# Central Banker to the World: Foreign Reserve Management and U.S. Money Market Liquidity

Ron Alquist [1] R. Jay Kahn [2] Karlye Dilts Stedman [3]

[1] Managed Funds Association
[2] Board of Governors of the Federal Reserve System
[3] Federal Reserve Bank of Kansas City

15th Workshop on Exchange Rates

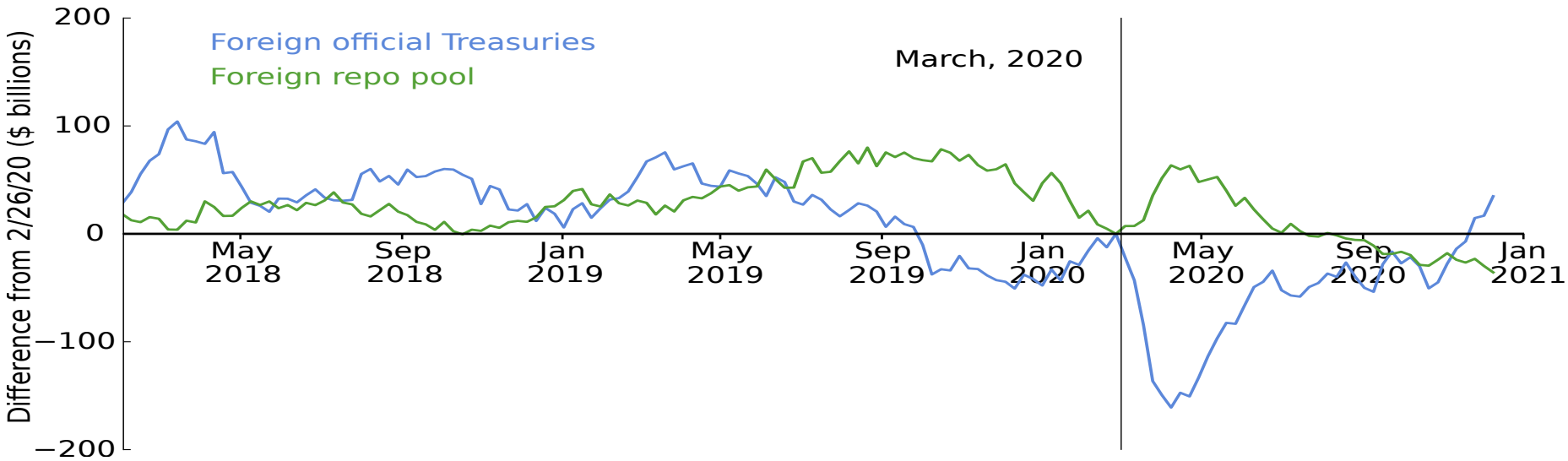
Banka Slovenije

December 2-3, 2025

---

*Disclaimer: The views expressed in this presentation are the authors' own and do not necessarily represent those of the U.S. Department of Treasury, the Financial Stability Oversight Council, the Office of Financial Research, the Board of Governors of the Federal Reserve System, or the Federal Reserve Bank of Kansas City.*

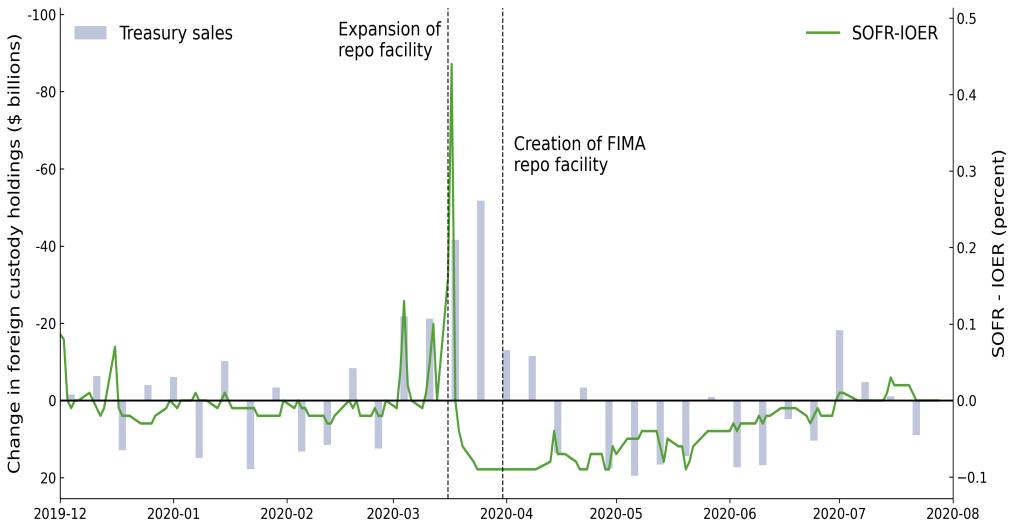
# Motivation: Dollar's use as a reserve and funding currency

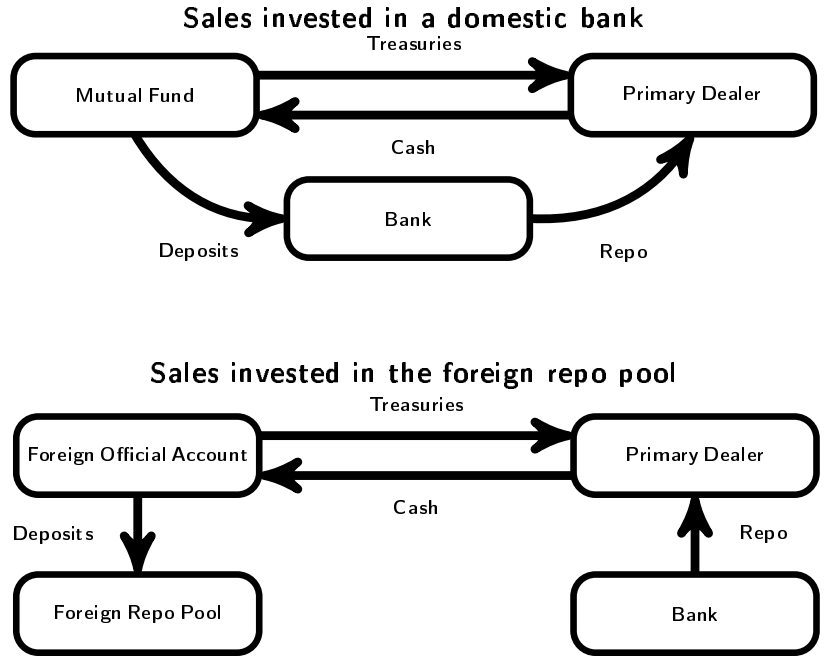



Dollar's status permits United States to invest in equity and FDI abroad and supply liquidity to foreign asset holders (e.g., Gourichas and Rey 2007).

- But shifts in foreign liquidity demand can spill over to U.S. liquidity conditions.
  - In March 2020, foreign official accounts sold $147 billion in Treasuries.
    - Foreign repo pool activity suggests precautionary motive.
  - How large an effect did such sales have on U.S. money market liquidity?

# How do foreign reserve sales affect domestic liquidity?




- Foreign official accounts sold $147 billion in Treasuries.
- In theory, sales had direct and indirect effects on repo markets:
  - **Direct:** More Treasuries needed to be funded.
  - **Indirect:** Fewer reserves to fund them.
- Do such sales influence repo and Treasury market liquidity?

