Global Portfolio Investments and FX Derivatives

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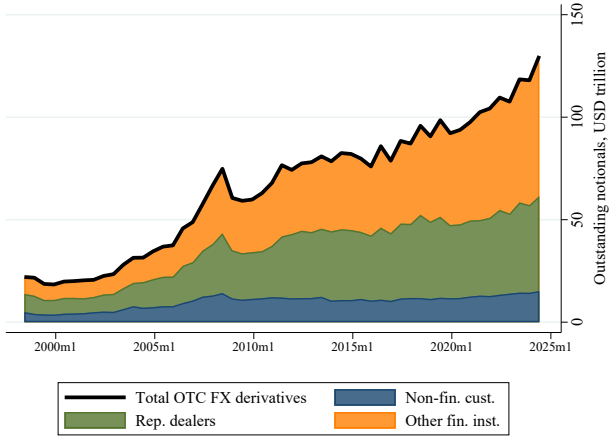
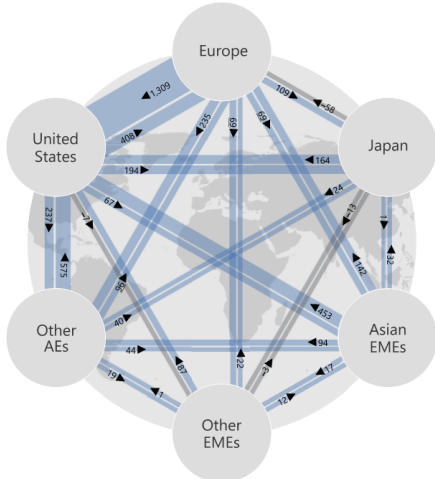
Outstanding FX derivatives have grown tremendously since 2009



Source: BIS OTC semi-annual derivatives statistics

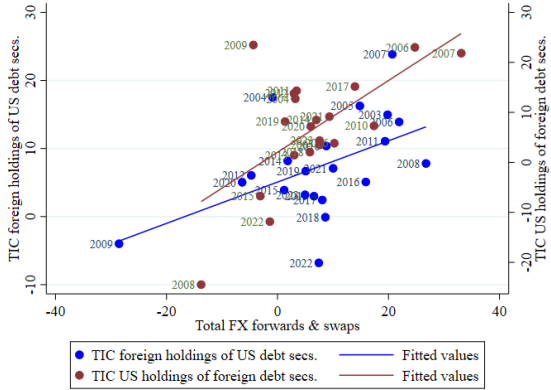
- FX swaps as largest instrument & central role of the US dollar (on one side of 90% of transactions)
- NBFIs (pension funds, insurers and hedge funds) as key driver of this growth

Global cross-border bond holdings



Notes: BIS Annual Economic Report (2025), Ch. 2; based on IMF CPIS data. Changes in outstanding stocks 2015-2023, in USD bn.

FXD activity tends to increase with cross-border bond investments



Focus here on cross-border debt securities positions (higher prevalence of hedging):

- Foreign holdings of US assets (blue)
- US holdings of foreign assets (red)

What we do...

- Draw on **BIS semi-annual OTC derivatives statistics** for FX swaps and forwards
- Link FX derivative activity with cross-border bond investments
- Devise a simple **portfolio choice model** (building on Du & Huber (2024)) to guide **empirical evaluation of hedging activity drivers**
  - focus on relative yield curve dynamics, hedging costs, and risk appetite

Key take-aways:

$\Rightarrow$ Symbiotic relation between FX derivatives activity & cross-border bond positions
$\Rightarrow$ FX derivatives fluctuations as **barometer** of global financial conditions

Related literature (selective)

- **FX hedging and bond investments**
  - Investors hedge currency risk in cross-border investments and especially so for bonds (McGuire et al., 2021; Du and Huber, 2024; Ahmed et al., 2023; Sialm and Zhu, 2024)
  - NBFIs typically rely on short-term contracts to manage FX risk in long-term bonds (Hacioğlu-Hoke et al., 2024; Kubitza et al., 2025)
- **Global financial cycle**
  - US monetary policy and financial markets drive global capital flows and asset prices (Rey, 2013; Miranda-Agrippino and Rey, 2020)
- **FX derivatives markets**
  - CIP deviations and their impact on exchange rates (Du et al., 2018b,a; Du and Schreger, 2022; Bacchetta et al., 2024; Bräuer and Hau, 2022)
  - Liquidity and other market characteristics influence FX derivatives trading (Kloks et al., 2023; Huang et al., 2025)

