Capital Flows and Foreign Exchange Intervention

Paolo Cavallino

International Monetary Fund

BoI-SNB-CEPR Conference
December 7-8, 2017

The views expressed in this presentation are those of the author and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

Introduction

This paper studies the use of FXI in response to capital flow shocks

- Why? Portfolio inflows generate inefficient boom-bust cycles
  - Optimal FXI leans against the wind and stabilizes the ex rate
    1. dynamic terms of trade manipulation
    2. improve output/inflation trade-off
    3. sustain exports (if monetary policy not available)
  - Monetary policy and FXI are complements not substitutes
- How? Optimal FXI rule as a function of 3 targets
  1. wedge in Backus-Smith condition
  2. net foreign assets
  3. foreign reserves level
- How much? Calibrate and estimate the model using Swiss data
  - A cap inflow of 16% of GDP appreciates franc 6% nominal, 3% real
  - Optimal FXI reduces exchange rate fluctuations by 2/3

- Continuous time, infinite horizon, NK Small Open Economy
- The representative Home household maximizes

$$\mathbb{E}\left[\int_0^\infty e^{-\rho t}\left(\ln C - \frac{L^{1+\varphi}}{1+\varphi}\right) dt\right]$$

where consumption is given by $C \equiv C_H^{1-\alpha} C_F^{\alpha}$

- A continuum of firms $j \in [0,1]$ produce differentiated goods

$$Y_j = L_j$$

and set prices in domestic currency $P_{H,j}^* = \frac{P_{H,j}}{\mathcal{E}}$

- Home households can only hold/issue bonds in domestic currency
- Must trade with international financial intermediaries
  - Financiers intermediate flows at a premium

$$\hat{Q}_H = \frac{i - i^* - \mu_{\mathcal{E}}}{\gamma \sigma_{\mathcal{E}}^v}$$

  - A fraction β of intermediaries are owned by Home households
- Home central bank can hold foreign reserves:

$$\hat{X}_H + \mathcal{E}\hat{X} = 0$$

- Market clearing in Home bond market requires:

$$\underbrace{\hat{A}}_{\text{Home HHs}} + \underbrace{\hat{Q}_H}_{\text{Intermediaries}} + \underbrace{\hat{X}_H}_{\text{Central Bank}} + \underbrace{\hat{F}^*_H}_{\text{Foreign HHs}} = 0$$

- Arbitrage condition between Home and foreign bonds

$$i - i^* - \mu_{\mathcal{E}} = -\gamma \sigma^2_{\mathcal{E}} \left(\underbrace{\hat{A}}_{\text{CA Flow}} + \underbrace{\hat{F}^*_H}_{\text{Portfolio Flow}} + \underbrace{\hat{X}_H}_{\text{Intervention}} \right)$$

- Deviations from UIP are proportional to global imbalances

Define the consumption wedge as

$$\mathcal{Q}\,\Lambda = (C^*/C)^{-1}$$

Its law of motion is

$$\frac{d\Lambda}{\Lambda} = \left[\underbrace{i - i^* - \mu_{\mathcal{E}}}_{\Delta UIP} + \sigma_{\mathcal{E}}^2 + \sigma_\Lambda\left(\sigma_{\mathcal{E}} + \sigma_\Lambda\right)\right] dt + \sigma_\Lambda dZ$$

Link between deviations from UIP and real variables:

$$\text{Cap Outflow} \implies \Delta\text{UIP} > 0 \implies \Lambda \downarrow \implies C \downarrow \text{ and } \mathcal{Q} \uparrow$$

$$\text{Cap Inflow} \implies \Delta\text{UIP} < 0 \implies \Lambda \uparrow \implies C \uparrow \text{ and } \mathcal{Q} \downarrow$$

Equilibrium and Planner Problem

The planner chooses foreign reserves $\hat{x}$ and interest rate i to min

$$\mathbb{L} = \frac{1}{2}\int_0^\infty e^{-\rho t}\left(\ \phi_x \hat{x}^2 + \phi_\lambda \lambda^2 + \phi_\pi \pi_H^2 + \phi_y y^2\ \right) dt$$

