The Optimal Exchange Rate Policy

Oleg Itskhoki
itskhoki@econ.UCLA.edu

Dmitry Mukhin
d.mukhin@LSE.ac.uk

XXIV Annual Conference of the Central Bank of Chile
November, 2021

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?

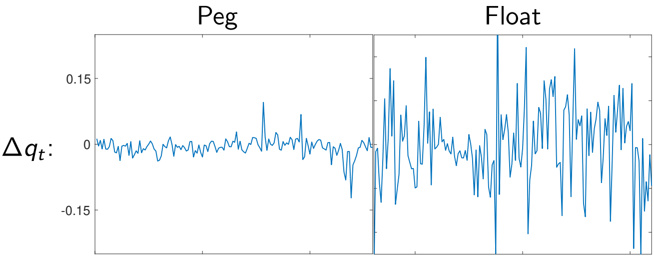
Approach

- 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

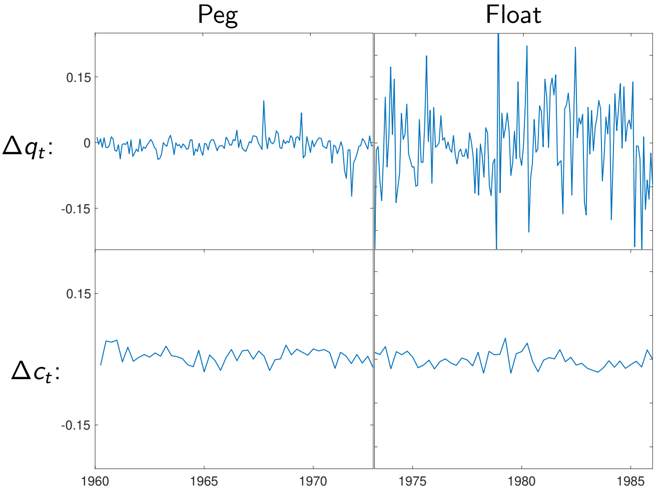
Mussa Puzzle Redux



$\Rightarrow$ ✗ IRBC (flex prices)

$q_t = e_t + p_t^* - p_t$

Mussa Puzzle Redux



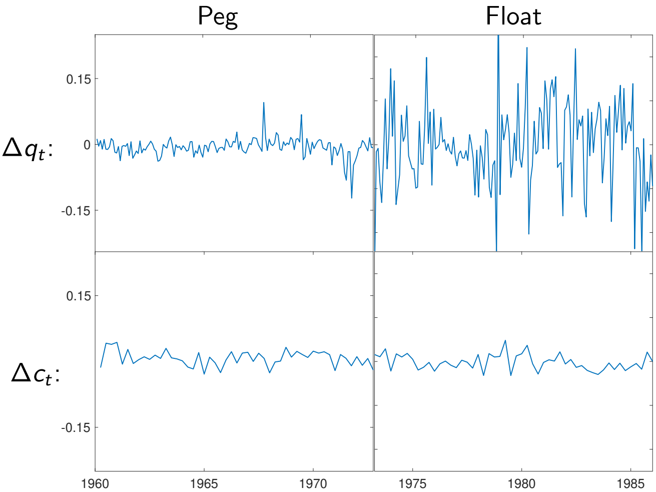
$\Rightarrow$ ✗ IRBC (flex prices)

$q_t = e_t + p_t^* - p_t$

$\Rightarrow$ ✗ NKOE (sticky prices)

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

Mussa Puzzle Redux



$\Rightarrow$ ✗ IRBC (flex prices)

$q_t = e_t + p_t^* - p_t$

$\Rightarrow$ ✗ NKOE (sticky prices)

