

The Optimal Exchange Rate Policy

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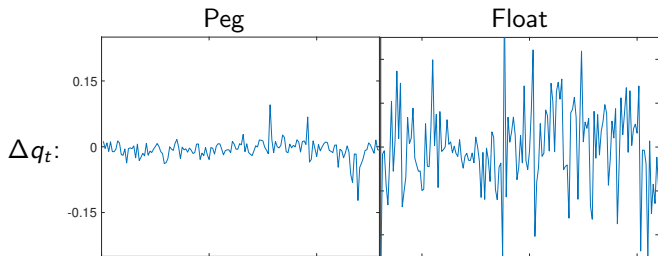
Objective

- What is the optimal exchange rate policy?
 - ① exchange rate is not an instrument of the policy
 - monetary policy, FX interventions, capital controls
 - what is the optimal instrument mix?
 - ② is exchange rate a target?
 - like inflation? should it be stabilized (fixed)?
 - or optimal float? what is a float?
 - ③ can inflation and exchange rate be simultaneous targets?
 - trilemma or divine coincidence?
 - tradeoffs and constrained optimality?

Approach

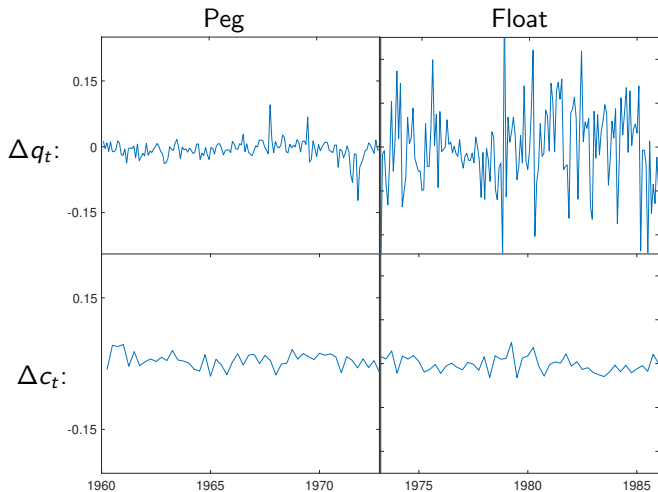
- A realistic GE model of exchange rates
 - in line with empirical patterns (PPP, UIP, Backus-Smith, Meese-Rogoff and in particular Mussa puzzles)
 - following Itskhoki and Mukhin (2021a and 2021b)
 - in particular, endogenous PPP and UIP deviations due to:
 - ① sticky prices and Balassa-Samuelson forces
 - ② segmented financial markets and noise-trader currency demand
- Dual role of exchange rates
 - ① expenditure switching in the goods market
 - exchange rate adjustment substitutes for price (wage) flexibility when prices are sticky, eliminating output gap
 - ② risk sharing in the financial market
 - nominal ER vol. amplifies UIP deviations/risk-sharing wedges
- Nominal exchange rate volatility links the two markets
 - monetary policy can eliminate ER volatility
 - to reduce risk-sharing wedge at the cost of output gap

Mussa Puzzle Redux



X IRBC
⇒ (flex prices)
 $q_t = e_t + p_t^* - p_t$

Mussa Puzzle Redux



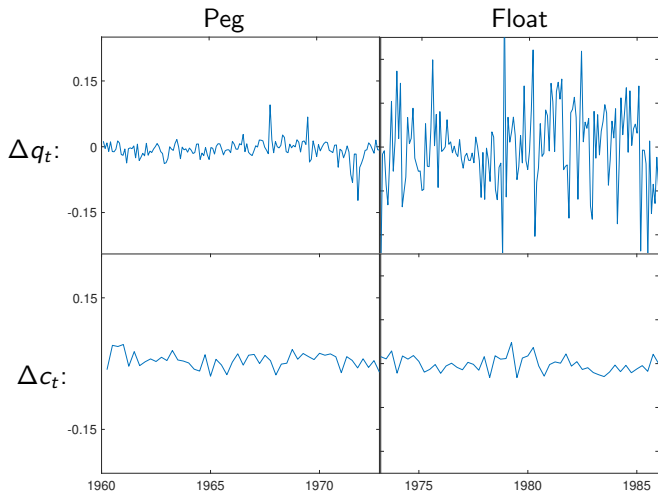
X IRBC
⇒ (flex prices)

$$q_t = e_t + p_t^* - p_t$$

X NKOE
⇒ (sticky prices)

