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.

Introduction

Foreign official demand for U.S. Treasuries (USTs) is important from a policy perspective, making up 20-50% of the UST market over the last 2 decades

- Savings Glut Hypothesis
- Monetary policy decision making
- Trade and Currency Wars
- Liquidity in UST markets

Introduction (Cont.)

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

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

Some components of FO demand are price-inelastic and pro-cyclical

- Precautionary and Mercantilist in particular

Others are price-elastic:

- See, for example, Arslanalp, Eichengreen, and Simpson-Bell (2022)

Identifying a FO flow shock on U.S. interest rates is challenging

- Not only endogeneity due to simultaneity
- But also endogeneity due to omitted factors

Contribution

- Identify a FO UST purchase/sale shock via heteroskedasticity to address simultaneity
  - Rigobon (2003), Brunnermeier et al. (2021), Lewis (2021) among others
- Controlling for foreign common factors in foreign yields and Fed asset purchases to address omitted variable bias

Main Results

Short-run impact of a FO UST purchase shock larger than previously estimated:

- More than 100bps per $100B of foreign official flows on long-term US yields, compared to 13-68bps typically estimated in the literature
- Impact of the shock decays to the range of estimates found in the literature within half a year

Important implications: a 1% shift away from USD assets by China or Saudi Arabia

- A $19.5B sale by China $\rightarrow$ 24.4bps impact effect
- A $2B sale by Saudi Arabia $\rightarrow$ 2.5bps impact effect

Outline

- Benchmark estimates in the literature
- Bias from endogeneity
- Identification via heteroskedasticity
- Evidence of time-varying volatility in FO flows around the time of the GFC in 2008
- Estimates from identified VARs and their economic implication
- Robustness checks
- Conclusions

Estimates in the Extant Literature

Table 1: Impact of $100 Billion Foreign Purchase or Sale* of UST on 10-yr U.S. Treasury Yield: Estimates from Previous Studies (in bps)

Study	**Impact**	**Measurement**	**Sample Period**
Bernanke et al. (2004)	-66	Japanese off. intervention (daily)	1/3/2000-3/3/2004
Warnock and Warnock (2009)	-34 to -68	12M FO flows, Treasuries+Agencies (% GDP)	1984M01-2005M05
Bertaut et al. (2012)	-13	FO holdings, Treasuries+Agencies (% debt)	1980Q1-2007Q2
Beltran et al. (2013)	-39 to -62	12M FO flows, Treasuries (% debt)	1994M01-2007M06
Beltran et al. (2013)	-46 to -50	FO flows, Treasuries (% debt)	1994M01-2007M06
Beltran et al. (2013)	-17 to -20	FO holdings, Treasuries (% debt)	1994M01-2007M06
Wolcott (2020)	-17	FO flows, Treasuries (% debt)	1985M01-2014M08
This study: OLS	-19 to -44	12-month FO flows, Treasuries (% debt)	1999M01-2018M12
This study: SVAR	-100 to -140	FO flows, Treasuries (% debt)	1999M01-2018M12

Bias from Simultaneity

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

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

- Reasonable to assume the true causal impact of $FO \rightarrow y_{us,t}$ is *negative* $\mathbf{(}a < 0\mathbf{)}$
- Presuming impact of $y_{us,t} \rightarrow FO$ is *positive* is also plausible $\mathbf{(}b > 0\mathbf{)}$
- With $a < 0$ and $b > 0$, bias in the direction of $b\sigma_1^2/(1 - ba) > 0 \rightarrow$ estimate is *less negative* than the true a
- Intuition: if $a < 0$ but $b > 0$, an estimate that confounds $\mathbf{(}a\mathbf{)}$ and $\mathbf{(}b\mathbf{)}$ is "less negative" than true $\mathbf{(}a\mathbf{)}$

Bias from Simultaneity (cont.)

