Capital Flows and Exchange Rates

A Quantitative Assessment of the Dilemma Hypothesis*

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15th Workshop on Exchange Rates

Banka Slovenije, 3 December 2025

***The views expressed in this paper do not necessarily represent those of the Bank of England or any of its Committees.**

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  - Does a flexible exchange rate regime provide enough insulation?
  - Are additional instruments necessary for domestic monetary policy independence?

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- Global Financial Cycle (Rey, 2013) $\rightarrow$ From Trilemma to Dilemma?
  - Does a flexible exchange rate regime provide enough insulation?
  - Are additional instruments necessary for domestic monetary policy independence?
- **Our contribution** $\rightarrow$ Revisit these questions in an estimated open economy DSGE model
  - Consistent with Global Financial Cycle evidence
  - Dominant currency paradigm in finance and trade

What We Do and What We Find

1. Panel VAR $\rightarrow$ Response of financial and macro variables to US monetary policy shock
   - Typical (small) open economy with flexible exchange rates
   - **Demand/financial channel dominates over expenditure-switching effect**

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   - Frictions in international financial intermediation and pricing
   - **Necessary to replicate empirical evidence**

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3. Policy analysis $\rightarrow$ Counterfactuals
   - **Exchange rate targeting increases domestic macroeconomic volatility**
   - Additional instruments (tax on capital flow / domestic credit) mitigate consequences of GFC
   - Same instruments can limit volatility of output under peg but not disinflationary pressures

1. Panel VAR

Data

- Panel of macro-financial variables for **15 countries with flexible exchange rate**
  - Australia, Canada, Chile, EMU (Germany), Japan, Korea, Mexico, New Zealand, Norway, Singapore, South Africa, Sweden, Switzerland, Thailand, United Kingdom
  - Robustness with a larger set of countries (24)

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  - **Shock:** US monetary policy surprise
  - **US:** Corporate spreads, real GDP, nominal interest rate
  - **Domestic:** Real GDP, CPI, exports, nominal interest rate, nominal FX, corporate spreads

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- Monthly frequency $\rightarrow$ 1997:M1–2019:M12 (subject to availability)
  - Corporate spreads constrain earlier starting date (robustness from 1985 without spreads)
  - Macro series interpolated from quarterly to monthly frequency (Miranda-Agrippino and Rey, 2020)

Panel VAR

- **VARX approach to identification** (Paul, 2019; Plagborg-Moeller and Wolf, 2021)

$$x_{it} = a_i + b_i t + \sum_{p=1}^{P} F_{i,p} x_{i,t-p} + \epsilon_{mt}^{US} + u_{it}$$

where

$$x_{it} = \left[\begin{array}{ccccccccc} CS_t^{US} & Y_t^{US} & i_t^{US} & Y_{it} & EX_{it} & CPI_{it} & i_{it} & FX_{it} & CS_{it} \end{array} \right]$$

- ϵ_{mt}^{US} → Monetary policy surprises from Jarocinski and Karadi (2020) Details

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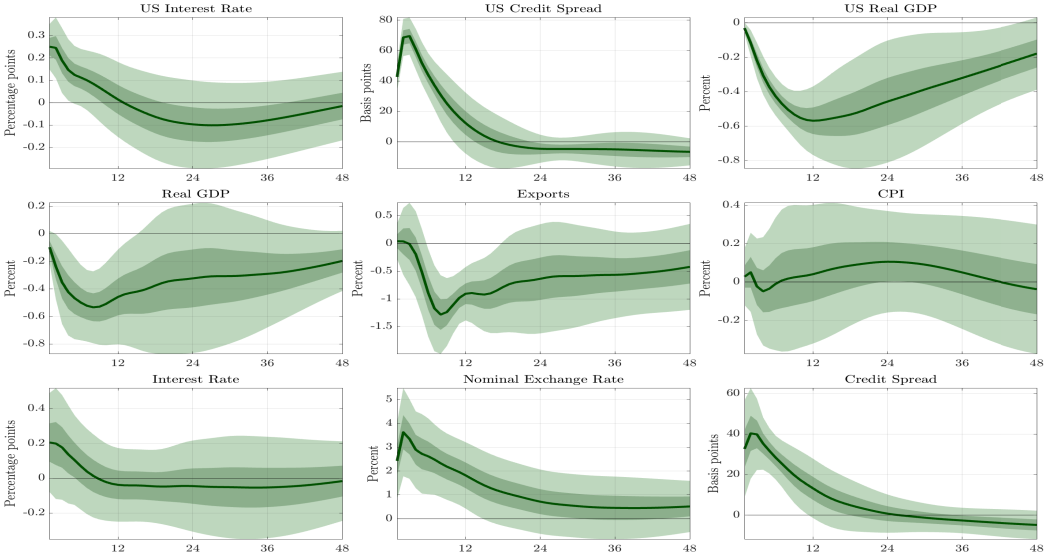
- $\epsilon_{mt}^{US} \rightarrow$ **Monetary policy surprises** from Jarocinski and Karadi (2020) Details

- Empirical model $\rightarrow$ Dynamic panel with heterogeneous slope coefficients
  - Set $P = 3$ (BIC; robustness with 6 lags)
  - **Mean group estimator** (Pesaran and Smith, 1995; Pesaran, 2006)
    - ★ Estimate country-by-country VARs with OLS
    - ★ Take average IRFs across countries $\rightarrow$ Response of typical country

IRFs to a US Monetary Policy Tightening



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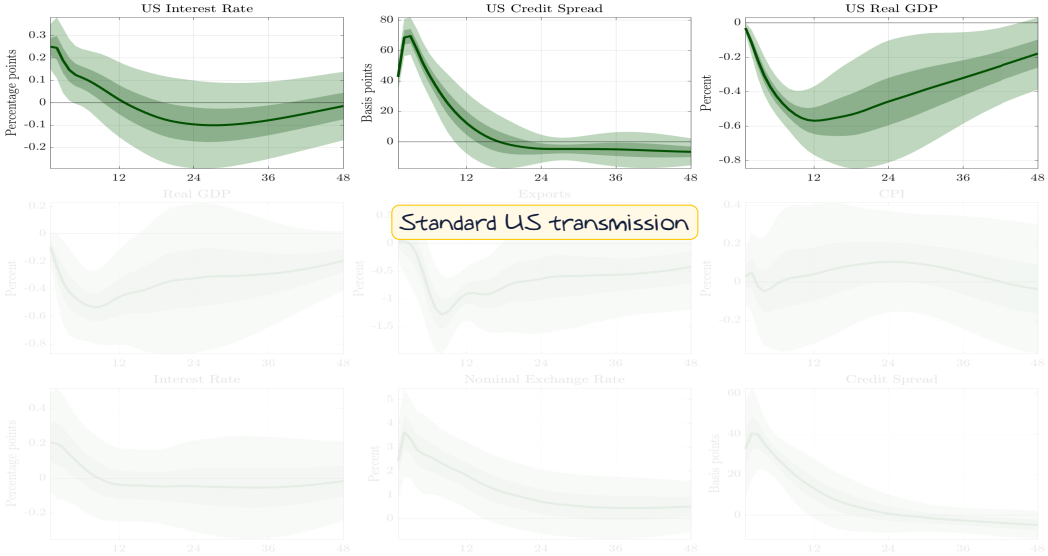

