

Monetary and Exchange Rate Policies in a Global Economy

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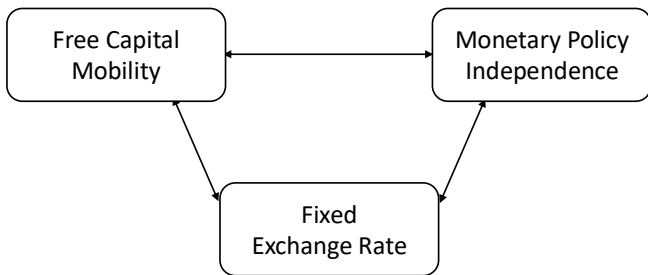
The University of Cambridge

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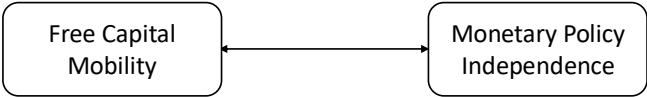
► Example

International Macro in the Past Decades



- Classical Theory (Mundell-Fleming)

International Macro in the Past Decades



Model Takeaway:

- Without FXI, external shocks **weaken the MP independence**
 - MP cannot stabilize domestic inflation/output
- **FXI improves the MP independence** and complements the MP
 - Stabilize inflation with small interest rate changes
 - FXI complements the MP

Step-by-step construction of a large two-country model

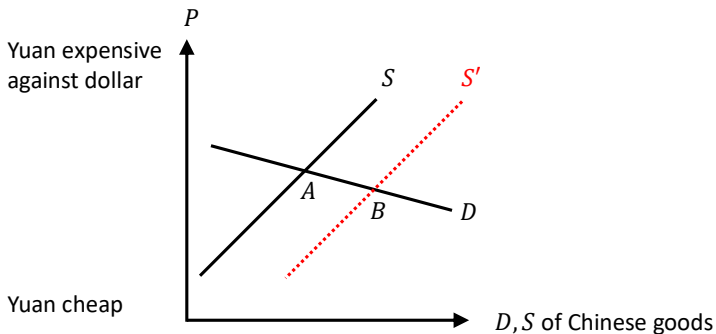
- ① (Known) starting point: monetary policy (Corsetti/Dedola/Leduc'23)
- ② Model setup: monetary policy & FXI
- ③ Optimal policy under cooperation
- ④ Extension: Dollar pricing
- ⑤ Robustness: Optimal policy under non-cooperation

Step-by-step construction of a large two-country model

- ① (Known) starting point: monetary policy (Corsetti/Dedola/Leduc'23)
 - Define international risk-sharing
 - Inflation-output trade-off due to the lack of risk-sharing
- ② Model setup: monetary policy & FXI
- ③ Optimal policy under cooperation
- ④ Extension: Dollar pricing
- ⑤ Robustness: Optimal policy under non-cooperation

International Risk Sharing (Concept)

- Planner targets risk-sharing under cooperation.
 - China supply $\uparrow \rightarrow$ China consumption \uparrow
 - Cheap yuan \rightarrow US import price \downarrow , US consumption \uparrow (smoothing)



International Risk Sharing (Definition)

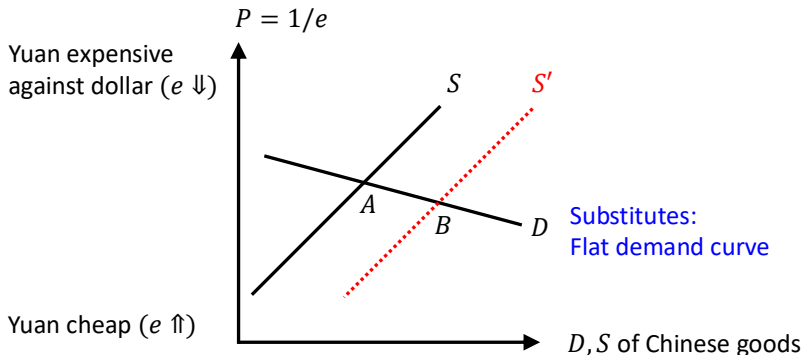
- Risk-sharing wedge = Difference in marginal utilities

$$\begin{aligned}\tilde{\mathcal{W}}_t &\equiv \widetilde{U'(C_t^*)} - \widetilde{U'(C_t)} - \tilde{e}_t \\ &= \tilde{C}_t - \tilde{C}_t^* - \tilde{e}_t \quad (\text{with log utility})\end{aligned}$$

- $\tilde{\mathcal{W}}_t > 0$ (China excess demand) when:
 - $\tilde{C}_t > \tilde{C}_t^*$ (China > US consumption)
 - $\tilde{e}_t \downarrow$ (Yuan is expensive against the dollar)

Lack of Risk Sharing when Goods are Substitutes

- China productivity $\uparrow \rightarrow$ excess demand ($\tilde{W} = \tilde{C} - \tilde{C}^* - \tilde{e} > 0$)
- China consumption $C \uparrow$ but small yuan depreciation $e \uparrow$



Step-by-step construction of a large two-country model

- 1 (Known) starting point: monetary policy
- 2 Model setup: monetary policy & FXI
 - FXI is effective under **frictions in international asset trade**
(Gabaix/Maggiore'15, Itskhoki/Mukhin'23)
 - **FXI mitigates the inflation-output trade-off** of monetary policy
- 3 Optimal policy under cooperation
- 4 Extension: Dollar pricing
- 5 Robustness: Optimal policy under non-cooperation

