Capital Flows and Exchange Rates

A Quantitative Assessment of the Dilemma Hypothesis*

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

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- **Monetary policy tightening cycle in advanced economies**
  - Renewed interest on cross-country transmission of monetary policy (shocks)

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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
  - Plus 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
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   - Frictions in international financial intermediation and pricing
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   - Frictions in international financial intermediation and pricing
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3. Policy analysis → Counterfactuals
   - Exchange rate targeting increases domestic macroeconomic volatility
   - Additional instruments (tax on capital flow / domestic credit) mitigate consequences of GFC
   - **Taxes can limit volatility of economic activity under peg** but with disinflationary side effect

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)

- 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 (2022)

- LCP and dominant currency paradigm

  Devereux and Engel (2003); 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)

1. Panel VAR

Data

- Panel of macro-financial variables for **15 countries with flexible exchange rate**
  - Australia, Canada, Chile, 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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- Variables
  - **US:** Excess bond premium, Real GDP
  - **Domestic:** Real GDP, CPI inflation, exports (in real terms), nominal interest rate, nominal exchange rate depreciation (LC per USD), corporate bond spreads

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- Variables
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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

- **Internal instrument** (Plagborg-Moeller and Wolf, 2021)

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

where

$$x_{it} = \left[\begin{array}{cccccccc} \epsilon_t^m & EBP_t^{US} & Y_t^{US} & Y_{it} & \pi_{it} & EX_{it} & i_{it} & \Delta e_{it} & CS_{it} \end{array} \right]$$

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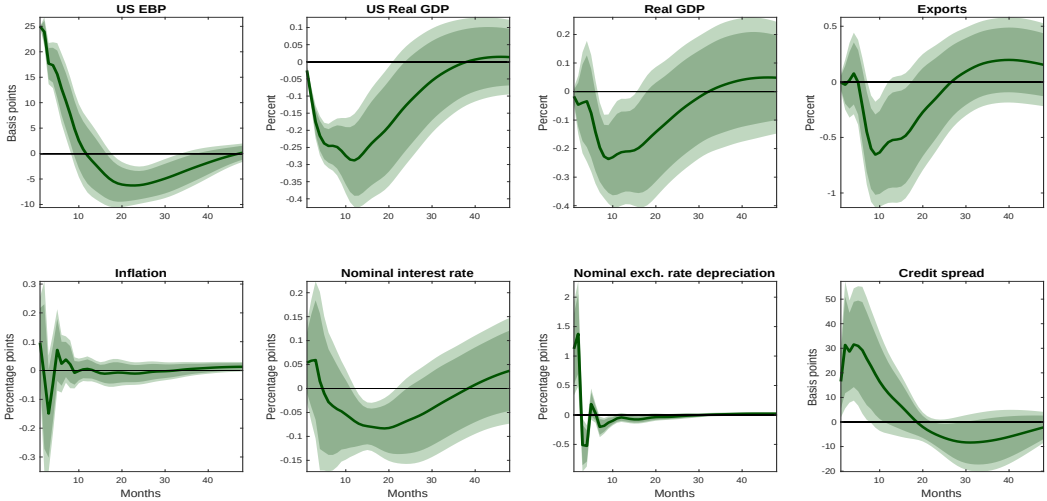
- Monetary policy surprises ϵ_t^m from Jarocinski and Karadi (2020)

- Dynamic panel with heterogeneous slope coefficients
  - Set $P = 3$ based on BIC criterion (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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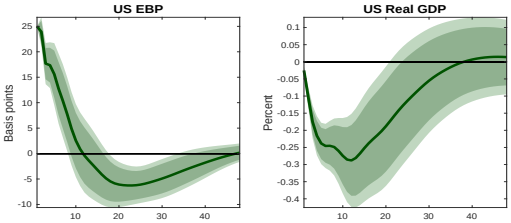
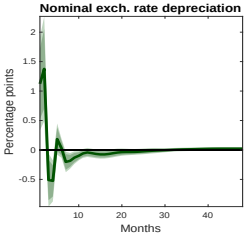