## How does the use of the dollar as a reserve currency affect domestic liquidity?

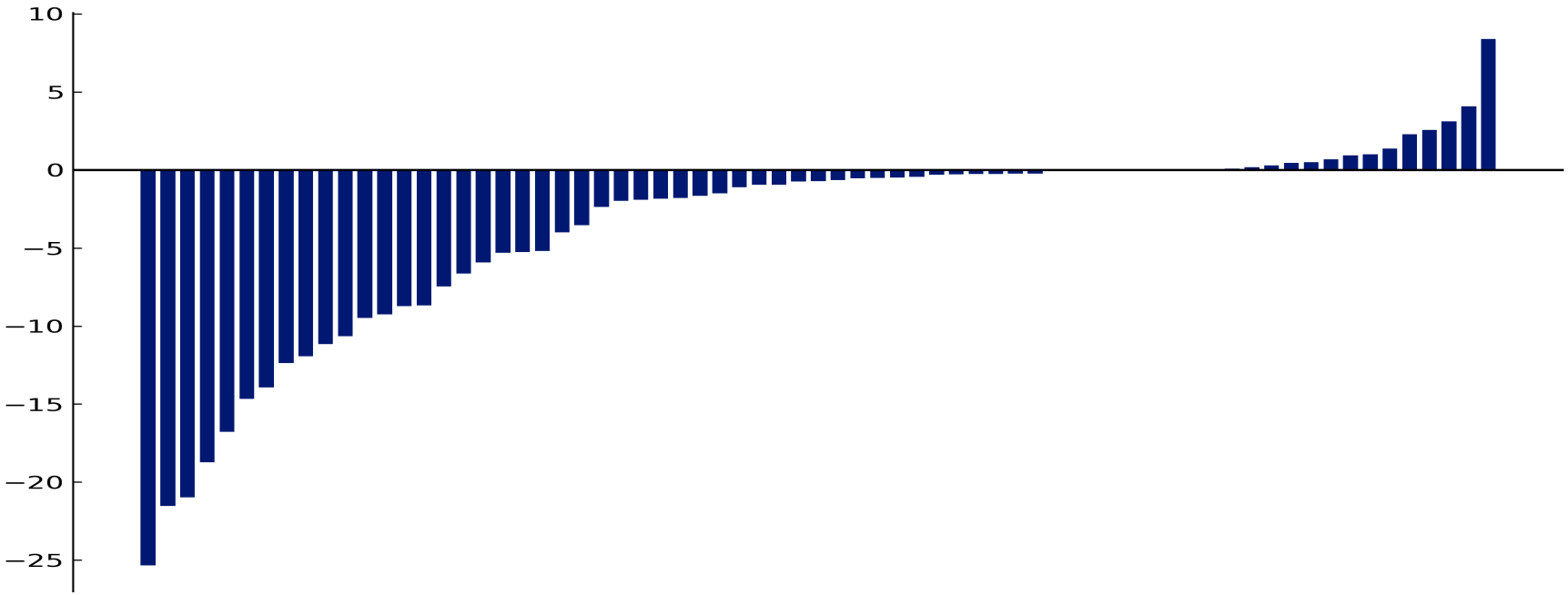
**Analyze this question from two angles:**

1. Develop a model of reserve management for pegged exchange rates.
   - Two-economy model with financial frictions.
   - The central bank desires liquid settlement balances, leading it to hoard liquidity.
2. Study empirical effects of FX management on U.S. repo market.
   - Examine time series of foreign official UST holdings and repo spreads.
   - **Identification challenge:** Need to isolate variation in reserve demand.
     - Focus on oil exporting countries with a dollar peg.
     - Use oil price volatility as an instrument.
   - **Results show significant and sizeable effects on U.S. repo spreads.**

**Primary contribution:**

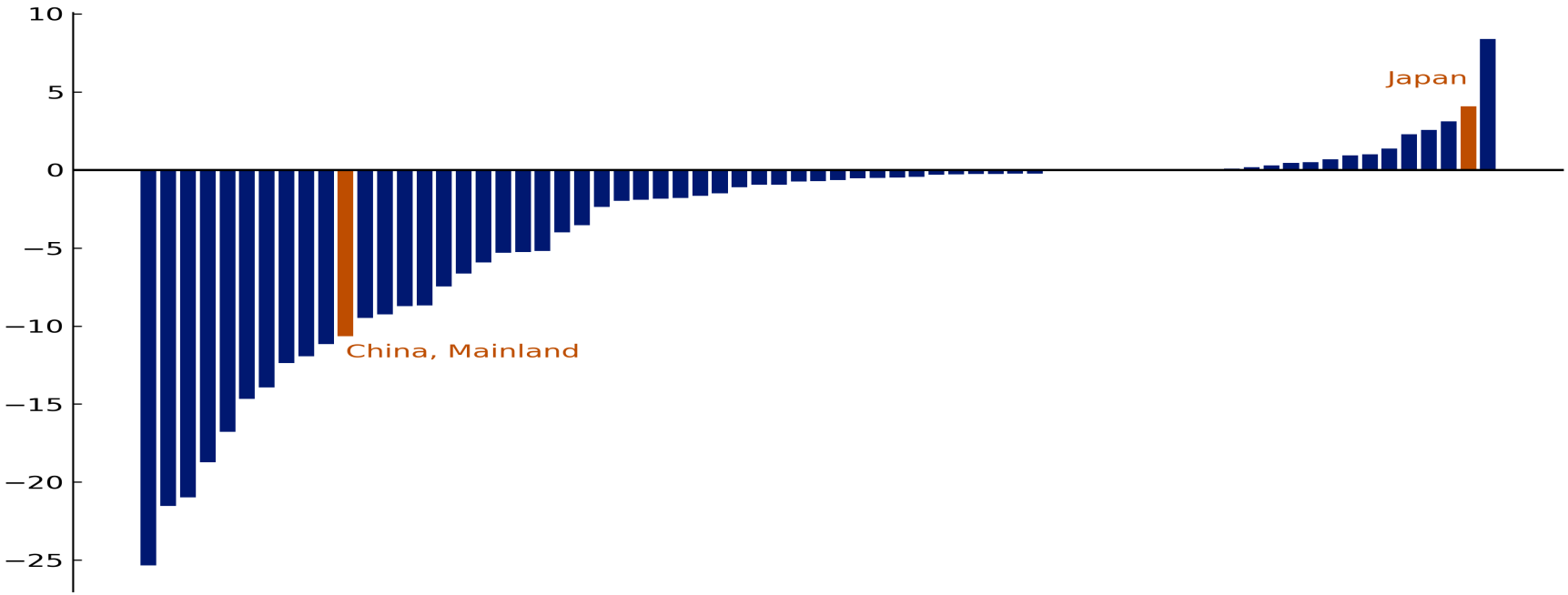
*Use of dollar as reserve and funding currency exposes U.S. money markets to export volatility of foreign countries through reserve managers' portfolio decisions.*

# Who were the major foreign sellers during March 2020?




**TIC data allow us to look across countries.**

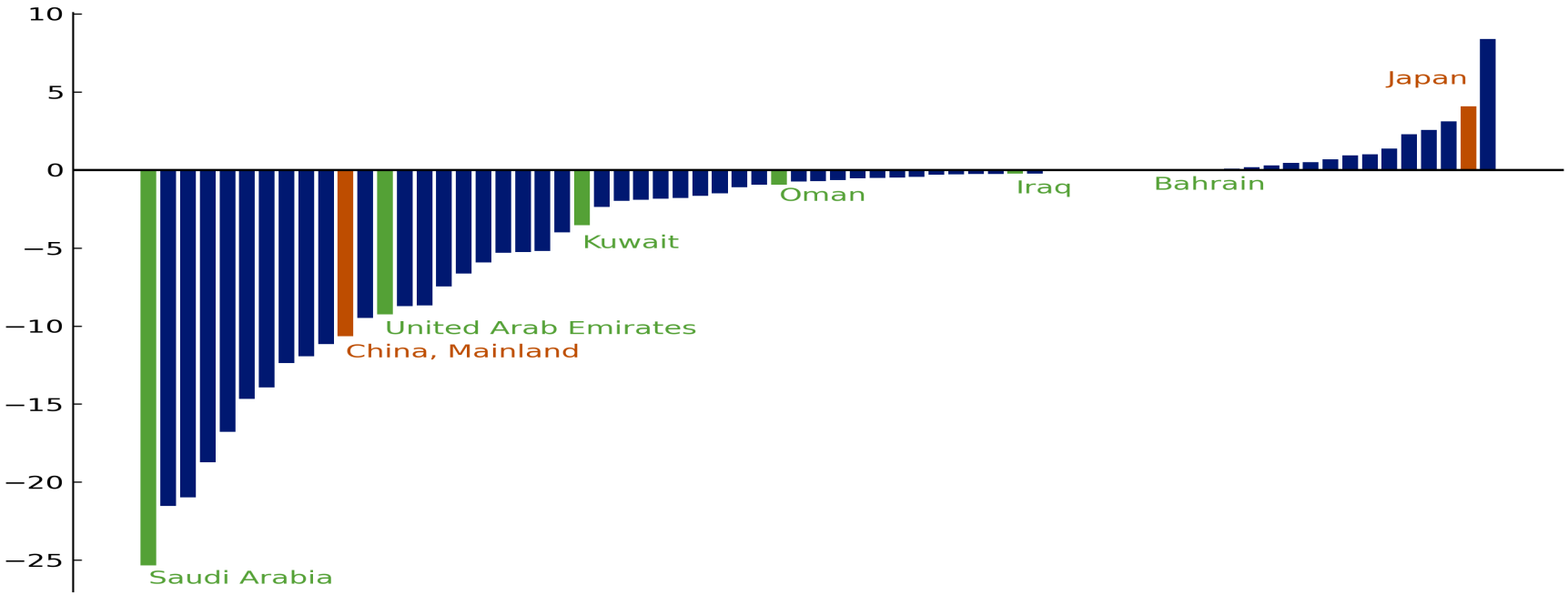
# Who were the major foreign sellers during March 2020?