A simple theoretical framework

- Two-period **bond portfolio choice problem** for foreign investors into US bonds and a mirror problem for US investors
- We build on Du and Huber (2024), with extension that
  - allows each investor access to **both** foreign and domestic **bonds**
  - considers hedging on cross-border investments **into and out of** the US
  - assumes **full FX hedging** of all cross-border bond investments

- Allows to derive **key drivers of FX hedging volumes**: notably relative yield curve slopes, hedging costs, risk aversion and exchange rate

Model - The **foreign** investor (I)

Foreign investor allocates a portfolio of size $A_{i=I,t}$ between a risk-free and two risky assets:

1. the **domestic risk-free rate** rf_t^I
2. a **domestic long-term bond** with local currency return $r_{t+1}^I = rf_t^I + T_{t+1}^I$
3. an **FX-hedged USD long-term bond** with dollar return $r_{t+1}^\$ = rf_t^\$ + T_{t+1}^\$$

$T_t^{\$/I}$ - (realized) risk premium compensation for taking on duration risk

Both bond returns feature the same volatility, $\sigma^2_{T^\$}$

Model - The **foreign** investor (II)

Excess return on hedged USD long-term bond from the foreign investor's perspective:

$$\begin{aligned} rx^{\$,H}_{t+1} &\approx r^{\$}_{t+1} + (f^{l}_{t} - s^{l}_{t}) - rf^{l}_{t} \\ &= T^{\$}_{t+1} + rf^{\$}_{t} + (f^{l}_{t} - s^{l}_{t}) - rf^{l}_{t} \\ &= T^{\$}_{t+1} + x^{l}_{t}, \end{aligned}$$

- Investor **fully hedges** exchange rate risk using an FX swap: $f^{l}_{t} - s^{l}_{t}$
  spot (forward) rate s_t (f_t) - defined as units of the foreign currency per 1 USD

- $x^{l}_{t} = f^{l}_{t} - s^{l}_{t} - (rf^{l}_{t} - rf^{\$}_{t})$ (cross-currency basis): commonly negative as it is more expensive to hedge USD than FC risk

Model - The **foreign** investor (III)

Maximization problem of the foreign investor:

$$\max_{w^{\$}, w^{l}} \mathbb{E}[rx^{p}_{t+1}] - \frac{\gamma_t}{2} \mathbb{V}\mathrm{ar}[rx^{p}_{t+1}]$$

$\Rightarrow$ Investor chooses portfolio weights $w^{\$}$ (w^{l}) in US (local) long-term bonds, leaving $1 - w^{\$} - w^{l}$ in the local risk-free asset

Portfolio excess return in local currency is given by

$$rx^{p}_{t+1} = w^{\$} \underbrace{(T^{\$}_{t+1} + x^{l}_{t})}_{rx^{\$,H}_{t+1}} + w^{l} \underbrace{T^{l}_{t+1}}_{rx^{l}_{t+1}}$$

The **foreign** investor: optimal portfolio weights and hedging demand

- The optimal portfolio weight for the US portion of the portfolio

$$w^{\$}_{i=I} = \frac{\sigma^2_{T^I}\left(\overline{T^{\$}_{t+1}} + x^I_t\right) - \sigma_{T^{\$},T^I}\,\overline{T^I_{t+1}}}{\gamma_t(\sigma^2_{T^{\$}}\sigma^2_{T^I} - (\sigma_{T^{\$},T^I})^2)},$$

$\overline{T^{\$/I}_{t+1}}$ denotes expectation (as of time t) of the bond's excess return one period ahead

- The **implied dollar volume of FX hedging** is

$$\frac{A_{i=I,t}}{S^I_t} \times w^{\$}_{i=I} = \frac{A_{i=I,t}}{S^I_t} \times \frac{\sigma^2_{T^I}\left(\overline{T^{\$}_{t+1}} + x^I_t\right) - \sigma_{T^{\$},T^I}\,\overline{T^I_{t+1}}}{\gamma_t(\sigma^2_{T^{\$}}\sigma^2_{T^I} - (\sigma_{T^{\$},T^I})^2)}$$