Standard US transmission

IRFs to a US Monetary Policy Tightening

Standard Home FX depreciation



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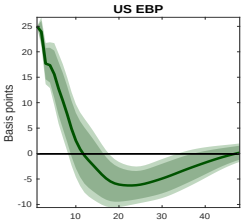
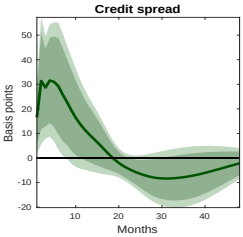


Spreads co-movement



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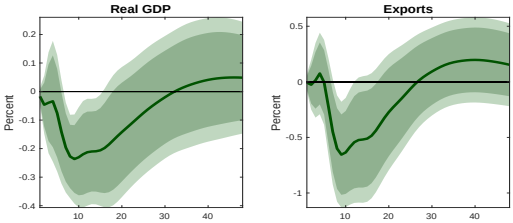
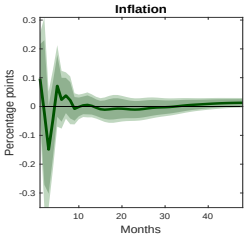
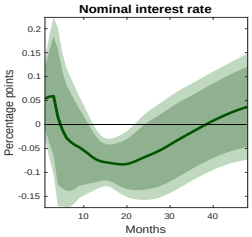


Expenditure-switching effect does not dominate

IRFs to a US Monetary Policy Tightening

Monetary policy stabilizes inflation





2. Two-Country DSGE Model

Overview

- Similar to Aoki, Benigno and Kiyotaki (2020) and Akinci and Queralto (2022)

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  - **Foreign banks** raise funds domestically, lend both domestically and internationally
  - **Home banks** raise funds domestically and internationally, lend only domestically

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  - Home exporters price in Foreign currency (**LCP**)
  - **Imperfect pass-through** of Home imports

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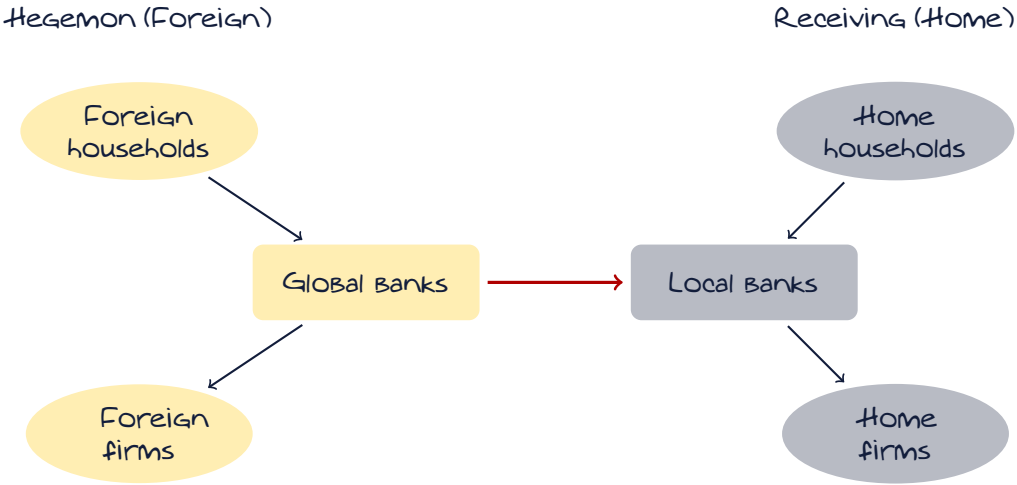
- **Dominant currency paradigm** in international goods and financial markets

Financial Flows



Financial Frictions

- **Foreign banks** $\rightarrow$ Standard (Gertler and Karadi, 2011), balance sheet fully in USD
  - Issue deposits to F households, lend to F firms and H banks