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

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

which gives

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

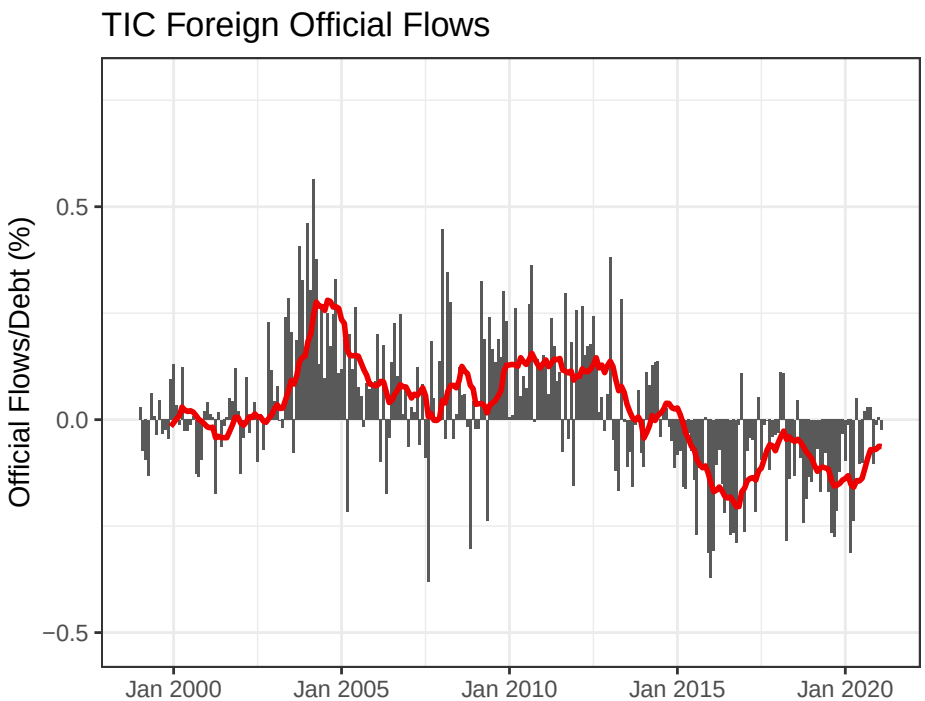
- If $a < 0$, $c < 0$ and $d > 0$, then $\frac{a}{1-cd}$ can be less negative than a

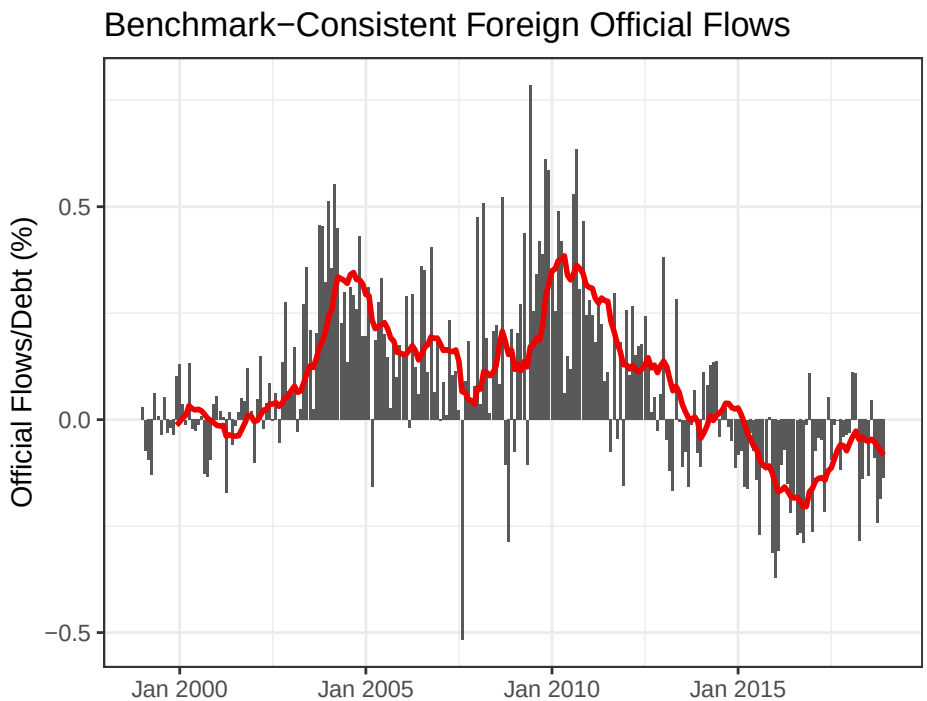
Bias from Omitted Factors

- Bias can go in either directions and the true model is unknown
- Literature controls for typical domestic drivers of U.S. yields but does not control for foreign yields.
- After 2008, one also needs to control for Fed asset purchases

Data: Monthly Frequency, 1999-2018

- Bertaut-Judson Adjusted TIC net purchases of U.S. Treasury securities by foreign officials, Feb 1999- Dec 2018
- 3-month, 2-year, 5-year, 10-year, and 30-year UST yields
- Macro factors, foreign sovereign yields, monetary policy shocks (Swanson, 2021)





Estimates from OLS Benchmark

Table 2: Benchmark OLS Estimates

	Dependent Variable: 10Y U.S. Yield			
	Benchmark-Consistent Flows		Including Omitted Variables	
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	-0.348*	(0.199)		
FO ($I = 0$)	-0.156	(0.166)		
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***			

Identification via Heteroskedasticity

Broad idea: if the error variances change over time $\rightarrow$ the VAR can be identified exactly.

