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# Dollar trinity and the Global Financial Cycle

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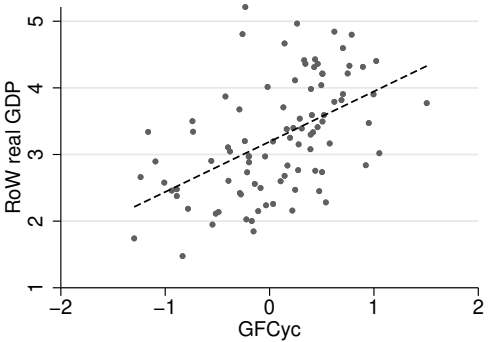
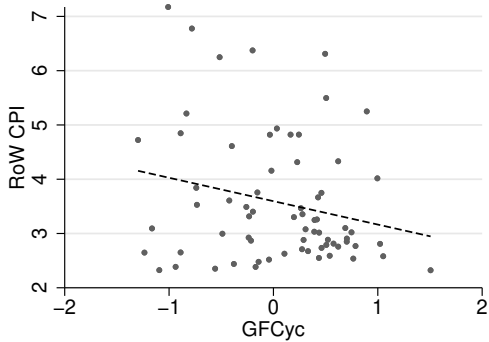
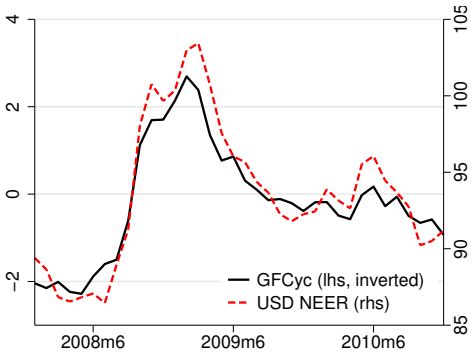
# Received wisdom: Powerful GFCyc, associated with policy trade-offs

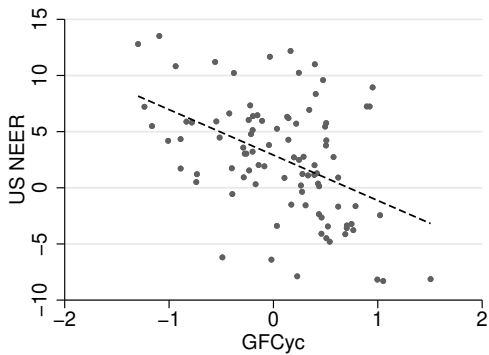



*Note: The figure shows scatter plots for year-on-year changes in the global factor in risky asset prices of Miranda-Agrippino & Rey (2020), rest-of-the-world real GDP and rest-of-the-world consumer price inflation from the Dallas Fed Global Economic Indicators (Martínez-García et al., 2015). The scatter plots are shown for the time period from 1990 to 2019, excluding the GFC and 9/11.*

# GFCyc also co-moves closely with US$ exchange rate




*Note: US nominal effective exchange rate (NEER) taken from J.P Morgan; increase represents appreciation. Right panel shows year-on-year changes for 1990m1 to 2019m12, excluding the Global Financial Crisis and 9/11.*

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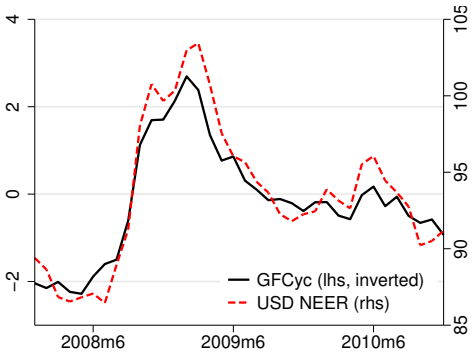


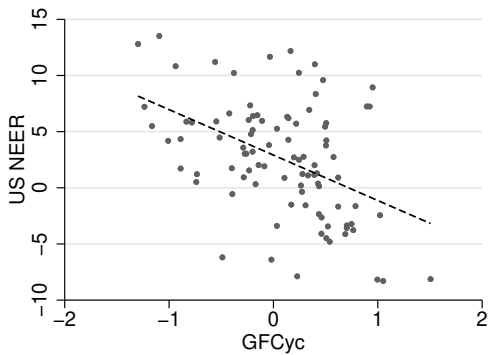


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# This paper

**In the data GFCyc correlated with**

- US$ exchange rate
- World business cycle and policy trade-offs

**US$ central in transmission of GFCyc to world economy or just a side-show?**

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**What we do**

- Pull together threads on US dominance in safe assets, cross-border credit, trade invoicing
- Explore how dimensions of 'US$ trinity' interact to shape transmission of GFCyc

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- Pull together threads on US dominance in safe assets, cross-border credit, trade invoicing
- Explore how dimensions of 'US$ trinity' interact to shape transmission of GFCyc

**Concretely**

- Estimate causal effect of the GFCyc on US & RoW in the data
- Structural two-country model with 'US$ trinity' that matches empirical evidence
- Simulate effects in counterfactual structural model without 'US$ trinity'

# Findings

**Causal effects of global risk aversion and US monetary policy in the data**

- Consistent with unconditional patterns
- US$ appreciates
- Global financing conditions tighten, business cycle slows down
- Policy trade-offs between stabilizing output vs. inflation (at least in EMEs)

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**Structural model: US$ dominance in**

- **Safe assets**: US$ appreciates when global investor risk aversion rises
- **Cross-border credit**: Global financing conditions tighten when US$ appreciates
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**US$ is 'linchpin' for transmission of GFCyc, GFCyc is in fact US$ cycle**

# Related work

**Global Financial Cycle**

- Miranda-Agrippino & Rey (2020, 2022)

**Empirical work on risk, US$ exchange rate, convenience yields, cross-border credit**

- Lustig et al. (2014), Verdelhan (2018), Lilley et al. (2022), Hassan et al. (forthcoming)
- Du et al. (2018), Krishnamurthy & Lustig (2019), Valchev (2020), Jiang et al. (2021b), Engel & Wu (forthcoming), Liao (2020), Caramichael et al. (2021)
- Avdjiev et al. (2019), Erik et al. (2020), Hofmann et al. (2020)

**Theoretical work on special role of US$ in international monetary system**

- Banerjee et al. (2016), Akinci & Queralto (2019), Aoki et al. (2018)
- Bruno & Shin (2015), Bianchi et al. (2021), Jiang et al. (2021a), Kekre & Lenel (2021), Akinci, Kalemli-Ozcan, & Queralto (2022), Akinci, Benigno, et al. (2022), Devereux et al. (2022), Hofmann et al. (2022)

# VAR model specification

**Specification**

- Gertler & Karadi (2015): US IP and CPI, 1-Y Treasury-bill rate, excess bond premium
- Add: US$ NEER, RoW IP, CPI, policy rates, US macroeconomic uncertainty

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**Identification**

- **US MP shock**: Intra-daily 'pure' interest rate changes around FOMC meetings
  Gertler & Karadi (2015); Jarociński & Karadi (2020); Miranda-Agrippino & Rey (2020); Miranda-Agrippino & Ricco (2021)
- **Global risk aversion shock**: Intra-daily gold price changes on narratively selected days
  Bloom (2009); Piffer & Podstawski (2018); Ludvigson et al. (2021)
- Tell apart global risk aversion and **global uncertainty shock** by FEVD restrictions
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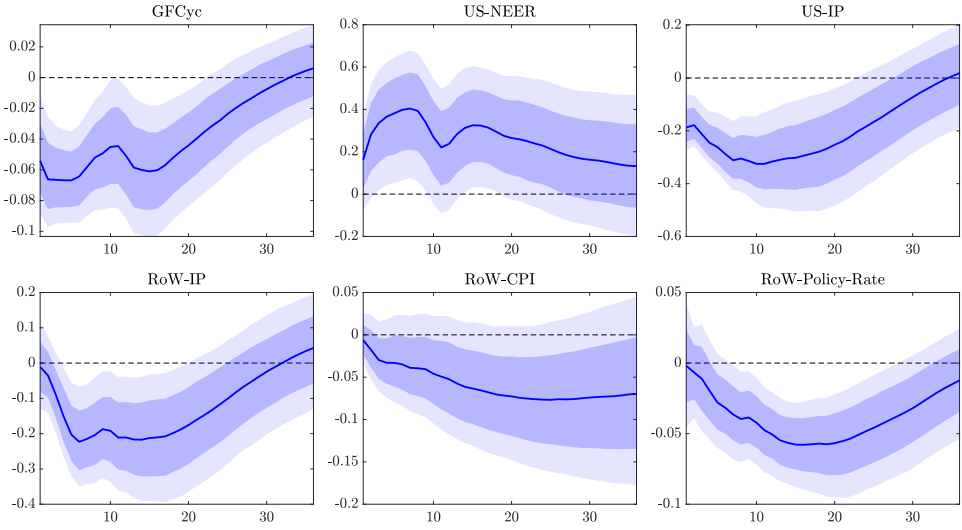
## Estimation