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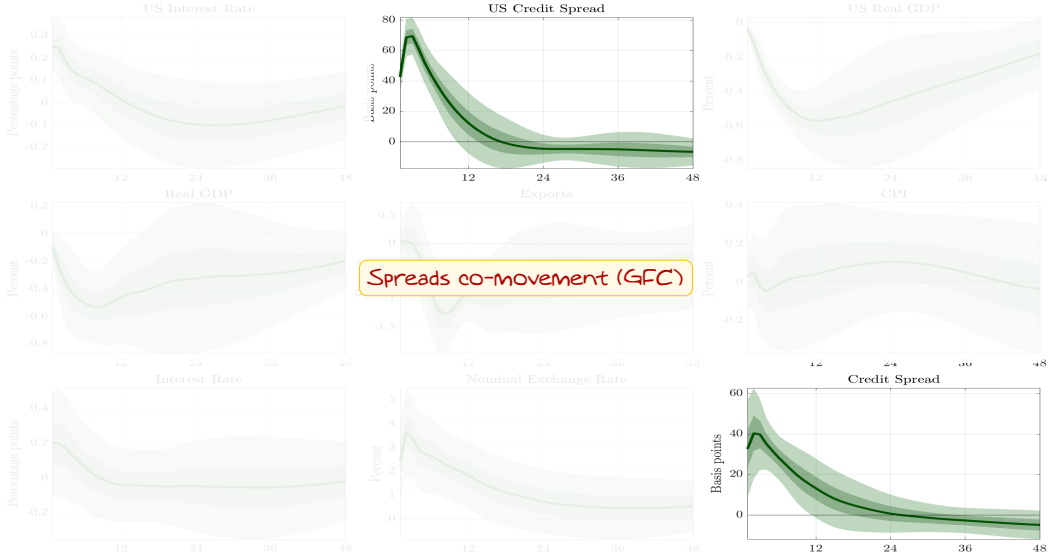

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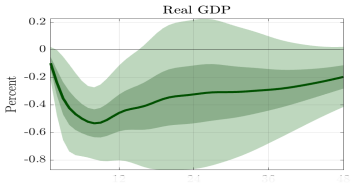

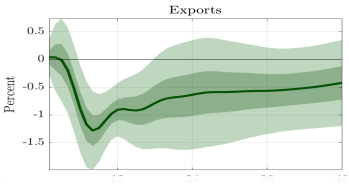

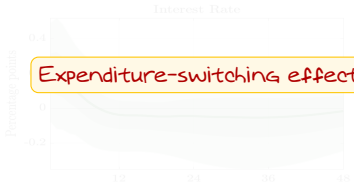

Expenditure-switching effect does not dominate (Dilemma?)

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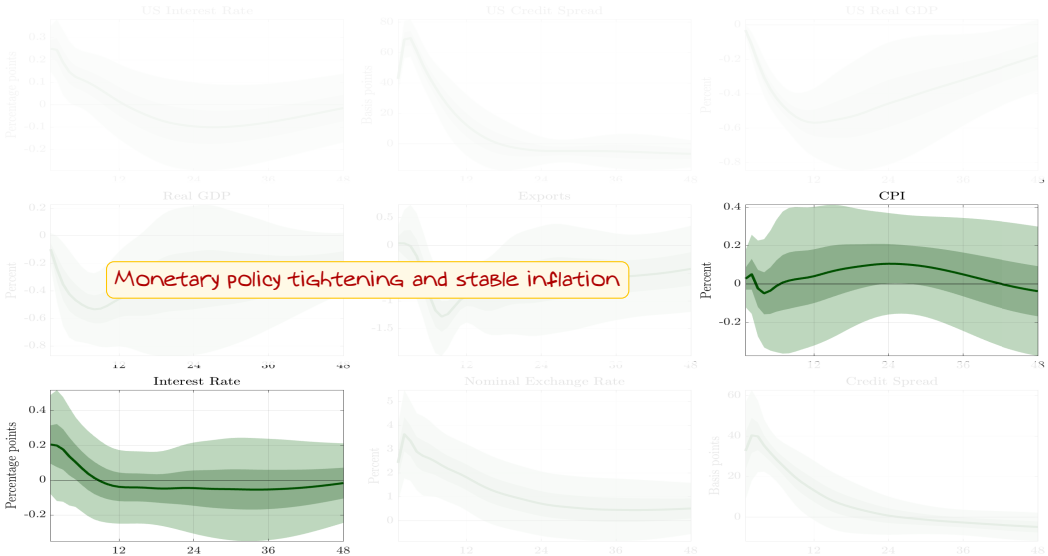

Summary of VAR Evidence

Robustness

- Contractionary US monetary policy shock
  - US variables $\rightarrow$ Interest rate and spreads increase, GDP falls
  - Home variables
    - Nominal exchange rate depreciates
    - Credit spreads increase
    - Real GDP and exports fall
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- Demand/financial channel dominates over expenditure-switching effect
  - **Consistent with idea of Global Financial Cycle**
  - Flexible exchange rate regime does not provide full insulation from foreign monetary policy shocks

2. Two-Country DSGE Model

Overview

- Standard household sector, identical across two countries (H small and F large)

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- Multi-layer production (capital producers, importers, wholesale producers, retailers)
  - Home exporters price in Foreign currency (**LCP**)
  - **Imperfect pass-through** for import prices

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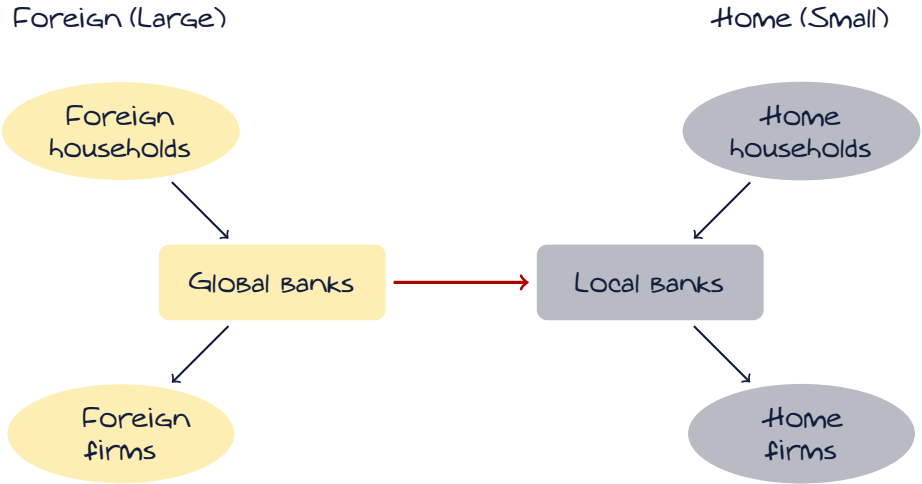
  - Imperfect pass-through for import prices
- **Dominant currency paradigm** in international goods and financial markets

Financial Flows



Financial Frictions

Details

- **Home banks** (Akinci and Queralto, 2024) → Balance sheet currency mis-match

$$\underbrace{q_t z_t}_{\text{Assets}} = \underbrace{d_t + s_t b_t^* + n_t}_{\text{Liabilities}}$$

  - Can divert fraction of assets

$$\Theta(x_t) = \theta\left(1 + \frac{\gamma}{2}x_t^2\right)$$

    with $\gamma > 0$, where $x_t = s_t b_t^* / (q_t z_t)$ (foreign funds harder to recover than domestic funds)