**TIC data allow us to look across countries.**

- China and Japan: -6.6B

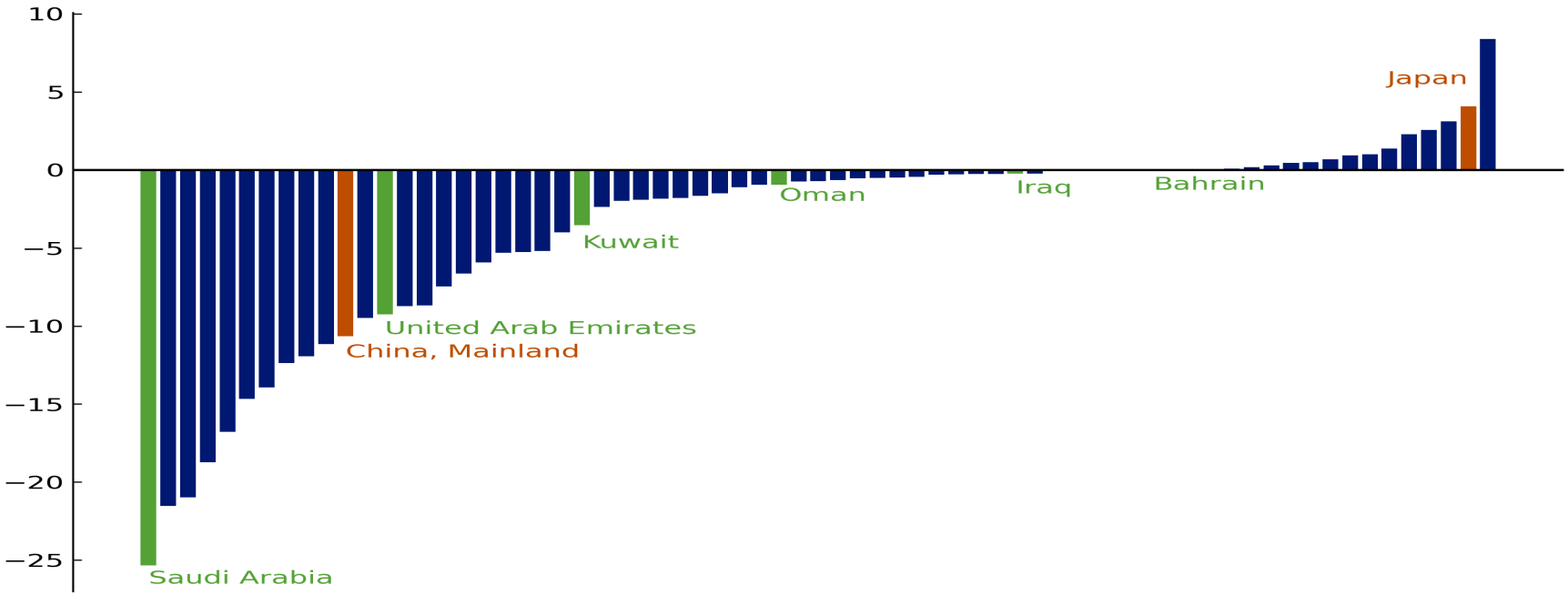
# Who were the major foreign sellers during March 2020?




**TIC data allow us to look across countries.**

- China and Japan: -6.6B
- Middle East oil exporters: -39.3B

# Who were the major foreign sellers during March 2020?




**TIC data allow us to look across countries.**

- China and Japan: -6.6B
- Middle East oil exporters: -39.3B
  - ***Increase*** of $12.7B in holdings of short-term, non-Treasury U.S. assets.
  - ***Increase*** of $7.8B in "other" ST U.S. assets (includes foreign repo pool).

  $\Longrightarrow$ **Shift from less liquid to more liquid dollar holdings.**

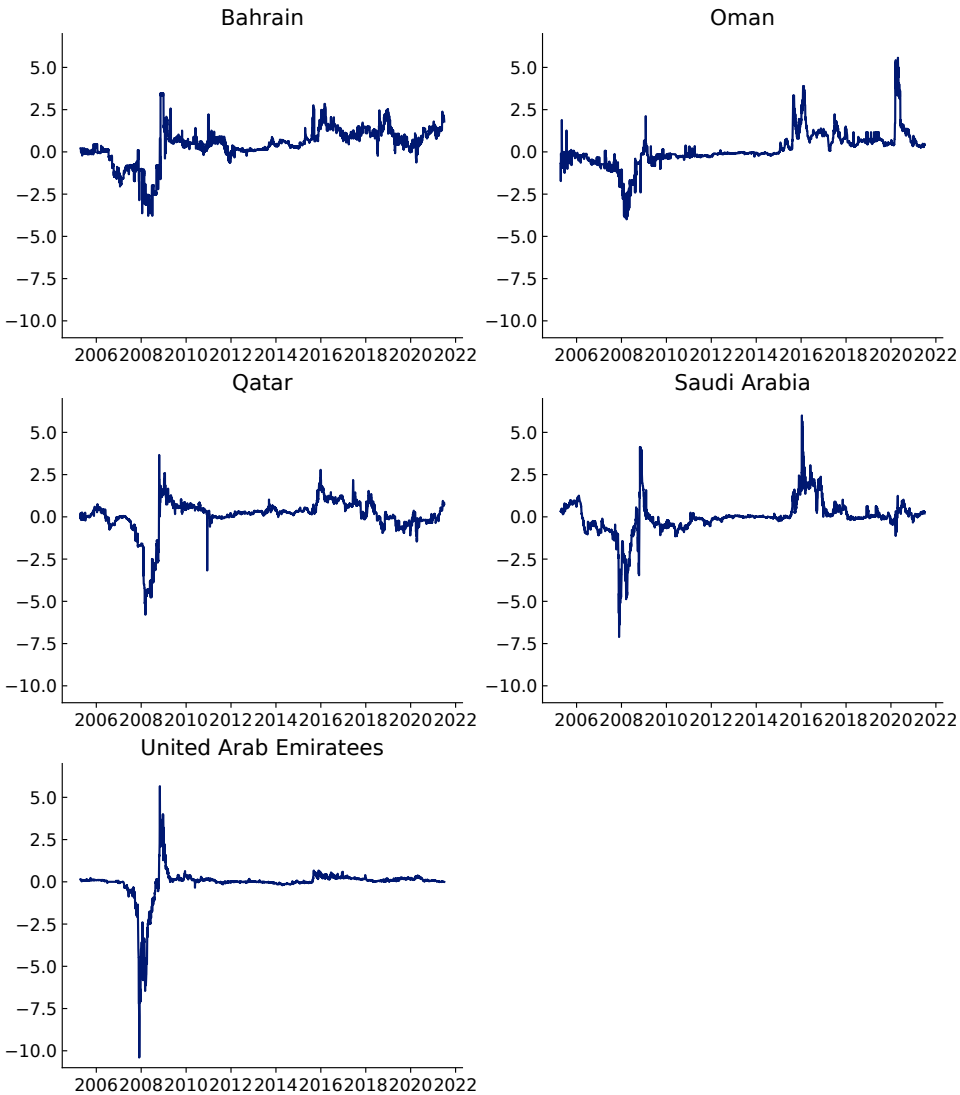
## Focus on oil producers with dollar pegs provides a laboratory