Mirror problem for US investor and total FX hedging demand

Proceed analogously for the **US investor** to derive weight on foreign assets

$$w^{I}_{i=US} = \frac{\sigma^2_{T^\$} \, (\overline{T^{I}_{t+1}} - x^{I}_{t}) - \sigma_{T^\$, T^I} \, \overline{T^{\$}_{t+1}}}{\gamma_t (\sigma^2_{T^\$} \sigma^2_{T^I} - (\sigma_{T^\$, T^I})^2)}$$

Differences:

- US investor benefits from a negative cross-currency basis
- No rescaling to hedging volume to express in dollars

US investor and total hedging demand

Summary: variables that affect FX hedging demand

Variable	Foreign	US	Data
US slope $\overline{T^{\$}_{t+1}}$	$\uparrow$	$\downarrow$	$\uparrow$
Foreign slope $\overline{T^{I}_{t+1}}$	$\downarrow$	$\uparrow$	$\downarrow$
CCB x^{I}_{t}	$\uparrow$	$\downarrow$	$\downarrow$
Risk aversion γ_t	$\downarrow$	$\downarrow$	$\downarrow$
Spot FX S^{I}_{t}	$\downarrow$	0	$\downarrow$
US wealth $A_{i=US,t}$	0	$\uparrow$	N/A
Foreign wealth $A_{i=I,t}$	$\uparrow$	0	N/A

Data

- Amounts outstanding of outright forwards & FX swaps (from BIS OTCD statistics)
- 5 major currencies: EUR, JPY, GBP, CAD, CHF (mostly vis-à-vis USD)

- Combine with data on:
  - Domestic & foreign yield curves (3-month, 10-year)
  - 3-month CIP deviations
    (majority of FX derivative contracts have short maturity & hedges are rolled over
    $\rightarrow$ similar but weaker results using longer 2-year contract)

  - Proxies of global risk aversion: US financial conditions index & its underlying factors: equity, bond, FX markets' implied vols (VIX, MOVE, JPMFXVOL)

Empirical specification

Run panel regressions of the form:

$$\Delta_{t,t-6} \ln(\mathit{FXswaps}_{l,t}) = \alpha_l + \beta_1 \, \Delta_{t,t-6} \mathit{Slope}_{\$,t}^{10y-3m} + \beta_2 \, \Delta_{t,t-6} \mathit{Slope}_{l,t}^{10y-3m} + \beta_3 \, \Delta_{t,t-6} \mathit{CIPdev}_{l/\$,t} + \beta_4 \, \Delta_{t,t-6} \mathit{Risk}_t + \beta_5 \, \Delta_{t,t-6} \ln(S_{l,t}) + \zeta_{l,t},$$

where $\Delta_{t,t-6}$ denotes the six-monthly difference in the respective variable

$l \in \{\mathit{CAD}, \mathit{CHF}, \mathit{EUR}, \mathit{GBP}, \mathit{JPY}\}$ refers to the currency

LHS corresponds to (change in) outstanding notionals of FX swaps and outright forwards taken up by **OFIs** in each currency outstanding at the end of month t

Baseline results

	(1)	(2)	(3)	(4)	(5)
Slope USD (10y-3m)	2.706**	2.702**	1.861	1.798	1.645
	(1.239)	(1.248)	(1.161)	(1.116)	(1.123)
Slope local (10y-3m)	-7.346***	-7.348***	-4.827***	-4.730***	-5.106***
	(1.656)	(1.661)	(1.582)	(1.521)	(1.524)
CIP dev. (3m)		0.062	-4.335**	-4.774**	
		(2.244)	(2.178)	(2.096)	
GS US FCI			-5.580***	-3.647***	-3.124***
			(0.845)	(0.914)	(0.892)
Spot ER (local per 1 USD)				-0.502***	-0.490***
				(0.108)	(0.109)
Currency FE	Yes	Yes	Yes	Yes	Yes
Obs	258	258	258	258	258
Adj. Rsq.	0.06	0.05	0.19	0.25	0.24

- Steepening of US yield curve: FXD activity ↑ (but not sign. in all specs)
- Flattening of foreign yield curve: ↑ FXD activity
- Tighter financial conditions: ↓ FXD activity