  - Incentive compatibility constraint

$$V(n_t) \geq \Theta(x_t) q_t z_t$$

UIP wedge

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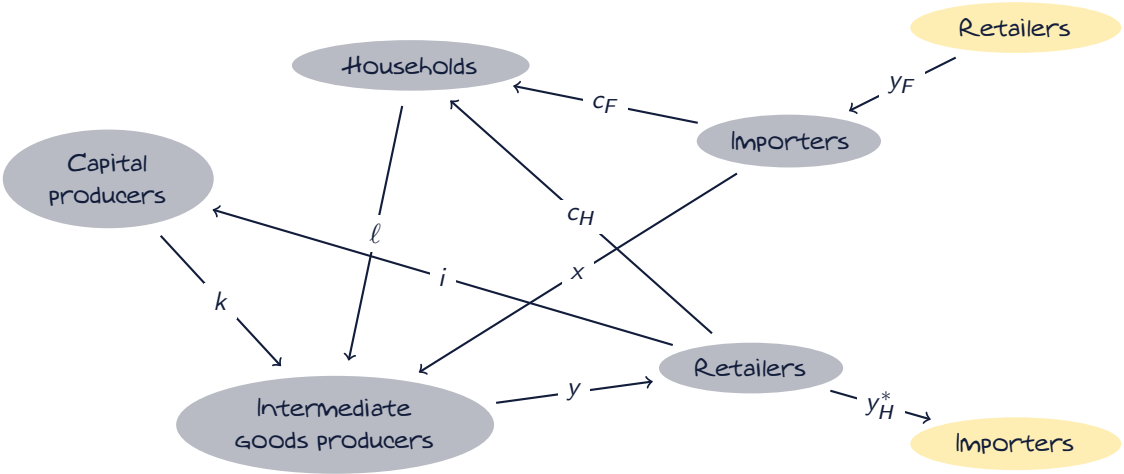
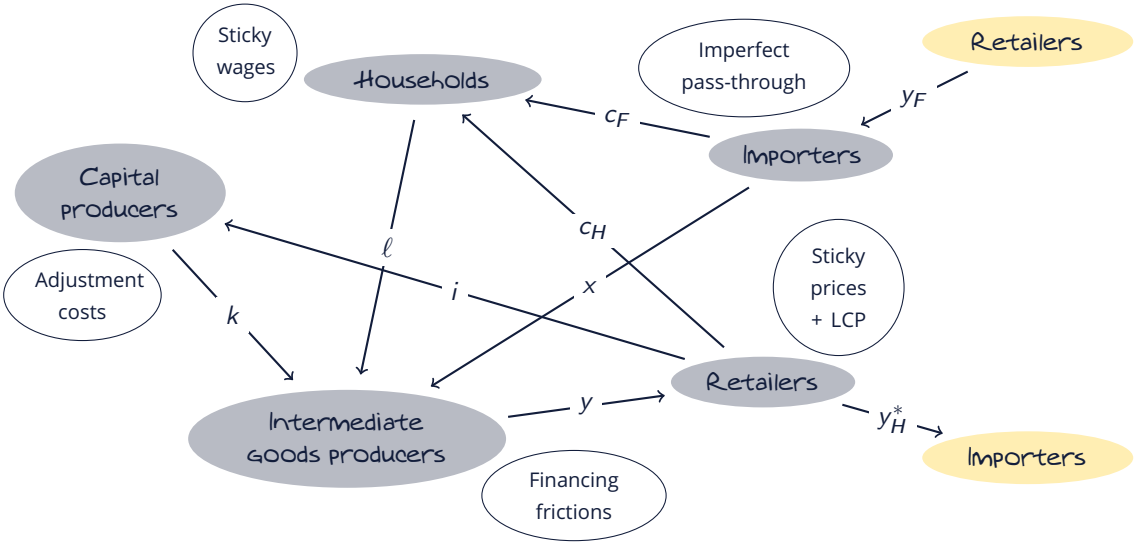
UIP wedge

- **Foreign banks** (Gertler and Karadi, 2011) → Balance sheet fully in USD
  - Issue deposits to F households, lend to F firms and H banks

Home Production Structure



Home Production Structure and Frictions



Policy

- Baseline $\rightarrow$ Monetary policy rule

$$\frac{R_t}{R} = \left(\frac{R_{t-1}}{R}\right)^{\rho_R} \left[\Pi_t^{\phi_\pi} \left(\frac{y_t}{y_{t-1}}\right)^{\phi_y} \left(\frac{\mathcal{E}_t}{\mathcal{E}_{t-1}}\right)^{\phi_\mathcal{E}}\right]^{1-\rho_R},$$

  - **Home** $\rightarrow$ Estimate $\phi_\mathcal{E}$ (to check degree of exchange rate flexibility)
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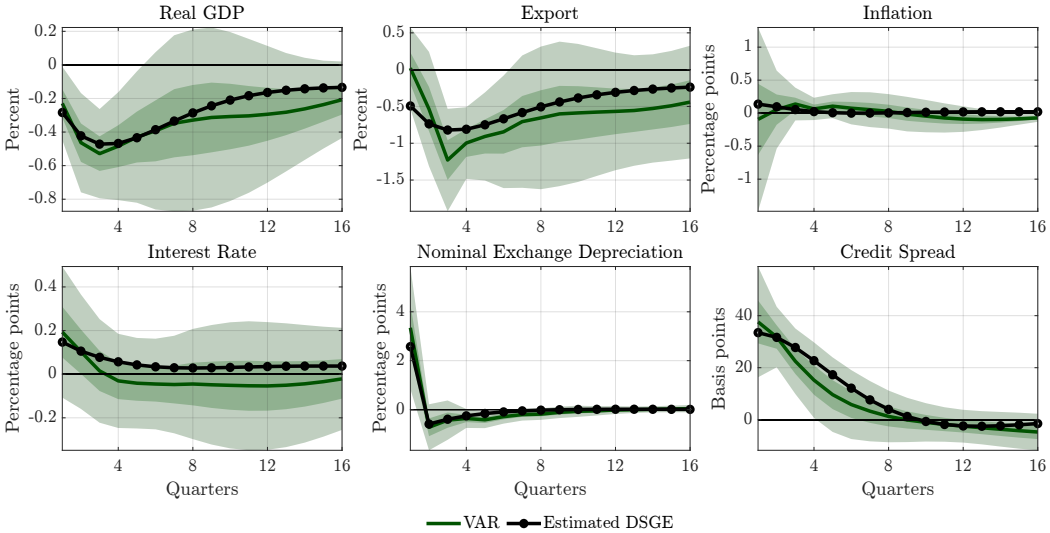
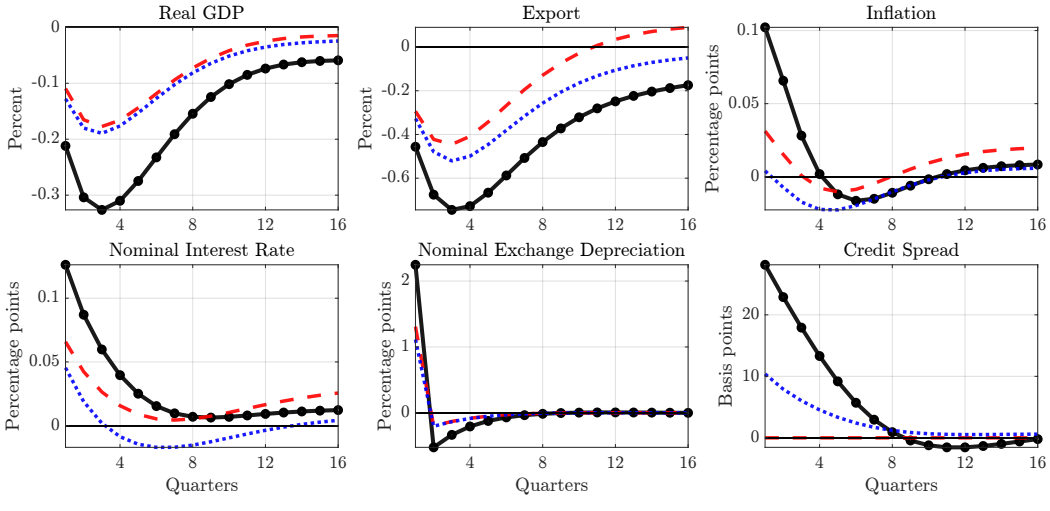
- **Policy experiments** (later) $\rightarrow$ In Home country
  - Stronger response to exchange rate
  - Taxes on
    - ⋆ Domestic credit (financial stability tool)
    - ⋆ Foreign liabilities (capital flows management tool)