- Sample: 1990m2 to 2019m6
- Informative Minnesota-type priors, optimal hyperpriors/prior tightness

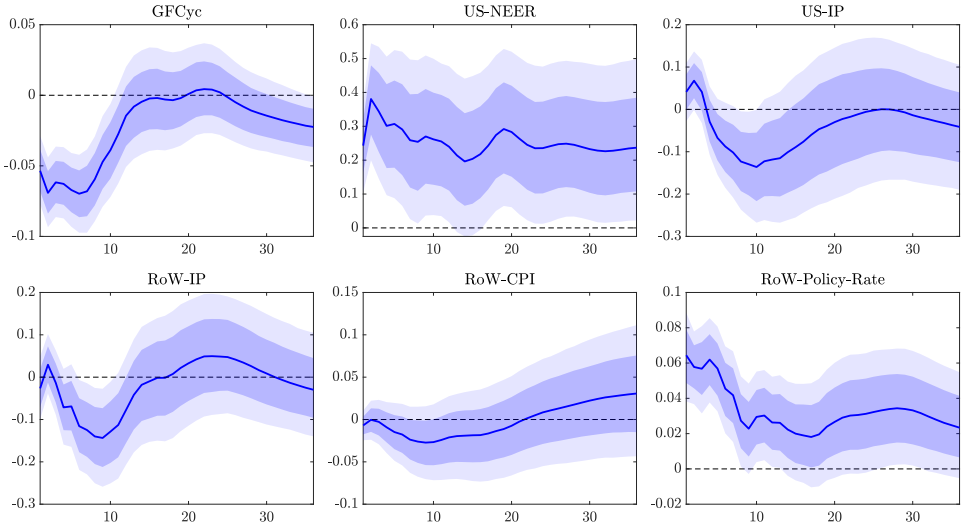
▸ Proxy time series

# Global risk aversion shock



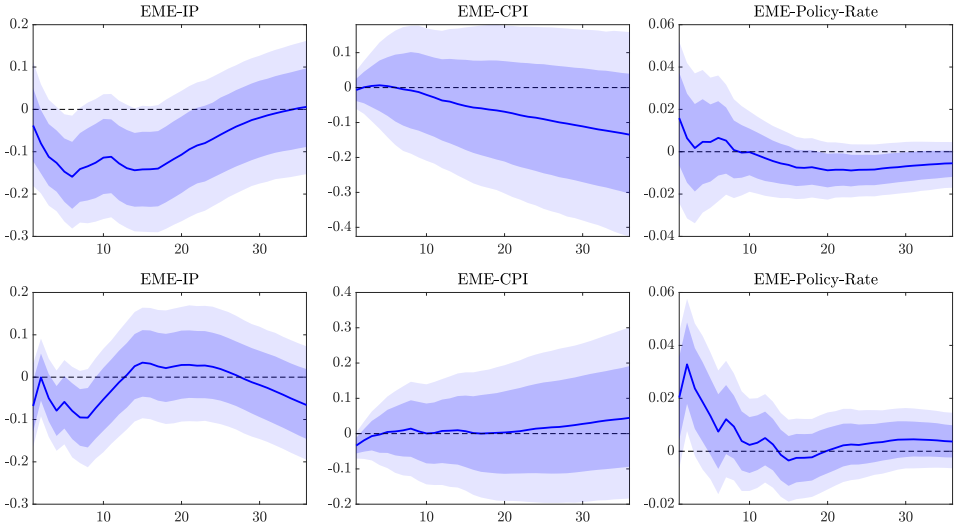

Remaining variables | Global uncertainty shock

# US monetary policy shock



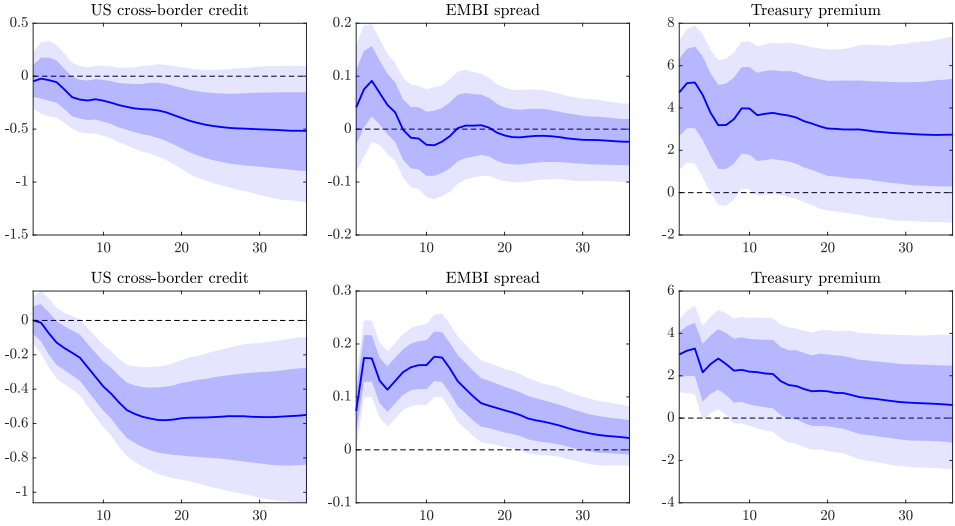

Return

# EMEs: Global risk aversion (top) and US monetary policy (bottom)




▸ Effects on AEs

# Financial variables and price of safety (risk top, US MP bottom)



# Sensitivity analysis and extensions

**Similar results for**

- ▶USD-EUR FX or Treasury yield surprises global risk shock proxy variable IRFs
- ▶Only global 'risk-off' events (i.e. with positive gold price surprises) IRFs
- ▶Alternative US MP shock proxy variables to account for forward guidance and LSAPs IRFs
- ▶Alternative cleaninsg from CBI effects IRFs

# US$ dominance in global trade, finance and safe assets

**Rich two-country New Keynesian model for US and RoW**

- Standard sticky prices and wages, habit formation, investment adjustment costs, variable capacity utilization ▸ Schematic overview

**US$ trinity**

- US$ pricing in ▸ Multi-layered production structure
  - US-RoW trade
    Gopinath et al. (2020); Boz et al. (2022)
  - intra-RoW trade
    Georgiadis & Schumann (2021); Boz et al. (2022)
- Cross-border US$ credit from US to RoW banks
  Bruno & Shin (2015); Akinci & Queralto (2019)
- Demand for US Treasuries by RoW banks
  Devereux et al. (2022)

**Focus on US$ dominance in cross-border credit and safe assets: US and RoW banks**

# Bank balance sheets

**US banks provide cross-border US$ loans to RoW**

$$Q_{US,t}K_{US,t} + CBDL_t \quad = \quad D_{US,t} + N_{US,t}$$

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**RoW banks funded by cross-border US$ loans, hold US Treasuries**

$$Q_{RoW,t}K_{RoW,t} + RER_t\,TREAS_t \quad = \quad D_{RoW,t} + RER_t\,CBDL_t + N_{RoW,t}$$

# Bank balance-sheet constraints

**Generally**

$$V_t \geq \underbrace{\delta_t}_{\substack{\textbf{balance-sheet-specific} \text{ risk weight} \\ \text{on overall portfolio structure}}} \times \underbrace{\left(\sum \Gamma_t^j A_{j,t}\right)}_{\substack{\textbf{asset-specific} \text{ risk-weighted assets}}}$$

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**Specifically**

$$\begin{aligned} V_{RoW,t} &\geq \delta_{RoW,t} \times \left(Q_{RoW,t} K_{RoW,t} + \Gamma_{RoW,t}^{TREAS} RER_t \, TREAS_t\right) \\ V_{US,t} &\geq \delta_{US,t} \times \left(Q_{US,t} K_{US,t} + \Gamma_{US,t}^{CBDL} CBDL_t\right) \end{aligned}$$

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**Maximum leverage ratios**

- Pinned down by portfolio's riskiness ($-$) and FX/risk-weight-adjusted profitability ($+$)

# RoW bank

**Balance sheet and constraint**

$$Q_{RoW,t} K_{RoW,t} + RER_t \, TREAS_t = D_{RoW,t} + RER_t \, CBDL_t + N_{RoW,t}$$

$$V_{RoW,t} \geq \delta_{RoW,t} \times (Q_{RoW,t} K_{RoW,t} + \Gamma^{TREAS}_{RoW,t} RER_t \, TREAS_t)$$

