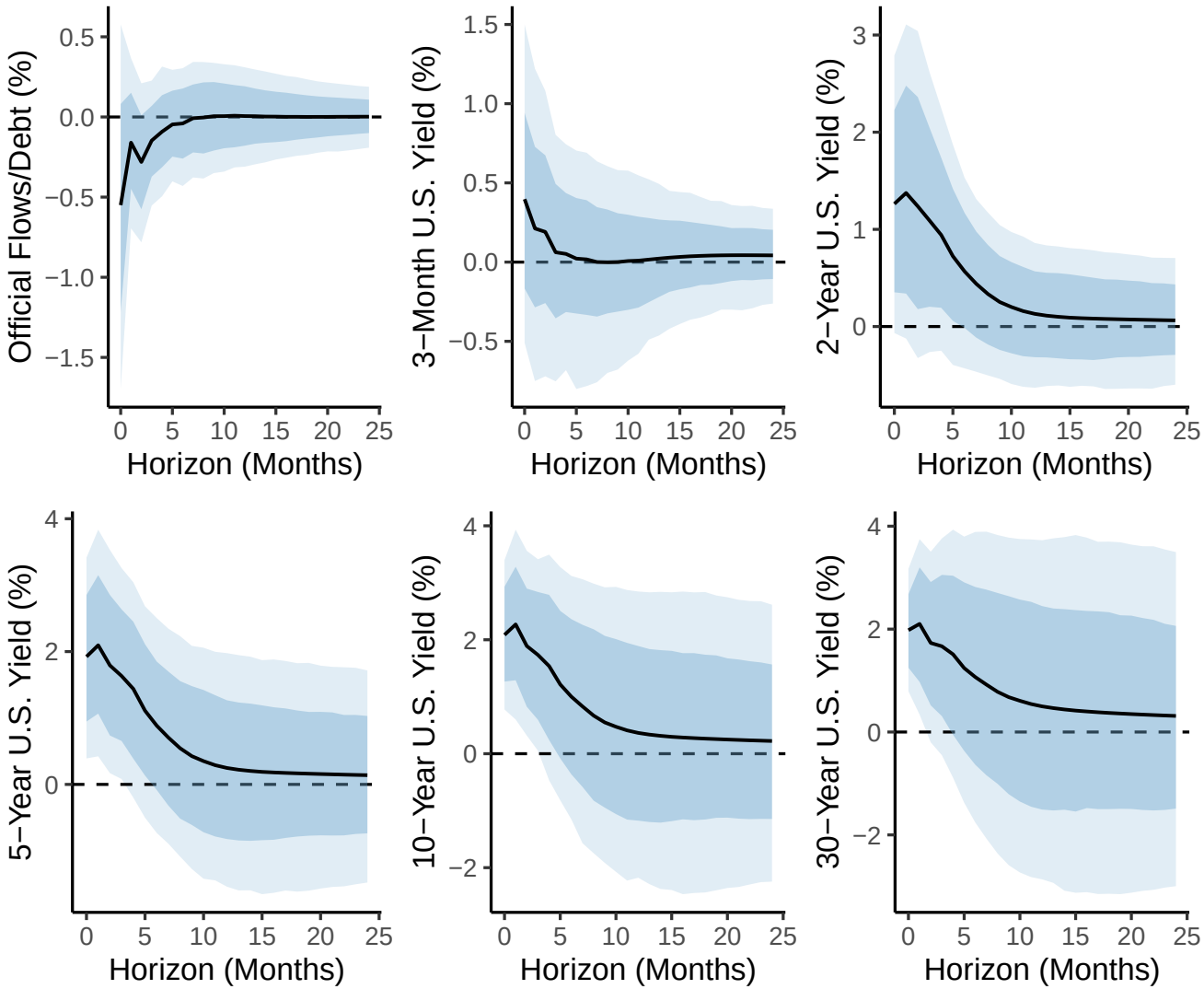
Additional Material

Identified Volatility Breaks



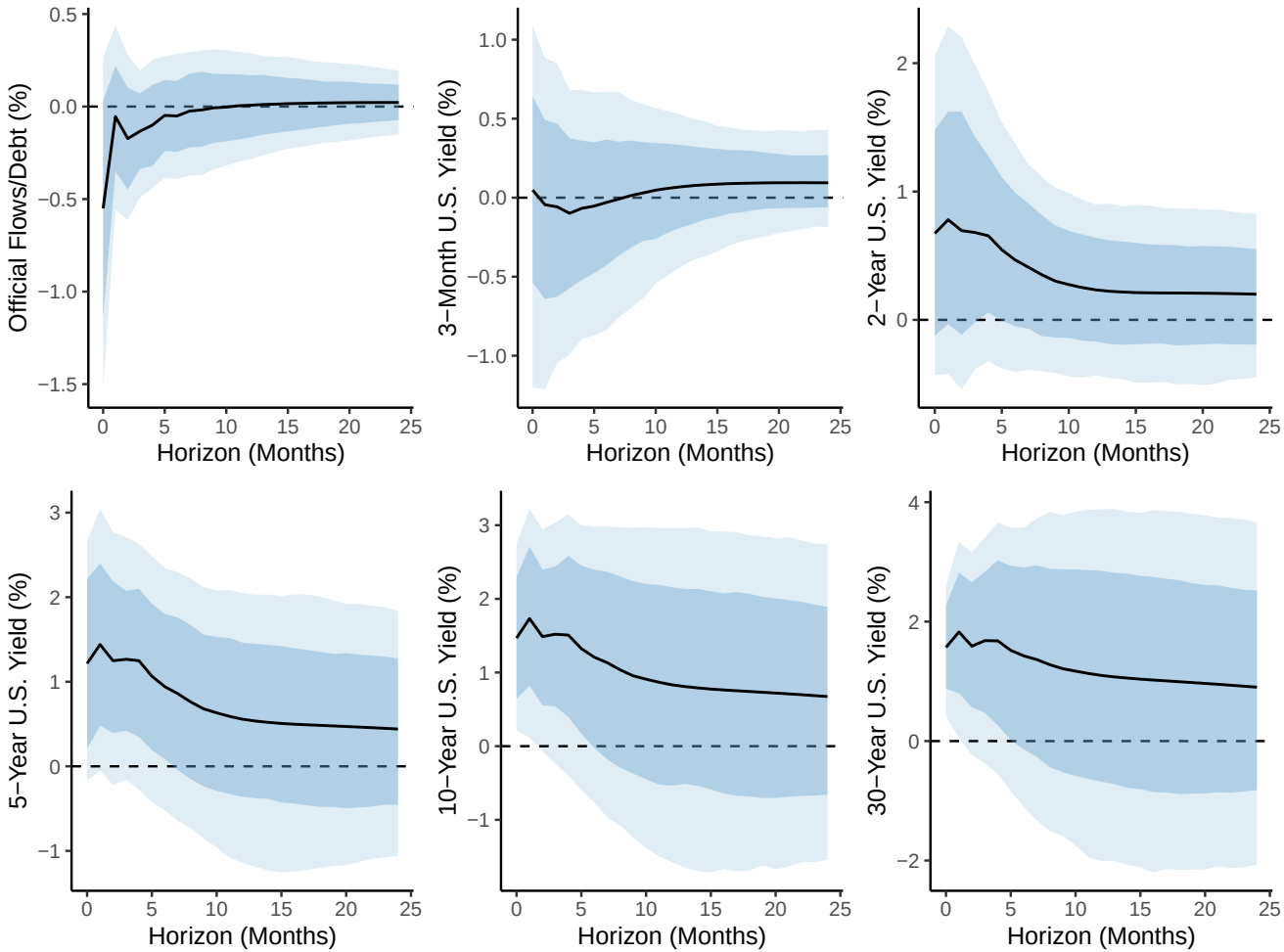
Appendix: VAR with Only Endogenous Variables

Responses from VAR excluding $\boldsymbol{X}_t$ variables (only FO flows and US yields)



Appendix: VAR with Alternate Break Date

Responses from VAR, break date May 2011



Economic Significance: March COVID Shock

- March 2020, foreign investors sold roughly $300B in USTs,
  - $150-200B of which have been tied to sales by foreign official institutions (Vissing-Jorgensen, 2021, Weiss, 2022)
  - -$266B by US mutual funds; -$196 by US households
- March 9-18, nominal 10Y US yields rose 64 bps
- Scaling by 2020Q2 marketable debt and assuming $50-66B FO sales between March 9-18, estimated impact of 51bps-68.5bps
- Impact of FOs disproportionately large relative to share of UST sales