Impulse Response Matching

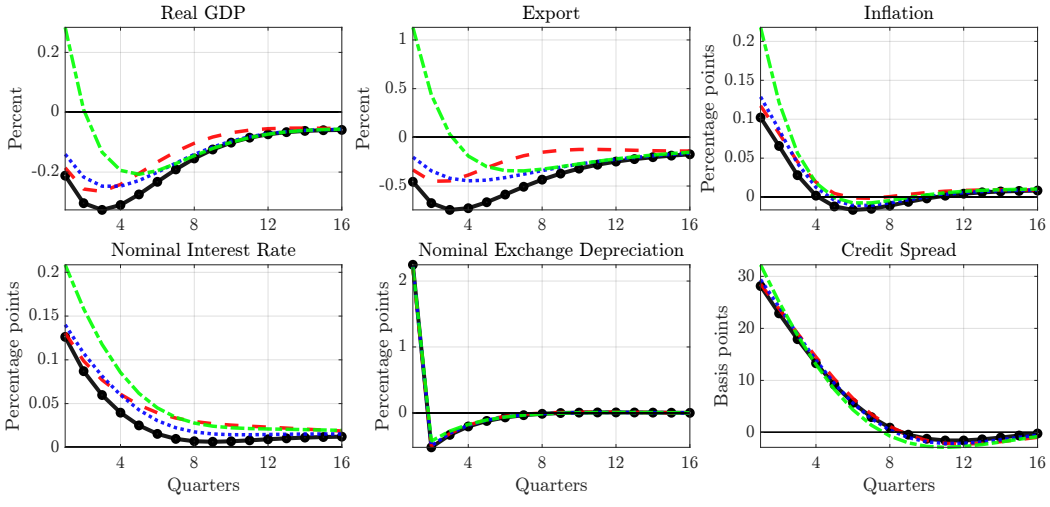
Calibration & Estimation



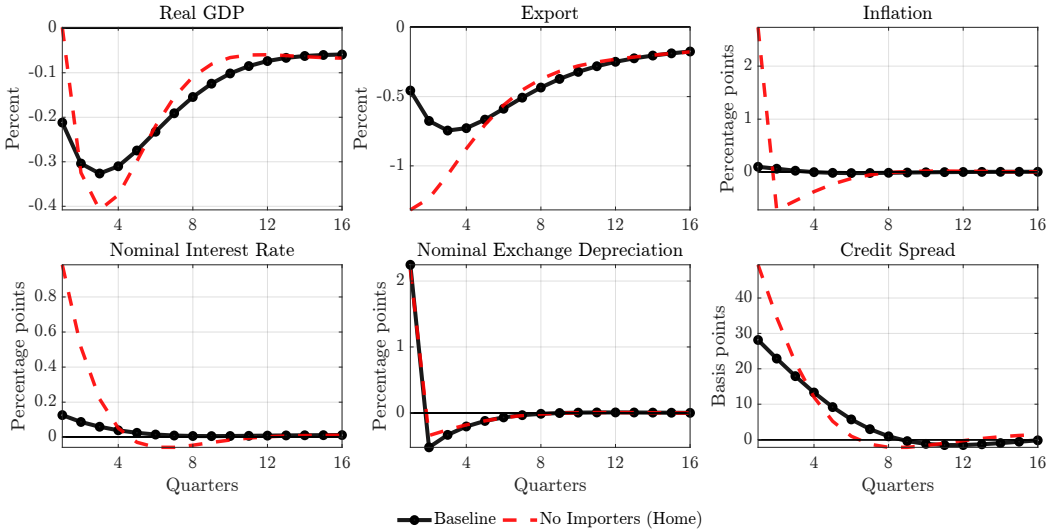
Amplification



Imperfect Pass-Through and Exports



Imperfect Pass-Through and Inflation



Summary of DSGE Results

- **Estimated DSGE model matches well VAR evidence**

- Two key frictions
  1. Financial $\rightarrow$ Amplification and spreads co-movement (GFC)
  2. Imperfect pass-through
     - ⋆ Foreign import prices fall at the dock but not for consumers VAR evidence
     - ⋆ Home inflation not very responsive to depreciation

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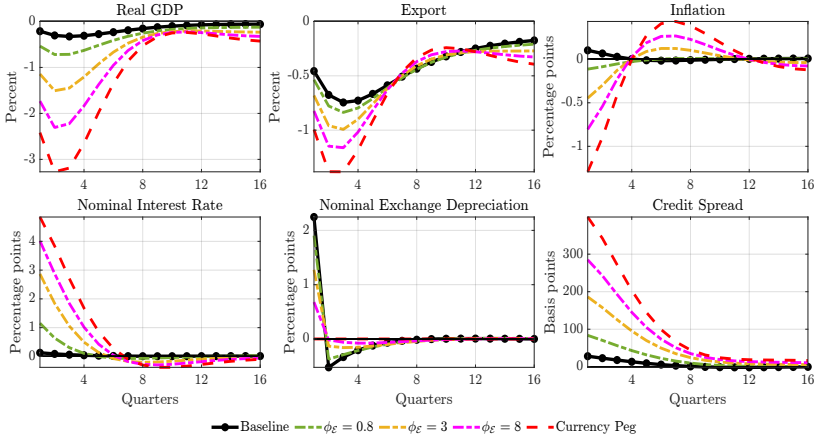
- Next $\rightarrow$ Revisit **two policy questions**
  1. How important is exchange rate regime?
  2. What's role of additional (financial stability/capital-flow management) tools?

3. Policy Analysis

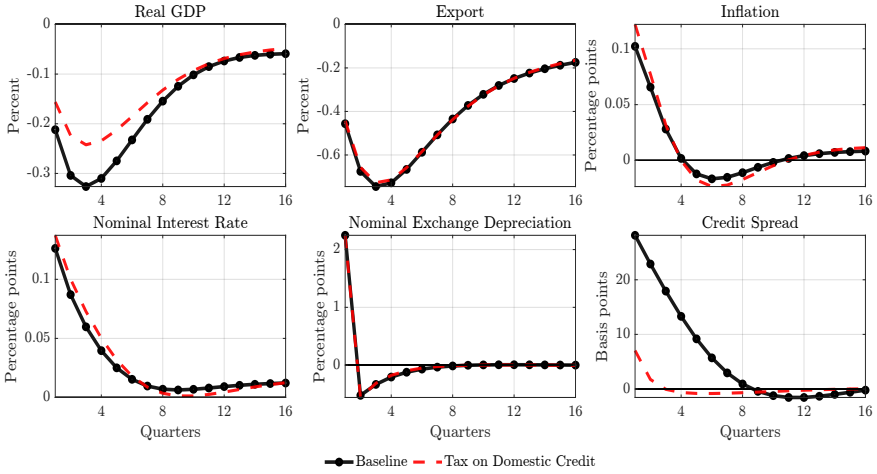
Exchange Rate Flexibility

- **Exchange rate regime not irrelevant**
  - Macroeconomic volatility increasing with weight on exchange rate in monetary policy rule