FXI: Basic Idea

- Central banks use **both MP and FXI**
- **Data:** unhedged returns on savings are different across currencies
 - Uncovered Interest Parity (UIP) deviation (Fama'94) [Details](#)
- Assume **households can only borrow/lend in their own currency.**
⇒ FXI affects the exchange rate (Gabaix/Maggiore'15, Itskhoki/Mukhin'21)
- **Example:** China buys the yuan → return on yuan < \$
 - Households cannot borrow in yuan to invest in \$
 - (More formally) limits to financial intermediation [Details](#)

UIP Condition (Case 1: No FXI)

- Known result in Corsetti/Dedola/Leduc'23 (No FXI case)

$$\underbrace{E_t \tilde{\mathcal{W}}_{t+1} - \tilde{\mathcal{W}}_t}_{\tilde{\mathcal{W}}_t > 0: \text{ local demand}} = \underbrace{\tilde{r}_t - \tilde{r}_t^* - (E_t \tilde{e}_{t+1} - \tilde{e}_t)}_{\text{Local} - \$ \text{ return}} = 0$$

- Same return \rightarrow consumption smoothing on average
- When goods are substitutes, $\tilde{\mathcal{W}}_t \neq 0$
 \rightarrow MP trades off inflation-output

UIP Condition (Case 2: FXI)

- Formalization of Gabaix/Maggiori'15 gives:

▶ Details

$$\underbrace{E_t \tilde{W}_{t+1} - \tilde{W}_t}_{\tilde{W}_t > 0: \text{local demand}} = \underbrace{\tilde{r}_t - \tilde{r}_t^* - (E_t \tilde{e}_{t+1} - \tilde{e}_t)}_{\text{Local} - \$ \text{ return}} = \underbrace{\omega f_t^*}_{\text{FXI}}$$

(ω : intermediation friction, $f_t^* > 0$: buy \$ / sell local)

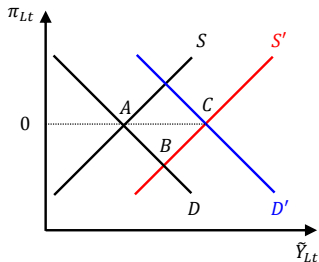
- **Buy \$:** \rightarrow \$ expensive ($\tilde{e}_t \uparrow \uparrow$), return on local $>$ \$

- Local demand $\tilde{\mathcal{W}}_t \Downarrow$

- FXI affects the MP trade-off (My paper's focus)

FXI Affects the Inflation/Output Trade-off

- Buy \$ \rightarrow \$ expensive
- Income effect:
 - Local demand $\tilde{\mathcal{W}}_t \downarrow$, $\pi_{Lt} \downarrow \rightarrow$ interest rate \downarrow , $\tilde{Y}_{Lt} \uparrow$
- Substitution effect:
 - Demand shifts from US to local goods, $\tilde{Y}_{Lt} \uparrow$



FXI Affects the Inflation/Output Trade-off

- Buy \$ \rightarrow \$ expensive
- Income effect:
 - Local demand $\tilde{W}_t \downarrow$, $\pi_{Lt} \downarrow \rightarrow$ interest rate \downarrow , $\tilde{Y}_{Lt} \uparrow$
- Substitution effect:
 - Demand shifts from US to local goods, $\tilde{Y}_{Lt} \uparrow$
- Implications:
 - The planner cares about both domestic and global distortions
 - FXI affects the inflation-output trade-off of monetary policy via changes in the exchange rate and global demand

Roadmap

Step-by-step construction of a large two-country model

- ① (Known) starting point: monetary policy
- ② Model setup: monetary policy & FXI
- ③ Optimal policy under cooperation
 - Analytical characterization of optimal MP and FXI rules
 - Calibrate the model and quantify the effect of FXI
 - Relationship with Mundell-Fleming “trilemma”
- ④ Extension: Dollar pricing
- ⑤ Robustness: Optimal policy under non-cooperation

Optimal Policy: Cooperation & Commitment

- Planner maximizes the sum of welfare in the two countries
- Minimize the weighted sum of: [▶ Objective function](#)
 - **Inflation rate** for goods produced in each country (producer-price)
 - **Output gap** in each country
 - **Risk-sharing wedge** across countries (Corsetti/Dedola/Leduc'23)
- Analytical FXI rule + quantification
- Calibration: FXI & UIP data for 11 major currencies [▶ Details](#)

Optimal Policy: Cooperation & Commitment

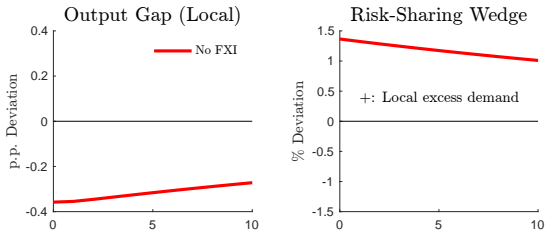
- Planner maximizes the sum of welfare in the two countries
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▶ Objective function

 - **Inflation rate** for goods produced in each country (producer-price)
 - **Output gap** in each country
 - **Risk-sharing wedge** across countries
- Case 1: **No FXI**, inflation-targeting MP (Corsetti/Dedola/Leduc'23)
- Case 2: **Optimal FXI**, inflation-targeting MP
- Case 3: **Optimal MP & FXI**

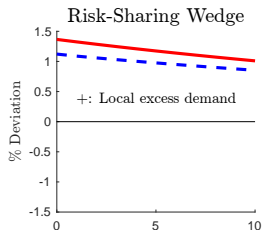
Case 1: Inflation-Targeting MP, No FXI (Recap)

- Monetary policy follows strict inflation targeting ($\pi_{Lt} = 0$)
- Local productivity $A_t \uparrow \rightarrow$ demand $\tilde{W}_t \uparrow$
 \rightarrow Inflation $\pi_{Lt} \uparrow \rightarrow$ interest rate \uparrow , output gap $\tilde{Y}_{Lt} \downarrow$