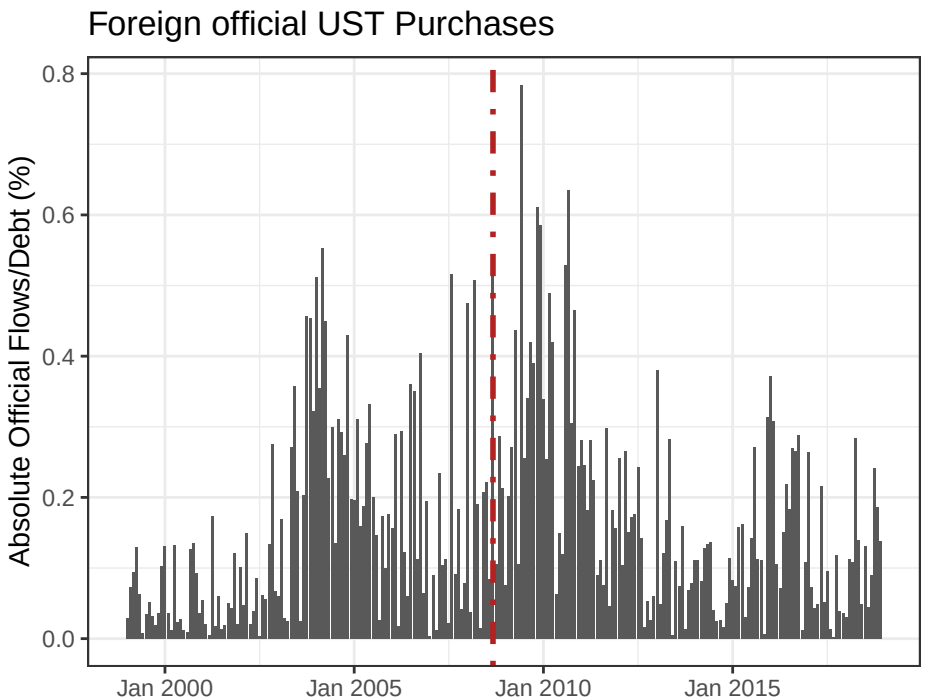
- K^2 unknowns $\rightarrow K^2 + K$
- $(K^2 + K)/2$ equations $\rightarrow K^2 + K$

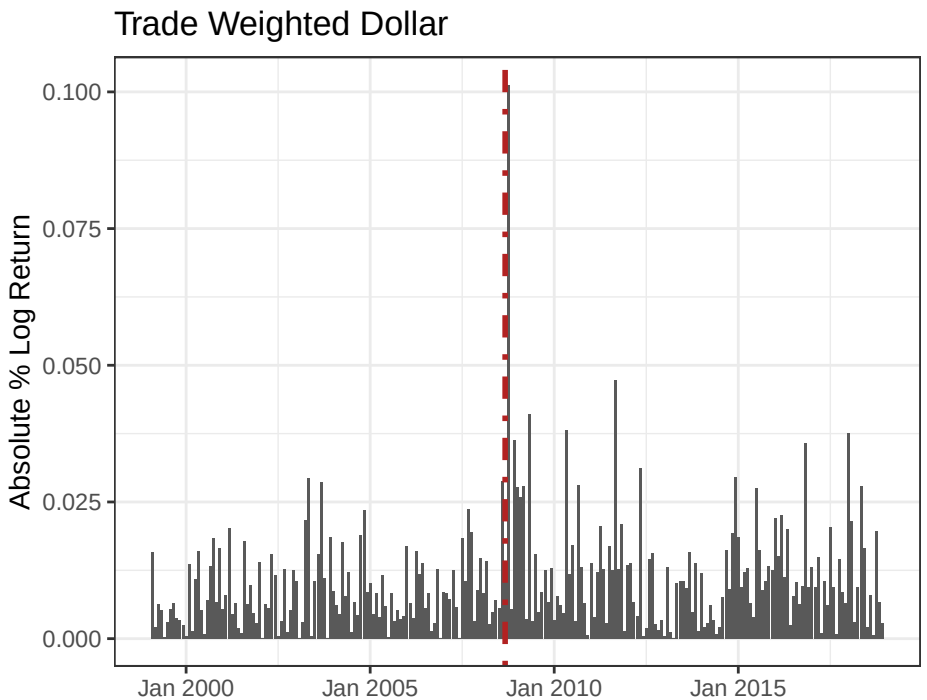
Auxiliary conditions (Lewis 2021 and 2022):