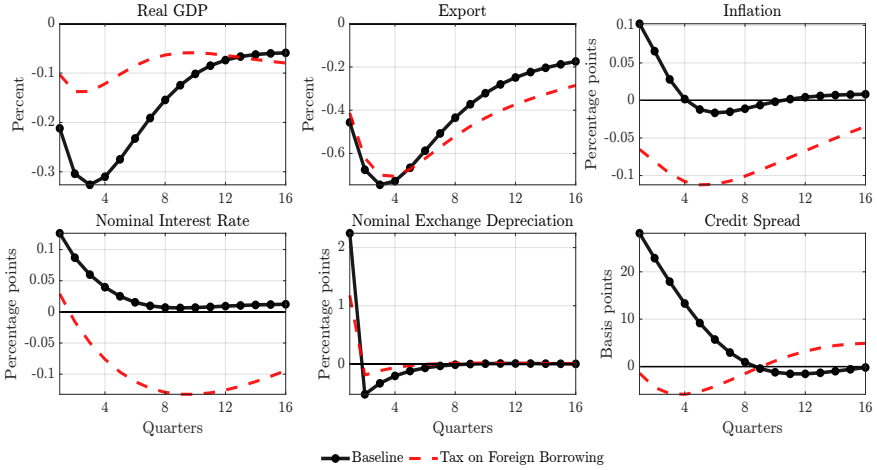
Tax on Domestic Credit

- **Reduces GDP volatility** by compressing credit spreads



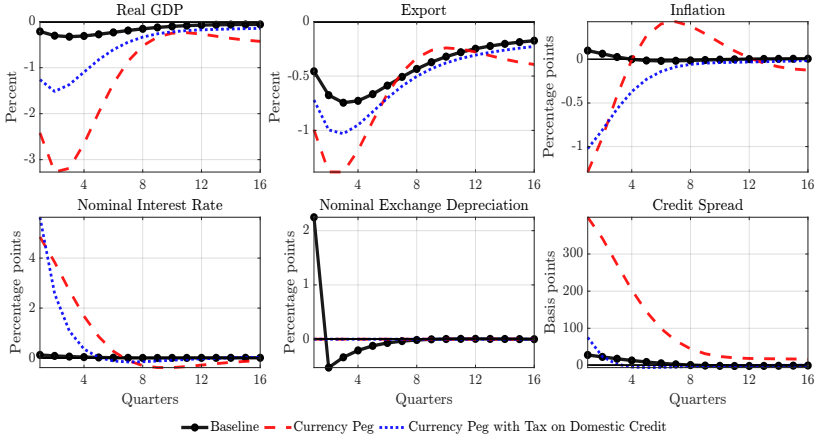
Tax on Foreign Borrowing

- **Similar effects to those of tax on total credit** but acts on UIP wedge



Peg + Tax on Domestic Credit

- **Tax on domestic credit can also alleviate negative consequences of peg**
  - Similar effects with tax on foreign borrowing



Conclusions

1. Panel VAR $\rightarrow$ Consistent with idea of Global Financial Cycle
   - Contractionary US monetary policy shock leads to domestic recession
   - Despite domestic currency depreciation (expenditure-switching effect does not dominate)

2. Estimated two-country DSGE $\rightarrow$ Can match empirical evidence
   - Key role of financial frictions in banking sector and pricing frictions in international trade

3. Policy analysis
   - Peg exacerbates macroeconomic volatility (exchange rate regime not irrelevant)
   - Taxes on domestic credit or foreign borrowing reduce consequences of GFC
   - Both taxes can limit negative effects of peg on GDP but not on inflation

A1: Panel VAR

Interest Rate Surprises

Back

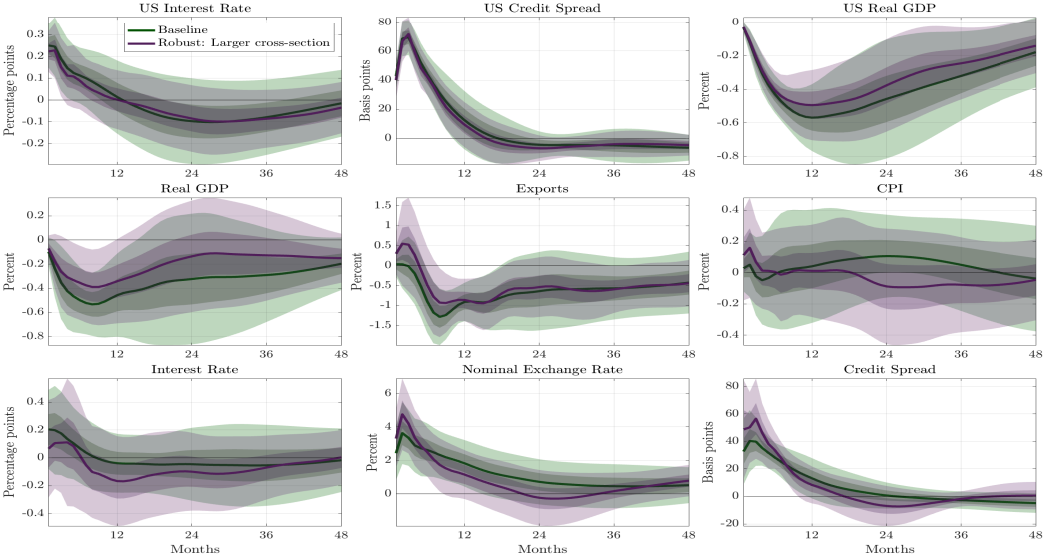
- High frequency surprises s_t^i possibly contaminated by monetary policy "signalling" component
  - Potential bias in estimated effect of monetary policy shocks

- Decompose s_t^i into monetary (ϵ_t^m) and non-monetary (ϵ_t^{other}) shocks
  - Simple sign restriction approach (Jarocinski and Karadi, 2020)

	Monetary (ϵ_t^m)	Non-monetary (ϵ_t^{other})
Equity surprises (s_t^{eq})	$-$	$+$
Interest rate surprises (s_t^i)	$+$	$+$

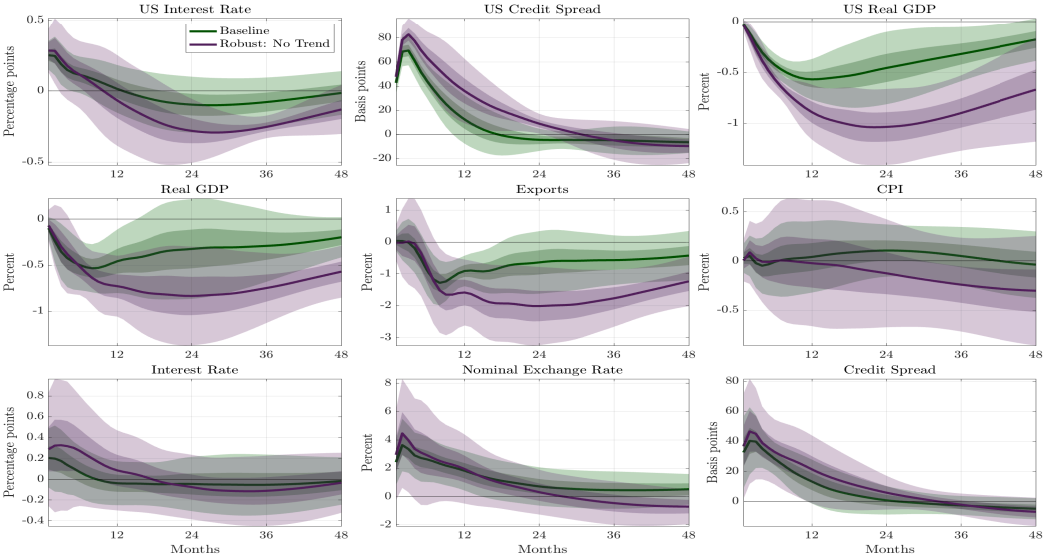
Larger Sample (24 countries)

Back



No Time Trend

Back



Longer Sample (1985-2019, no spreads)