$$z_t = \sigma(c_t - c_t^*) - q_t$$

Mussa Puzzle Redux



~~IRBC~~
 \Rightarrow (flex prices)
 $q_t = e_t + p_t^* - p_t$

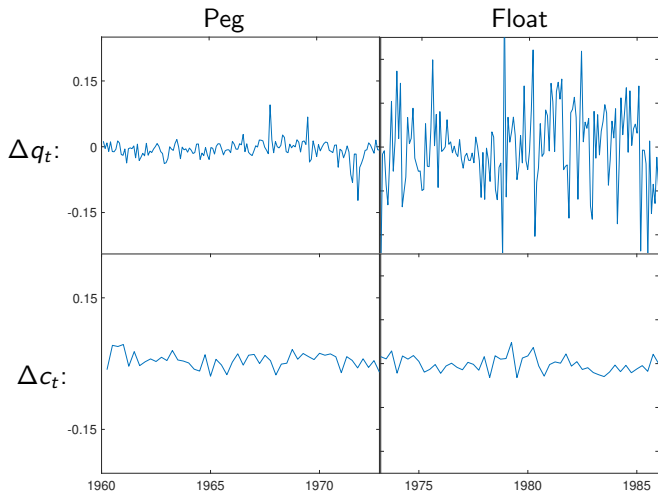
~~NKOE~~
 \Rightarrow (sticky prices)
 $z_t = \sigma(c_t - c_t^*) - q_t$



\checkmark ER Disconnect

$$i_t - i_t^* - \mathbb{E}_t \Delta e_{t+1} = \chi(\sigma_e^2) \cdot \psi_t$$

Mussa Puzzle Redux



✗ IRBC
 ⇒ (flex prices)
 $q_t = e_t + p_t^* - p_t$

✗ NKOE
 ⇒ (sticky prices)
 $z_t = \sigma(c_t - c_t^*) - q_t$

✓ Mussa Redux

✓ ER Disconnect

$$i_t - i_t^* - \mathbb{E}_t \Delta e_{t+1} = \chi(\sigma_e^2) \cdot \psi_t$$

Main Results

Exact non-linear analytical model

- ① **Divine coincidence in an open economy:** if the frictionless RER is stable, then fixed nominal ER is the optimal policy
 - both stabilizes output gap and eliminates risk sharing wedge
 - superior to inflation targeting (eliminates multiplicity)
- ② More generally, the first best requires:
 - i. monetary policy stabilizes output gap (inflation target.+ float)
 - ii. FX interventions eliminate UIP deviations (risk sharing wedges)— fixed exchange rate is not the goal
 - FX effective under segmented financial markets, weakly superior relative to capital controls, relax the trilemma
- ③ Without FX, optimal MP with commitment balances out output gap and UIP deviations by partially stabilizing ER
 - FX do not allow to stabilize output gap when MP constrained
- ④ Explore possibility of income and losses from FX interventions

Related Literature

Portfolio models

- **Segmented markets:** Kouri (1976), Jeanne & Rose (2002), Blanchard, Giavazzi & Sa (2005), Alvarez, Atkeson & Kehoe (2002,2009), Pavlova & Rigobon (2008), Gabaix & Maggiori (2015), Vutz (2020), Itskhoki & Mukhin (2021), Gourinchas, Ray & Vayanos (2021)
- **Currency crisis:** Krugman (1979), Morris & Shin (1998), Fornaro (2021)

Optimal policy in open economy

- **Monetary policy:** Obstfeld & Rogoff (1995), Clarida, Gali & Gertler (1999,2001,2002), Devereux & Engel (2003), Benigno & Benigno (2003), Gali & Monacelli (2005), Engel (2011), Goldberg & Tille (2009), Corsetti, Dedola & Leduc (2010, 2018), Fanelli (2018), Egorov & Mukhin (2021)
- **Capital controls:** Jeanne & Korinek (2010), Bianchi (2011), Farhi & Werning (2012,2013,2016,2017), Costinot, Lorenzoni & Werning (2014), Schmitt-Grohe & Uribe (2016), Basu, Boz, Gopinath, Roch & Unsal (2020)
- **FX interventions:** Jeanne (2013), Cavallino (2019), Amador, Bianchi, Bocola & Perri (2016,2020), Fanelli & Straub (2021)

MODEL ENVIRONMENT

Model Setup

- Small Open Economy with tradables and non-tradables
 - eq'm RER shaped by sticky prices and Balassa-Samuelson