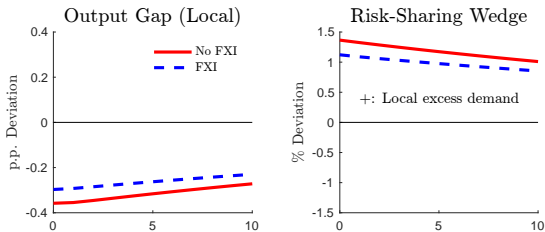
Case 2: Optimal FXI, Inflation-Targeting MP (Concept)

- Demand shifts from US to local goods, $\tilde{Y}_{Lt} \uparrow$

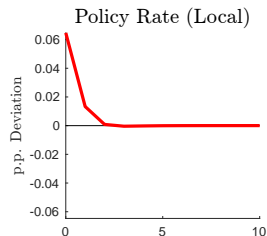


Case 2: Optimal FXI, Inflation-Targeting MP (Concept)

- Without FXI, monetary policy trades off inflation and output due to the lack of risk-sharing.
- FXI mitigates this monetary policy trade-off.



- External shocks **weaken monetary policy independence**

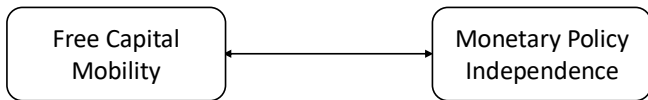


Model Takeaway



- Without FXI, external shocks **weaken the MP independence**
 - MP cannot stabilize domestic inflation/output
- **FXI improves the MP independence**
 - Stabilize inflation with small interest rate changes
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Model Takeaway



- Without FXI, external shocks **weaken the MP independence**
 - MP cannot stabilize domestic inflation/output
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- **Literature:** separate objectives
 - MP \Rightarrow inflation/output, FXI \rightarrow capital flow (UIP) shocks

Step-by-step construction of a large two-country model

- ① (Known) starting point: monetary policy
- ② Model setup: monetary policy & FXI
- ③ Optimal policy under cooperation
- ④ Extension: Dollar pricing
 - Optimal FXI volume is large under dollar pricing
 - Transmission is asymmetric: FXI stabilizes local inflation more
- ⑤ Robustness: Optimal policy under non-cooperation

Step-by-step construction of a large two-country model

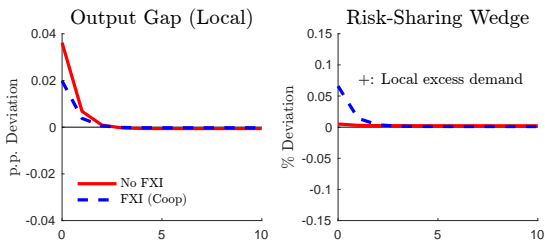
- 1 (Known) starting point: monetary policy
- 2 Model setup: monetary policy & FXI
- 3 Optimal policy under cooperation
- 4 Extension: Dollar pricing
- 5 Robustness: Optimal policy under non-cooperation
 - Case 1: **Optimal FXI**, inflation-targeting MP
 - Case 2: **Optimal MP and FXI**

Robustness: Non-Cooperative Equilibrium

- CB in each country maximizes domestic objective
 - Abstract from full strategic interaction in repeated games
- Assumptions:
 - CBs target **domestic inflation/output gap** (Bodenstein/etal'23)
 - Local CB uses **both MP & FXI**
 - US (Fed) uses **only MP**

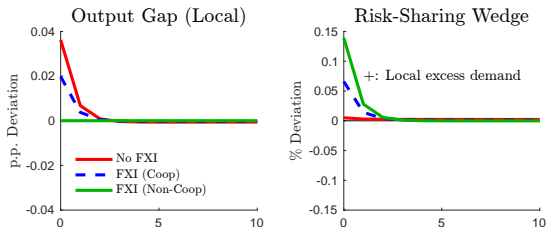
Optimal FXI under Inflation-Targeting MP (Recap)

- **No FXI:** US cost-push inflation $\uparrow \rightarrow$ \$ expensive $\rightarrow \tilde{Y}_{Lt} \uparrow$
- **FXI (Cooperation):** Sell \$ \rightarrow \$ cheap $\rightarrow \tilde{Y}_{Lt} \downarrow$



Optimal FXI under Inflation-Targeting MP

- **FXI (Non-Cooperation)** stabilizes local output: $E_t \tilde{Y}_{Lt+1} = \tilde{Y}_{Lt}$
- Sell \$ more than cooperation
- **Stabilizes** the output gap, **destabilizes** the risk-sharing



Conclusion

- Identification of FXI, empirical analysis (Rodnyansky/Timmer/Yago'24)
- How to combine FXI with capital control and macroprudential policy (Basu/etal'20)

Appendix

Monetary Policy and FXI: Recent Examples

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- Low interest rate policy during the pandemic and war:
 - China and India set a record low of 4% interest rate.
 - Brazil lowered the rate to 2%.
 - Japan set a negative interest rate.
- FXI by large open economies:
 - China and Japan have 3.5 trillion and 1.4 trillion dollars of foreign exchange reserves
 - 40% of the world's reserves, 20-30% of Chinese/Japanese GDP
 - US monitoring list for gaining unfair competitive advantage in trade
 - World foreign exchange reserves fell by 1 trillion dollars in 2021-22.
 - China and Brazil sold 38 billion and 25 billion dollars in 2020.
 - India and Japan sold 32 billion and 63 billion dollars in 2022.