Results by currency / geography of investor

	(1) EUR	(2) JPY	(3) GBP	(4) CHF	(5) CAD
Slope USD (10y-3m)	4.511*	-0.174	1.047	2.894	-2.675
	(2.283)	(1.811)	(2.759)	(2.770)	(3.979)
Slope local (10y-3m)	-9.081***	-10.048*	-0.390	-6.163	-1.195
	(2.898)	(5.878)	(3.633)	(4.360)	(4.102)
CIP dev. (3m)	-1.839	-5.866	-5.137	-8.980**	0.418
	(4.705)	(4.057)	(5.436)	(4.239)	(5.688)
GS US FCI	-0.461	-3.924**	-6.794**	-3.651	0.728
	(1.942)	(1.636)	(2.548)	(2.360)	(2.136)
Spot ER (local per 1 USD)	-0.631**	-0.123	-0.412	-0.380	-1.631***
	(0.237)	(0.173)	(0.329)	(0.278)	(0.311)
Obs	50	52	52	52	52
Adj. Rsq.	0.29	0.15	0.30	0.15	0.48

- Prominent role of investors with euro and yen liabilities

Results by counterparty sector

	(1) All	(2) Other fin. inst.	(3) Rep. dealers	(4) Non-fin. customers
Slope USD (10y-3m)	0.258	1.798	-0.370	-1.748
	(0.975)	(1.116)	(1.308)	(1.256)
Slope local (10y-3m)	-2.800**	-4.730***	-2.298	0.080
	(1.329)	(1.521)	(1.783)	(1.712)
CIP dev. (3m)	-3.685**	-4.774**	-3.640	-1.776
	(1.832)	(2.096)	(2.457)	(2.360)
GS US FCI	-2.771***	-3.647***	-1.568	-2.893***
	(0.798)	(0.914)	(1.071)	(1.028)
Spot ER (local per 1 USD)	-0.509***	-0.502***	-0.636***	-0.290**
	(0.095)	(0.108)	(0.127)	(0.122)
Currency FE	Yes	Yes	Yes	Yes
Obs	258	258	258	258
Adj. Rsq.	0.25	0.25	0.15	0.08

- Financial institutions other than dealers (OFIs) stand out, with weaker relations for other counterparty sectors

Results by alternative risk proxies

	(1)	(2)	(3)	(4)	(5)
Slope USD (10y-3m)	1.798	1.994	2.000*	2.515**	2.038*
	(1.116)	(1.581)	(1.137)	(1.154)	(1.116)
Slope local (10y-3m)	-4.730***	-3.691**	-5.581***	-5.912***	-5.358***
	(1.521)	(1.744)	(1.528)	(1.526)	(1.503)
CIP dev. (3m)	-4.774**	-6.464***	-5.148**	-4.352*	-7.162***
	(2.096)	(2.356)	(2.326)	(2.305)	(2.365)
Spot ER (local per 1 USD)	-0.502***	-0.661***	-0.636***	-0.669***	-0.613***
	(0.108)	(0.113)	(0.102)	(0.100)	(0.099)
GS US FCI	-3.647***				
	(0.914)				
BIS US FCI (level)		**0.052**			
		(0.440)			
BIS US FCI (risk)		**-1.280*** **			
		(0.388)			
VIX			-0.225**		
			(0.096)		
MOVE				-4.947*	
				(2.921)	
JP Morgan FX vol.					-1.118***
					(0.300)
Currency FE	Yes	Yes	Yes	Yes	Yes
Obs	258	220	258	258	258
Adj. Rsq.	0.25	0.27	0.22	0.21	0.25

Chart

Monetary policy spillovers and IV estimation

- Use **high-frequency** monetary policy surprises and risk shifts as instruments for yield curve slopes, risk aversion and spot exchange rate More Details

	(1)	(2)	(3)	(4)
Slope USD (10y-3m)	1.798	7.317***	1.496*	7.786***
	(0.963)	(2.040)	(0.869)	(1.897)
Slope local (10y-3m)	-4.730**	-14.015**	-3.772**	-13.762***
	(1.537)	(5.535)	(1.570)	(4.835)
CIP dev. (3m)	-4.774*	-3.003	-6.291***	-3.938
	(1.976)	(2.221)	(1.469)	(2.771)
GS US FCI	-3.647**	-2.345**	-7.003***	-4.703***
	(1.035)	(1.138)	(1.502)	(1.724)
Spot ER (local per 1 USD)	-0.502*	-0.471***	-0.213	-0.159
	(0.185)	(0.172)	(0.251)	(0.457)
Obs	258	218	258	218
Adj. Rsq.	0.26	0.17	0.20	0.15
Curr FE	Yes	Yes	Yes	Yes
Endog.	OLS	Slopes (MP)	FCI & FX (shift)	All (MP+shift)
F (p-val): US slope		0.00		0.00
F (p-val): LC slope		0.32		0.06
F (p-val): US FCI			0.00	0.00
F (p-val): FX spot			0.00	0.00