$$d\lambda = -\gamma\left(\hat{a} + \hat{f}_H^* - \hat{x}\right) dt$$

$$d\hat{a} = \left(\rho\hat{a} - \alpha\lambda\right) dt$$

$$dy = \left(i - \rho - \pi_H\right) dt - \alpha d\lambda$$

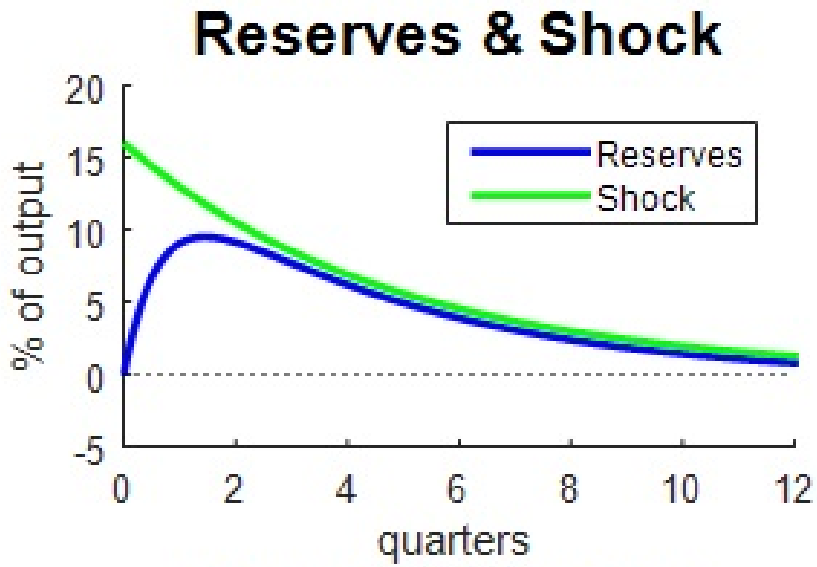
$$d\pi_H = \left[\rho\pi_H - \kappa\left(1+\varphi\right) y - \alpha\kappa\lambda\right] dt$$

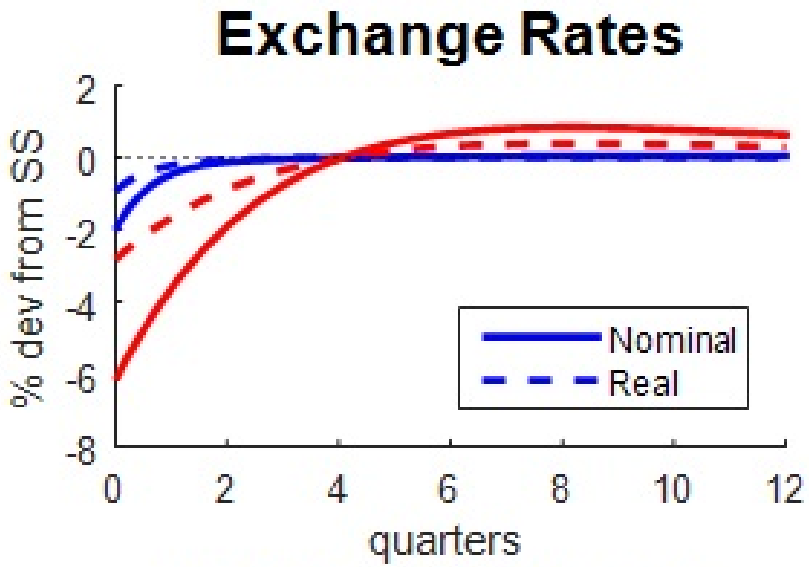
with $d\hat{f}_H^* = -\varrho\hat{f}_H^* dt$. Fluctuations in λ cause 3 types of welfare cost

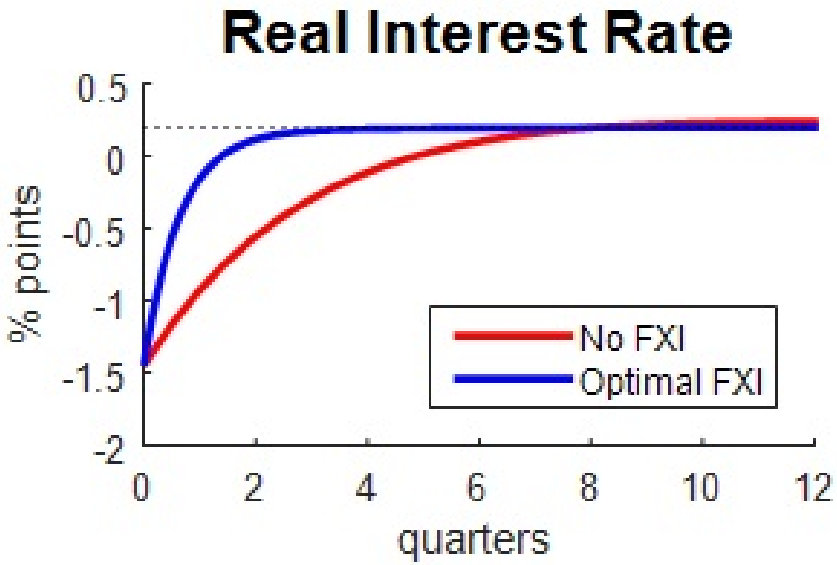
1. lower PDV of consumption stream (direct cost)
2. raise real wage and shift Phillips curve (indirect cost)
3. alter foreign currency prices (indirect cost, price rigidity)