- VAR coefficients remain constant
- Variances changes are not proportional to each other (driven by time-varying volatility in a common factor)
- Variance change of FO flows must be the largest

Structural Break in FO Flows Volatility in 2008

- $\hat{\sigma}$ of FO UST flows: from **0.17%** during 1M1999-8M2008 to **0.23%** during 9M2008-12M2018
- Related to the structural change in flows, $\hat{\sigma}$ of US Dollar factor in exchange rates also changed from **3.77%** to **6.14%**





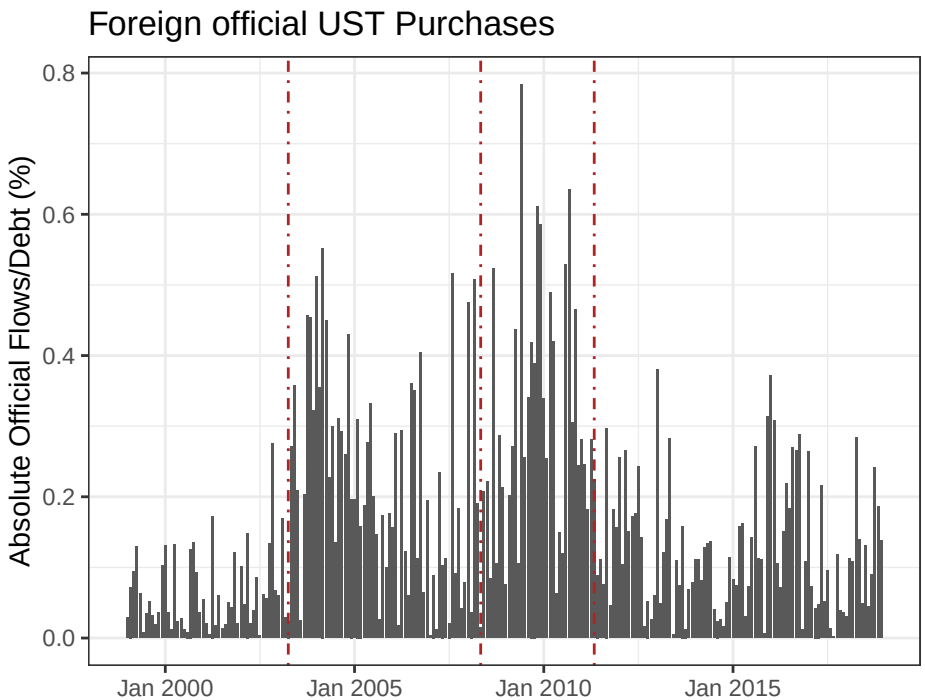
Time-Varying Volatility in FO Flows Around the 20008 GFC

- 1. **Evidence from other studies:** Ahmed and Zlate (2014), Erik et al. (2020), Forbes and Warnock (2021), Stracca (2021)
- 2. **OLS estimates weaker** in longer sample that includes post-GFC (from -44bps to -19bps)
- 3. **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^{***}

Time-varying Volatility in FO Flows (Cont.)

- 4. 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**



- More evidence on the relative size of FO flow variance change and absence of proportional changes in the paper
- **NB:** SVAR estimation is consistent under mispecified regimes (Sims, 2021)

Structural VAR identified via heteroskedasticity

VAR(4) in US Yields of different maturities:

$$\boldsymbol{Y}_t = \beta' \boldsymbol{Y}_{t-l} + \boldsymbol{\Gamma}' \boldsymbol{X}_t + \boldsymbol{u}_t,$$

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

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

Identified via heteroskedasticity:

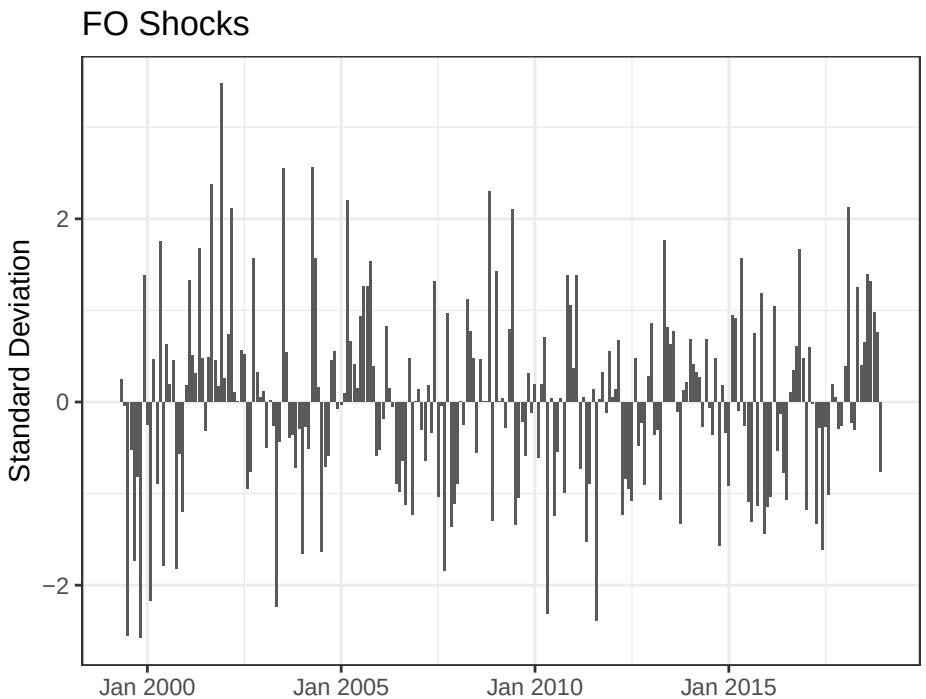
$$E(\mathbf{u}_t \mathbf{u}_t') = \begin{cases} \Sigma_1, & \text{for } t = 1, ..., t_{Sep2008} - 1 \\ \Sigma_2, & \text{for } t = t_{Sep2008}, ..., T \end{cases}$$

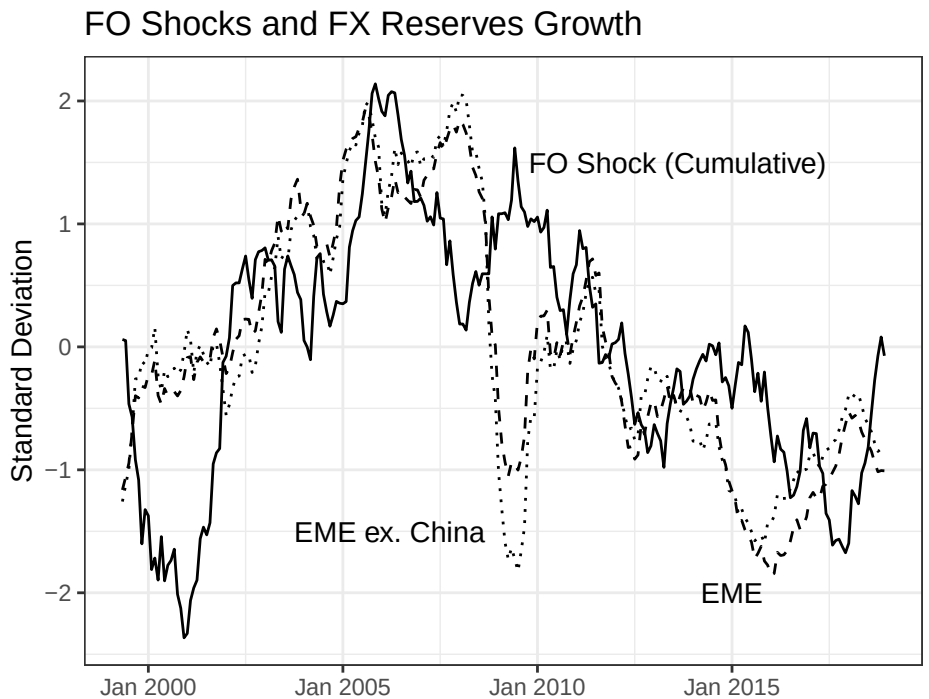
Recall that the volatility break needs not to be assumed occurring exactly in September 2008