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- **Home banks** → Balance sheet currency mis-match

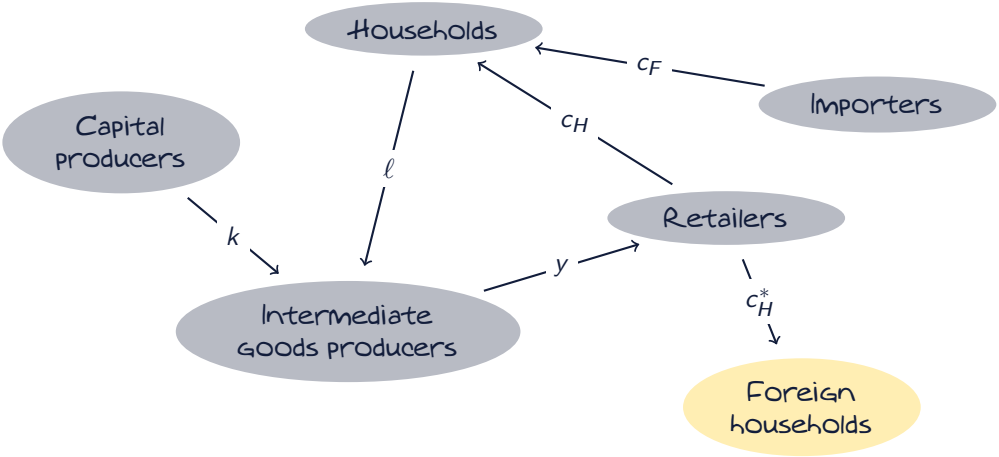
$$\underbrace{q_t z_t}_{\text{Assets}} = \underbrace{d_t + s_t b_t^* + n_t}_{\text{Liabilities}}$$

  - 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)
  - **Endogenous UIP wedge**

Production Structure (Home)