Evidence for Limits to Arbitrage: UIP Deviation

Country	Currency	α_0	(s.e.)	β_1	(s.e.)	$\chi^2(\alpha_0 = \beta_1 = 0)$	R^2
Australia	AUD	-0.001	(0.002)	-1.63***	(0.48)	16.3***	0.014
Austria	ATS	0.002	(0.002)	-1.75***	(0.58)	9.5***	0.023
Belgium	BEF	-0.0002	(0.002)	-1.58***	(0.39)	17.5***	0.025
Canada	CAD	-0.003	(0.001)	-1.43***	(0.38)	19.1***	0.013
Denmark	DKK	-0.001	(0.001)	-1.51***	(0.32)	25.4***	0.025
France	FRF	-0.001	(0.002)	-0.84	(0.63)	1.9	0.007
Germany	DEM	0.002	(0.001)	-1.58***	(0.57)	7.9**	0.015
Ireland	IEP	-0.002	(0.002)	-1.32***	(0.38)	12.3***	0.020
Italy	ITL	-0.002	(0.002)	-0.79**	(0.33)	7.0**	0.013
Japan	JPY	0.006***	(0.002)	-2.76***	(0.51)	28.9***	0.038
Netherlands	NLG	0.003	(0.002)	-2.34***	(0.59)	16.0***	0.041
Norway	NOK	-0.0003	(0.001)	-1.15***	(0.39)	10.4***	0.013
New Zealand	NZD	-0.001	(0.002)	-1.74***	(0.39)	28.3***	0.038
Portugal	PTE	-0.002	(0.002)	-0.45**	(0.20)	5.9*	0.019
Spain	ESP	0.002	(0.003)	-0.19	(0.46)	2.8	0.001
Sweden	SEK	0.0001	(0.001)	-0.42	(0.50)	0.9	0.002
Switzerland	CHF	0.005***	(0.002)	-2.06***	(0.55)	13.9***	0.026
UK	GBP	-0.003**	(0.001)	-2.24***	(0.60)	14.2***	0.028
Panel, pooled		0.0002	(0.001)	-0.79***	(0.15)	22.3***	
Panel, fixed eff.				-1.01***	(0.21)	19.1***	

Source: Valchev (2015).

- If households could invest freely in two currencies, the excess return is zero (uncovered interest rate parity holds). However, UIP does not hold in data.
- Fama (1985) regression: $e_{t+1} - e_t - (i_t - i_t^*) = \alpha_0 + \beta_1(i_t - i_t^*) + \epsilon_t$
- When $\beta_1 < 0$, high interest rate currency appreciates in future = positive return

Solution to Households' Problem

- Euler equation for the local bond: $\beta R_t E_t \left(\frac{C_{t+1}}{C_t} \right)^{-\sigma} = 1$
- Labor supply equation: $C_t^\sigma L_t^\eta = \frac{W_t}{P_t}$
- Demand for local and US goods:

$$C_{Lt} = a \left(\frac{P_{Lt}}{P_t} \right)^{-\phi} C_t, \quad C_{Ut} = (1-a) \left(\frac{P_{Ut}}{P_t} \right)^{-\phi} C_t$$

- Demand for differentiated goods produced within each country:

$$C_t(l) = \left(\frac{P_t(l)}{P_{L_t}} \right)^{-\theta} C_{L_t}, \quad C_t(u) = \left(\frac{P_t(u)}{P_{L_t}} \right)^{-\theta} C_{U_t}$$

Intuition on NKPC

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Effects of terms-of-trade gap: (Clarida/Gali/Gertler'02)

- Consider US output $\tilde{Y}_{Ut} \uparrow$, local appreciation, import price \downarrow ($\tilde{\mathcal{T}}_t \downarrow$)
- $\phi > 1$: Local and US goods are **substitutes**
 - Import price \downarrow , local consumption $C_t \uparrow$ via risk sharing
 - Marginal cost $w_t = \frac{V'(L_t)}{U'(C_t)} \uparrow$, inflation $\pi_{Lt} \uparrow$
- $\phi < 1$: Local and US goods are **complements**
 - Export price $\uparrow \rightarrow$ marginal benefit of export \uparrow , inflation $\pi_{Lt} \downarrow$

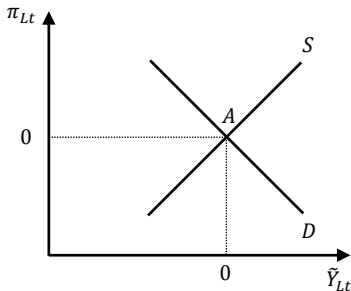
Effect of demand gap: (Corsetti/Dedola/Leduc'10)

- $\mathcal{W}_t \uparrow = U'(C_t) \downarrow \rightarrow$ marginal cost $w_t = \frac{V'(L_t)}{U'(C_t)} \uparrow$, inflation $\pi_{Lt} \uparrow$

Monetary Policy Trade-off: Special Case

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- Assume inflation targeting ($\pi_{Lt} = 0$) & trade elasticity = 1
- Local productivity $A_t \uparrow$ has no effect on $\tilde{\mathcal{W}}_t$
 → Inflation = output gap = 0 (No trade-offs)



International Asset Market: Details

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- $\bar{R}_t \equiv R_t - R_t^* \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t}$: local – \$ bond return

- Zero net position (aggregate):

$$B_t/R_t + \mathcal{E}_t B_t^*/R^* = 0, \quad U_t/R_t + \mathcal{E}_t U_t^*/R^* = 0,$$

$$D_t/R_t + \mathcal{E}_t D_t^*/R^* = 0, \quad F_t/R_t + \mathcal{E}_t F_t^*/R^* = 0$$