Labelling and Interpreting a FO Flow Shock

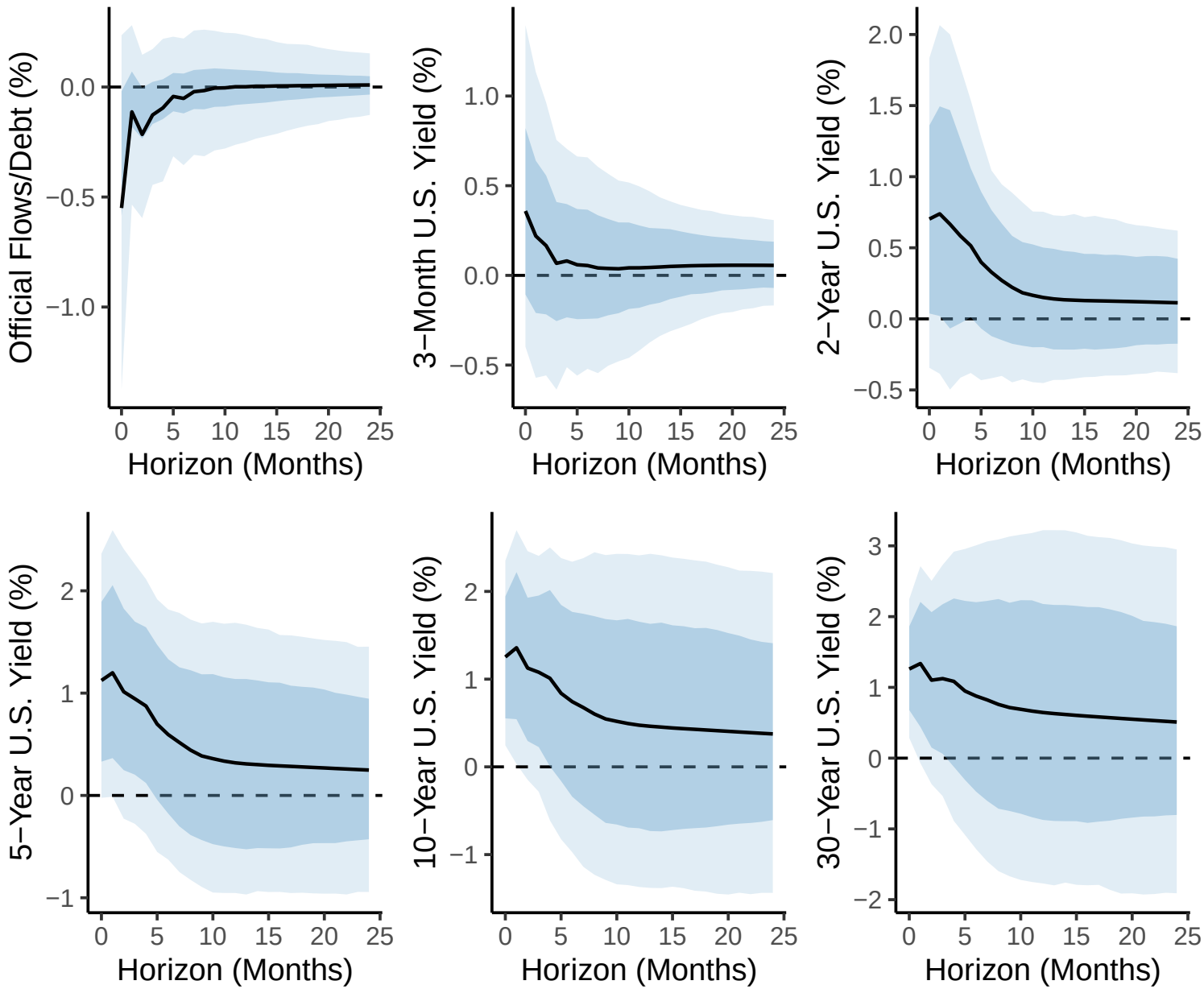
- Heteroskedasticity can identify a SVAR only up to a rotation and column ordering
- No set technical conditions for labeling and interpreting shocks. Researcher needs to present additional circumstantial evidence
- We show that
  - 1. There is significant Time-0 impact of FO flows on yilds (like in Brunnermeier et al., 2021)
  - 2. Responses of FO flows and yields have expected sign only wrt to this shock
  - 3. Sizable FEVD of FO flow shock for FO flow variable (Volpicella, 2021)
  - 4. Ex-post comovement with observable variables

Identified FO Flow Shocks Clearly Associated with Reserve Accumulation and Decumulation





Impact of a $100B FO Sale Shock (All Controls Included)