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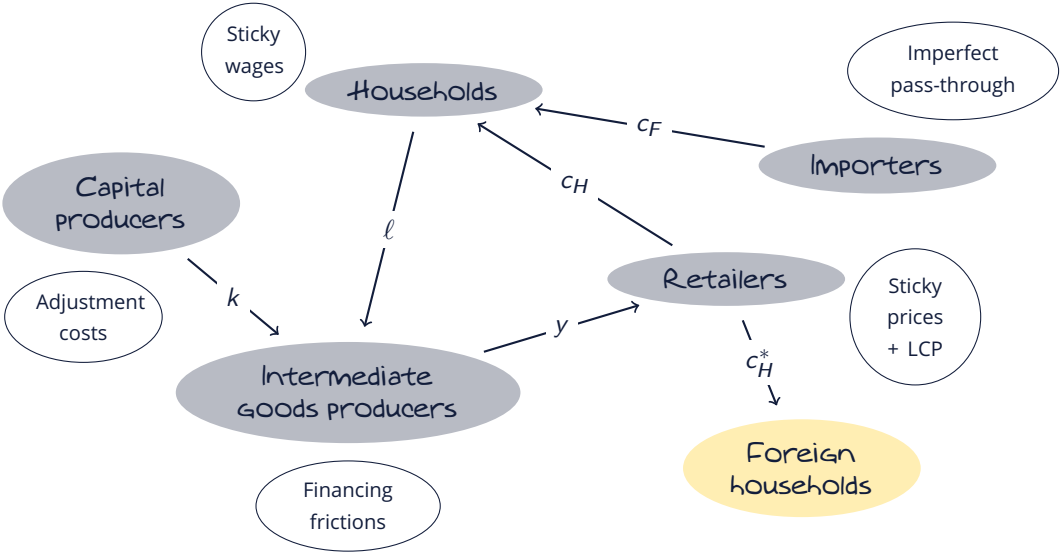
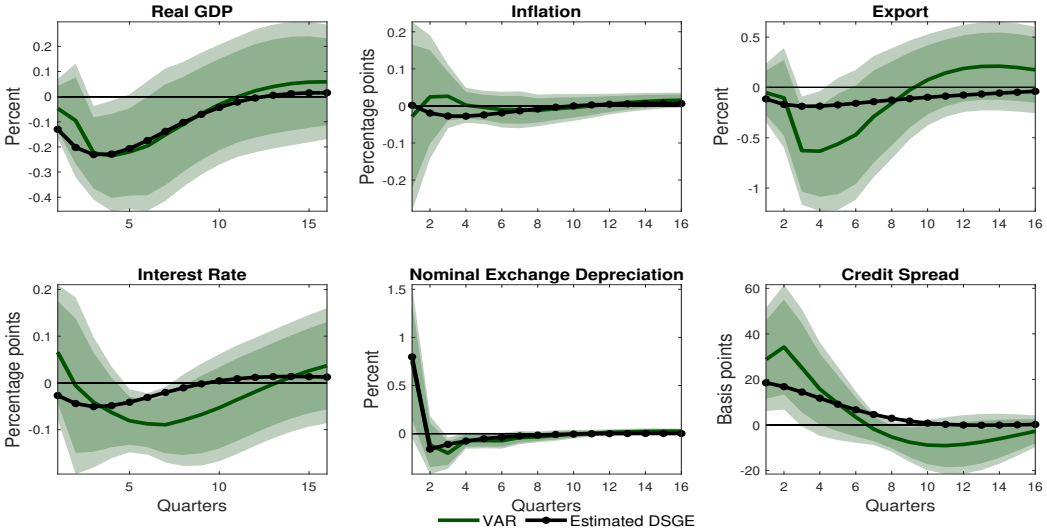
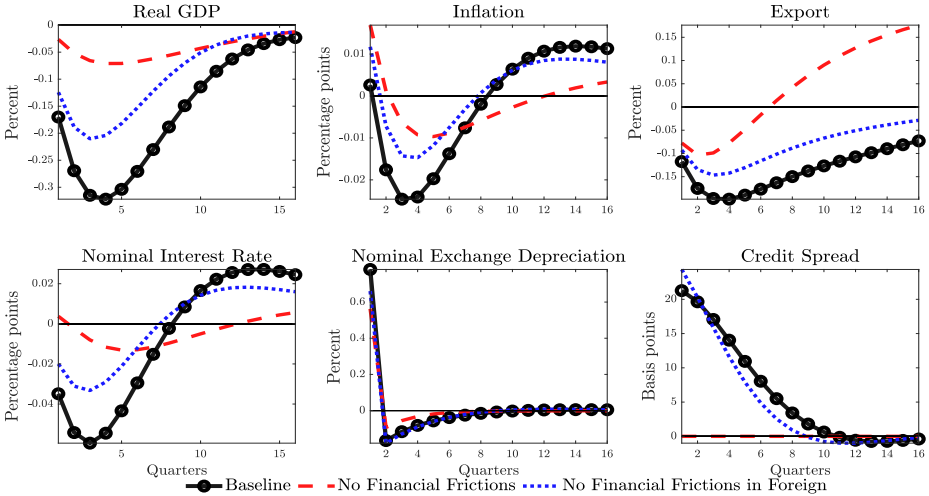