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**Asset-specific risk weight on US Treasuries**

$$\Gamma^{TREAS}_{RoW,t} = 0$$

- US Treasuries perceived riskless by banks' creditors as an asset in general

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**Balance-sheet-specific risk weight**

$$\delta_{RoW,t} = \overline{\delta}_{RoW} + \delta_{RoW}\left[\underset{-}{\alpha^{TREAS}_t}, (\ell^{CBDL}_t - \underset{+}{\alpha^{TREAS}_t})^2\right] + \epsilon_{RoW,t}$$

- US Treasuries 'safe', well-understood & provide liquidity buffer $\longrightarrow$ RoW bank riskiness $\downarrow$
- US Treasuries hedge especially against US$ funding shortages $\longrightarrow$ RoW bank riskiness $\downarrow$

# RoW bank problem: Implications

**Endogenous UIP deviation due to US Treasury convenience yield**

- Treasuries loosen balance-sheet constraints, allow greater leverage, hence additional profits
- Interpret this additional indirect pecuniary return as convenience yield
- UIP condition:

  (direct) FX-adjusted Treasury return + convenience yield = Cost of domestic deposits

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**US$ appreciates when convenience yield ↑**

- When overall Treasury return ↑ equilibrium requires US$ depreciates in expectation
- Convenience yield ↑ when leverage becomes more profitable, i.e. when domestic credit spreads ↑

▸ Details

# US bank

**Balance sheet and constraint**

$$Q_{US,t}K_{US,t} + CBDL_t = D_{US,t} + N_{US,t}$$
$$V_{US,t} \geq \delta_{US,t} \times \left(Q_{US,t}K_{US,t} + \Gamma^{CBDL}_{US,t} CBDL_t\right)$$

**Asset-specific risk weight on cross-border US$ loans**

$$\Gamma^{CBDL}_{US,t} = \Gamma^{CBDL}_{US}\left[\underset{+}{lev_{RoW}}\left(RER_t \underset{+}{CBDL_t}\right)\right]$$

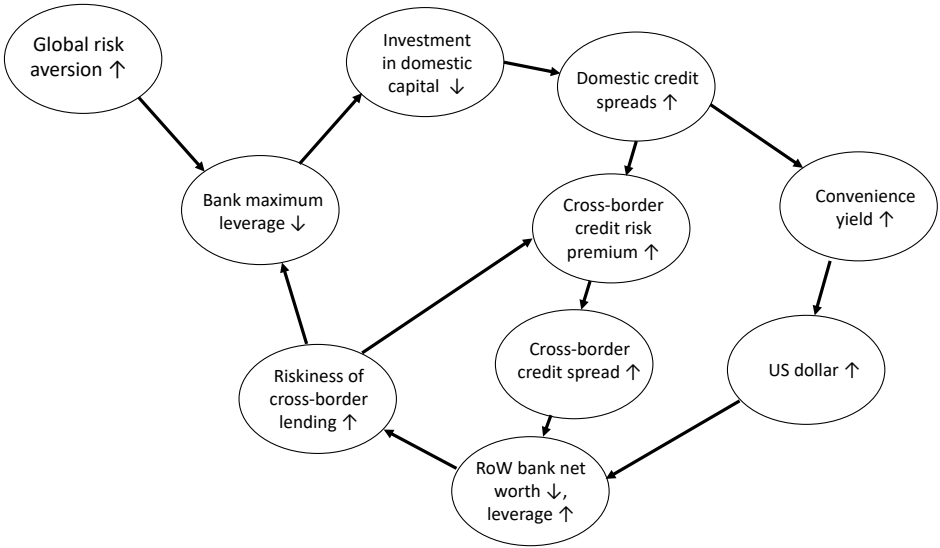
- Riskiness of cross-border US$ loans varies with RoW bank's leverage
- US$ appreciation triggers global financial accelerator on cross-border credit

**Balance-sheet-specific risk weight**

$$\delta_{US,t} = \overline{\delta}_{US} + \epsilon_{US,t}$$

▸ Details US bank problem implications

# Global financial accelerator on cross-border US$ lending



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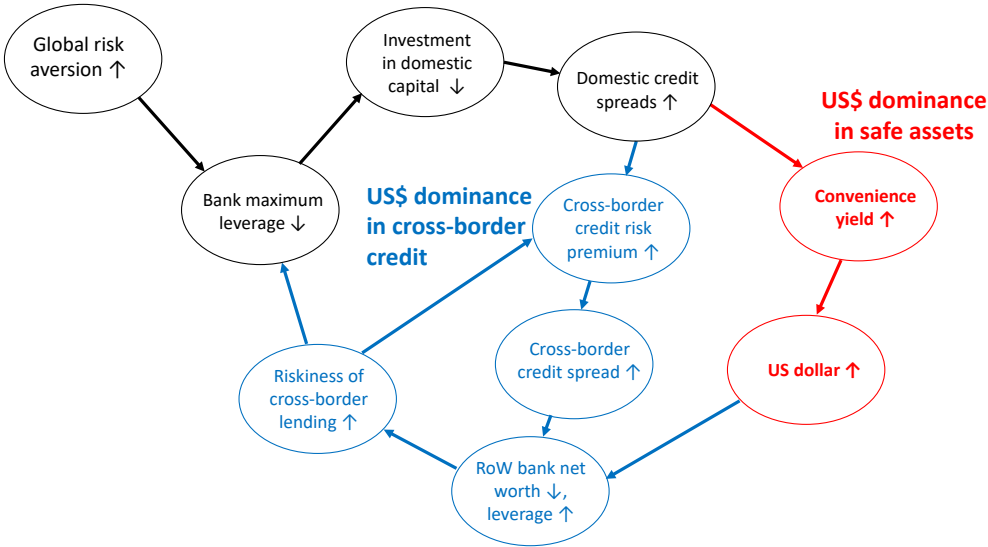

# Global risk aversion shock

**Bank balance sheets**

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**Constraints**

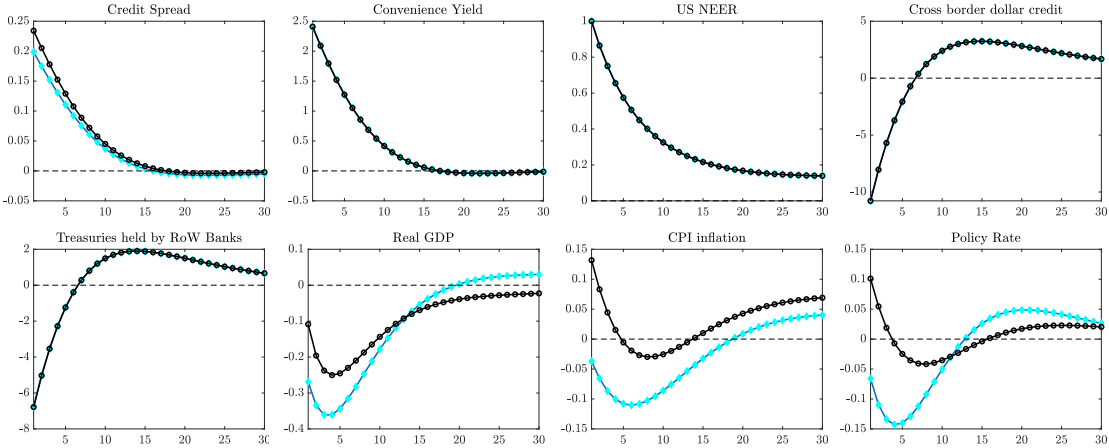
$$\begin{aligned} V_{US,t} &\geq \delta_{US,t} \times \left[Q_{US,t}K_{US,t} + \Gamma_{US}^{CBDL} CBDL_t\right] \\ &\quad \delta_{US,t} = \overline{\delta}_{US} + \epsilon_{US,t} \\ V_{RoW,t} &\geq \delta_{RoW,t}(Q_{RoW,t}K_{RoW,t} + \Gamma_{RoW}^{TREAS} RER_t\,TREAS_t) \\ &\quad \delta_{RoW,t} = \overline{\delta}_{RoW} + \delta_{RoW}\left[\alpha_t^{TREAS}, (\ell_t^{CBDL} - \alpha_t^{TREAS})^2\right] + \epsilon_{RoW,t} \end{aligned}$$

**Global risk aversion shock: creditor willingness to provide funding for given net worth ↓**

$$\begin{aligned} \epsilon_{US,t} &= \eta_{US,t} + \eta_{G,t} \\ \epsilon_{RoW,t} &= \eta_{RoW,t} + \eta_{G,t} \end{aligned}$$