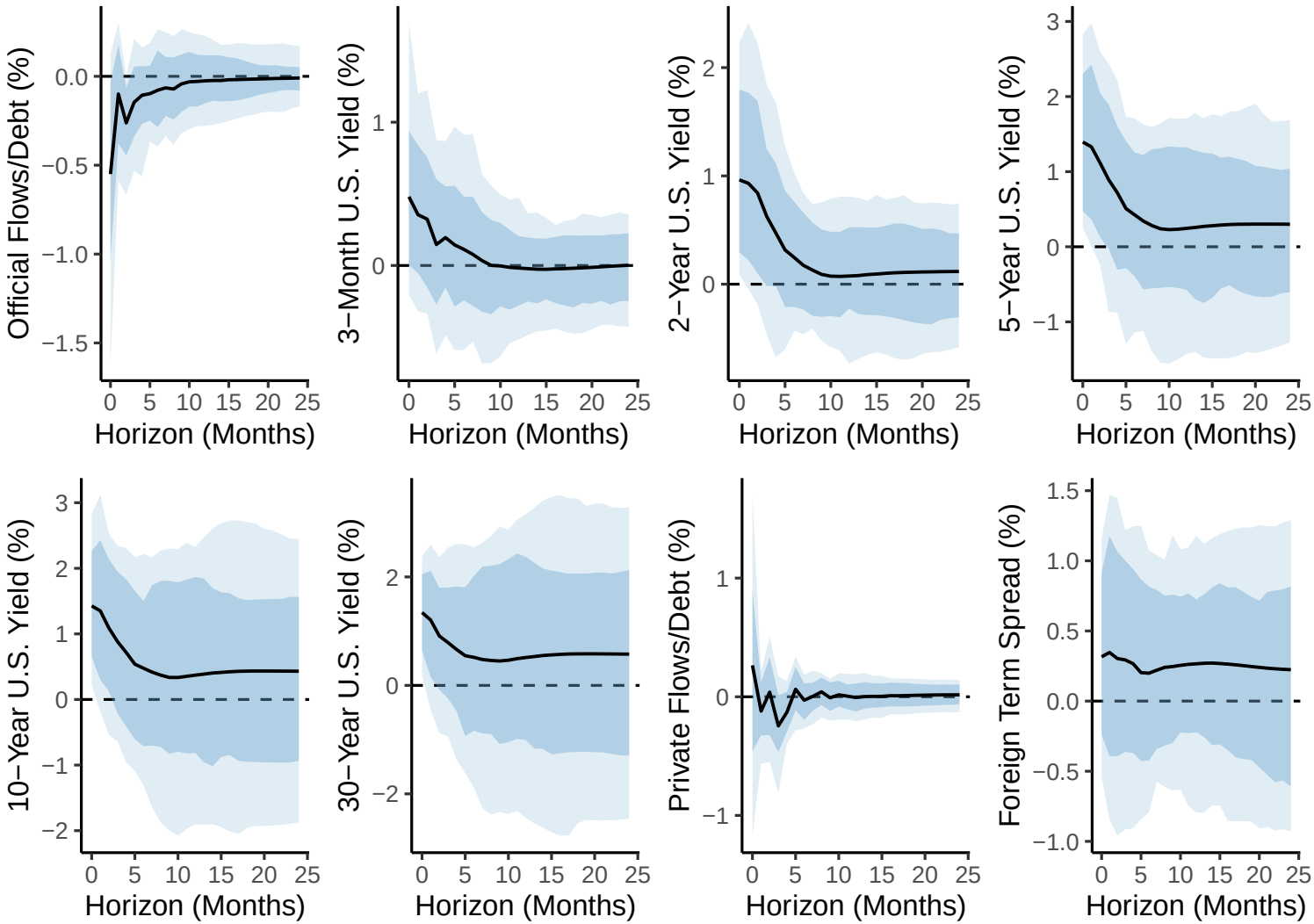
Economic Significance

Consider a scenario in which a large official UST holder shifts allocation away from Dollar Reserves by 1%, *ceteris paribus*