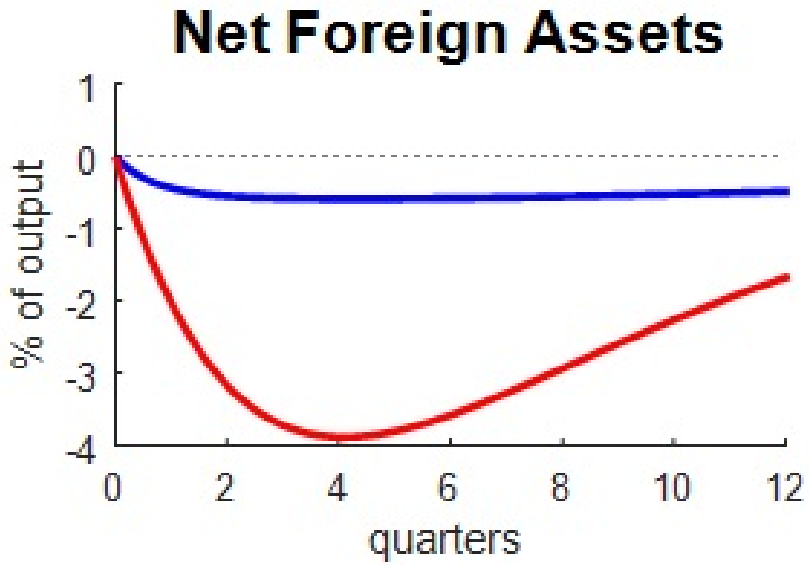
Optimal FX Intervention

Flexible Prices



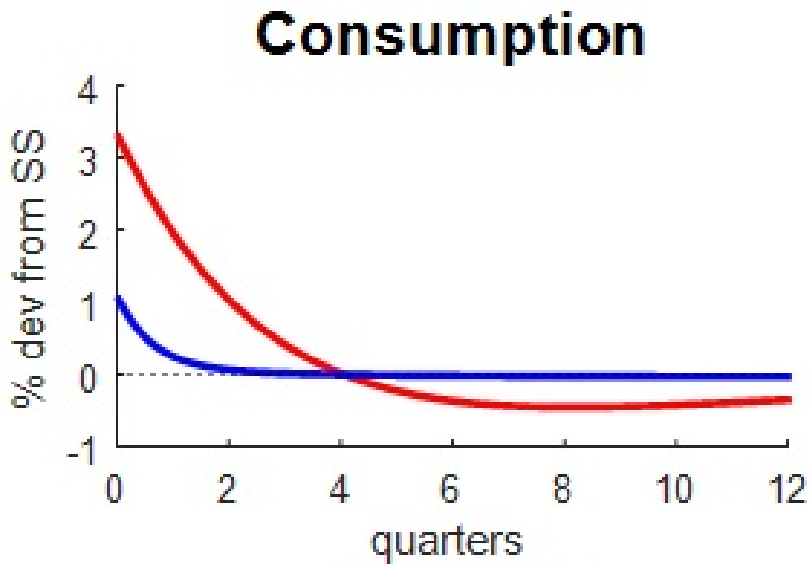


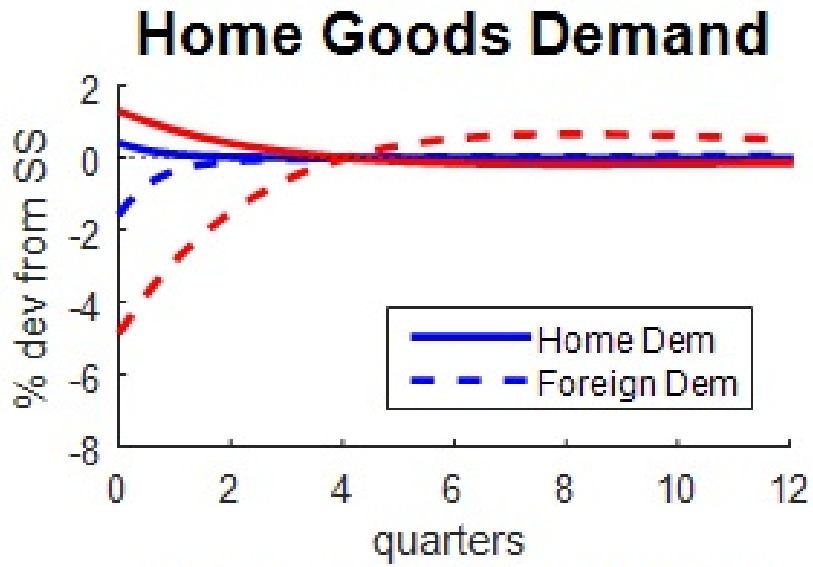


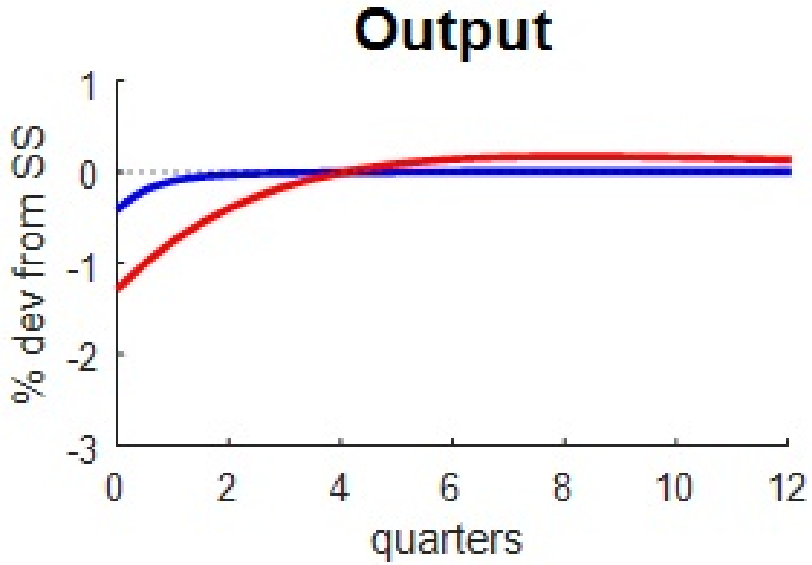


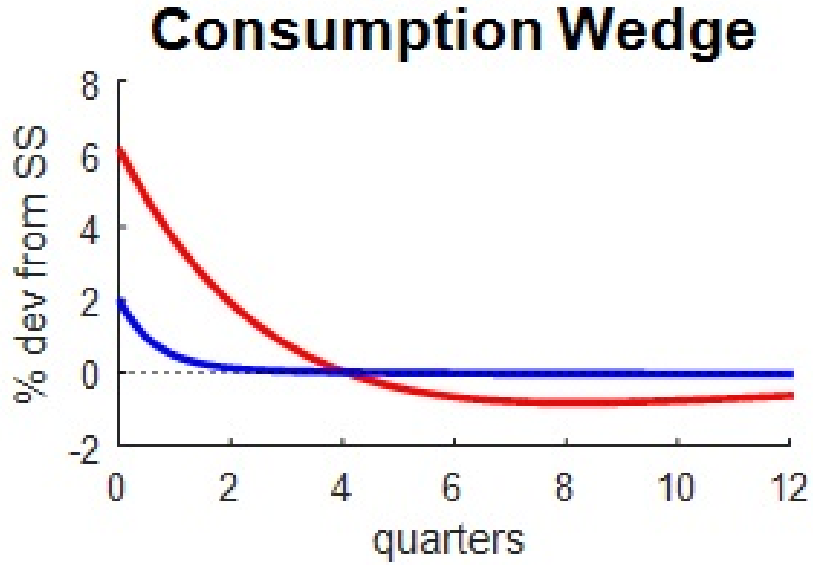
Optimal FX Intervention

Flexible Prices