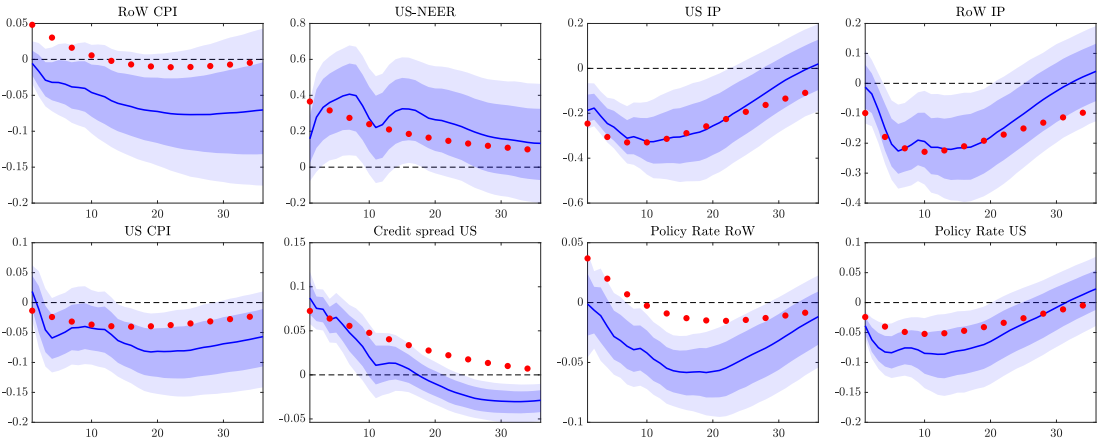
▸ Calibration ▸ Comparison to Devereux et al. (2022)

# Effects of global risk shock in US (cyan diamond) and RoW (black circled)




▸ US monetary policy shock

# Structural model IRFs match BPSVAR IRFs well




▸ Fit for US monetary policy shock

# How does GFCyc transmit without US$ trinity?

**Baseline model with US$ trinity**

**Counterfactual model without US$ trinity**

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- No cross-border lending, households trade US bonds and UIP holds

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# How does GFCyc transmit without US$ trinity?

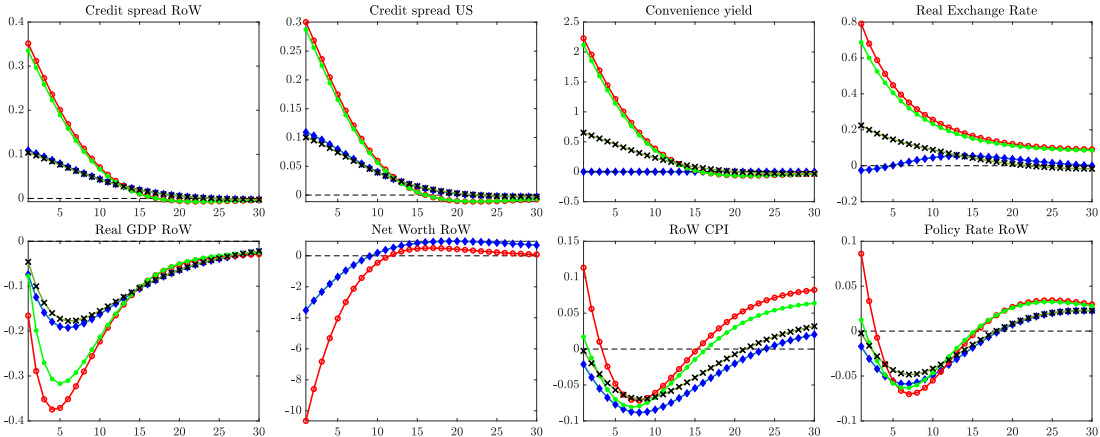
**Baseline model with US$ trinity**

- Cross-border US$ lending by US banks to RoW banks
- RoW banks hold US Treasuries as safe/liquid asset
- US$ pricing of US-RoW trade and intra-RoW trade

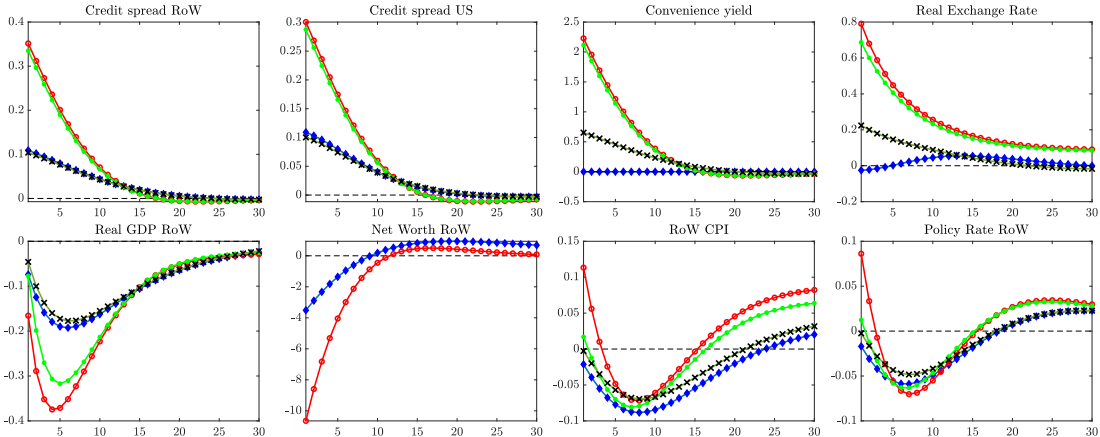
**Counterfactual model without US$ trinity**

- No cross-border lending, households trade US bonds and UIP holds
- No demand for US Treasuries as safe/liquid asset by banks
- Producer-currency pricing

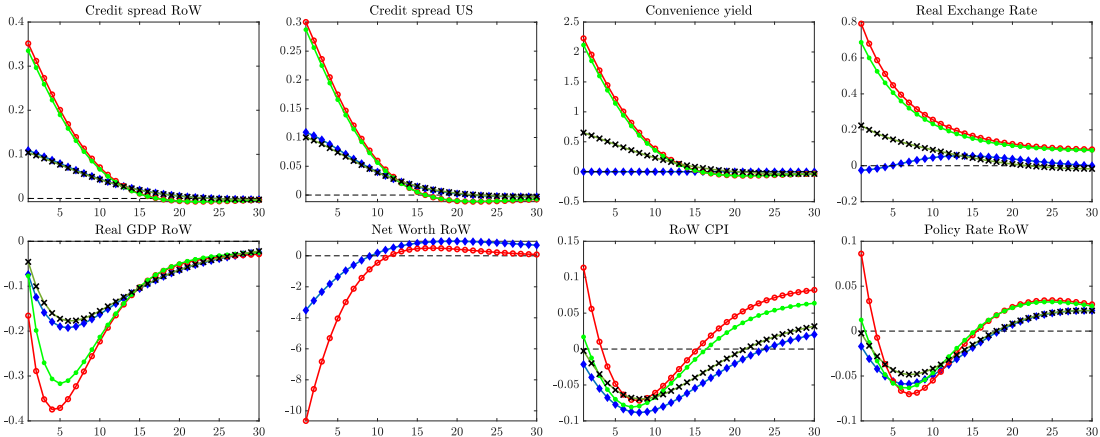
# US$ trinity removing cumulatively dominance in trade, credit, safe assets



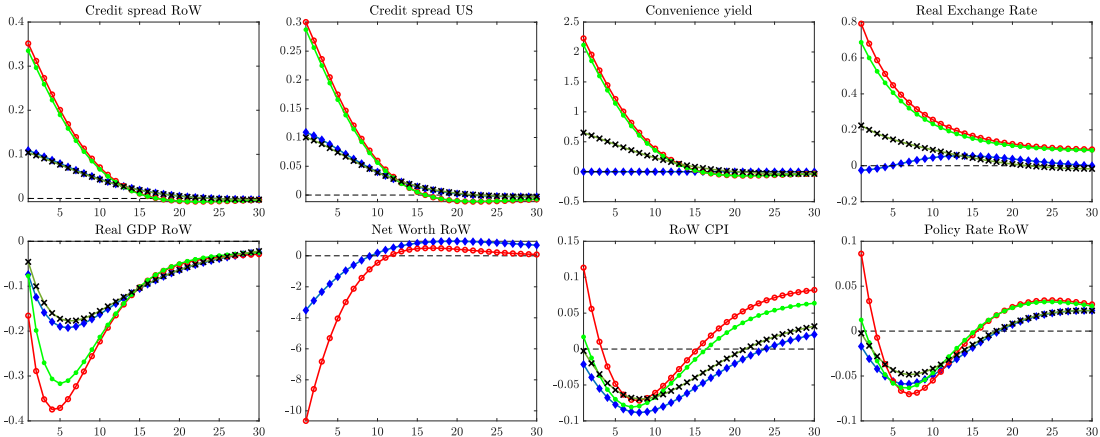
# W/o trade DCP: No price pressures due to US$ appreciation, no trade-off