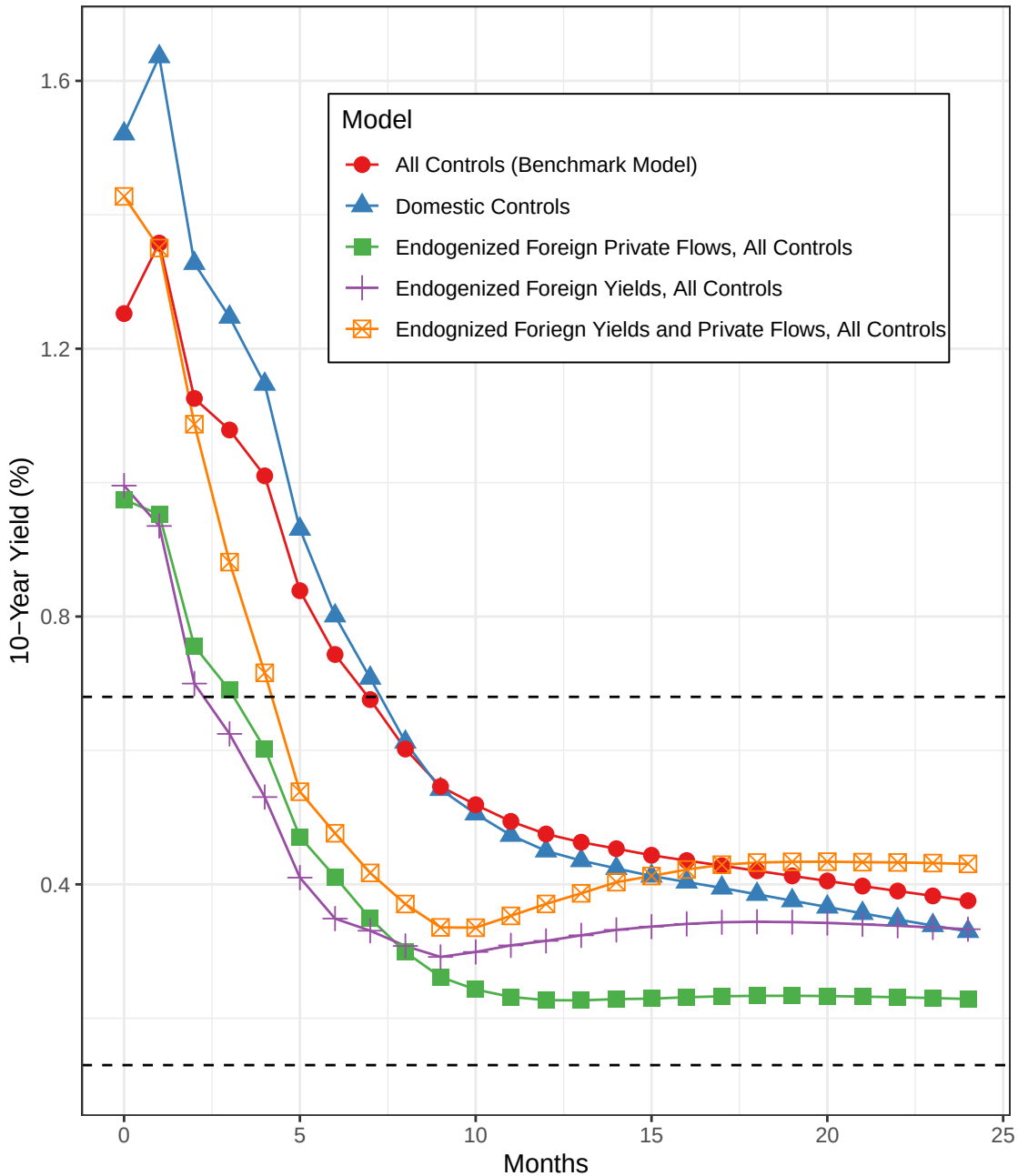
	China	Saudi Arabia
FX Reserves ($\$B$, Mar 2022)	3,250	326
Assume % USD	60%	60%
1% Outflow ($\$B$)	-19.5	-2
5Y yield elasticity per $\$1B$	1.12bps	1.12bps
Contemporaneous impact on 5Y yield	**+21.8bps**	**+2.2bps**
10Y yield elasticity per $\$1B$	1.25bps	1.25bps
Contemporaneous impact on 10Y yield	**+24.4bps**	**+2.5bps**

Assuming all USD reserves are held in Treasury securities.

Impact of a $100B FO Sale Shock ("Endogenized" Model)



Robustness: Alternative Specifications



Concluding Remarks

- Accounting for endogeneity leads to much larger price impact than the previous literature implies, despite longer sample period with more volatile FO flows
- A \$100B **identified** flow shock causes U.S. yields to change by more than 100bps in the short-run; effects stabilizes to the literature's range within 5-6 months
- Quantitative result is important in the context of rising US policy rates and a diminished attractiveness of US Dollar Reserves after the freezing of Russia holdings