Conclusion

- Outstanding volumes in FX derivatives proxy for **hedging activity** of AE investors in international bond markets
- **Symbiotic relation** between hedging through FX derivatives and bond portfolio flows
- Yield curve slopes, hedging costs and risk appetite as key drivers of hedging

- Implications:
  - FX swaps as conduit of how financial conditions and shocks transmit globally
  - Central bank policies (not just by Fed) have far-reaching global consequences
  - Maturity mismatches could amplify vulnerabilities during market stress

- FX derivatives volumes & associated hedging activity $\Rightarrow$ **barometer of risk-taking** & complementary indicator to track the global financial cycle

- Annex slides -

BIS FX swaps and forwards by OFIs & TIC holdings by asset class

	(1) Total LT securities	(2) LT debt	(3) Equity	(4) ST debt
Foreign into US	0.362***	0.442***	0.189*	-0.051
	(0.120)	(0.117)	(0.098)	(0.054)
US abroad	0.179*	0.171**	0.189**	0.094**
	(0.105)	(0.075)	(0.093)	(0.047)
Obs	125	125	125	210
Adj. Rsq.	0.15	0.14	0.12	-0.01

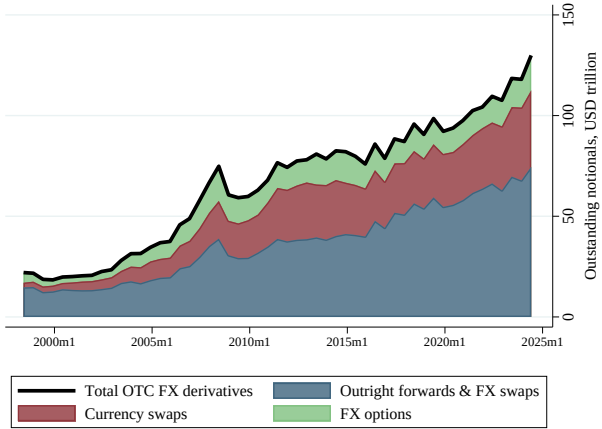
Back

Financial conditions & portfolio flows to the US

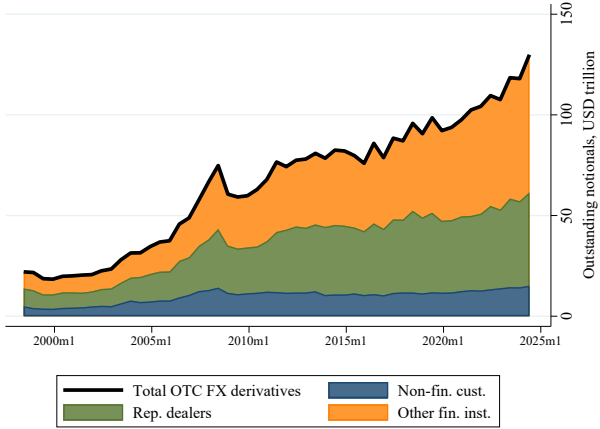
Stylized facts

- Rapid growth in FX derivatives since the 2008-09 financial crisis:
- Dominance of non-bank financial institutions (NBFIs):
  - Investment funds, pension funds, and insurance companies.
- USD's outsized role:
  - Appears in 90% of FX derivatives contracts.
- Maturity mismatch:
  - Short-term FX contracts hedge long-term bond investments.
  - Yield curve slopes are critical for hedging decisions.