That oil exporters played an outsized role in recent episodes of money market stress points to two characteristics that we can use for identification:

1. Reserve demand relatively easy to characterize as function of export prices.

2. Treasury holdings are almost exclusively the national government's.

# Stylized fact 1: Substantial variation in implied interest rate differentials




**Specifically, construct:**

$$x_{i,t} = \frac{F_{i,t}}{e_{i,t}} - 1$$

- Under CIP:

$$x_{i,t} \approx r_{i,t} - r_{\text{U.S.},t}$$

- Under UIP, no revaluations:

$$x_{i,t} = \mathrm{E}\left[\frac{e_{i,t+1}}{e_{i,t}}\right] - 1 = 0$$

- Range from -2.38% to 3.64% after excluding crises.

**We work with first PC:**

- Explains 69% of daily variance.

Call first PC the implied interest rate differential factor, or IR factor: $x_t$

## Stylized fact 2: Strong common component to implied interest rate differentials

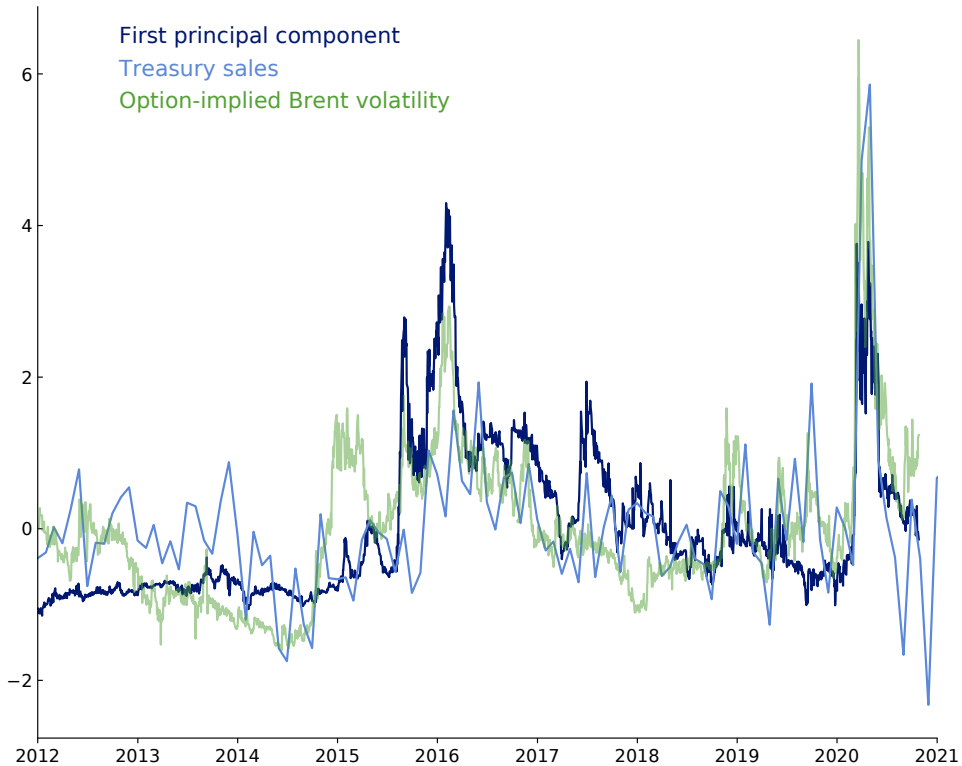
Take first principal component across five countries.

| | | **Correlation** | | **Regression on oil-price volatility** | |
|---|---|---|---|---|---|
| | PC1 | G10 CIP | EME CIP | Coefficient | Standard error |
| **BHD** | 0.800 | 0.126 | 0.233 | 0.451 | (12.528) |
| **OMR** | 0.864 | 0.154 | -0.242 | 5.730 | (58.469) |
| **QAR** | 0.824 | 0.406 | 0.254 | 0.212 | (2.753) |
| **SAR** | 0.839 | 0.267 | 0.074 | 1.299 | (22.397) |
| **AED** | 0.791 | 0.306 | 0.089 | 0.513 | (32.063) |
| **PC1** | 1.000 | 0.322 | -0.060 | 4.549 | (47.385) |

- First principal component explains 69% of daily variance.
- ***Not*** driven by same CIP deviations as average G10 or EME.
- **Strong relationship with oil price volatility.**
  - As measured using at-the-money Brent options.

$$OIV \rightarrow x_t$$

# Stylized fact 3: Relationship with oil-price volatility and Treasury sales




Establish series on LT Treasuries held by sample countries.

Combine with data on option implied Brent oil-price volatility.

Correlation with IR factor:

- Oil-price volatility = 72%
- Treasury sales = 52%

$$OIV_t \rightarrow x_t \rightarrow \Delta UST$$

**Interpreting these relationships requires a structural framework.**

## International macro model with financial frictions provides our framework

**Two-country, two-period model (short horizon)**:

1. Oil-producing economy: oil endowment, central bank pegs FX rate
2. U.S. economy: consumption good endowment, exogenous CB policy

**Intermediaries hold reserves in each currency for settlement balances**

- Poole (1968), d'Avernas and Vandeweyer (2020), Bianchi et al. (2021)
- Can borrow from CB at a penalty rate to cover reserve requirements

**Exogenous shocks to oil demand drive net exports**

- With fixed FX rate, CB $\downarrow$ net holdings of U.S. assets
- But CB needs sufficient *liquid* dollar reserves to meet settlement needs

**Model generates three predictions**:

1. $\uparrow$ in oil vol leads to $\uparrow$ CB demand for dollar liquidity, Treasury sales
2. $\uparrow$ foreign CB demand for liquidity leads to less liquid U.S. money markets
3. Providing liquidity to foreign CB eases the impact of oil vol, $\downarrow$ spreads

## Basic friction: intermediaries need to hold sufficient settlement balances

**Intermediaries** take deposits $(\bar{D}, \tilde{D})$ in both countries (fixed on aggregate)

- Decide how to store funds among: Reserves in each currency ($M_t$, $\tilde{M}_t$), UST ($B_t$)
- Reserve requirement in each country segment markets.

Two deposit shocks reallocate (1) among banks w/in currency (2) b/w currencies.

$$\text{Liquidity premium}_{i,t} = cF(\theta \times \text{Deposits}_{i,t} - \text{Reserves}_{i,t})$$