- Households maximize

$$\mathbb{W}_0 = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U_t, \quad U_t = \log C_t - (1-\gamma)L_t, \quad C_t = C_{Tt}^\gamma C_{Nt}^{1-\gamma}$$

$$\text{subject to } P_t C_t + \frac{B_t}{R_t} = B_{t-1} + W_t L_t + P_{Tt} Y_{Tt} + \Pi_t + T_t,$$

- Exogenous stochastic endowment of the tradables Y_{Tt}
 - homogenous and LOP holds: $P_{Tt} = \mathcal{E}_t P_{Tt}^*$ and $P_{Tt}^* = 1$
 - \mathcal{E}_t is the nominal exchange rate ($\mathcal{E}_t \uparrow$ is home depreciation)
 - home net exports: $NX_t = P_{Tt}(Y_{Tt} - C_{Tt}) = \mathcal{E}_t(Y_{Tt} - C_{Tt})$

Non-tradables and Output Gap

- Non-tradables: $Y_{Nt} = A_t L_t$ with $\Pi_t = P_{Nt} Y_{Nt} - W_t L_t$
- Permanently sticky prices: $P_{Nt} = 1$
- Household labor supply: $C_{Nt} = W_t / P_{Nt} = W_t$
- Market clearing: $Y_{Nt} = C_{Nt}$
- First best: $\tilde{P}_{Nt} = W_t / A_t \Rightarrow L_t = 1, C_{Nt} = Y_{Nt} = A_t$
- Output gap: $X_t = \frac{Y_{Nt}}{A_t} = L_t = \frac{W_t}{A_t}$ and $Y_{Nt} = C_{Nt} = W_t$
- **Monetary policy**: choice of W_t can eliminate output gap X_t
 - equivalent to interest rate rule with $\beta R_t \mathbb{E}_t \{ W_t / W_{t+1} \} = 1$
 - fully characterizes allocation in non-tradables $\{ Y_{Nt}, C_{Nt}, L_t \}$

Exchange Rates

- Consumption expenditure: $P_t C_t = P_{Tt} C_{Tt} + P_{Nt} C_{Nt}$
- Optimal expenditure allocation implies:

$$\mathcal{E}_t = \frac{\gamma}{1-\gamma} \frac{P_{Nt} C_{Nt}}{C_{Tt}} = \frac{\gamma}{1-\gamma} \frac{W_t}{C_{Tt}} \quad (1)$$

- NER shifts with monetary policy and tradable consumption
- RER $Q_t \equiv \mathcal{E}_t/P_t$ with sticky prices tracks NER: $Q_t = \mathcal{E}_t^{1-\gamma}$
- **Frictionless RER:**

$$\tilde{Q}_t = \left(\frac{\gamma}{1-\gamma} \frac{A_t}{C_{Tt}} \right)^{1-\gamma}$$

- Balassa-Samuelson forces: relative supply of T and NT
- output gap \propto eq'm/frictionless RER: $X_t = (Q_t/\tilde{Q}_t)^{1/(1-\gamma)}$

Segmented Financial Market

- Market clearing: $B_t + N_t + D_t + F_t = 0$
- ① Government holds ptf (F_t, F_t^*) of bonds with value $\frac{F_t}{R_t} + \frac{\varepsilon_t F_t^*}{R_t^*}$
- ② Households trade only home-currency bond
 - fundamental currency demand due to CA imbalance, $\frac{B_t}{R_t}$
- ③ Noise traders: zero-capital exogenous carry trade position
 - liquidity currency demand, $\frac{N_t^*}{R_t^*} = \psi_t$ and $\frac{N_t}{R_t} = -\frac{\varepsilon_t N_t^*}{R_t^*}$
- ④ Risk-averse intermediaries (arbitrageurs) take carry trades:

$$\frac{D_t^*}{R_t^*} = \arg \max V_t(\pi_{t+1}^{D^*}) = \frac{\mathbb{E}_t \{ \Theta_{t+1} \tilde{R}_{t+1}^* \}}{\omega \sigma_t^2}$$

- $\pi_{t+1}^{D^*} = \tilde{R}_{t+1}^* \cdot \frac{D_t^*}{R_t^*}$, where $\tilde{R}_{t+1}^* = R_t^* - R_t \frac{\varepsilon_t}{\varepsilon_{t+1}}$, $\frac{D_t}{R_t} = -\frac{\varepsilon_t D_t^*}{R_t^*}$
- objective $V_t = \mathbb{E}_t \{ \Theta_{t+1} \pi_{t+1}^{D^*} \} - \frac{\omega}{2} \text{var}_t(\pi_{t+1}^{D^*})$, $\Theta_{t+1} = \beta \frac{C_{T,t}}{C_{T,t+1}}$
- ω is risk aversion and $\sigma_t^2 \equiv \text{var}_t(\tilde{R}_{t+1}^*) = R_t^2 \cdot \text{var}_t\left(\frac{\varepsilon_t}{\varepsilon_{t+1}}\right)$