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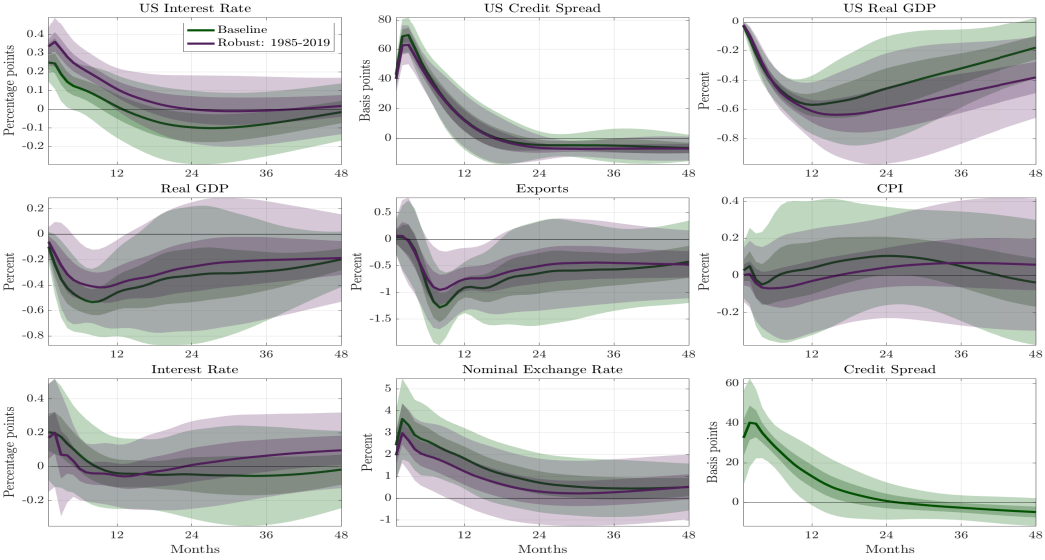
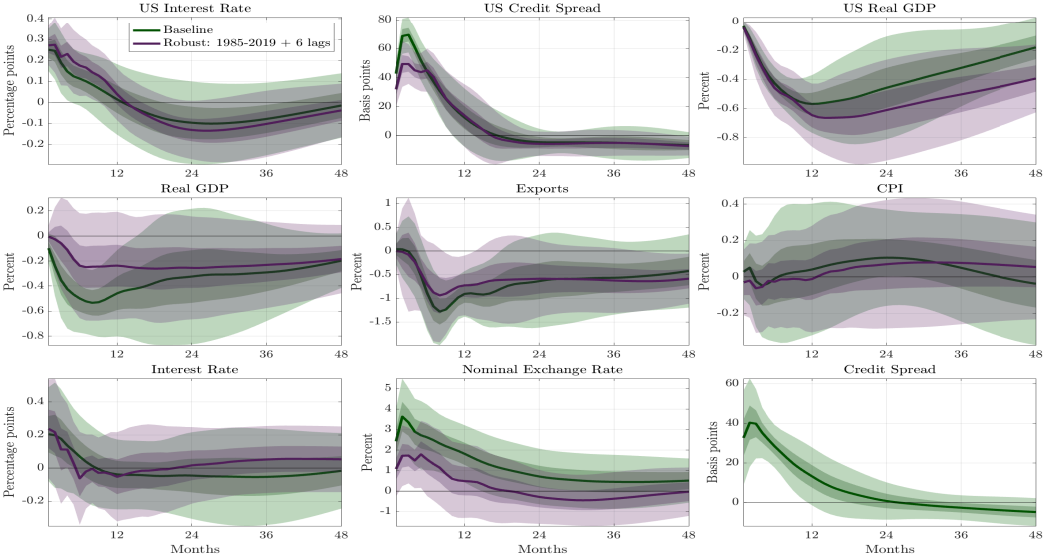


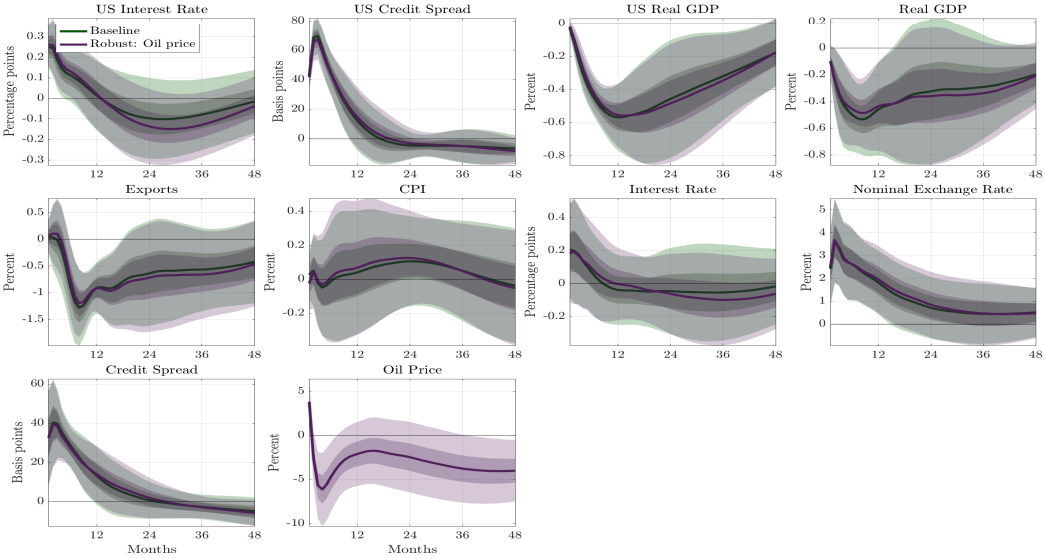
Longer Sample (1985-2019, no spreads) and 6 lags