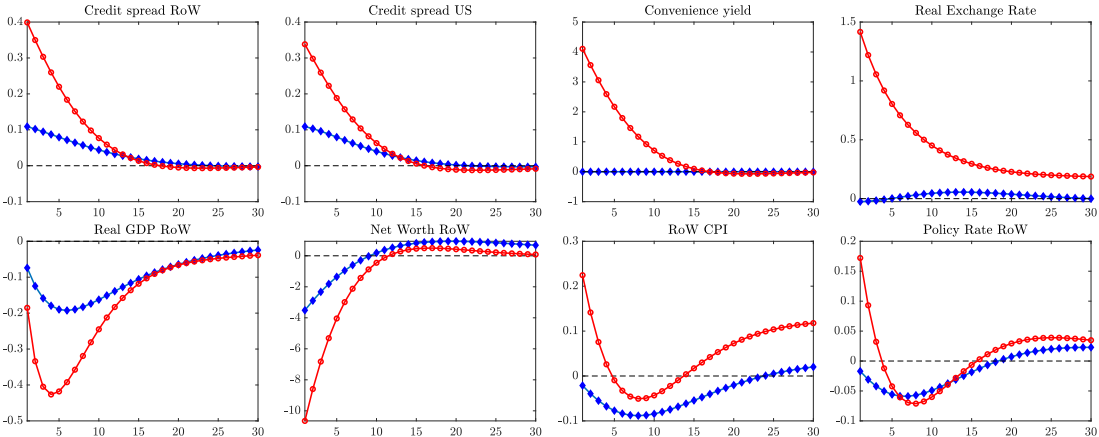
# W/o credit DCP: No global financial accelerator



# W/o safe asset DCP: No US$ appreciation



# With (red circled) and without (blue diamond) US$ trinity



# Extensions

**'Original sin redux'** Details IRFs

- Data: EMEs reduced FX exposures, trinity model: RoW net short in US$
- Assume cross-border credit denominated in US$ instead RoW currency
- Now US instead of RoW banks exposed to currency mismatches
- Global financial accelerator dampened, especially for RoW

**US 'exorbitant duty' & RoW pension funds** IRFs

- Data: US NFA$<0$, trinity model: US NFA$>0$
- But in data NFA$<0$ largely due to unconstrained RoW entities
- Introduce unconstrained RoW entity (aka pension funds, SWFs, FX reserves)
- Results unchanged

# Conclusion

**In the data a subsiding tide of the GFCyc induces**

- US$ appreciation
- Synchronized global recession
- Monetary policy trade-offs, at least in EMEs

**How does US$ trinity shape transmission of the GFCyc?**

- US$ trinity dimensions interact so that variation in risk aversion gives rise to US$ appreciation, RoW financial tightening, recession & monetary policy trade-offs
- W/o US$ trinity, no US$ appreciation, recessionary effect reduced, no monetary policy trade-offs
- US$ exchange rate the 'linchpin' in transmission of GFCyc to world economy
- GFCyc is in fact a US$ cycle

Akinci, O., Benigno, G., Pelin, S., & Turek, J. (2022). The Dollar's Imperial Circle. *Federal Reserve Bank of New York Staff Report*, *1045*.

Akinci, O., Kalemli-Ozcan, S., & Queralto, A. (2022). Uncertainty Shocks, Capital Flows, and International Risk Spillovers. *Federal Reserve Bank of New York Staff Report*, *1016*.

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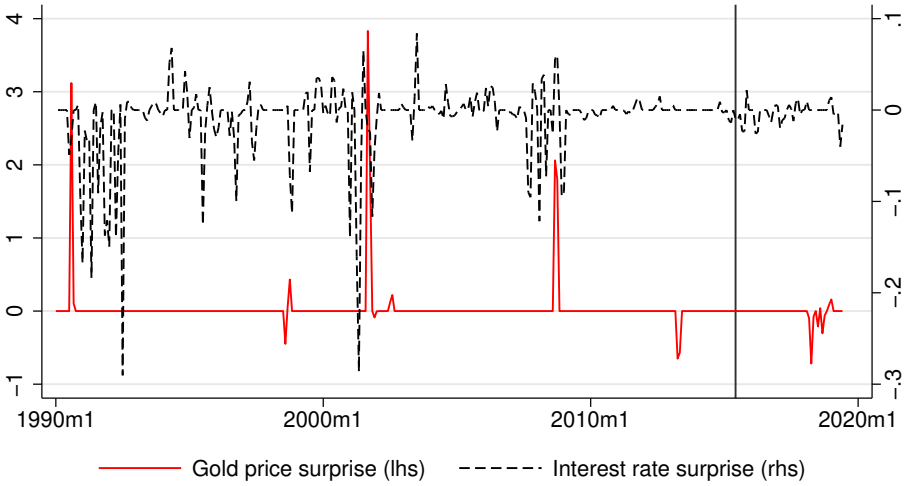
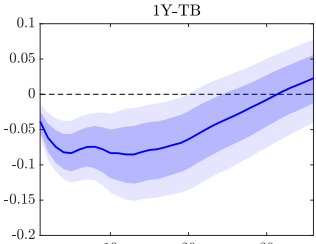
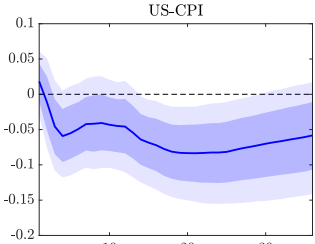
# Monthly time series of gold price and interest rate surprises

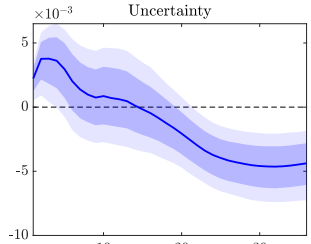


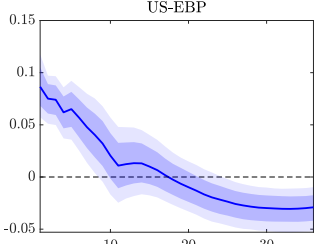

Return

# Global risk aversion shock: Remaining baseline BPSVAR variables

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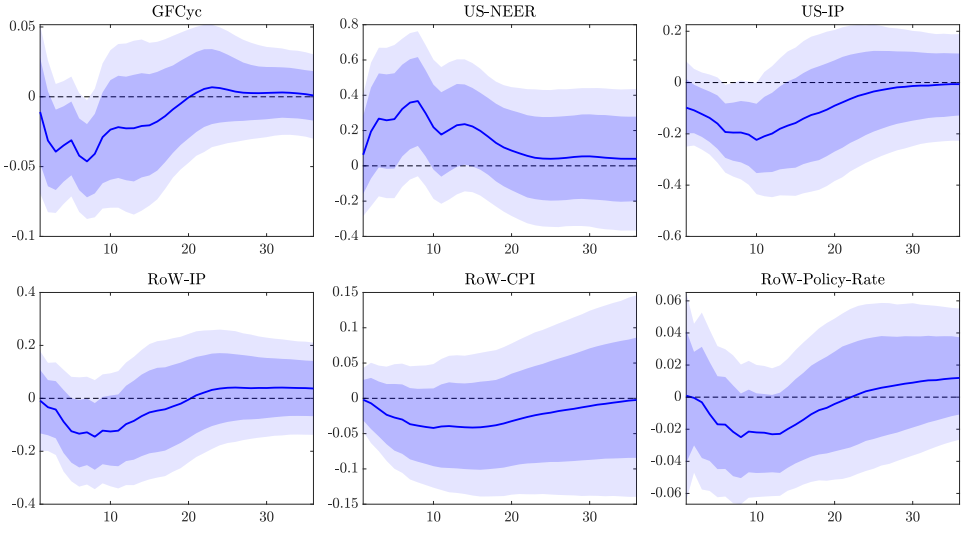
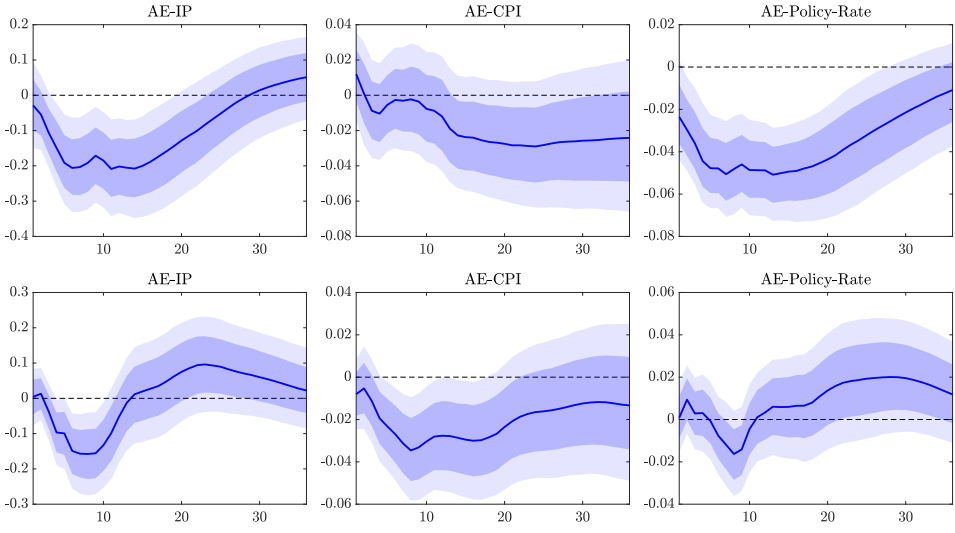
# Global uncertainty shock