POLICY PROBLEM

Primal Approach

- **Definition:** Home NFA position B_t^* : $\frac{\varepsilon_t B_t^*}{R_t^*} = \frac{B_t + F_t}{R_t} + \frac{\varepsilon_t F_t^*}{R_t^*}$
- **Lemma 1:** $B_t^* = F_t^* + N_t^* + D_t^*$.
- **Lemma 2:** Home budget constraint

$$B_t^*/R_t^* - B_t^* = Y_{Tt} - C_{Tt} \quad (2)$$

- **Lemma 3:** International risk sharing condition:

$$\beta R_t^* \mathbb{E}_t \frac{C_{Tt}}{C_{T,t+1}} = 1 + Z_t. \quad (3)$$

IRS wedge $Z_t \equiv \omega \sigma_t^2 \frac{B_t^* - N_t^* - F_t^*}{R_t^*}$ and $\sigma_t^2 = R_t^2 \cdot \text{var}_t \left(\frac{\varepsilon_t}{\varepsilon_{t+1}} \right)$.

- UIP wedge: $\mathbb{E}_t \Theta_{t+1} \tilde{R}_{t+1} = \beta \mathbb{E}_t \left\{ \frac{C_{Tt}}{C_{T,t+1}} [R_t^* - R_t \frac{\varepsilon_t}{\varepsilon_{t+1}}] \right\} = Z_t$
- **Equilibrium:** given shocks $\{A_t, Y_{Tt}, R_t^*, N_t^*\}$ and policies $\{W_t, F_t^*\}$, eq'm vector $\{C_{Tt}, B_t^*, \varepsilon_t\}$ and $\{\sigma_t^2\}$ solve (1)-(3).
 - side variables: $\{Y_{Nt}, C_{Nt}, L_t, R_t, D_t^*, B_t, F_t\}$

Policy Problem

- Maximize:

$$\max W_0 = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\gamma \log C_{Tt} + (1 - \gamma) \underbrace{\left(\log W_t - \frac{W_t}{A_t} \right)}_{\log A_t + \log X_t - X_t} \right]$$

- with respect to $\{C_{Tt}, B_t^*, \mathcal{E}_t, R_t, W_t, F_t^*\}$ and σ_t^2
- subject to:

$$\frac{B_t^*}{R_t^*} - B_{t-1}^* = Y_{Tt} - C_{Tt},$$

$$\beta R_t^* \mathbb{E}_t \frac{C_{Tt}}{C_{T,t+1}} = 1 + Z_t,$$

- where risk sharing wedge $Z_t = \omega \sigma_t^2 \frac{B_t^* - N_t^* - F_t^*}{R_t^*}$
with $\sigma_t^2 = R_t^2 \text{var}_t \left(\frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} \right)$ and $\mathcal{E}_t = \frac{\gamma}{1-\gamma} \frac{W_t}{C_{Tt}}$
 - output gap $X_t = W_t/A_t$
- First best: $X_t = 1$ and $Z_t = 0$

EXACT OPTIMAL POLICY

First Best

- **Proposition 1** (First Best)
 - FB allocation maximizes welfare s.t. budget constraint alone
 - eliminates both output gap and risk sharing wedges
 - can be implemented with monetary policy $\tilde{W}_t = A_t$ and FX interventions $\tilde{F}_t^* = B_t^* - N_t^*$
 - FX interventions eliminate UIP deviations, $\mathbb{E}_t \Theta_{t+1} \tilde{R}_{t+1}^* = 0$, and ensure efficient international risk sharing
 - resulting nominal exchange rate is given by $\tilde{\mathcal{E}}_t = \frac{\gamma}{1-\gamma} \frac{A_t}{\tilde{C}_{Tt}}$, and thus optimal policy eliminates the effects of N_t^* on eq'm ER
 - optimal policy is time consistent and requires no commitment
- Optimal policy eliminates UIP deviations, but not ER volatility
- Both MP and FX are essential, with MP focusing on output gap and FX on risk sharing wedges (UIP deviations)
 - FX eliminate the need for costly intermediation ($D_t^* = 0$)

Divine Coincidence

- **Proposition 2** (Divine coincidence in an open economy)

Fixed nominal exchange rate $\mathcal{E}_t = \bar{\mathcal{E}}$ implements FB allocation IFF the frictionless real exchange rate is stable, $\tilde{Q}_t = \text{const.}$