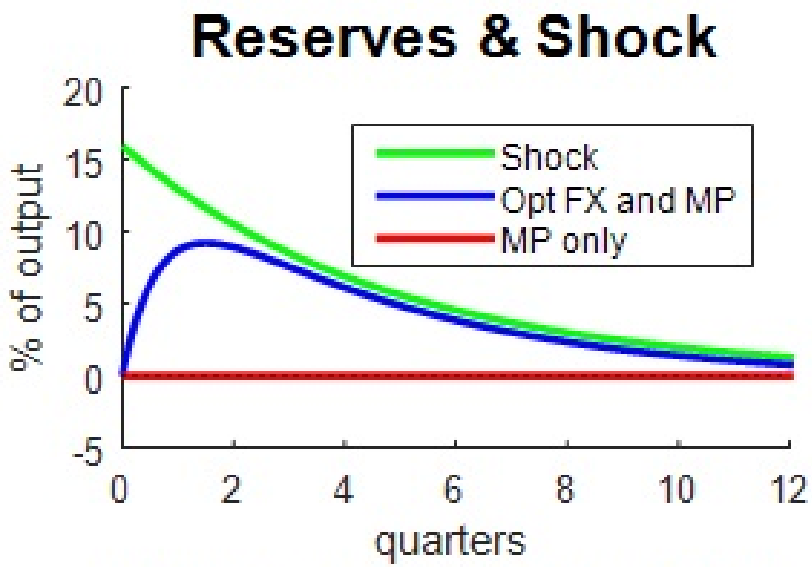
Optimal FX Intervention

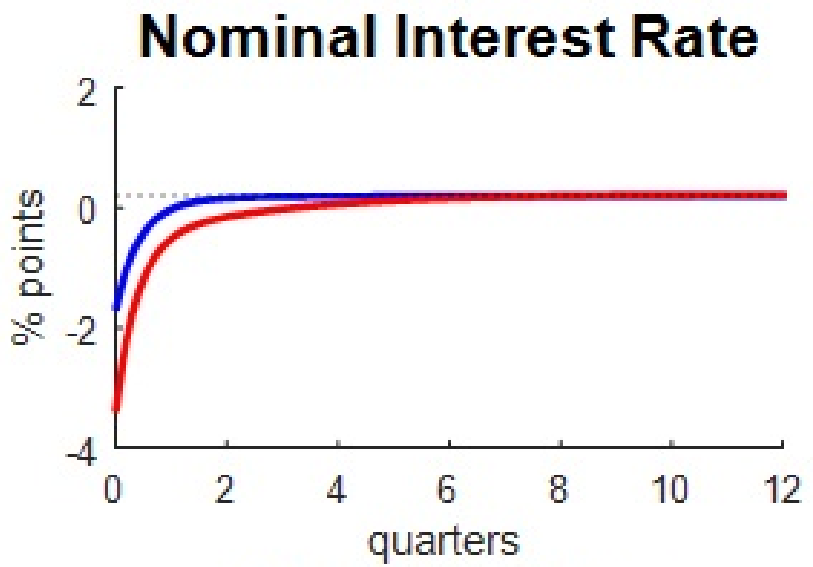
Flexible Prices

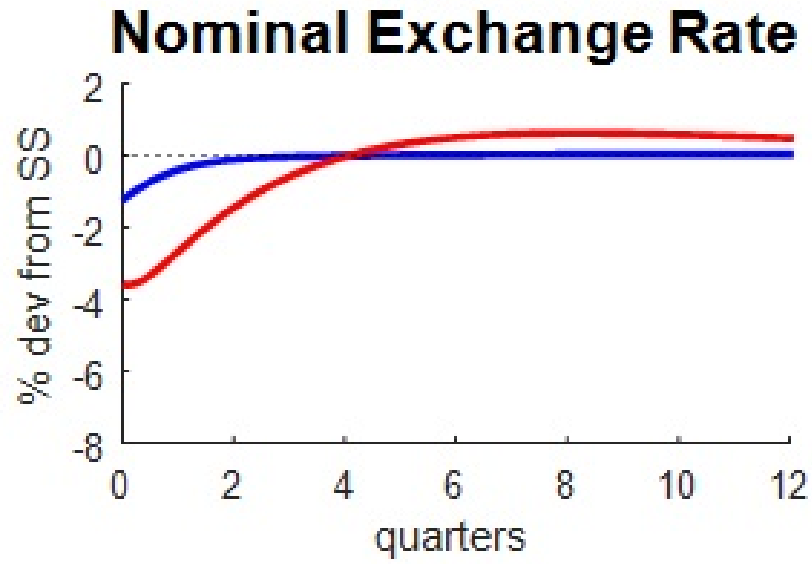
- Portfolio flow shocks cause boom-bust cycles in output and consumption
- The central bank wants to smooth out consumption fluctuations and stabilize terms of trade (ToT)
- An increase in domestic consumption appreciates ToT through:
  1. Home-bias effect $\rightarrow$ increases domestic demand
  2. wealth effect $\rightarrow$ increases wages
- Welfare cost of ToT fluctuations:
  1. consumption wedge $\rightarrow$ reduce PDV of output
  2. output gap