Back



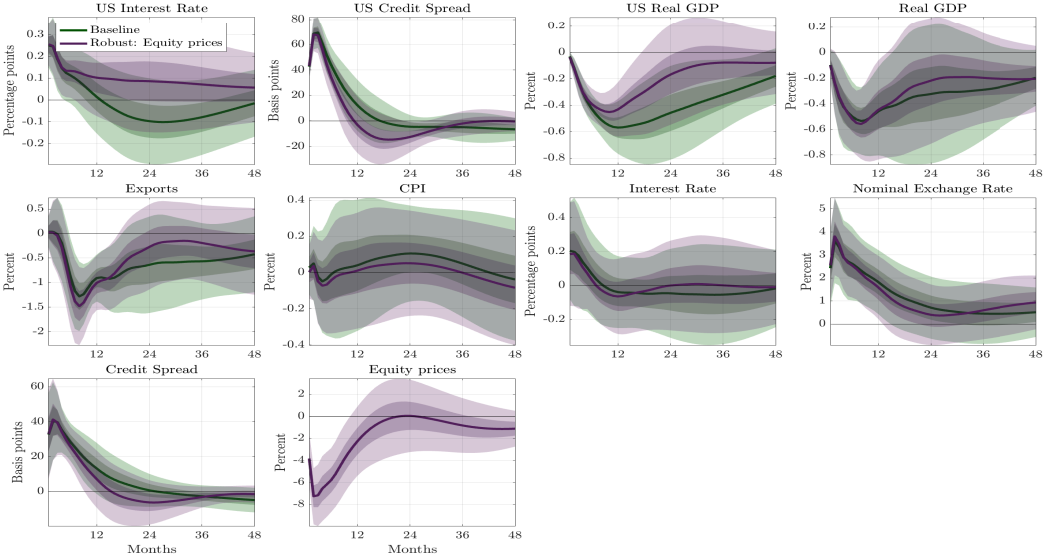
Oil Prices

Back



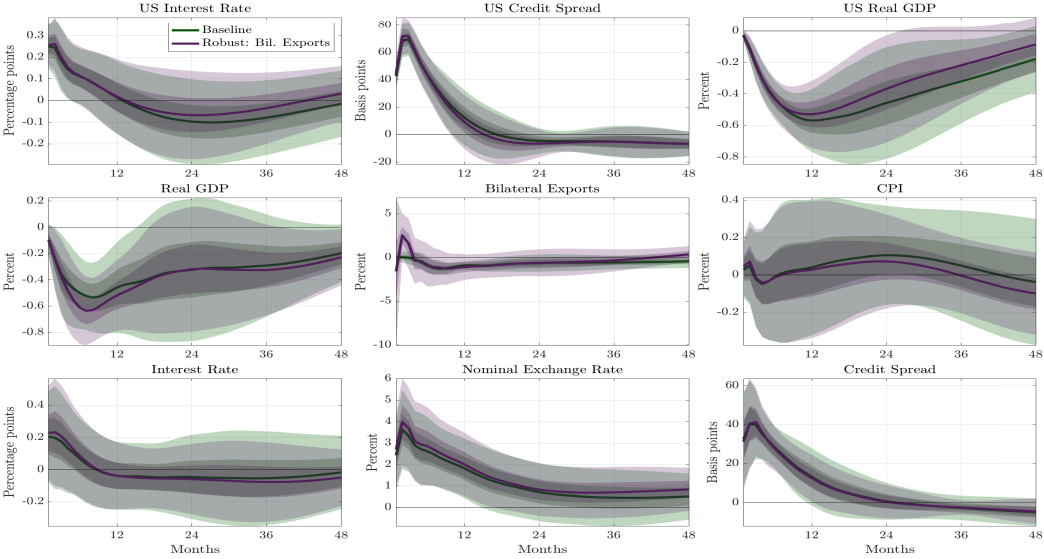
SOE Equity Prices

Back



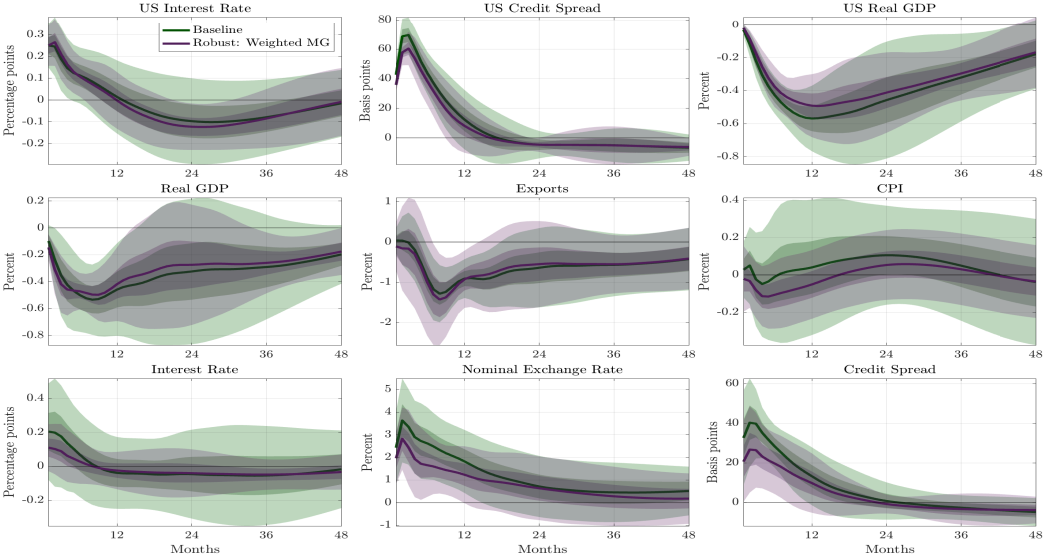
Bilateral Exports

Back



PPP-GDP Weights

Back



A2: DSGE Model

Home Banks

Back

- Choose loans (z_t), deposits (d_t) and interbank borrowing (b_t^*) to solve

$$V(n_t) = \max \mathbb{E}_t \left\{ \mathcal{M}_{t,t+1} [(1-\omega) n_{t+1} + \omega V(n_{t+1})] \right\}$$

subject to

$$\begin{aligned} q_t z_t &= d_t + s_t b_t^* + n_t \\ V(n_t) &\geq \Theta(x_t) q_t z_t \\ n_t &= r_{Kt} q_{t-1} z_{t-1} - \frac{R_{t-1}}{\Pi_t} d_{t-1} - \frac{R_{Bt-1}^*}{\Pi_t^*} s_t b_{t-1}^* \end{aligned}$$

where

$$\Theta(x_t) = \theta \left(1 + \frac{\gamma}{2} x_t^2 \right)$$

and $x_t = s_t b_t^* / (q_t z_t)$

Solution of Local Banks' Problem

- All bankers choose same leverage and same ratio of foreign liabilities (binding ICC)

- **Optimal portfolio allocation**

$$\frac{\mu_{kt}}{\mu_{bt}} = \frac{\Theta(x_t)}{\Theta'(x_t)} - x_t$$

  - $\mu_{kt} \rightarrow$ Discounted excess return of capital on deposits
  - $\mu_{bt} \rightarrow$ Discounted excess return of deposits on interbank borrowing

- **Incentive compatibility constraint at equality**

$$\phi_t = \frac{\mu_{dt}}{\Theta(x_t) - (\mu_{kt} + \mu_{bt} x_t)}$$

  - $\mu_{dt} \rightarrow$ Discounted return of deposits

UIP Wedge

Back

- Without financial frictions, UIP would hold

$$1 = \mathbb{E}_t \left[\mathcal{M}_{t,t+1} \Omega_{t+1} \left(\frac{R_t}{\Pi_{t+1}} - \frac{R^*_{Bt}}{\Pi^*_{t+1}} \frac{s_{t+1}}{s_t} \right) \right]$$

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- Financial frictions create **wedge** between domestic and foreign interest rate

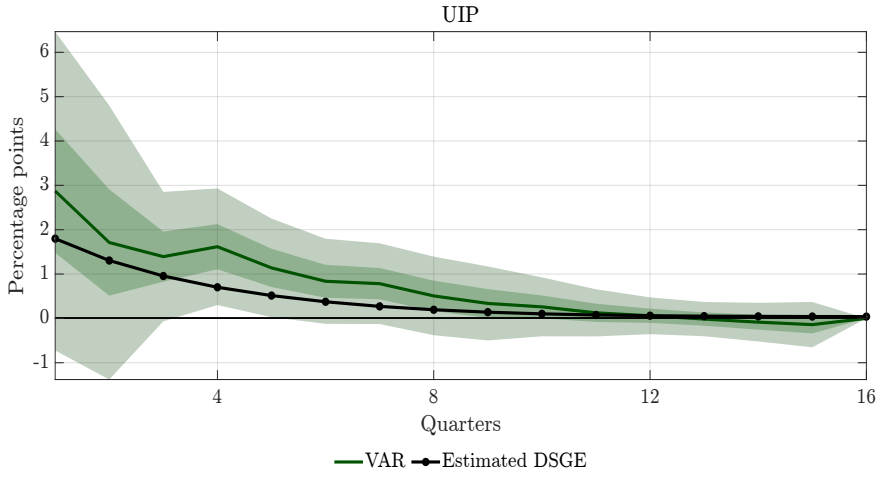
$$\mu_{bt} = \mathbb{E}_t \left[\mathcal{M}_{t,t+1} \Omega_{t+1} \left(\frac{R_t}{\Pi_{t+1}} - \frac{R^*_{bt}}{\Pi^*_{t+1}} \frac{s_{t+1}}{s_t} \right) \right]$$

  - Foreign funds harder to recover
  - Domestic currency must pay a premium relative to foreign currency