**Foreign CB** needs sufficient *liquid* FX reserves to meet currency shock (repo pool).
Constraints:

1. Exchange rate management: To keep $e_t = \bar{e}$, need Fin Acct = Curr Acct

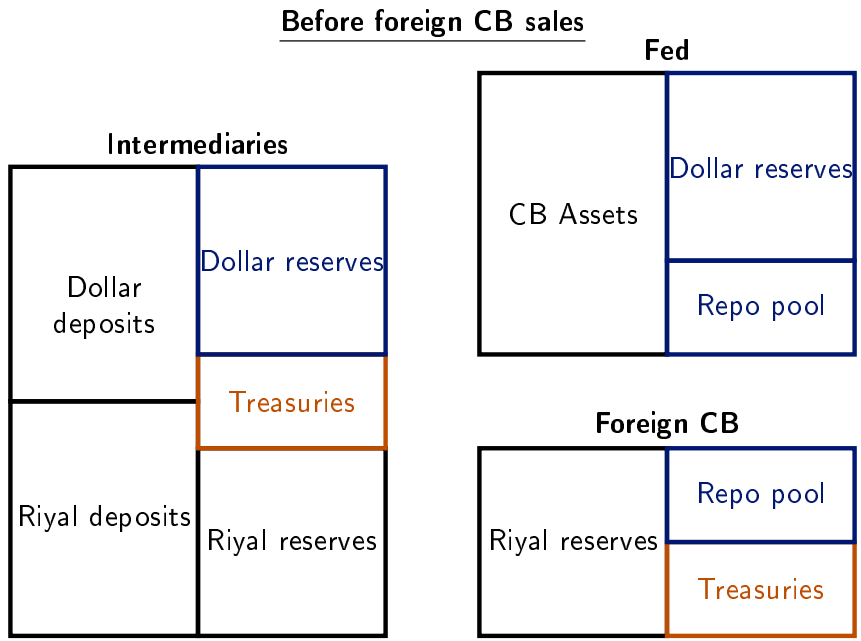
$$\downarrow NX = f(\underbrace{\downarrow B}_{\text{UST (+)}}, \underbrace{\downarrow \tilde{M}^c}_{\text{USD reserves w/ Fed (+)}}, \underbrace{\uparrow M}_{\text{domestic reserves (-)}}, \underbrace{\bar{D}}_{\text{deposits (fixed)}})$$

2. Conduct of monetary policy

$$M_t = \kappa(\underbrace{\theta\bar{D} - \theta\tilde{D} - \bar{A} + \tilde{M}^c}_{\text{reserves consistent with int. rate diff} = 0}) + (1-\kappa)\underbrace{\bar{M}}_{\text{reserves consistent with MP rule}}$$

3. CB cannot always sell Treasuries to increase reserves.
   $\Longrightarrow$ Precautionary motive to hold liquid FX reserves.

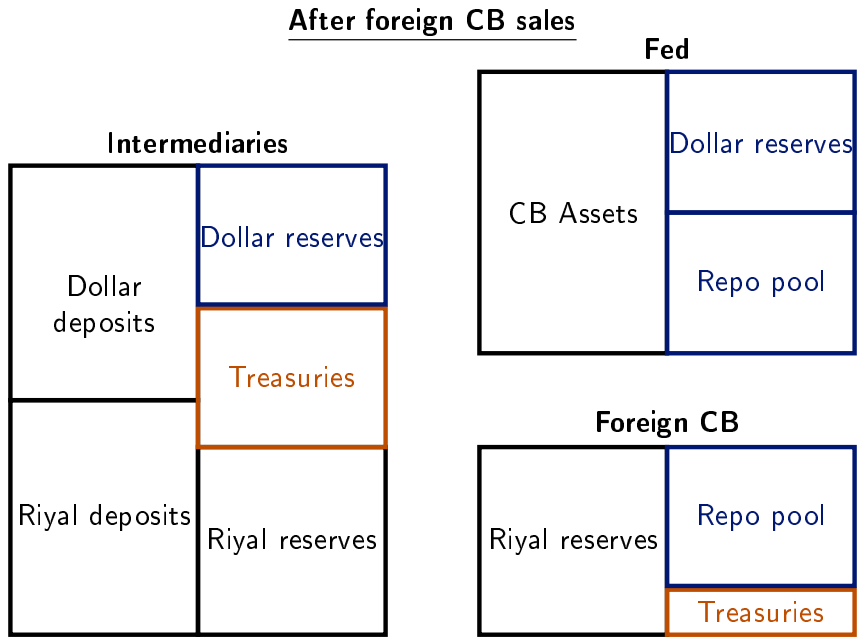
# Precautionary central bank reserve balances crowd out intermediaries



# Precautionary central bank reserve balances crowd out intermediaries

In response to increased oil-price volatility,

- Foreign CB sells Treasuries and increases liquid reserves.
- Holding Fed assets constant, intermediaries hold fewer dollar reserves.