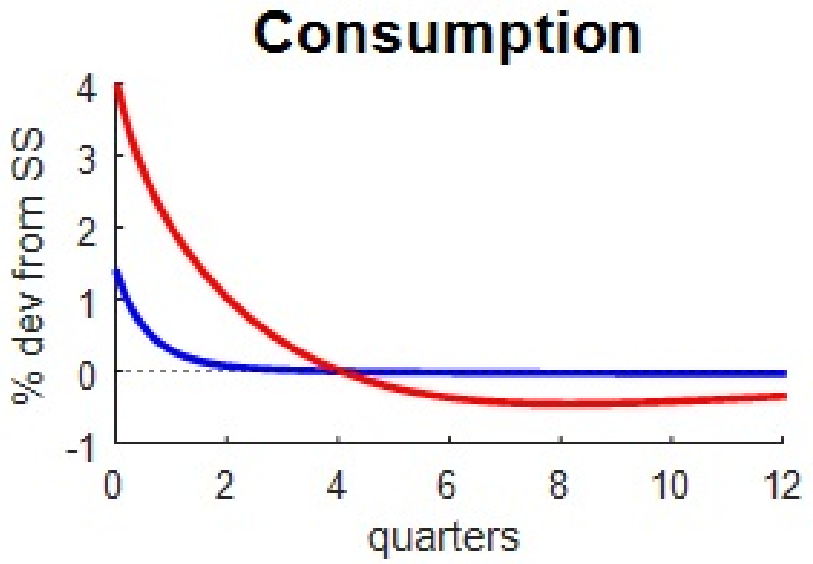
Optimal FXI and Monetary Policy

Sticky Prices



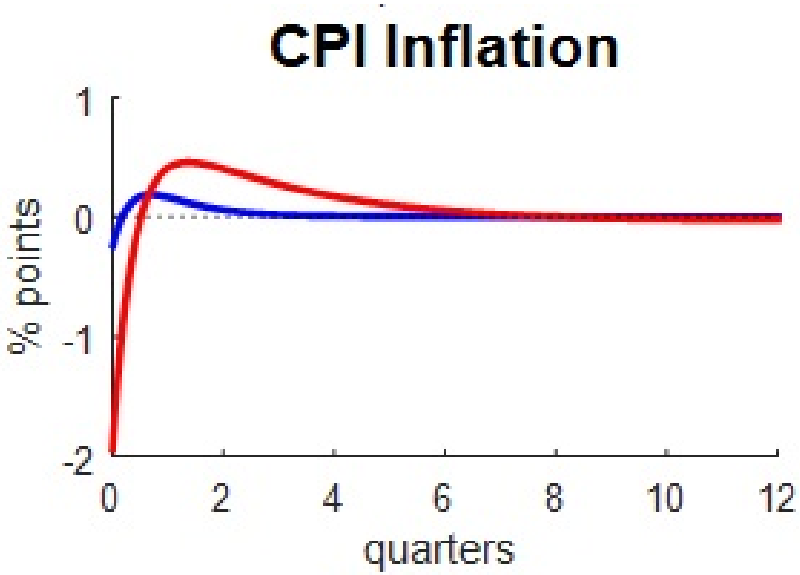


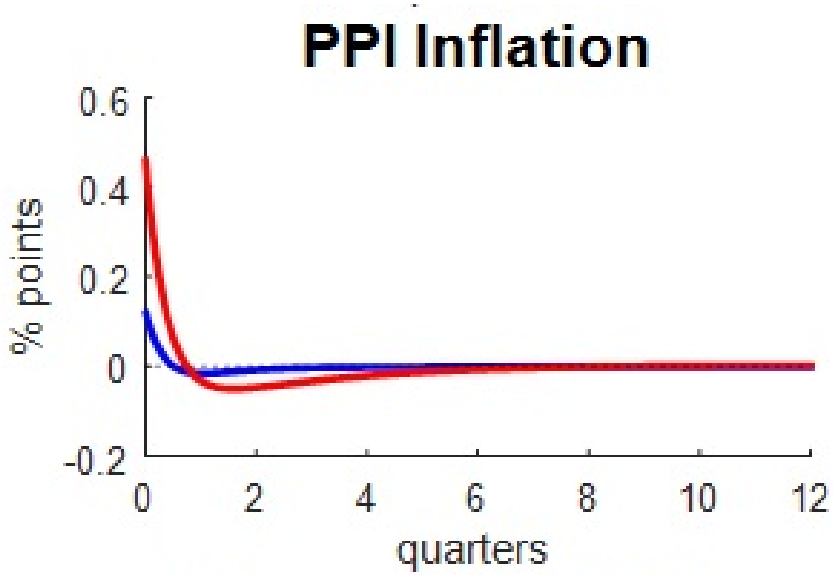


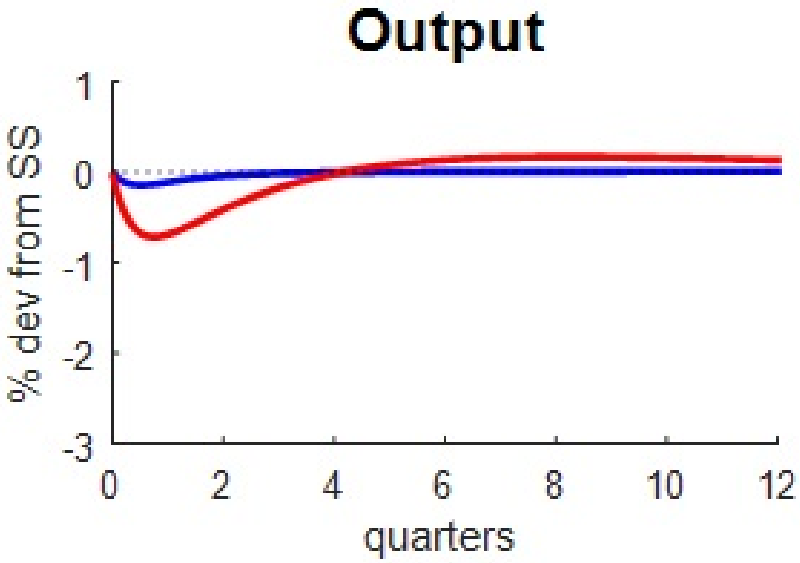


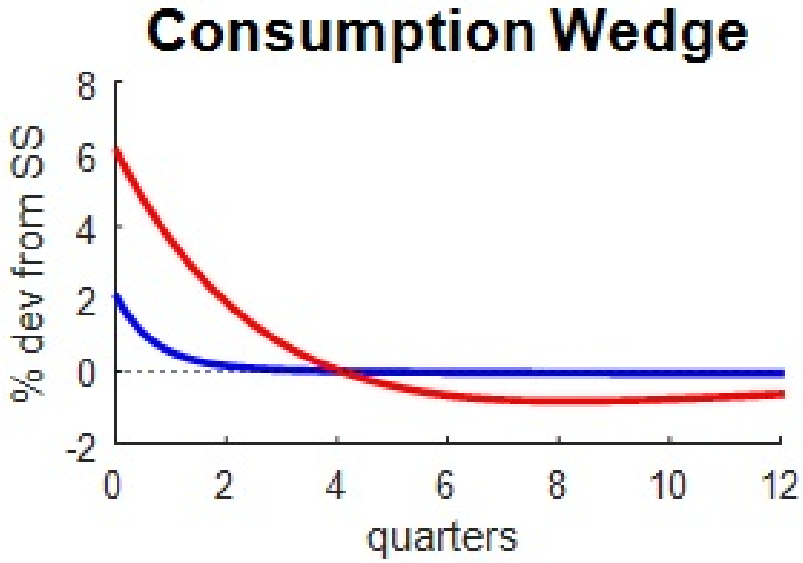
Optimal FXI and Monetary Policy

Sticky Prices









Optimal FXI and Monetary Policy

Sticky Prices

The central bank optimally uses both tools

- Foreign exchange interventions
  - dynamic ToT manipulation
  - improve output/inflation trade-off
  - can support exports (if MP is not available)
- Monetary policy
  - more effective (cheaper) to stabilize output
  - does not affect λ
- Without wealth effect monetary policy fully stabilizes output

Optimal FX Intervention

FX Intervention Rule

- The optimal intervention rule has three implicit targets:

$$d\hat{x} = \psi_\lambda \lambda dt + \psi_a \hat{a} dt + \psi_x \hat{x} dt$$

with $x(0) = 0$ and

$$\psi_\lambda > 0 \;\; \psi_a < 0 \;\; \psi_x < 0$$

- Comparative static resuts

$$\frac{\partial |\psi_\lambda|}{\partial \gamma} < 0 \;\; \frac{\partial |\psi_a|}{\partial \gamma} > 0 \;\; \frac{\partial |\psi_x|}{\partial \gamma} > 0$$

$$\frac{\partial |\psi_\lambda|}{\partial \varrho} > 0 \;\; \frac{\partial |\psi_a|}{\partial \varrho} > 0 \;\; \frac{\partial |\psi_x|}{\partial \varrho} < 0$$

Empirical Evidence

Estimate VAR using quarterly data for Switzerland 1999:1 to 2011:3

$$Z_t = BZ_{t-1} + u_t$$

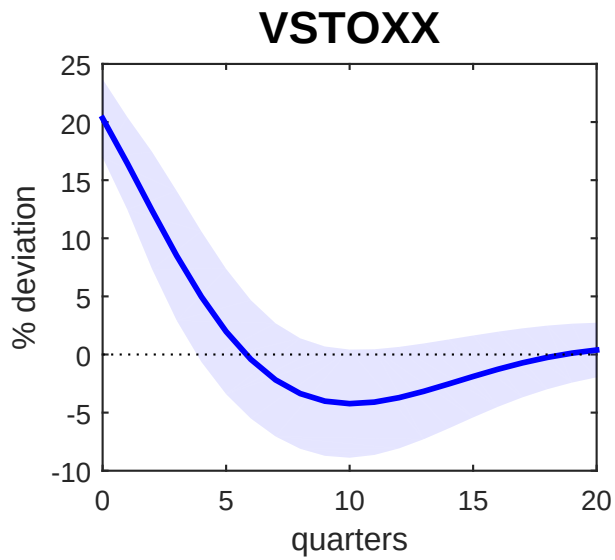
where $u_t = W\varepsilon_t$, W^{-1} is lower triangular, and

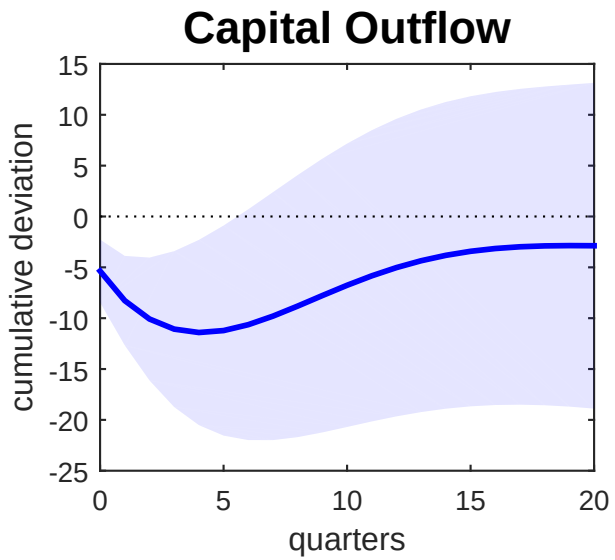
$$Z_t = \begin{bmatrix} y_t^* & vix_t^* & q_t & d\hat{a}_t & y_t \end{bmatrix}^\top$$