Significant growth in FX derivatives markets post-GFC



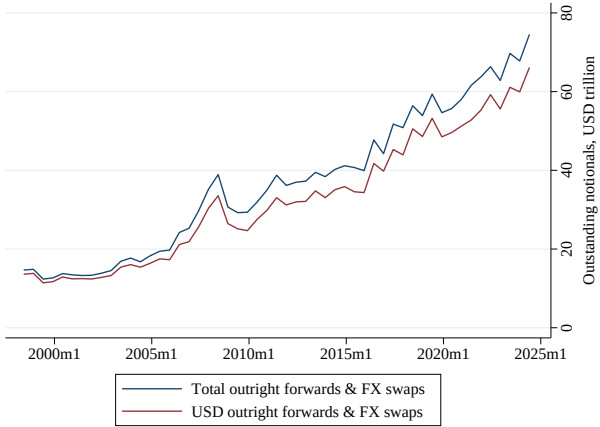
Dominance of non-dealer financial institutions



OFIs as key players behind hedging demand:

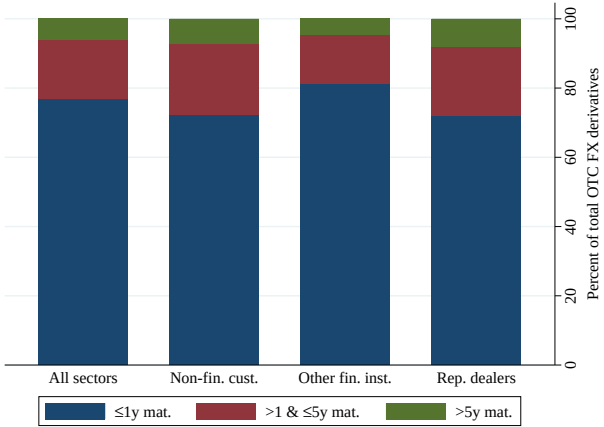
- Investment funds, pension funds, and insurance companies

USD's outsized role



- USD appears in 90% of FX derivatives contracts

Maturity mismatch of FX hedging



Total hedging demand

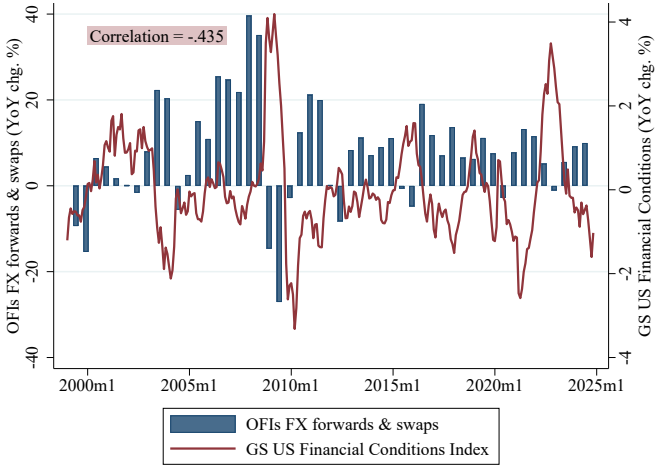
Total FX hedging demand can be obtained as a weighted sum of the FX-hedged cross-currency bond allocations of the foreign and the US investors:

$$\frac{A_{i=I,t}}{S_t^I} \times w_{i=I}^{\$} + A_{i=US,t} \times w_{i=US}^{I} =$$

$$= \frac{A_{i=I,t}}{S_t^I} \times \frac{\sigma_{T^I}^2 \, (\overline{T_{t+1}^{\$}} + x_t^I) - \sigma_{T^\$,T^I} \, \overline{T_{t+1}^I}}{\gamma_t(\sigma_{T^\$}^2 \sigma_{T^I}^2 - (\sigma_{T^\$,T^I})^2)} + A_{i=US,t} \, \frac{\sigma_{T^\$}^2 \, (\overline{T_{t+1}^I} - x_t^I) - \sigma_{T^\$,T^I} \, \overline{T_{t+1}^{\$}}}{\gamma_t(\sigma_{T^\$}^2 \sigma_{T^I}^2 - (\sigma_{T^\$,T^I})^2)}$$

Back

NBFI's FX derivatives volumes fluctuates with financial conditions



- NBFI's FX derivatives (FXD) activity strengthens when financial conditions loosen (here captured by GS FCI) Back

Details on instruments in 2SLS estimation

- Use two types of **high-frequency surprises** constructed in short-windows around monetary policy events:

  1. **Interest rate surprises** at 3-m and 10-yr maturities sourced from Jarociński (2024) for the US and Kearns et al. (2023) internationally
     - used to instrument changes in interest rate slopes

  2. **FOMC risk shifts** in the spirit of Kroencke et al. (2021); Bauer et al. (2023)
     $\rightarrow$ not spanned by interest rate changes, captures channel via investor risk-taking
     - used to instrument the risk aversion proxies and exchange rates

Back

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