- Market clearing:

$$B_t + U_t + D_t + F_t = 0, \quad B_t^* + U_t^* + D_t^* + F_t^* = 0$$

Loss Function (PCP, Details)

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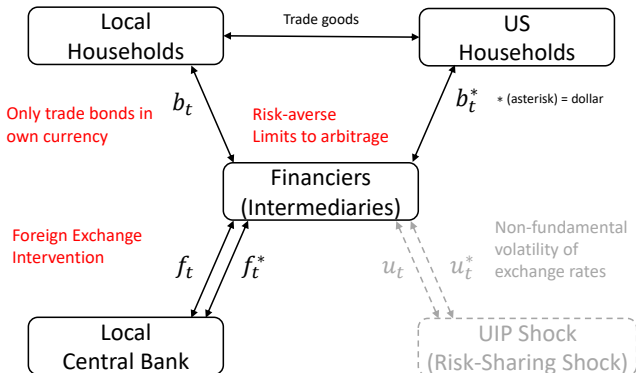
$$\mathcal{L} = -E_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{2} \left[\begin{aligned} & (\tilde{Y}_{Lt}^2 + \tilde{Y}_{Ut}^2) + \frac{\theta}{\kappa} (\pi_{Lt}^2 + \pi_{Ut}^{*2}) \\ & - \frac{2a(1-a)(\phi-1)}{4a(1-a)(\phi-1)+1} (\tilde{Y}_{Lt} - \tilde{Y}_{Ut})^2 \\ & + \frac{2a(1-a)\phi}{4a(1-a)(\phi-1)+1} \tilde{\mathcal{W}}_t^2 \end{aligned} \right],$$

where $\tilde{Y}_{Lt} - \tilde{Y}_{Ut} = [\{4a(1-a)(\phi-1)+1\}\tilde{\tau}_t + (2a-1)\tilde{\mathcal{W}}_t]$.

- Local supply $\tilde{Y}_{Lt} \uparrow \rightarrow$ local currency cheap, import price $\tilde{\tau}_t \uparrow$
- $\tilde{\mathcal{W}}_t \neq 0$ under incomplete asset market
 - Local productivity \uparrow
 \rightarrow local HHs lend to US HHs (under complete market)

Friction in International Asset Market

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- China buys the yuan \rightarrow return on yuan $<$ \$
- Financiers are risk-averse \rightarrow risk premium on \$

Financiers' Problem

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- Risk-averse financiers trade local & US bonds (Itskhoki/Mukhin'21)

$$\max_{d_t} E_t \left\{ -\frac{1}{\omega} \exp \left(-\omega^F \bar{R}_t d_t \right) \right\}$$

- $\omega^F > 0$: risk aversion
- \bar{R}_t : local – \$ bond return ($\neq 0$ when risk-averse)
- d_t : local bond purchases (\$ sales)

UIP condition (General Case)

► UIP simple case

$$\underbrace{E_t \tilde{W}_{t+1} - \tilde{W}_t}_{\Delta \text{ Demand gap}} = \underbrace{\tilde{r}_t - \tilde{r}_t^* - E_t \Delta \tilde{e}_{t+1}}_{\substack{\text{UIP deviation} \\ (\text{Local} - \$ \text{ return})}} = \underbrace{\chi_1(n_t^* - f_t)}_{\substack{\text{Noise trader buys } \$ (n_t^*) \\ - \text{ CB buys local } (f_t)}} - \underbrace{\chi_2 b_t}_{\text{HHs' savings}}$$

where $\omega_1 \equiv m_n(\omega\sigma_e^2/m_d)$, $\omega_2 \equiv \bar{Y}(\omega\sigma_e^2/m_d)$ for finite $(\omega\sigma_e^2/m_d)$.

- The risk aversion ω is scaled so that $\omega\sigma_e^2$ is finite and nonzero and risk premium is first-order. (Hansen/Sargent'11)
- I assume $\omega_2 = 0$ for analytical traceability.
 - The financial sector's population (m_d financiers and m_n traders) is larger than households.

Calibration

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▶ Countries / Sumstats

▶ Parameters

▶ Identification

▶ Regression

- Estimate the effect of FXI on UIP deviation
 - 2000-23, quarterly, 11 major currencies against the dollar
 - **UIP deviation**: exchange rate forecast & interbank rate (Bloomberg)
 - **FXI**: central bank websites, FRED, IMF data (Adler/etal'23)
- Identify FXI via **deviation from estimated policy rules**
(Fratzscher/etal'19, Rodnyansky/Timmer/Yago'24)
- Result: sell \$ (1% of GDP) → UIP ↓ by 0.51pp (local return ↓)

Countries / Summary Statistics

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Countries:

- Australia, Brazil, Canada, China, Euro area, India, Japan, Korea, Russia, Switzerland, and the United Kingdom
- **Robustness:** exclude small-open economies (Australia, Canada, Korea, and Switzerland) and managed exchange rate regime (China)

Summary Statistics of FXI:

	Mean	Median	SD	p25	p75	p90	Max	Obs
Sell Dollars (Billions)	10.19	2.09	24.65	0.74	7.73	22.10	179.88	262
Buy Dollars (Billions)	14.66	5.53	25.71	1.59	13.21	33.79	164.17	448

	Mean	Median	SD	p25	p75	p90	Max	Obs
Sell Dollars (% GDP)	0.48	0.18	0.92	0.06	0.52	1.09	9.11	262
Buy Dollars (% GDP)	0.91	0.35	1.79	0.13	1.02	2.08	19.86	448