▸ Return

# Effects on AEs (risk top, US MP bottom)

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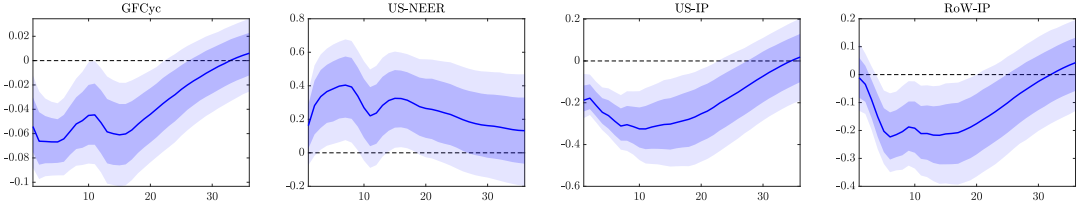
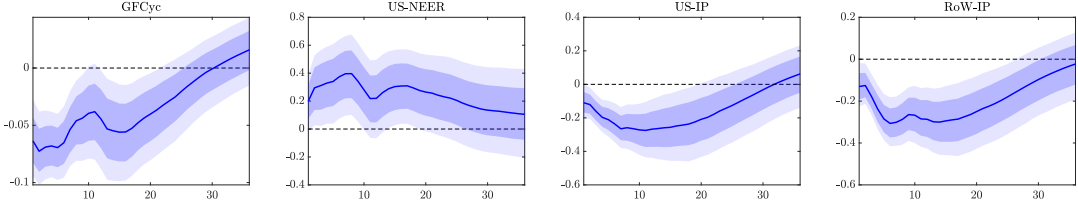
# Global risk aversion shock: Use intra-daily US$-EUR changes

**Baseline with gold price changes as instrument**

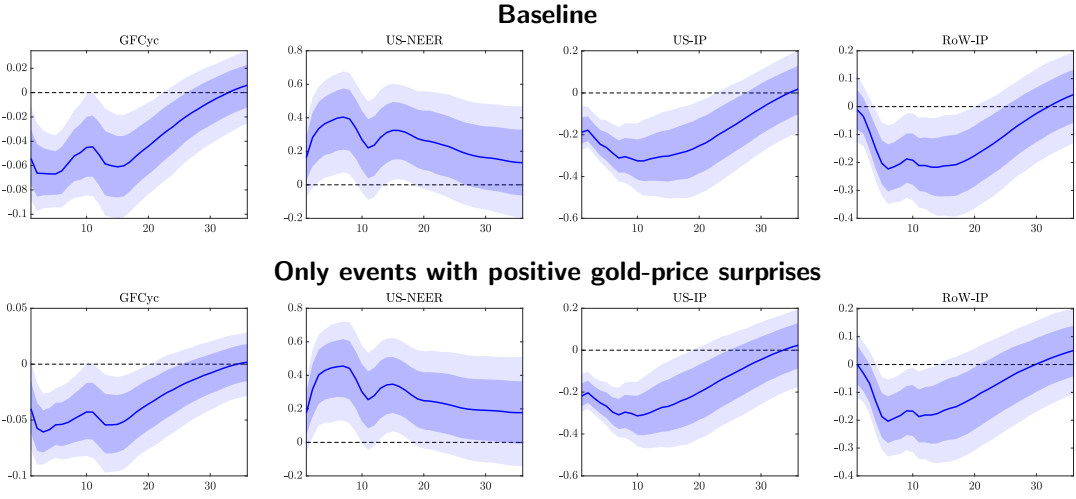



**With US$-EUR changes as instrument**




Return

# Global risk aversion shock: Only positive gold price surprises

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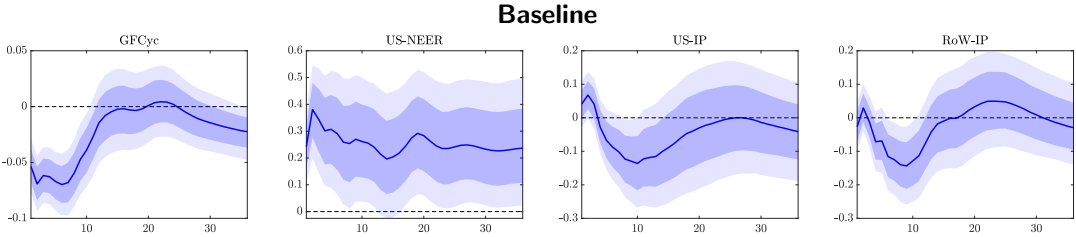
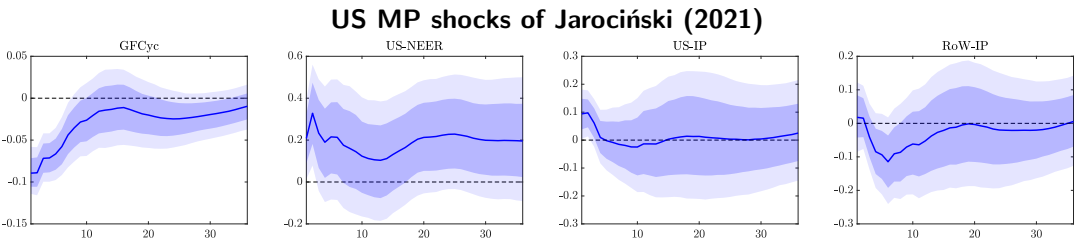
# US MP shocks of Jarociński (2021)

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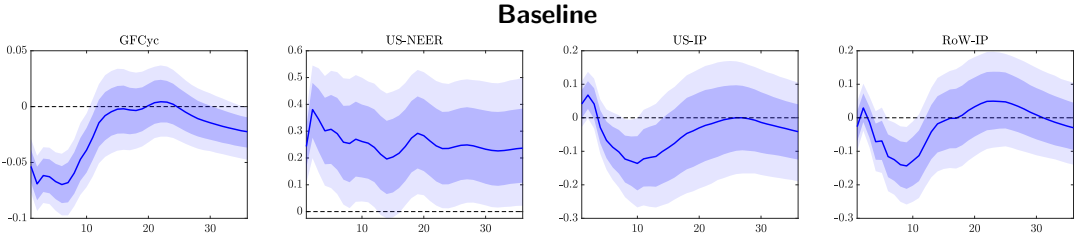
# US MP shocks of Miranda-Agrippino & Ricco (2021)




Return

# What about 'flight-to-safety'?

**Widespread view**

- 'Flight-to-safety' = The world flocks into Treasuries
  *"purchases of Treasuries on average tend to follow a widening of the Treasury basis, as Treasuries become more expensive relative to foreign bonds. Foreign investors buy Treasuries when they are expensive."* (Krishnamurthy & Lustig, 2019, pp. 458)

**But not obvious in theory**

- Many structural models do not predict 'flight-to-safety' *in terms of purchases*
  Jiang et al. (2021a); Kekre & Lenel (2021); Devereux et al. (2022)