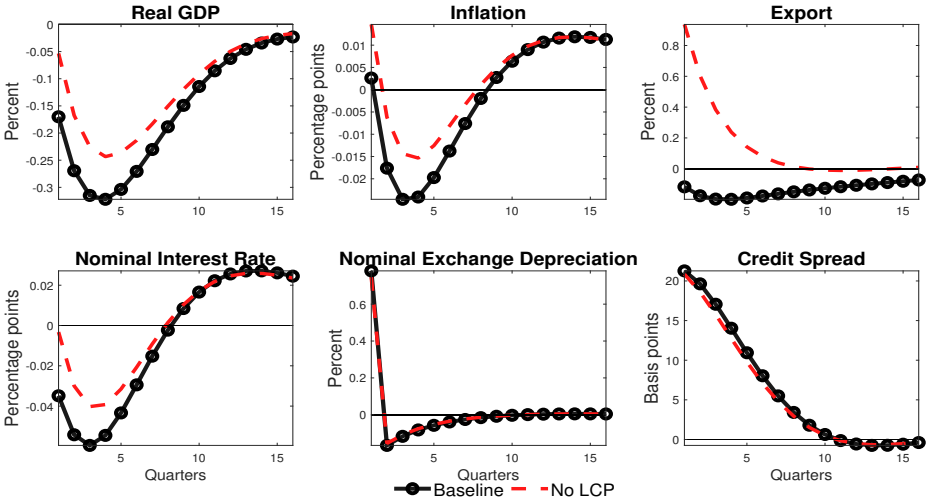
Impulse Response Matching



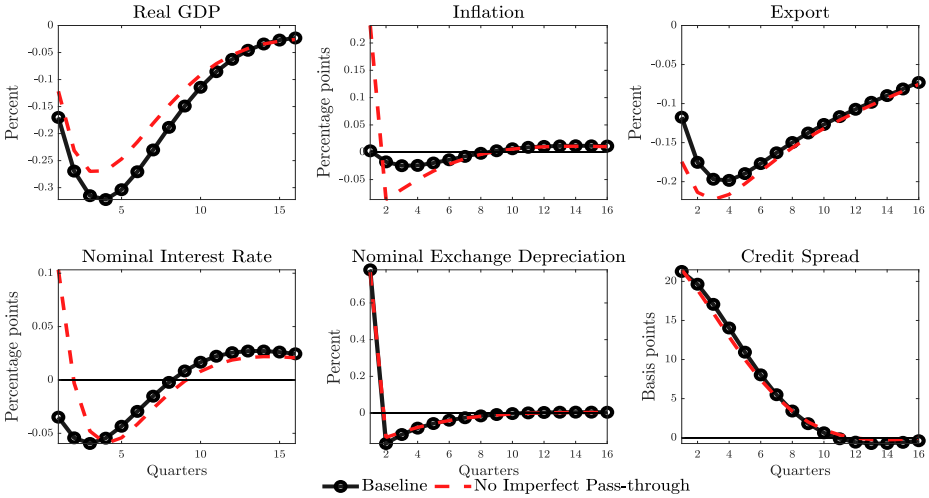
The Role of Financial Frictions



The Role of LCP



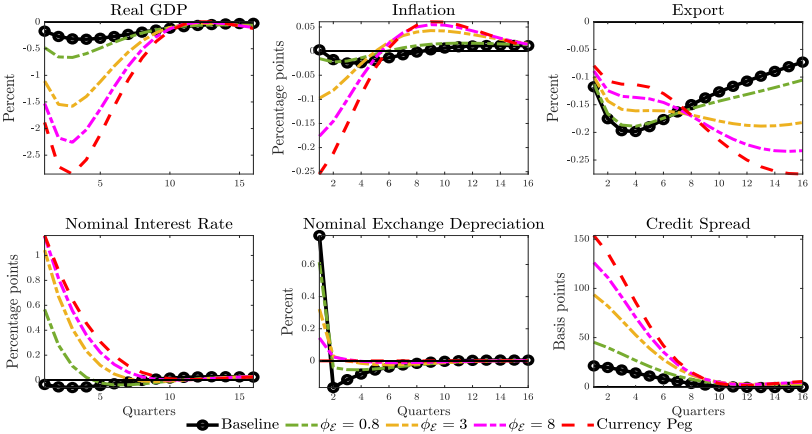
The Role of Imperfect Pass-Through



3. Policy Analysis

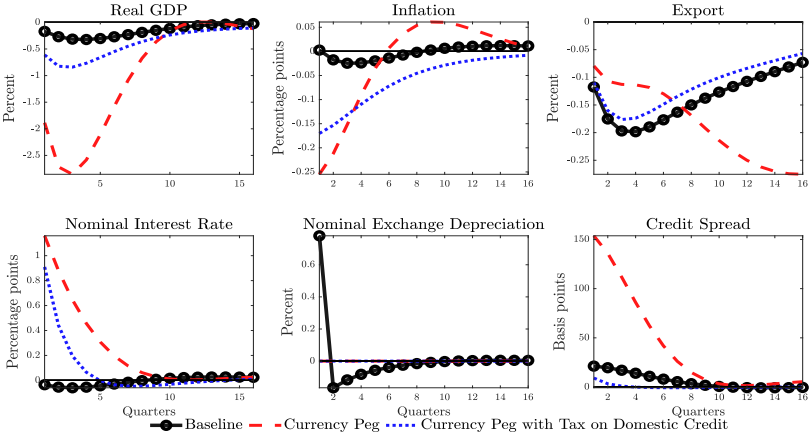
Exchange Rate Peg

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



Peg + Tax on Domestic Credit

- **Tax on domestic credit alleviates negative consequences of peg**
  - Feedback rule that responds to credit spreads



Conclusions

1. Panel VAR $\rightarrow$ Consistent with idea of Global Financial Cycle
   - Contractionary US monetary policy shock leads to a domestic recession
   - Despite domestic currency depreciation