In this case:

- MP alone achieves both goals ($X_t = 1, Z_t = 0$) w/out FX&CC
 - float has no benefit from the point of view of output gap, so there is no trade off to fixing
 - UIP deviations are minimized with $\sigma_t^2 = 0$ irrespective of F_t^*
 - direct exchange rate targeting superior to inflation/output gap stabilization which may lead to multiplicity ($\sigma_t^2 = 0$ & $\sigma_t^2 > 0$)
-
- Without divine coincidence:
 - fixed nominal exchange rate is suboptimal
 - MP alone does not achieve first best

Constrained Optimum

- **Proposition 3** (Constrained Optimum)
 - MP can implement efficient risk sharing without FX
 - by fixing nominal exchange rate
 - FX cannot close the output gap when MP is constrained
 - can only ensure efficient international risk sharing, $Z_t = 0$
 - Optimal MP in the absence of FX:
 - i. eliminates the output gap on average, $\mathbb{E}_t X_{t+1} = 1$
 - ii. uses state-by-state variation in X_{t+1} to reduce \mathcal{E}_{t+1} volatility and hence σ_t^2 to reduce the risk sharing wedge Z_t at time t

$$X_{t+1} - 1 \propto -\gamma \cdot \underbrace{\omega \mu_t (B_t^* - N_t^*)}_{\geq 0} \cdot [\mathcal{E}_{t+1} - \mathbb{E}_t \mathcal{E}_{t+1}]$$

- lean against the wind ex post: $C_{Nt} \downarrow$ during outflows ($C_{Tt} \downarrow$)
- partial peg of \mathcal{E}_{t+1} , stronger if γ and $\omega \sigma_t^2$ larger
- not time consistent, requires commitment (o/w $X_{t+1} \equiv 0$)

International Transfers

- Profits and losses of the financial sector:

$$\pi_{t+1}^* = \tilde{R}_{t+1}^* \cdot \frac{N_t^* + D_t^*}{R_t^*}, \quad \tilde{R}_{t+1}^* = R_t^* - R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}}$$

- fraction $\tilde{\tau} = 1 - \tau \in [0, 1]$ of π_{t+1}^* accrues abroad
- FX controls ex ante UIP deviation: $\mathbb{E}_t \Theta_{t+1} \tilde{R}_{t+1}^* = Z_t$, where $Z_t = \omega \sigma_t^2 \frac{B_t^* - N_t^* - F_t^*}{R_t^*}$ is the risk sharing wedge
- Country budget constraint:

$$\frac{B_t^*}{R_t^*} - B_{t-1}^* = (Y_{Tt} - C_{Tt}) - \tilde{\tau} \pi_t^*, \quad \mathbb{E}_t \Theta_{t+1} \pi_{t+1}^* = \psi_t Z_t + \frac{Z_t^2}{\omega \sigma_t^2}$$

- Proposition 4:** Incomes and losses from FX
 - expected income from FX is weakly negative when $N_t^* = 0$
 - no noise traders $N_t^* \Rightarrow$ fully offset UIP deviations from B_t^*
 - if $N_t^* \neq 0$, and for $\omega \sigma_t^2 > 0$, there exist F_t^* resulting in incomes that exceed welfare losses from induced UIP wedges Z_t
 - bounds on incomes imposed by arbitrageurs, tighter if $\omega \sigma_t^2$ low

Final Remarks

- In the absence of international transfers, FX weakly dominate capital controls
- FX interventions can be limited however by various constraints:
 - non-negative foreign positions, $F_t^* \geq 0$
 - requires use of forward guidance
 - vol. or VaR constraints: $\text{var}_t(\tilde{R}_{t+1}^* \frac{F_t^*}{R_t^*}) = \sigma_t^2 \cdot (\frac{F_t^*}{R_t^*})^2 \leq \alpha$
 - (partial) pegs may be optimal
- Capital controls, however, allow to extract further rents in the financial market when international transfers are present

CONCLUSION

Conclusion

- Shall exchange rate be fixed or freely float?
 - with MP and FX available, eliminate output gap and UIP deviation, but not exchange rate volatility
 - nonetheless, do eliminate non-fundamental exchange rate volatility from noise traders
 - possibly the dominant portion of exchange rate volatility and UIP deviations under laissez faire
 - explicit partial peg when FX is unavailable
- Divine coincidence:
 - fix exchange rate with MP.
- Without divine coincidence:
 - neither fully fixed nor freely floating is optimal