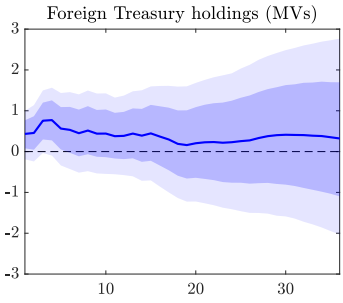
**Also contested by recent evidence in Tabova & Warnock (2021)**

- Confidential security-level surveys on *universe* of foreign and US investor US Treasury portfolios
- Point out previous analyses predicated on inadequate data, and instead
  *"foreigners do not buy Treasuries when they are expensive. (...) Foreigners purchase Treasuries after the Treasury premium is low or falling."*
- Recommend to use data of Bertaut & Tryon (2007) and Bertaut & Judson (2014, 2022)

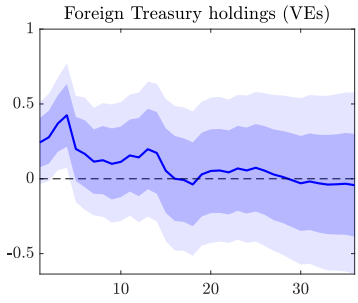
▸ Time series plot

# What about 'flight-to-safety'?

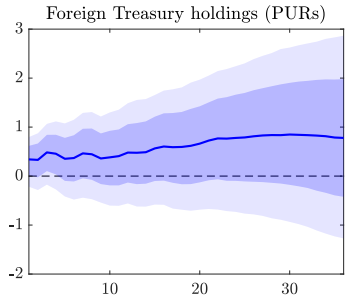
**At market values**




**Valuation effect**

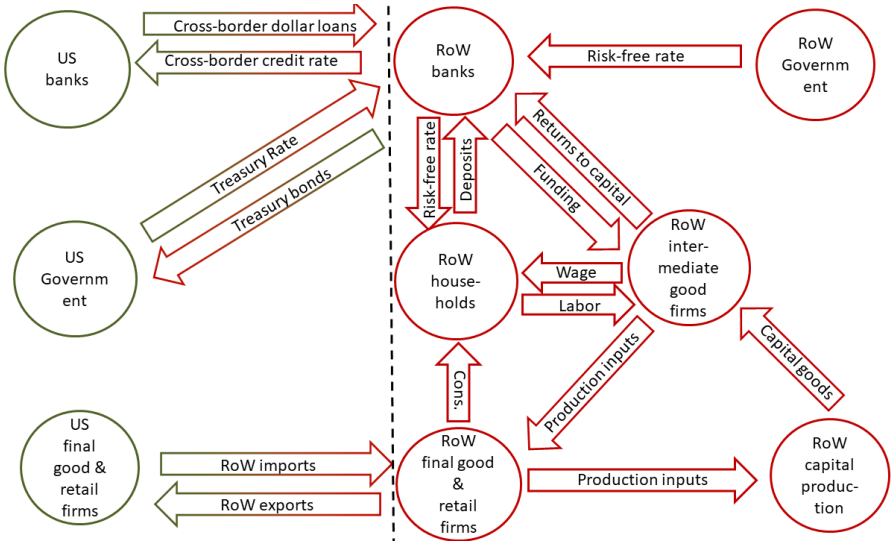



**Actual purchases**



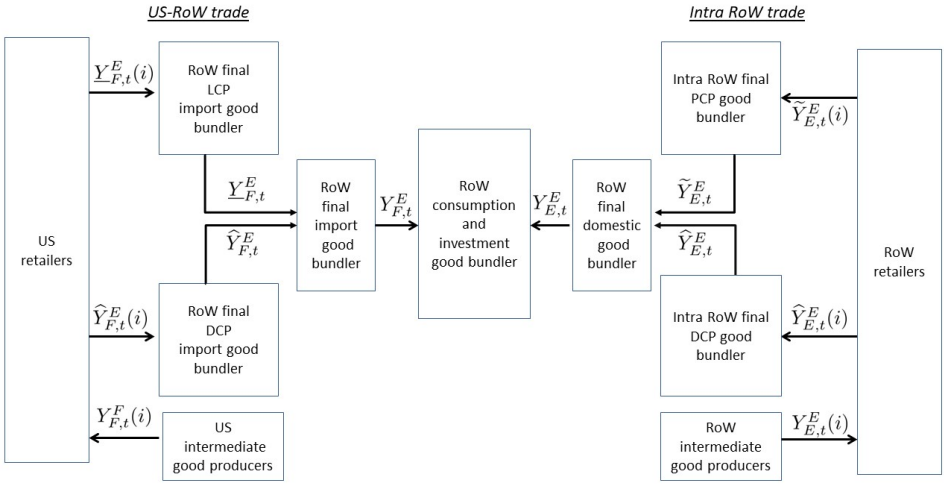

▸ Valuation effects and exorbitant duty ▸ Return

# Schematic overview




Return

# Multi-layered production structure




Return

# RoW bank problem: Implications

**Optimal asset/liability choice equalizes returns and funding costs**

$$\underbrace{\mathbb{E}_t\left[\Omega_{RoW,t,t+1}\left(\Delta\mathcal{E}_{t+1}R_t^{TREAS}\right)\right] + CY_{RoW,t}}_{\text{FX-adjusted } \textit{overall} \text{ return of US Treasuries}} = \underbrace{\mathbb{E}_t\left[\Omega_{RoW,t,t+1}R^D_{RoW,t}\right]}_{\text{Cost of funding through domestic deposits}}$$

**Endogenous Treasury convenience yield as UIP deviation**

- Additional, indirect return from investment in US Treasuries

$$CY_{RoW,t} = \underbrace{-\frac{\partial\delta_{RoW,t}/\partial\alpha^{TREAS}_{RoW,t}}{\delta_{RoW,t}}}_{\text{Additional leverage freed by Treasury investment}} \underbrace{(1-\alpha^{TREAS}_{RoW,t})\mathbb{E}_t\left[\Omega_{RoW,t,t+1}\left(R^K_{RoW,t+1} - R^D_{RoW,t}\right)\right]}_{\text{Portfolio-weight-adjusted excess return from additional investment in domestic capital}}$$

- Convenience yield high when credit spreads high, US$ appreciates when convenience yield ↑

Return

# US bank problem: Implications

**Optimal asset choice equalizes excess returns**

$$\underbrace{\mathbb{E}_t\left[\Omega_{US,t,t+1}\left(R_t^{CBDL} - R_{US,t}^{D}\right)\right] - RP_{US,t}^{CBDL}}_{\textit{Overall}\text{ excess return on cross-border US\$ loans}} = \underbrace{\Gamma_{US,t}^{CBDL}\mathbb{E}_t\left[\Omega_{US,t,t+1}\left(R_{US,t+1}^{K} - R_{US,t}^{D}\right)\right]}_{\text{Risk-weight-adjusted excess return on investment in domestic capital}}$$

**Endogenous risk premium on cross-border US$ lending**

- Additional, negative indirect return from cross-border lending

$$RP_{US,t}^{CBDL} = \frac{\partial \Gamma_{US,t}^{CBDL}}{\partial \alpha_{US,t}^{CBDL}} \alpha_{US,t}^{CBDL} \mathbb{E}_t\left[\Omega_{US,t,t+1}\left[\left(1-\alpha_{US,t}^{CBDL}\right)\left(R_{t+1}^{K} - R_{US,t}^{D}\right) + \alpha_{US,t}^{CBDL}\left(R_t^{CBDL} - R_{US,t}^{D}\right)\right]\right]$$

- Cross-border spread ↑ when (i) domestic spread ↑ and (ii) cross-border lending riskiness $\Gamma_{US,t}^{CBDL}$ ↑

Return

# Calibration

- US and RoW generally calibrated asymmetrically, relative country size 1:3
- Use standard calibrations for conventional model elements
- 37.5% of intra-RoW exports priced in US$
- US households more patient: $R^D_{RoW} = 3.5\%$, $R^D_{US} = 2\%$
- Calibration of banks' risk weights targeting
  - US enjoys exorbitant privilege: $R^{CBDL} - R^{TREAS} = R^{CBDL} - R^D_{US} = 1\%$
    $\longrightarrow$ Cross-border US$ credit is cheap funding for RoW banks $R^{CBDL} = 3\% < R^D_{RoW} = 3.5\%$
  - $CV = 1.65\%$
  - $\alpha^{TREAS}_{RoW} = 15\%$ and $\ell^{CBDL}_{RoW} = 25\% \longrightarrow$ RoW banks have net US$ exposure
- $TB_{US}/Y_{US} = -1.8\%$, financed by positive $NFI_{US}/Y_{US}$

