Monetary Policy under Alternative Asset Market Structures
The Case of a Small Open Economy

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Motivation

How should monetary policy be conducted in an open economy?
- Does the answer depend on the level of sophistication of asset markets?
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  - Does the answer depend on the level of sophistication of asset markets?
- What is the optimal level of exchange rate volatility?
  - Does the answer depend on the degree of international risk sharing?
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  - Does the answer depend on the level of sophistication of asset markets?
- What is the optimal level of exchange rate volatility?
  - Does the answer depend on the degree of international risk sharing?

Approach

- Formalize a small open economy model under different asset market structures
- Characterize a utility based loss function each specification
- Derive the optimal monetary policy
- Rank policy rules that imply different levels of exchange rate volatility
Motivation (2):
Complementing the existing literature

- ... 

- Is this result robust to imperfections in asset markets?
Anticipating the results

- Implication of externality for monetary policy changes with degree of risk sharing
Anticipating the results

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Optimal Monetary Policy under Complete Markets:
- Real exchange rate stabilization is part of the optimal plan
- When domestic and foreign goods are substitutes in the utility, smaller volatility in FX improves welfare
- PEG can lead to higher welfare than inward looking policies.

Optimal Monetary Policy under Incomplete Markets:
- Conclusions regarding exchange rate stabilization are different
- When domestic and foreign goods are substitutes in the utility, larger volatility in FX improves welfare
- Central bank should concentrate in stabilizing domestic prices
  Results are reversed when goods are complements
Anticipating the results

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The Model:
overview

- 2-country DSGE model ⇒ small open economy
- Home bias ⇒ deviations from PPP
- Monopolistic competition and nominal rigidities *a la* Calvo ⇒ Role for monetary policy
- Preferences ⇒ allow for trade imbalances
- Stochastic environment: domestic and foreign productivity shocks (paper also considers fiscal and markup shocks)
The Model:
Asset markets

- Asset market structure:
  - Financial autarky
  - Incomplete markets
  - Complete markets (optimal risk-sharing)
Table: Equilibrium Conditions under Financial Autarky

\[ \pi_t = k(c_t + \eta y_t + \frac{\lambda}{1-\lambda} q_t - \eta \epsilon_t) + \beta E_t \pi_{t+1} \quad \text{AS} \]

\[ y_t = (1 - \lambda)c_t + \lambda c^*_t + \gamma q_t \quad \text{AD} \]

\[ y_t - \frac{\lambda}{1-\lambda} q_t = c_t \quad \text{FA} \]
Log-linear Model:
Complete Markets

Table: Equilibrium Conditions under Complete Markets

\[
\pi_t = k \left( c_t + \eta y_t + \frac{\lambda}{1-\lambda} q_t - \eta \varepsilon_t \right) + \beta E_t \pi_{t+1} \quad \text{AS}
\]

\[
y_t = (1 - \lambda) c_t + \lambda c^*_t + \gamma q_t \quad \text{AD}
\]

\[
c_t = c^*_t + q_t \quad \text{CM}
\]
Log-linear Model:
Incomplete Markets

Table: Equilibrium Conditions under Incomplete Markets

\[
\pi_t = k(c_t + \eta y_t + \frac{\lambda}{1-\lambda} q_t - \eta \varepsilon_t) + \beta E_t \pi_{t+1} \quad \text{AS}
\]

\[
y_t = (1 - \lambda)c_t + \lambda c_t^* + \gamma q_t \quad \text{AD}
\]

\[
E_t(c_{t+1} - c_t) = E_t(c_t^* - c_t^*) + E_t \Delta q_{t+1} - \delta b_t \quad \text{IM}
\]

\[
\beta b_t = b_{t-1} + y_t - c_t - \frac{\lambda}{1-\lambda} q_t \quad \text{IM'}
\]
Log-linear model:
Rest of the World

Table: Foreign Equilibrium Conditions

\[ \pi^*_t = k(c^*_t + \eta y^*_t - \eta \varepsilon^*_t) + \beta E_t \pi^*_{t+1} \quad AS^* \]
\[ y^*_t = c^*_t \quad AD^* \]
Agent’s Utility $\Rightarrow$ Loss Function

Loss Function

Method of Benigno & Woodford (2003), Sutherland (2002)

$2^{nd}$ order Taylor expansion of utility function:

$$L_t = (1 - \lambda) U_c \bar{CE}_t - \sum_{i=1}^{\infty} \beta_i d_t + \frac{1}{2} (\eta + 1) (y_t y_0 t)^2 + \frac{1}{2} \sigma_k (\pi_t)^2 + t.i.p + O(jj \xi jj^3).d_t y_t 1 - (1 - \lambda) c_t$$

(In this presentation: expansion around a steady state with a subsidy that eliminates monopolistic distortion when $\lambda = 0$ or $\theta = 1$)
Loss Function