Parameter Values

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Table 1: Parameter Values

Value	Description	Notes
$\beta = 0.995$	Discount factor (local)	Annual interest rate = 2%
$\sigma = 2$	Relative risk aversion	Itskhoki and Mukhin (2021)
$\eta = 0.35$	Inverse Frisch elasticity	Bodenstein et al. (2023)
$\zeta_l = 13.3$	Labor disutility (local)	Steady-state labor = 1/3
$a = 0.88$	Home bias of consumption	Bodenstein et al. (2023)
$\phi = 2.0$	CES Local & US goods	Bodenstein et al. (2023)
$\theta = 10$	CES differentiated goods	Price markup = 11%
$\xi_p = 0.60$	Calvo price stickiness	Duration of four quarters
$\bar{\pi} = 1$	Steady-state inflation	
$\chi = 1.42$	UIP coefficient on FXI	$\Delta(UIP)/\Delta(FXI/GDP) = 0.47$
$\rho_a = 0.97$	Persistence of productivity shock	Itskhoki and Mukhin (2021)
$\rho_\mu = 0.2$	Persistence of markup shock	Bodenstein et al. (2023)
$\sigma_a = 0.015$	SD of productivity shock	Bodenstein et al. (2023)
$\sigma_\mu = 0.019$	SD of markup shock	Bodenstein et al. (2023)

Identification of FXI

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- Identify direct effect of FXI by **deviations from an FXI policy rule**

$$FXI_{i,t} = \alpha + \beta X_{i,t-1} + \gamma_i + \epsilon_{i,t}$$

- $FXI_{i,t}$: FXI in country i , quarter t (> 0 : sell \$, % over GDP)
- $X_{i,t-1}$: controls (lagged)
 - Past FXI over GDP ratio, trend/volatility of the spot exchange rate, UIP deviation, VIX, local/US policy rates, consumer price inflation, unemployment rate, current account over GDP ratio
- γ_i : country fixed effect

First-step Regression

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Dependent Variable	FXI / GDP (%)	
	(1)	(2)
Lagged FXI / GDP (%)	0.129*** (0.040)	0.283*** (0.056)
Lagged Exchange Depreciation (%)	0.005 (0.014)	0.006 (0.011)
Lagged Exchange Volatility (%)	0.089 (0.062)	0.006 (0.044)
Lagged UIP Deviation (p.p.)	0.010 (0.007)	0.012** (0.006)
Lagged log(VIX)	-0.135 (0.203)	-0.065 (0.162)
Lagged Policy Rate (Local)	-0.078* (0.046)	-0.030 (0.032)
Lagged Policy Rate (US)	0.041 (0.048)	-0.077* (0.040)
Lagged CPI Inflation (%)	0.041 (0.039)	0.026 (0.026)
Lagged Unemployment Rate (%)	0.004 (0.055)	-0.003 (0.035)
Lagged Current Account / GDP (%)	-0.115*** (0.031)	-0.069* (0.038)
R^2	0.176	0.259
N	627	309
Country Fixed Effect	✓	✓
Exclude Small Economy		✓
Exclude Managed Exchange Rate		✓

- 74 - 82% of variation in intervention cannot be explained.

Estimating the Effect of FXI on UIP Deviation

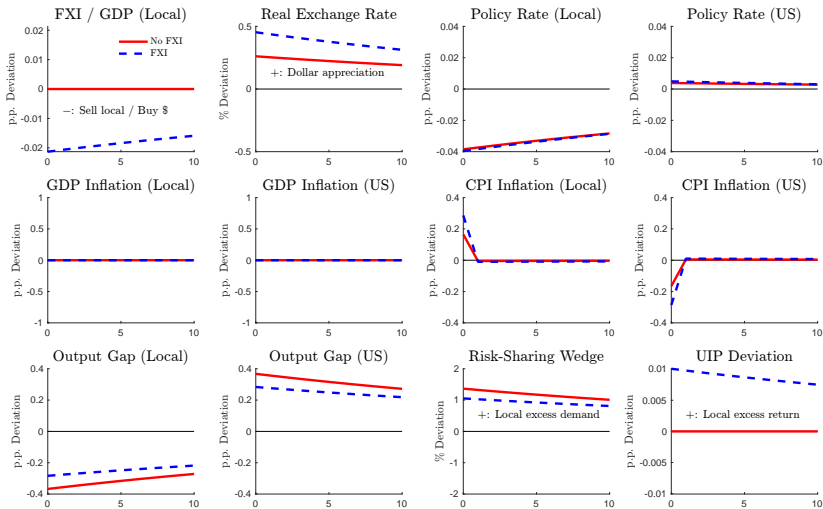
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Dependent Variable	$UIP_t - UIP_{t-1}$			
	(1)	(2)	(3)	(4)
Net \$ Sales / GDP (%)	-0.589** (0.264)	-0.509** (0.212)	-1.599*** (0.182)	-1.106*** (0.178)
R^2	0.004	0.013	0.009	0.020
N	706	392	367	212
Country Fixed Effect	✓	✓	✓	✓
Identified		✓		✓
Exclude Small Economy			✓	✓
Exclude Fixed Exchange Rate			✓	✓

- Sell \$ (1% of GDP) → UIP ↓ by 0.5-0.6 pp (local return ↓)
- More effective without small economies (Swiss franc: liquid)

Optimal FXI + Inflation-Targeting MP (Productivity)