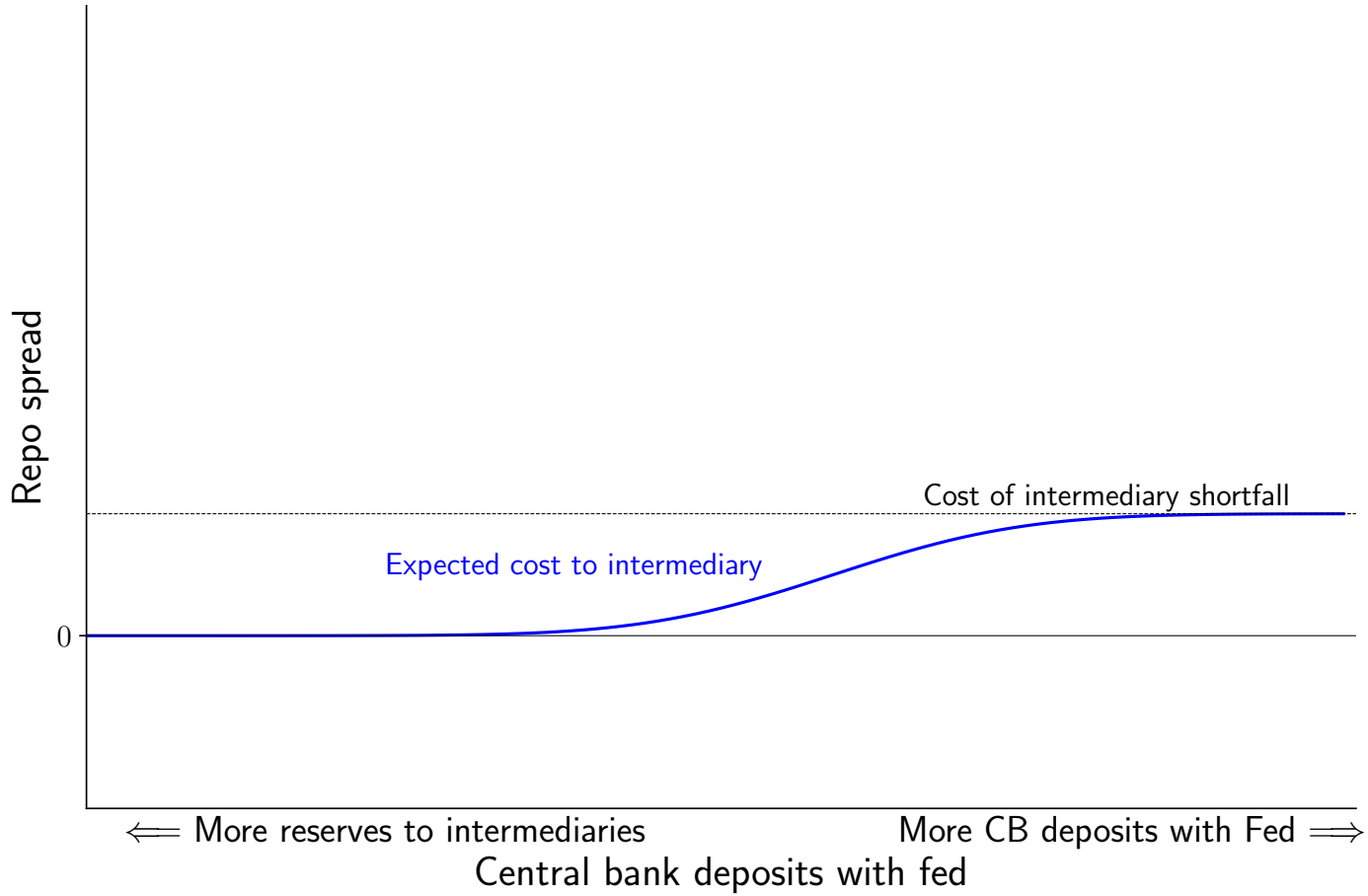



**Two ways U.S. CB can counteract demand by foreign official accounts:**

1. Expand reserves when demand is high.
2. Provide a way to secure liquidity from Treasuries (FIMA repo).

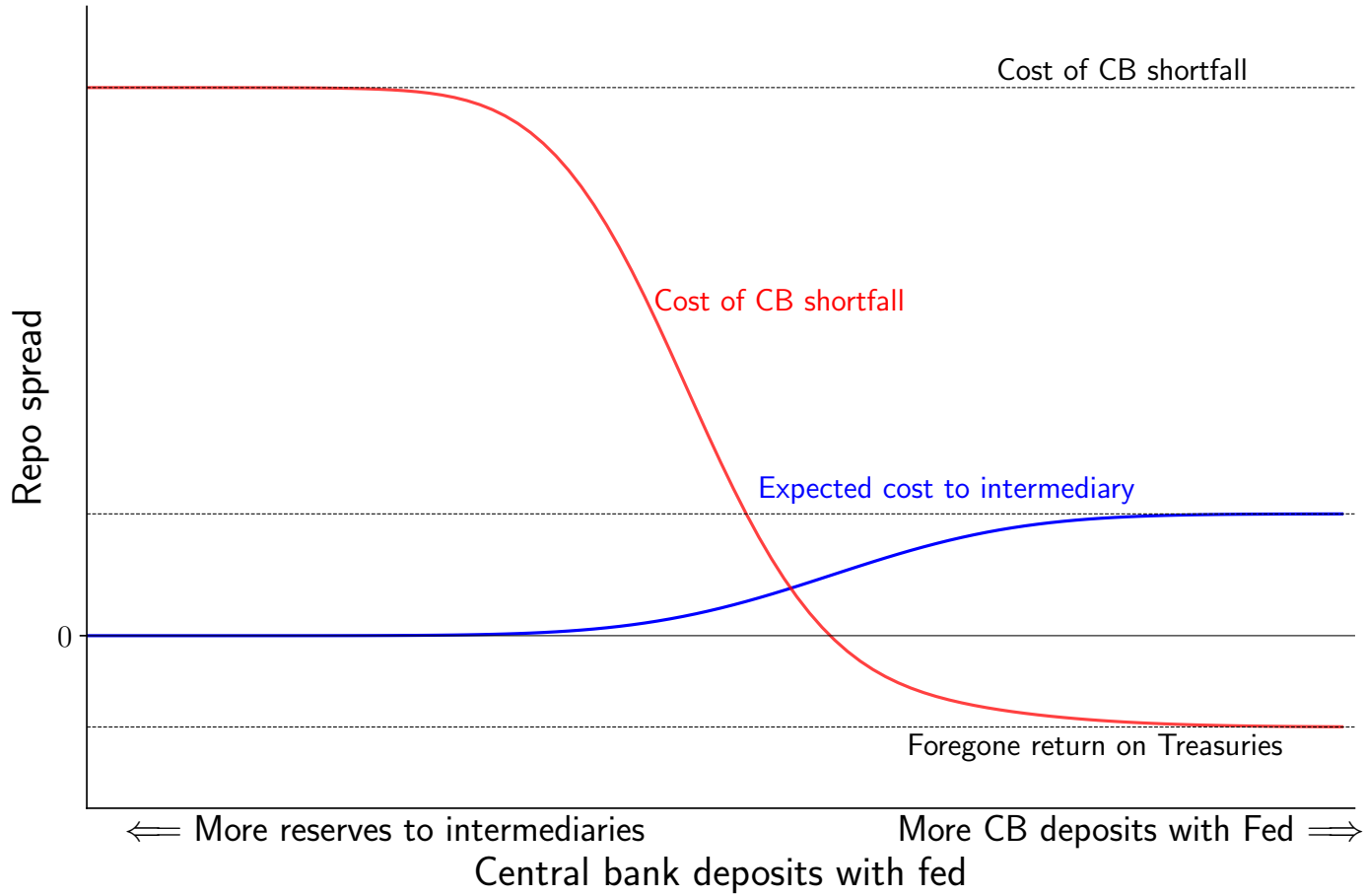
# The cost of crowding out is driven by the cost of central bank USD shortfalls

Intermediary needs to hold reserves to avoid a shortfall




- Effective supply of reserves is the Fed balance sheet after intermediary demand
- Intermediary demand for cash balances is determined by
  - Repo spread $(y - \delta)$
  - Penalty rate when borrowing from CB to meet shortfalls
  - Reserve requirement

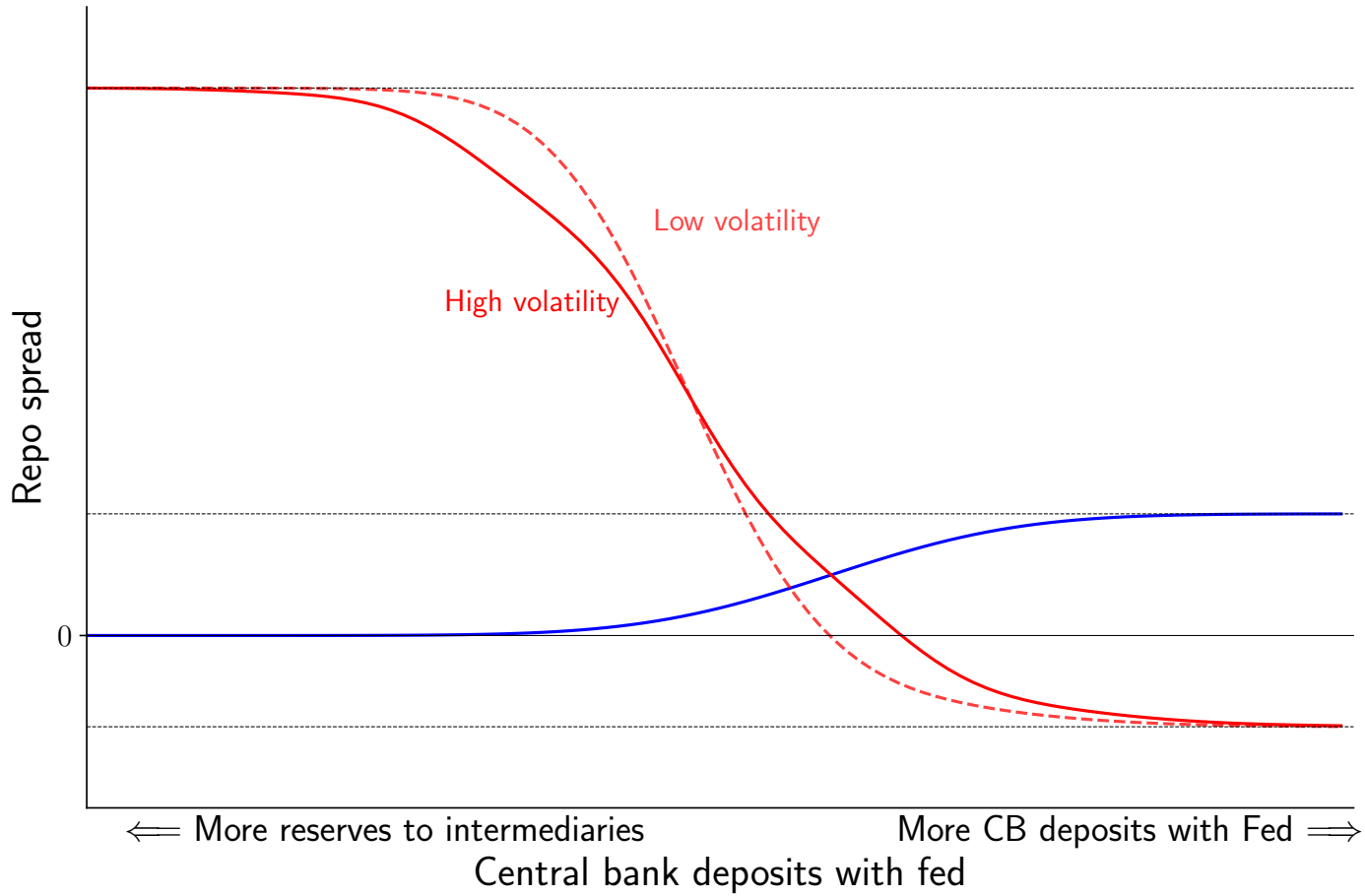
# Foreign CB balances cost of short fall against lower return