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)
   - Tax on domestic credit (or foreign borrowing) limits negative effects of peg on GDP

A1: Panel VAR Details

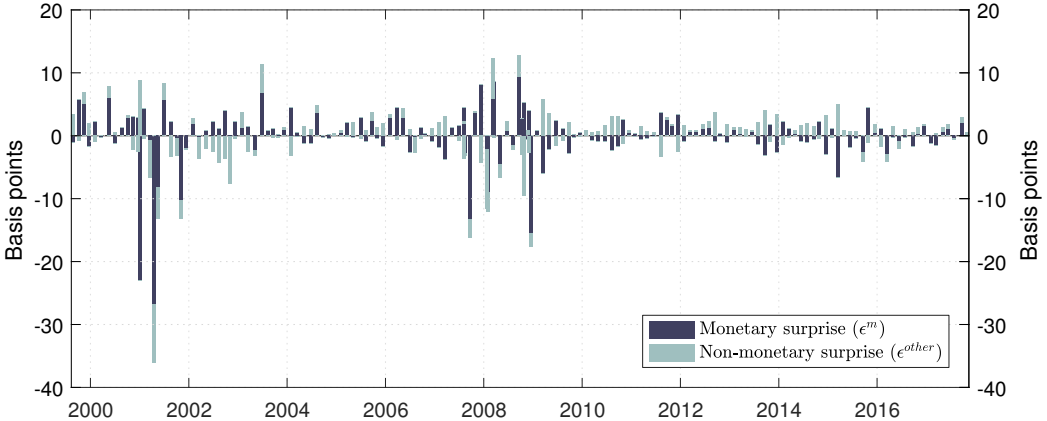
Interest Rate Surprises

- 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)	$+$	$+$

Decomposition of Interest Rate Surprises

- Decomposition of s_t^i into monetary (ϵ_t^m) and non-monetary (ϵ_t^{other}) shocks



A2: DSGE Model Details

Home Banks

- 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)

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- **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

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- 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