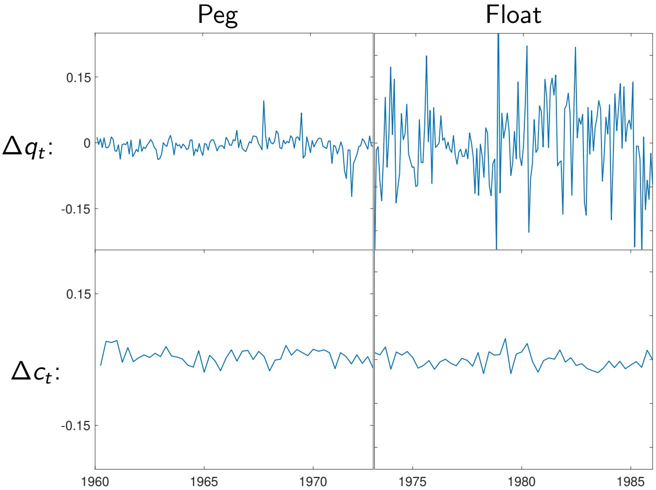
$z_t = \sigma(c_t - c_t^*) - q_t$

$\Downarrow$

✓ ER Disconnect

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

Mussa Puzzle Redux



$\Rightarrow$ ✗ IRBC (flex prices)

$q_t = e_t + p_t^* - p_t$

$\Rightarrow$ ✗ NKOE (sticky prices)

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

$\Downarrow$ ✓ Mussa Redux

$\Downarrow$ ✓ 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

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

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

- 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: $\tilde{P}_{Nt} = W_t / A_t \quad \Rightarrow \quad L_t = 1,\ C_{Nt} = Y_{Nt} = A_t$
- 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:

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

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

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

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

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

POLICY PROBLEM

Primal Approach

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

$$B_t^*/R_t^* - B_t^* = Y_{Tt} - C_{Tt} \tag{2}$$

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

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

IRS wedge $Z_t \equiv \omega \sigma_t^2 \frac{B_t^* - N_t^* - F_t^*}{R_t^*}$ and $\sigma_t^2 = R_t^2 \cdot \mathrm{var}_t \Big(\frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} \Big)$.

  - UIP wedge: $\mathbb{E}_t \Theta_{t+1} \tilde{R}_{t+1} = \beta \mathbb{E}_t \big\{ \frac{C_{Tt}}{C_{T,t+1}} \big[R_t^* - R_t \frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} \big] \big\} = Z_t$

- **Equilibrium**: given shocks $\{A_t, Y_{Tt}, R_t^*, N_t^*\}$ and policies $\{W_t, F_t^*\}$, eq'm vector $\{C_{Tt}, B_t^*, \mathcal{E}_t\}$ 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:

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

  - 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 $\sigma_t^2 = R_t^2 \,\mathrm{var}_t \Big(\frac{\mathcal{E}_t}{\mathcal{E}_{t+1}} \Big)$ 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, $\tilde{\mathcal{Q}}_t = const$.

  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 $Z_t = \omega \sigma^2_t \frac{B^*_t - N^*_t - F^*_t}{R^*_t}$ is the risk sharing wedge

- Country budget constraint:

$$\frac{B^*_t}{R^*_t} - B^*_{t-1} = (Y_{Tt} - C_{Tt}) - \tilde{\tau} \pi^*_t, \quad \mathbb{E}_t \Theta_{t+1} \pi^*_{t+1} = \psi_t Z_t + \frac{Z^2_t}{\omega \sigma^2_t}$$

- **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 $\omega \sigma^2_t > 0$, 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 $\omega \sigma^2_t$ low

Final Remarks

- In the absence of international transfers, FX weakly dominate capital controls
  - — requires less information for implementations
  - — can be conditioned on observed UIP deviations or ER

- 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: $\mathrm{var}_t\left(\tilde{R}_{t+1}^* \frac{F_t^*}{R_t^*}\right) = \sigma_t^2 \cdot \left(\frac{F_t^*}{R_t^*}\right)^2 \leq \alpha$
    - — (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

- Divinie coincidence:
  - fix exchange rate with MP.

- Without divine coincidence:
  - neither fully fixed nor freely floating is optimal