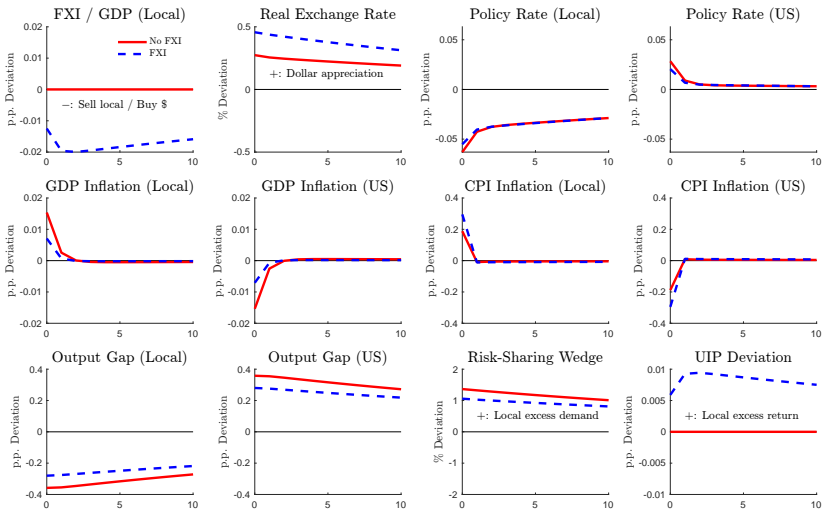
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- The local policy rate can increase (buy \$) or decrease (to target inflation).

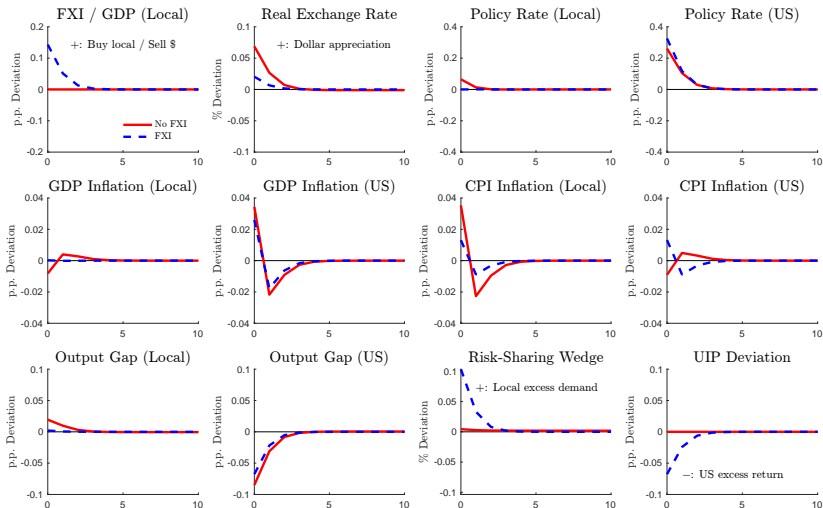
Impulse Response to a Local Productivity Increase

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Impulse Response to a US Markup Increase

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NKPC and Loss Function under Dollar Pricing

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- NKPCs for local goods in LC (π_{Lt}) and \$ (π_{Lt}^*), US goods in \$ (π_{Ut}^*)
 - Local good inflation depends on the LOOP deviation (Δ_{Lt})

$$\pi_{Lt} = \beta\pi_{Lt+1} + \kappa\{(\sigma + \eta)\tilde{Y}_{Lt} - (1 - a)[2a(\sigma\phi - 1)(\tilde{T}_t + \tilde{\Delta}_{Lt}) + (\tilde{D}_t + \tilde{\Delta}_{Lt})] + \mu_t\}$$

$$\pi_{Lt}^* = \beta\pi_{Lt+1}^* + \kappa\{(\sigma + \eta)\tilde{Y}_{Lt} - (1 - a)[2a(\sigma\phi - 1)(\tilde{T}_t + \tilde{\Delta}_{Lt}) + (\tilde{D}_t + \tilde{\Delta}_{Lt})] - \tilde{\Delta}_{Lt} + \mu_t^*\}$$

$$\pi_{Ut}^* = \beta\pi_{Ut+1}^* + \kappa\{(\sigma + \eta)\tilde{Y}_{Ut} + (1 - a)[2a(\sigma\phi - 1)\tilde{T}_t - \tilde{D}_t] + \mu_t^*\}$$

- Loss function depends on the LOOP deviation (Δ_{Lt}):

$$\mathcal{L} = -E_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{2} \left[\begin{aligned} & (\sigma + \eta) (\tilde{Y}_{Lt}^2 + \tilde{Y}_{Ut}^2) + \frac{\theta}{\kappa} (a\pi_{Lt}^2 + (1 - a)\pi_{Lt}^{*2} + \pi_{Ut}^{*2}) \\ & - \frac{2a(1 - a)(\sigma\phi - 1)\sigma}{4a(1 - a)(\sigma\phi - 1) + 1} (\tilde{Y}_{Lt} - \tilde{Y}_{Ut})^2 \\ & + \frac{2a(1 - a)\phi}{4a(1 - a)(\sigma\phi - 1) + 1} (\tilde{W}_t + \Delta_{Lt})^2 \end{aligned} \right]$$

Dollar Pricing: Optimal Monetary Policy

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Optimal monetary policy under DCP when FXI is not available:

$$0 = \theta a \pi_{L_t} + (\tilde{C}_t - \tilde{C}_{t-1}) + \frac{2a(1-a)\phi}{2a(\phi-1)+1} \frac{\sigma-1}{\sigma} (\tilde{W}_t - \tilde{W}_{t-1} + \tilde{\Delta}_t - \tilde{\Delta}_{t-1})$$

$$0 = \theta[(1-a)\pi_{L_t}^* + \pi_{U_t}^*] - (\tilde{C}_t^* - \tilde{C}_{t-1}^*) - \frac{2a(1-a)\phi}{2a(\phi-1)+1} \frac{\sigma-1}{\sigma} (\tilde{W}_t - \tilde{W}_{t-1} + \tilde{\Delta}_t - \tilde{\Delta}_{t-1})$$

- Local: trades off **local inflation** and demand growth.
- US: trades off **international dollar price inflation** and demand growth.
- When $\sigma \neq 1$, MP also trades off the LOOP deviation.