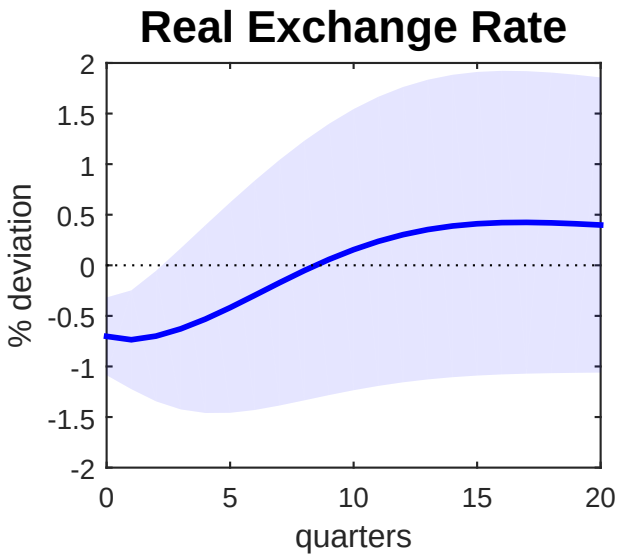
with

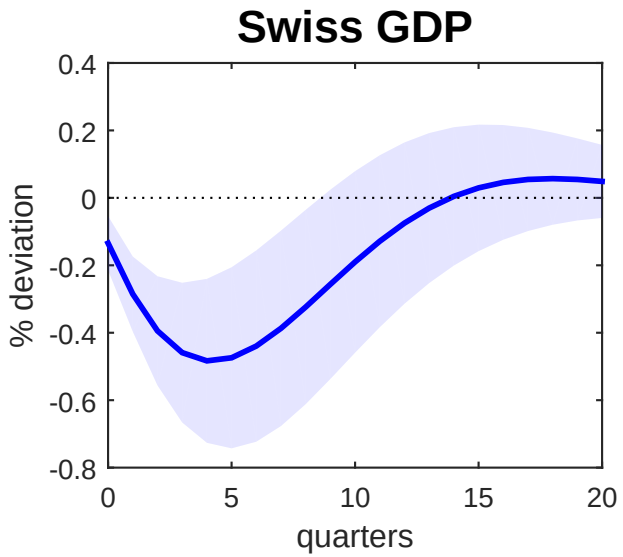
- y^* real EU GDP (EUROSTAT)
- vix^* EURO STOXX 50 Volatility index (VSTOXX)
- q real franc/euro exchange rate (SFSO and EUROSTAT)
- $d\hat{a}$ net nonofficial capital outflows (IMF Financial Flows Analytics Database)
- y real Swiss GDP (SFSO)

Empirical Evidence









Empirical Evidence

Calibration

Table 1: Calibration

Parameter	Description	Value	Source/Target
ρ	Intertemporal discount factor	0.002	Annual real interest rate
ω	Inverse elasticity of intertemporal substitution	1	Rudolf and Zurlinden (2014)
φ	Inverse elasticity of labor supply	1	Rudolf and Zurlinden (2014)
η	Elasticity of substitution domestic/foreign goods	1	Bäurle and Menz (2008)
α	Weight of foreign goods in total consumption	0.42	Average exp and imp shares
θ	Calvo parameter	0.75	Average price duration
ϵ	Elasticity of substitution across varieties	6	Gali and Monacelli (2005)
ψ_y	Output stabilization weight in Taylor rule	0.4	Markov and Nitschka (2013)
ψ_π	Inflation stabilization weight in Taylor rule	1.6	Markov and Nitschka (2013)
ϱ	Shock mean reversion coefficient	0.21	Author's estimation
ε	Shock size	0.16	Author's estimation
β	Fraction of domestic financial intermediaries	0.995	Cost of holding reserves

Empirical Evidence

Estimation

Match empirical and theoretical IRFS to estimate γ and χ where

$$\hat{f}_H^* = \chi vix^*$$

Parameter	Description	Value	S. E.
γ	Financial sector inverse aggregate risk-bearing capacity	0.194	0.082**
χ	Proportionality between vix and foreign demand for domestic assets	0.764	0.340**

A one-standard deviation shock to VSTOXX index causes:

- a surge in demand for Swiss assets equal to 16% of Swiss GDP
- an appreciation of the franc equal to 6% nominal and 3% real
- the optimal FXI reduces ex rate fluctuations by 2/3
- the optimal FXI accumulates reserves up to 10% of GDP

Conclusions

In the paper, financial integration constraints domestic MP

- Fin integration opens the door to cap flow shocks
- Cap flow shocks worsen the output/inflation trade-off

Cavallino & Sandri (2017): fin integration limits MP independence

- Carry-trade outflows induce credit crunch
- Expansionary Lower Bound (ELB): global fin conditions, US MP
- Capital controls, FXI, etc. to regain monetary space (one target)