CB demand is shaped by:

- Repo spread $(y - \delta)$
- Pr[illiquid UST market]
- Cost of borrowing USD reserves from the Fed
- NX and deposit shocks

# For high cost of CB short-fall, increases in volatility lead to CB hoarding

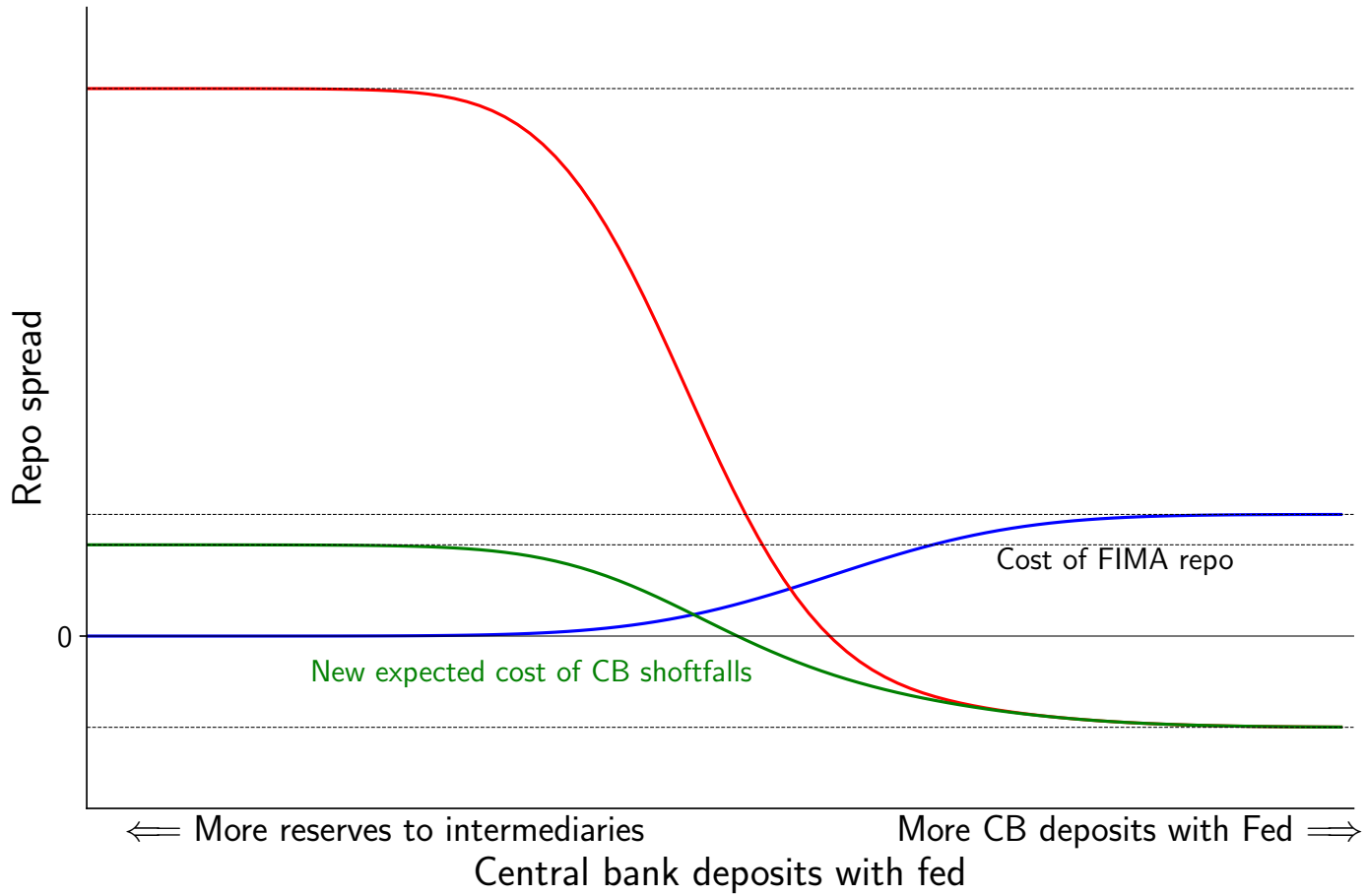



Higher volatility leads the CB to hold more deposits with the Fed

$\rightarrow$ higher repo spreads

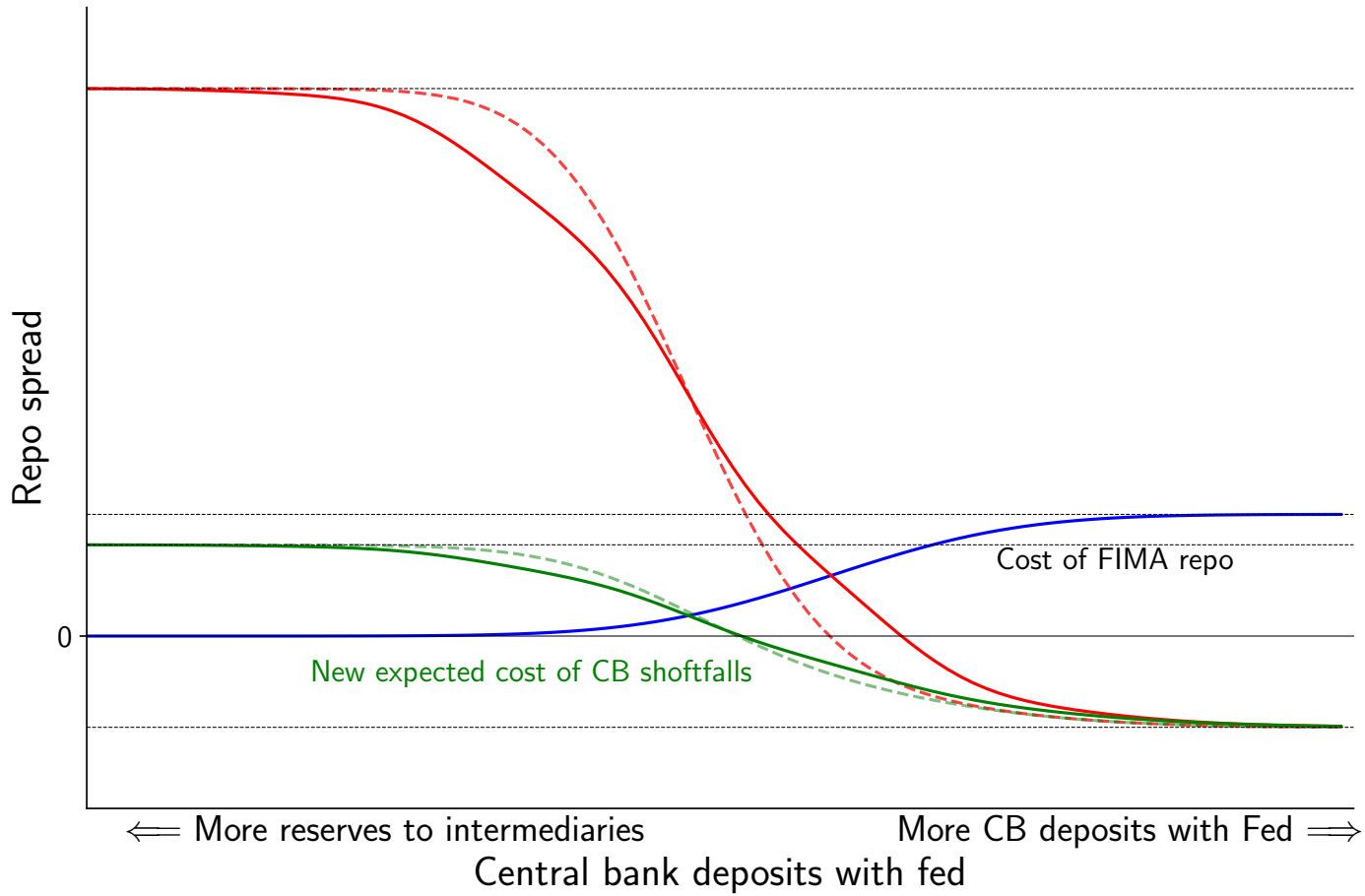
# Introducing a FIMA repo facility reduces rates...