Return

# Comparison to Devereux et al. (2022)

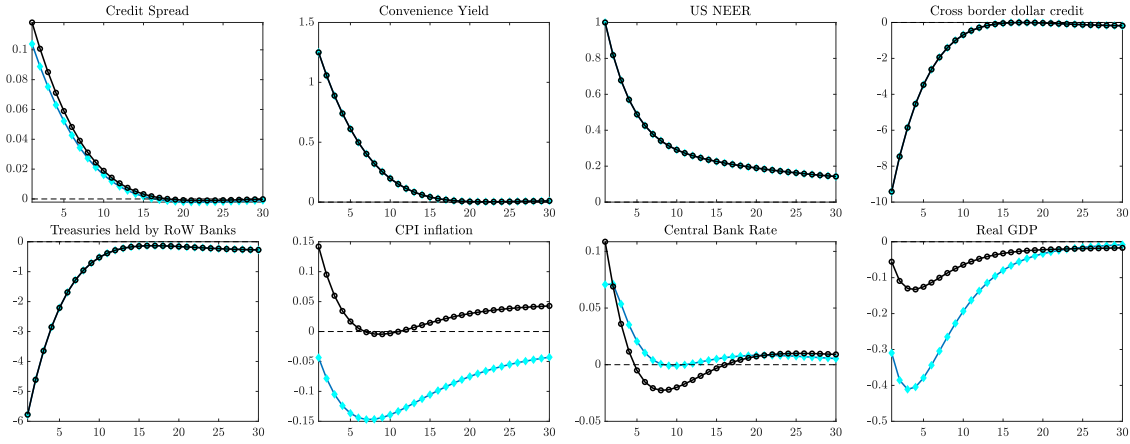
**Two-country NK model for US and RoW with cross-border financial intermediation**

- Banks
  - Face common, exogenous bank-specific risk weights that limit their leverage
  - Invest in domestic and foreign capital and GBs, no liability portfolio choice
  - US and RoW GBs have lower exogenous asset-specific risk-weight for RoW and US banks
  - US GBs more 'pledgable as collateral', even more so for US banks
  - Fixed supply of GBs (allowing $R^{GB} \neq R^{D}$)
  - No negative foreign-currency exposures, hence no financial channel of exchange rate
- Local currency pricing (LCP), calibration asymmetric only in bond constraint parameters

**Predictions**

- US enjoys exorbitant privilege in normal times, exorbitant duty in times of stress
- Convenience yield $CV \equiv r^{rf} - r^{GB} < 0$ (= negative of Lagrange multiplier $\times$ risk weight)
- Global shock to bank-specific risk weight
  - Domestic convenience yields $CV_j \downarrow$
  - Nonetheless Treasury premium ($\equiv CV_{US} - CV_{RoW}$, 'liquidiy yield') $\uparrow$, US\$ $\uparrow$, output $\downarrow$
- Because US GBs especially 'pledgable' for US banks
  - US recession greater, given greater re-balancing from capital to GBs in US
  - Retrenchment in US and RoW (given fixed supply of bonds and US\$ appreciation)

# Effects of US monetary policy shock in US (cyan diamond) and RoW (black circled)

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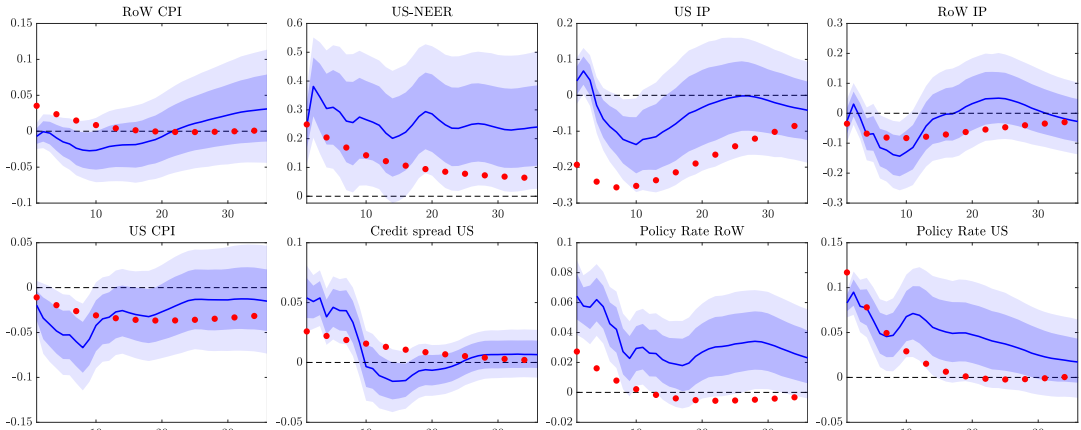
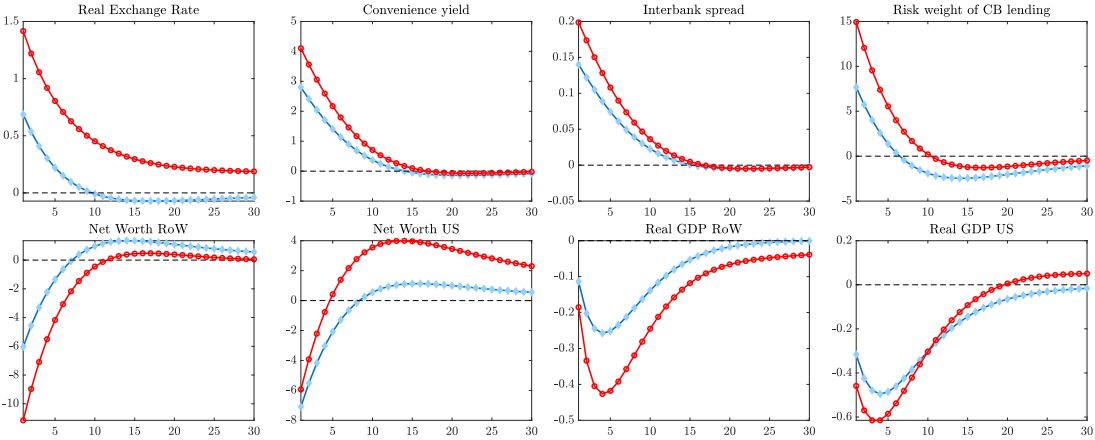
# Empirical fit for US monetary policy shock




▸ Return

# US$ trinity (red circled) and 'original sin redux' (light blue diamond)




Return

# Carstens & Shin (2019): 'Original sin redux'

**Bertaut et al. (2021)**

- Comprehensive data on US investor flows into EME government bonds
- US$ appreciation amplifies sell-off in EME local currency but not US$-denominated bonds
- Local-currency borrowing does not insulate EMEs from fluctuations in global financial conditions

**Hofmann et al. (2022)**

- Structural two-country model with AE and EME banks
- Local-currency borrowing shifts currency mismatches from EM borrowers to AE lenders
- AE monetary tightening spills over to EMEs by tightening AE lenders' financial constraints
- Local-currency borrowing does not eliminate EME vulnerability to foreign financial shocks

# 'Original sin redux'

**Domestic financial accelerators in US and RoW STILL THERE**

- Perceived riskiness of US and RoW banks increases
- Credit supply ↓, investment ↓, price of capital and credit spreads ↓, net worth ↓, output ↓

**Global financial accelerator KEY US$ MISMATCH MIGRATES FROM ROW TO US**

- Convenience yield ↑ as indirect Treasury return ↑ when credit spreads ↑
- US$ ↑ to equalize (overall) returns on US Treasuries and RoW capital
- US$ appreciation means US bank net worth ↓, cross-border US$ credit spreads ↑ and supply ↓
- RoW bank trades off liquidity vs safety benefit of US Treasuries

**Trade STILL THERE**

- US$ appreciation triggers expenditure switching, favouring RoW at expense of US
- Intra-RoW import prices rise and RoW monetary policy tightens

# Comparison to Hofmann et al. (2022)

- In common: Local currency borrowing (LCB) mitigates impact of global risk shocks on RoW
- But in DCP$^3$ UIP does not hold
  - LCB $\rightarrow$ looser RoW financial conditions
  - looser RoW financiing conditions $\rightarrow$ lower convenience yield
  - lower convenience yield $\rightarrow$ smaller US$ appreciation
- DCP$^3$ has endogenous portfolio choice & endogenous risk weights
  - LCB $\rightarrow$ larger fall in US net worth (-)
  - LCB $\rightarrow$ smaller increase cross-border dollar lending risk (+)
- LCB $\rightarrow$ Smaller US$ appreciation & less CB lending risk $\rightarrow$ impact on US also mitigated

Return

# US$ trinity (red circled) and ‘original sin redux’ (light blue diamond)

Return