Dollar Pricing: Optimal Monetary Policy and FXI

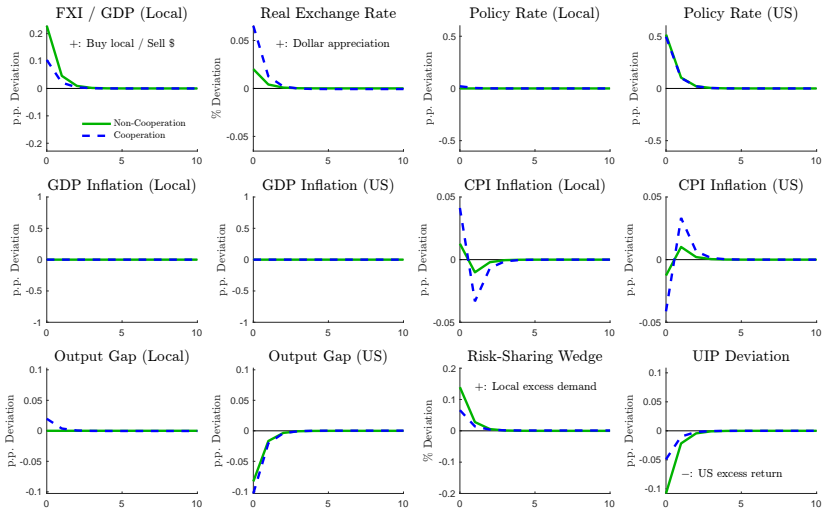
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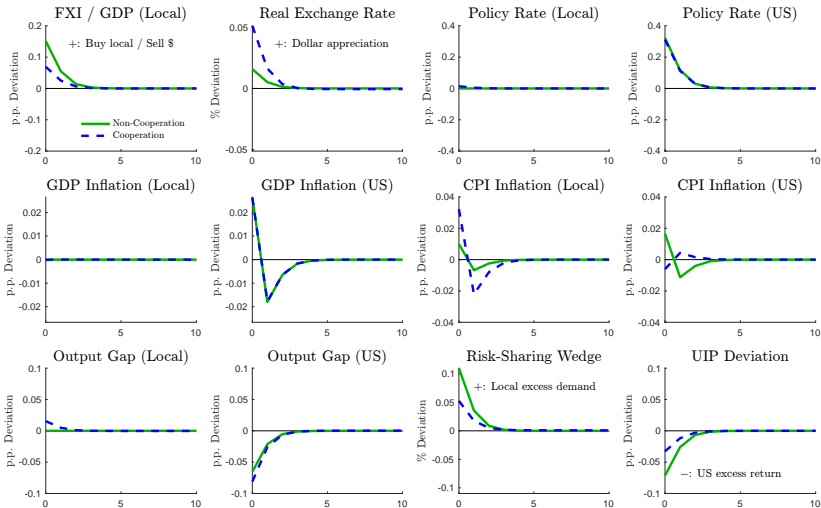
Optimal monetary policy and FXI under DCP:

$$\begin{aligned}
 0 &= \tilde{Y}_{Lt} + \theta[a\pi_{Lt} + (1-a)\pi_{Lt}^*], \\
 0 &= \tilde{Y}_{Ut} + \theta\pi_{Ut}^* + \gamma\Delta_{Lt} - \gamma\Delta_{Lt-1}, \\
 \gamma\Delta_{Lt} &= -\frac{4a(1-a)}{2a-1}(\tilde{\Delta}_{Lt} + \tilde{\mathcal{V}}_t) + \theta\frac{1}{2a-1} \\
 &\quad \times [a\pi_{Lt} - ((1-a)\pi_{Lt}^* + \pi_{Ut}^*)] - (2a-1)[a\pi_{Lt} + (1-a)\pi_{Lt}^* + \pi_{Ut}^*] \\
 f_t &= n_t^* + \frac{\theta}{2a\chi_1}E_t[a\pi_{Lt+1} + (1-a)\pi_{Lt+1}^* + \pi_{Ut+1}^*] \\
 &\quad + \frac{2a-1}{2a(1-a)\chi_1}(E_t\gamma\Delta_{t+t} - \gamma\Delta_t).
 \end{aligned}$$

- Local: MP trades off local inflation and output growth.
- US: MP trades off US inflation, output growth, LOOP deviation, and demand gap.
- FXI responds to the LOOP deviation.

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Maximization Problem (Non-Cooperation)

- The local CB solves:

$$\max \mathcal{L} = -E_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{2} \left[\tilde{Y}_{Lt}^2 + \frac{\theta}{\kappa} \pi_{Lt}^2 \right] \quad \text{s.t.}$$

$$\pi_{L_t} = \beta E_t \pi_{L_{t+1}} + \kappa [\tilde{Y}_{L_t} - 2a(1-a)(\phi-1)\tilde{\mathcal{T}}_t + (1-a)\tilde{\mathcal{W}}_t,$$

$$E_t \tilde{\mathcal{W}}_{t+1} - \tilde{\mathcal{W}}_t = -\bar{\omega} f_t$$

- Optimal MP & FXI rules:

$$0 = \theta \pi_{Lt} + \frac{\sigma + \eta}{\sigma + \eta - \frac{(1-a)(\sigma-1)}{2a(\phi-1)+1}} (\tilde{Y}_{Lt} - \tilde{Y}_{Lt-1})$$

$$E_t \tilde{Y}_{L_{t+1}} = \tilde{Y}_{L_t} \quad (E_t \tilde{\pi}_{L_{t+1}} = 0)$$