...by reducing the the cost to the foreign CB of meeting USD shortfalls



# Introducing a FIMA repo facility reduces rates...

...by reducing the the cost to the foreign CB of meeting USD shortfalls




The reduced cost weakens the foreign central bank's incentive to hoard dollar liquidity.

## Model disciplines the regression analysis

Oil price volatility $\rightarrow$ foreign CB demand for liquidity $\rightarrow$ U.S. liquidity; isolate exogenous variation in oil exporters' official demand for Treasuries.

**Three concerns:**

1. Treasury sales are low frequency.
   - Use IR factor as a proxy.

2. Deviations may increase *because of* U.S. illiquidity.
   - Use Brent oil-price volatility as an instrument.

3. Oil prices may be affected by OPEC decisions.
   - Scrape all OPEC press releases from website.
   - Construct an announcement control:

$$\text{OPEC control}_t = 1(\text{OPEC announcement}_t) \times \text{Brent vol}_t$$

**Include additional controls for possible factors affecting money markets:**

- Bill, note, and bond issuance, T-bill yield, TGA balances, income-tax pmts, FOMC dates, VIX, Brent returns, month-end and March 2020 dummies

## Oil risk→ reserve management→ demand for liquidity→ liquidity premium

**First stage**: Oil risk → reserve management *pressure*, proxied by $x_t$

$$x_t = \gamma_0 + \gamma_1 BrentOIV_t + \underbrace{\sum_{j=2}^{J} \beta_j z_{jt}}_{\text{2nd stage controls}} + \nu_t$$

**Second stage**: Reserve management pressure ($\hat{x}_t$) from macro shocks ($OIV_t$) alters demand for liquidity which drives a rotation from Treasuries $H_t$

$$H_t = \beta_0 + \beta_1 \hat{x}_t + \sum_{j=2}^{J} \beta_j z_{jt} + \epsilon_t$$

and increases liquidity premia, proxied by money market spreads, $S_t$

$$S_t = \beta_0 + \rho S_{t-1} + \beta_1 \hat{x}_t + \sum_{j=2}^{J} \beta_j z_{jt} + \epsilon_t$$

## We find evidence of strong effects of reserve management on U.S. liquidity

| | Spread Measure | | | |
|---|---|---|---|---|
| | (1) SOFR-IOER | (2) GCF-IOER | (3) GCF-TGCR | (4) GCF-EFFR |
| *IR factor* | 2.85* | 2.41** | 0.72 | 2.08** |
| | (1.46) | (0.95) | (0.45) | (0.84) |
| IV F-stat | 197.0 | 367.1 | 173.1 | 364.5 |
| Observations | 1339 | 2439 | 1338 | 2439 |
| $R^2$ | 0.45 | 0.56 | 0.58 | 0.34 |

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

- Increase in all money market spreads, largely from inter-dealer secured rates over unsecured rates.
- Increase of this size falls in the top 75% of daily, unconditional spread changes.
- *Consistent* with dealers taking on more Treasuries funded in the repo market, affecting liquidity.
  - **Inspect this mechanism in more detail.**

# Independent evidence is consistent with model's economic logic

1.) ↑ interest-rate differential factor ⇒ Treasury sales by countries in sample

| | Tot | LT | ST |
|---|---|---|---|
| *IR factor* | -1.99*** | -1.64*** | -0.41 |
| | (0.74) | (0.55) | (0.46) |
| IV F-stat | 368 | 368 | 368 |
| Observations | 92 | 92 | 92 |
| $R^2$ | 0.64 | 0.71 | 0.21 |

2.) ↑ interest-rate differential factor ⇒ Higher precautionary CB balances $\Longrightarrow$ ↓ reserves

| | Foreign repo | Foreign repo | Swap lines | Swap lines |
|---|---|---|---|---|
| *IR factor* | 1.50*** | 1.17** | 2.05*** | 0.16 |
| | (0.57) | (0.57) | (0.60) | (0.13) |
| March 2020 | | 31.52*** | | 169.22*** |
| | | (6.74) | | (22.77) |
| IV F-stat | 368 | 368 | 368 | 368 |
| Observations | 521 | 521 | 521 | 521 |
| $R^2$ | 0.99 | 0.99 | 0.97 | 0.99 |

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

## Robustness: U.S. demand shocks affect OVX and MM spreads

Orthogonalize U.S. demand with respect to OVX:

1. Flag dates on which there are US demand shocks: $\mathbb{1}[\Delta P_t^{oil} \times r_t^{s\&p} > 0]$
2. Construct OVX that advances only when the sign restriction is satisfied:

$$OVX_\tau^{U.S.} = \sum_{t=1}^{\tau} \Delta OVX_\tau \times \mathbb{1}[\Delta P_\tau^{oil} \times r_\tau^{s\&p} > 0]$$

3. Orthogonalize OVX to $\text{OVX}_\tau^{U.S.}$

$$OVX_\tau^{\perp US} = OVX_t - \beta OVX_\tau^{U.S.}$$

## Robustness: U.S. demand shocks affect OVX and MM spreads

Orthogonalize U.S. demand with respect to OVX:

1. Flag dates on which there are US demand shocks: $\mathbb{1}[\Delta P_t^{oil} \times r_t^{s\&p} > 0]$
2. Construct OVX that advances only when the sign restriction is satisfied:

$$OVX_\tau^{U.S.} = \sum_{t=1}^{\tau} \Delta OVX_\tau \times \mathbb{1}[\Delta P_\tau^{oil} \times r_\tau^{s\&p} > 0]$$

3. Orthogonalize OVX to $\text{OVX}_\tau^{U.S.}$

$$OVX_\tau^{\perp US} = OVX_t - \beta OVX_\tau^{U.S.}$$

| | **Spread Measure** | | | |
|---|---|---|---|---|
| | (1) SOFR-IOER | (2) GCF-IOER | (3) GCF-TGCR | (4) GCF-EFFR |
| *IR factor* | $6.54^{**}$ | $3.72^{**}$ | 1.72 | $3.58^{***}$ |
| | (2.95) | (1.51) | (1.14) | (1.38) |
| IV F-stat | 42.3 | 122.7 | 27.8 | 122.6 |
| Observations | 1344 | 2444 | 1343 | 2444 |
| $R^2$ | 0.29 | 0.53 | 0.56 | 0.30 |

Standard errors in parentheses

$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

## Robustness using $OVX_{\tau}^{\perp U.S.}$

1.) ↑ interest-rate differential factor ⇒ Treasury sales by countries in sample

| | Tot | LT | ST |
|---|---|---|---|
| *IR factor* | -1.83** | -1.41** | -0.49 |
| | (0.79) | (0.62) | (0.45) |
| IV F-stat | 127 | 127 | 127 |
| Observations | 92 | 92 | 92 |
| $R^2$ | 0.63 | 0.69 | 0.21 |

2.) ↑ interest-rate differential factor ⇒ Higher Treasury exposures, ↓ reserves

| | Foreign repo | Foreign repo | Swap lines | Swap lines |
|---|---|---|---|---|
| *IR factor* | 1.12** | 0.77* | 1.26* | -0.23 |
| | (0.44) | (0.44) | (0.66) | (0.24) |
| March 2020 | | 32.80*** | | 170.48*** |
| | | (6.82) | | (22.71) |
| IV F-stat | 127 | 127 | 127 | 127 |
| Observations | 525 | 525 | 525 | 525 |
| $R^2$ | 0.99 | 0.99 | 0.97 | 0.99 |

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

# Conclusion

*Foreign reserve management decisions can cause pressure on U.S. liquidity conditions.*

- Effects are sizable relative to money-market spreads.
- Consistent with Treasury sales by foreign official investors demanding liquidity needed by U.S. intermediaries.
- Imply meeting foreign liquidity demand is important for ensuring adequate availability of domestic liquidity.