- 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

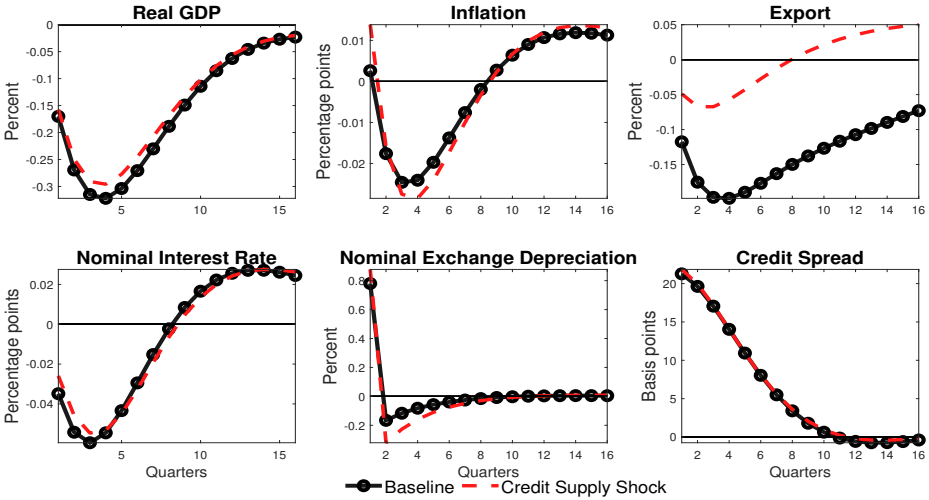
Calibrated Parameters

Parameter		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	0.91	0.99
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	Capital share	0.33	0.33
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

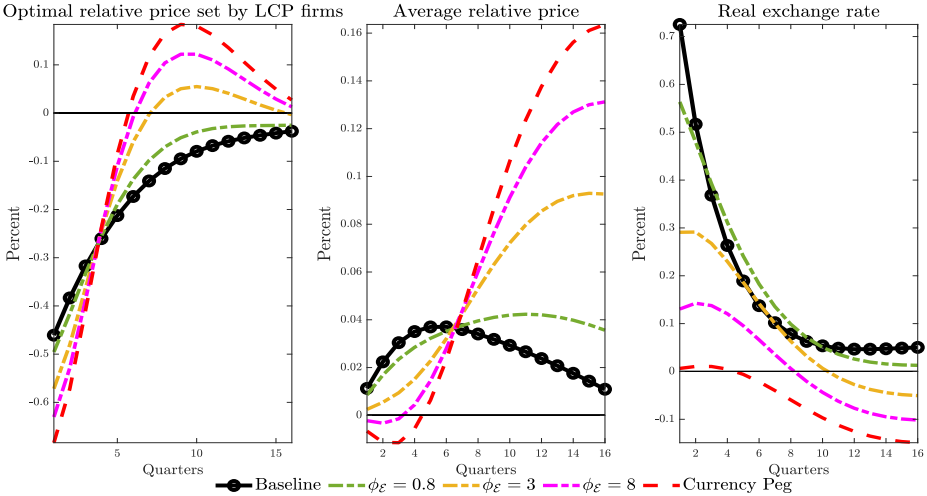
Estimated Parameters

Parameter	Prior			Posterior		
	Distribution	Mean	Standard Deviation	Mode	5%	95%
h	Beta	0.650	0.1	0.659	0.504	0.816
σ	Normal	1	0.375	0.779	0.553	1.300
λ	Normal	5	1	4.887	3.419	6.462
x	Normal	0.300	1	0.158	0.043	0.244
φ_i	Normal	2.850	1.5	0.517	0.122	1.554
ξ_p	Beta	0.660	0.1	0.909	0.791	0.960
ξ_{im}	Beta	0.660	0.1	0.705	0.540	0.854
ρ_R	Normal	0.750	0.1	0.691	0.565	0.860
ϕ_π	Normal	1.500	0.25	2.124	1.716	2.529
ϕ_y	Normal	0.125	0.05	0.151	0.064	0.226
ρ_R^*	Normal	0.750	0.1	0.784	0.633	0.861
ϕ_π^*	Normal	1.500	0.25	2.120	1.717	2.511
ϕ_y^*	Normal	0.125	0.05	0.126	0.043	0.206

US Credit Supply Shock



Peg and Real Exchange Rate



Tax on Domestic Credit

- Reduces banks' return on lending in domestic currency

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

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- Directly impacts credit spreads

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

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

- 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**

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

with $\phi_k < 0$