UIP Wedge

Back

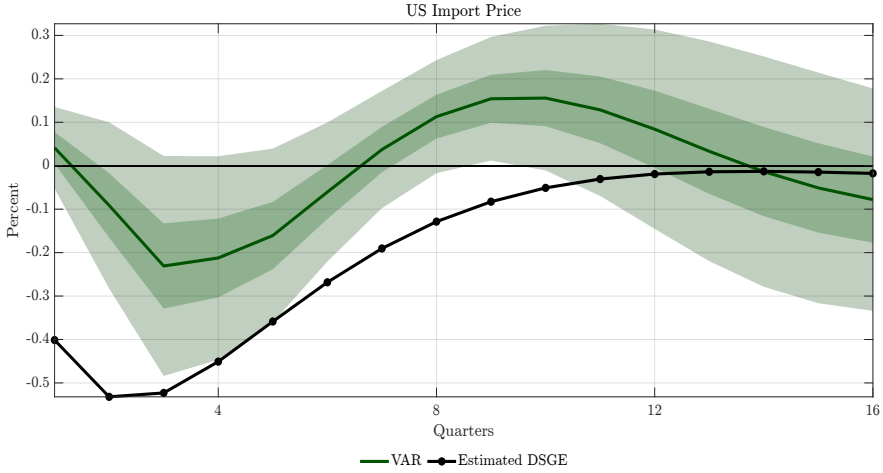
- Response of UIP wedge to US monetary policy shock (untargeted)



Import Prices

Back

- Response of US import prices (untargeted)



Calibrated Parameters

Back

Parameter	Description	Home	Foreign
n	Relative size of country H	0.1	0.9
β	Individual discount factor	0.9926	0.9975
h	Habits in consumption	–	0.71
σ	Relative risk aversion	–	1.38
ζ	Inverse Frisch elasticity	1	1
ϱ	Elasticity of substitution among goods varieties	6	6
a	Home bias in consumption	0.66	0.95
ϵ	Elasticity of substitution between H and F goods	1.5	1.5
ν	Elasticity of substitution among labor varieties	6	6
ξ_w	Wage rigidity	0.66	0.66
ξ_p	Price rigidity	–	0.66
α_k	Capital share	0.33	0.33
ϖ	Intermediate input share	0.1	0.1
δ	Depreciation rate	0.025	0.025
φ_i	Investment adjustment cost	–	5.74
ω	Bank survival rate	0.97	0.97
θ	Proportion of divertible funds	–	0.51
ξ_b	Bank transfer rate	–	0.002

Estimated Parameters

Back

Parameter	Prior			Posterior			
	Distribution	Mean	SD	Mode	Median	5%	95%
h	Beta	0.650	0.1	0.735	0.723	0.587	0.848
σ	Gamma	1	0.375	1.150	1.297	0.790	1.870
λ	Gamma	5	1	4.822	4.954	3.553	6.682
x	Beta	0.240	0.15	0.040	0.084	0.004	0.209
φ_i	Gamma	2.850	2	1.057	1.116	0.353	2.073
ξ_p	Beta	0.660	0.1	0.776	0.754	0.577	0.923
ξ_{im}	Beta	0.660	0.1	0.645	0.634	0.489	0.786
ξ^*_{im}	Beta	0.660	0.1	0.780	0.753	0.569	0.926
ϑ	Gamma	1.5	1	1.018	1.501	0.117	3.375
ϑ^*	Gamma	1.5	1	0.753	1.119	0.144	2.284
ρ_R	Beta	0.750	0.1	0.724	0.729	0.559	0.885
ϕ_π	Gamma	1.500	0.25	1.665	1.689	1.338	2.076
ϕ_y	Gamma	0.125	0.05	0.122	0.136	0.053	0.230
$\phi_\mathcal{E}$	Gamma	0.100	0.05	0.073	0.095	0.024	0.171
ρ^*_R	Beta	0.750	0.1	0.903	0.886	0.836	0.932
ϕ^*_π	Gamma	1.500	0.25	1.394	1.415	1.078	1.779
ϕ^*_y	Gamma	0.125	0.05	0.107	0.119	0.049	0.203

Tax on Domestic Credit (Financial Stability Tool)

- **Tax on domestic credit**

$$n_t = (1-\tau_t^k) r_{kt} q_{t-1} z_{t-1} - \frac{R_{t-1} d_{t-1}}{\Pi_t} - \frac{R^*_{bt-1}}{\Pi^*_t} s_t b^*_{t-1}$$

  - Directly impacts credit spreads

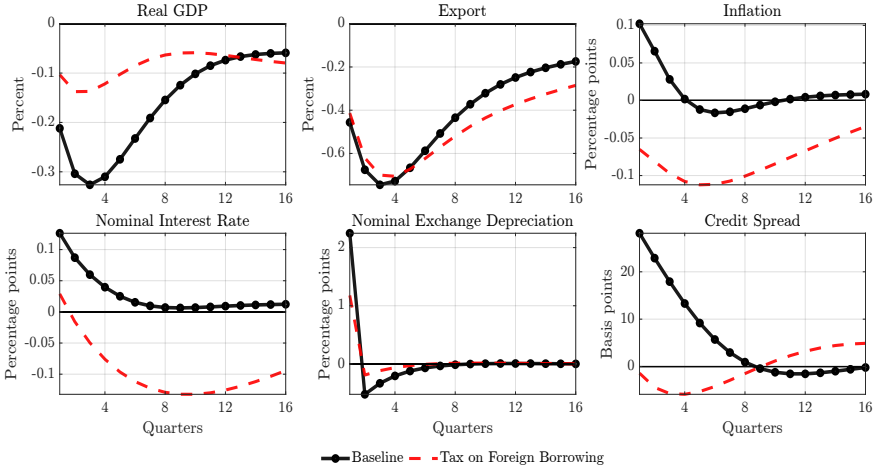
$$\mu_{kt} = \mathbb{E}_t \left\{ \mathcal{M}_{t,t+1} \Omega_{t,t+1} \left[(1-\tau^k_{t+1}) r_{kt+1} - \frac{R_t}{\Pi_{t+1}} \right] \right\}$$

- Policy rule responds to **credit spreads**

$$\tau_t^k = \mathbb{E}_t \left(\frac{r_{kt+1} - R_t/\Pi_{t+1}}{r_k - R} \right)^{\phi_k} - 1$$

Tax on Foreign Borrowing

- **Similar effects to those of tax on total credit** but acts on UIP wedge



Related Literature

- Empirical studies of global financial cycle and its drivers

  Rey (2013); Dedola, Rivolta and Stracca (2017); Cesa-Bianchi, Ferrero and Rebucci (2018); Cerutti, Claessens and Rose (2019); Corman and Lloyd (2019); Obstfeld, Ostry and Qureshi (2019); Miranda-Agrippino and Rey (2020); Degasperi, Hong and Ricco (2021); Ilzetzki and Jin (2021); Georgiadis, Muller, Schumann (2023a,b), Georgiadis and Jarocinski (2023)

- Financial frictions in open economy

  Farhi and Werning (2014); Gabaix and Maggiori (2015); Aoki, Benigno and Kiyotaki (2020); Gourinchas (2020); Adrian et al. (2020); Casas et al. (2020); Corsetti, Dedola, and Leduc (2020); Itskhoki and Mukhin (2021); Akinci and Queralto (2024); Camara, Christiano and Dalgic (2024)

- LCP, imperfect pass-through and dominant currency paradigm

  Betts and Devereux (2000); Devereux and Engel (2003); Monacelli (2005), Cook and Devereux (2006); Corsetti, Dedola and Leduc (2010); Engel (2011); Fujiwara and Wang (2017); Gopinath et al. (2020); Chen et al. (2021); Gopinath and Stein (2021)