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Agent’s Utility ⇒ Loss Function

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2nd order Taylor expansion of utility function:

\[
L_{to} = (1 - \lambda) U_c \bar{C} E_{t0} \sum \beta^t \left[ d_t + \frac{1}{2} (\eta + 1) (y_t - y'_t)^2 + \frac{1}{2} \frac{\sigma}{k} (\pi_t)^2 \right] \\
+ t.i.p + O(||\xi||^3).
\]

\[
d_t \equiv y_t - \frac{1}{(1 - \lambda)} c_t \text{ and } y'_t \equiv \frac{\eta}{(\eta + 1)} \varepsilon_t
\]
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2nd order Taylor expansion of utility function:

$$L_{to} = (1 - \lambda) U_c \tilde{C} E_t \sum \beta^t \left[ d_t + \frac{1}{2}(\eta + 1)(y_t - y'_t)^2 + \frac{1}{2k}(\pi_t)^2 \right] + t.i.p + O(||\zeta||^3).$$

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Understanding the Loss Function:
Closed economy

\[ L_{to} = (1 - \lambda) U_c \tilde{C} E_t \sum \beta^t \left[ d_t + \frac{1}{2} (\eta + 1) (y_t - y'_t)^2 + \frac{1}{2} \frac{\sigma}{k} (\pi_t)^2 \right] + t.i.p + O(\|\xi\|^3). \]

\[ d_t \equiv y_t - \frac{1}{(1 - \lambda)} c_t \quad \text{and} \quad y'_t \equiv \frac{\eta}{(\eta + 1)} \varepsilon_t \]

- Closed economy:
  - \( \lambda = 0 \Rightarrow d_t = 0 \) and \( y'_t = y_t^{\text{Flex}} \)
  - Given an efficient steady state \( \Rightarrow \) loss generated solely from nominal rigidities
  - Optimal policy: \( \pi_t = 0 \) (also closes the output gap)
Open economy $\Rightarrow$ ToT externality
Open economy ⇒ ToT externality

Corsetti and Pesenti (2001): improvements in ToT ⇒ allow larger consumption for a given level of labour effort (or domestic production)
Open economy $\Rightarrow$ ToT externality

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In our Taylor expansion

$$d_t \equiv y_t - \frac{1}{(1 - \lambda)} c_t$$
Understanding the Loss Function:
Open Economy with Complete Markets

- With **Complete Markets** \( d_t \) is proportional to

\[
(1 - \theta)q_t
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- $\theta > 1$: real exchange rate appreciation (or ToT improvement) increases welfare/ reduces loss
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- Substitute goods: appreciation decreases $C_H$ but increases $C_F$ - reduction in $U(C)$ smaller than in $V(Y)$
- $\theta < 1$: depreciation improve welfare
  - leads to higher $C_H$ that increases marginal utility of $C_F$:
    - $U(C)$ " > " $V(Y)$
- Externality only eliminated when $\theta = 1$ - in this case marginal utility of $C_H$ independent of $C_F$, and vice-versa
With **Complete Markets** $d_t$ is proportional to

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- Substitute goods: appreciation decreases $C_H$ but increases $C_F$ - reduction in $U(C)$ smaller than in $V(Y)$
- Complement goods: appreciation cannot divert consumption towards foreign goods (decrease in $C_H$ accompanied by decrease in $C_F$)
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\( \theta > 1 \): appreciation is not able to divert consumption towards imported goods without a fall in domestic consumption (consumption finance by domestic production)
With **Financial Autarky** $d_t$ is proportional to

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- $\theta > 1$: appreciation is not able to divert consumption towards imported goods without a fall in domestic consumption (consumption finance by domestic production)
- Appreciation improves ToT and purchasing power but generates a negative income effect (absent under complete markets)
With **Financial Autarky** $d_t$ is proportional to

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- $\theta > 1$: appreciation is not able to divert consumption towards imported goods without a fall in domestic consumption (consumption finance by domestic production)
- Appreciation improves ToT and purchasing power but generates a negative income effect (absent under complete markets)
- Purchasing power effect dominates only when $\theta$ is small and changes in exchange rates have small income effects
Understanding the Loss Function:
Special Case

- **Special case**

\[ \theta = 1 \]
Special case

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- No externality \( \Rightarrow \) marginal utility of \( C_H \) independent of \( C_F \), and vice-versa
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- Cobb Douglas+Log Utility: agents consume a fixed proportion of income - terms of trade do not change consumption composition
**Special case**

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- No externality \( \Rightarrow \) marginal utility of \( C_H \) independent of \( C_F \), and vice-versa
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- Monetary policy problem isomorphic to closed economy
### Special Case

\[ \theta = 1 \]

- No externality \( \Rightarrow \) marginal utility of \( C_H \) independent of \( C_F \), and vice-versa
- Cobb Douglas+Log Utility: agents consume a fixed proportion of income - terms of trade do not change consumption composition
- No trade imbalances \( \Rightarrow \) Asset markets are irrelevant
- Monetary policy problem isomorphistic to closed economy
- Optimal policy: \( \pi_t = 0 \) (also closes the output gap) regardless of the asset market structure
Quadratic Loss Function

- 2nd order Taylor expansion + 2nd order expansion of equilibrium conditions \(\Rightarrow\) Quadratic Loss Function

\[
L_{to} = U_c \bar{C} E_{t0} \sum \beta^t \left[ \frac{1}{2} l_{yy} y_t^2 + \frac{1}{2} l_{qq} q_t^2 + \frac{1}{2} l_{\pi \pi} \pi_t^2 + l_{yy} y_t q_t + L_{ey} e_t y_t + L_{eq} e_t q_t \right] + t.i.p. + O(\|\xi\|^3)
\]

\[
e_t = \begin{bmatrix} \varepsilon_t & c_t^* \end{bmatrix}.
\]
Quadratic Loss Function

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\[ e_t = [ \epsilon_t \ c_t^* ] . \]

- (extension includes fiscal and markup shocks)
Quadratic Loss Function

- 2nd order Taylor expansion + 2nd order expansion of equilibrium conditions \( \Rightarrow \) Quadratic Loss Function

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\]

\[
e_t = \begin{bmatrix} \varepsilon_t \\ c^*_t \end{bmatrix}.
\]

- (extension includes fiscal and markup shocks)
- Monetary policy problem: minimize quadratic loss given linear constraints.
Monetary policy implications

Optimal monetary policy - targeting rules:

\[ Q_y^c \Delta (y_t - y_t^{T,c}) + Q_q^c \Delta (q_t - q_t^{T,c}) + Q_{\pi}^c \pi_t = 0 \]

\[ Q_y^{fa} \Delta (y_t - y_t^{T,fa}) + Q_q^{fa} \Delta (q_t - q_t^{T,fa}) + Q_{\pi}^{fa} \pi_t = 0, \]

\[ Q_y^i E_t \Delta (y_{t+1} - y_{t+1}^{T,i}) + Q_q^i E_t \Delta (q_{t+1} - q_{t+1}^{T,i}) + Q_{\pi}^i E_t \pi_{t+1} = 0. \]

<table>
<thead>
<tr>
<th>( \theta )</th>
<th>Optimal risk-sharing Complete Markets</th>
<th>Sub-optimal risk-sharing Incomplete Markets</th>
<th>Financial Autarky</th>
</tr>
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<tbody>
<tr>
<td>1.5</td>
<td>( \sigma^o Q &lt; \sigma^p Q )</td>
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## Preferred policy rule

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<th>Complete</th>
<th>Incomplete</th>
<th>Financial Aut.</th>
<th>Asset Markets</th>
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<td>6</td>
<td>PEG</td>
<td>PPI</td>
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Extensions

- Result robust to:
  - Introduction of fiscal shocks
  - Changes in risk aversion
  - Steady-state conditions (net foreign asset position, intermediation cost)
- Markup shocks - Introduce policy trade-offs even in closed economies
Concluding remarks

- Monetary policy problem in an open economy ≠ closed economy
- Monetary policy problem with complete markets ≠ incomplete markets
- Monetary policy problem depends on trade pattern
- Example:
  - Country specialized in exporting commodities + underdeveloped capital markets = keep appreciated currency can be beneficial
  - Once markets develop ⇒ negative effect on purchasing power ⇒ targeting domestic inflation might be superior
Concluding remarks (2)

Future work:

- Gains from risk sharing under different policy regimes
- Optimal current account targeting?
The model:

Preferences

Utility (country \( H - \) measure \( n \))

\[
U_t = E_t \sum_{s=t}^{\infty} \beta^{s-t} \left[ U(C_s) - V(y(h)_s, \varepsilon_Y,s) \right]
\]

\[
U_t = E_t \sum_{s=t}^{\infty} \beta^{s-t} \left[ \log C_s - \frac{1}{n} \int_0^n \frac{\varepsilon_Y,s y(h)_s^{1+\eta}}{1+\eta} \right]
\]

Home bias (Sutherland 2001)

\[
C = \left[ \nu^{\frac{1}{\theta}} C_H^{\frac{\theta-1}{\theta}} + (1 - \nu)^{\frac{1}{\theta}} C_F^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}
\]

\((1 - \nu) = (1 - n)\lambda \) and \( \nu^* = n\lambda \)

\[
C_H = \left[ \left( \frac{1}{n} \right)^{\frac{1}{\sigma}} \int_0^n c(z)^{\frac{\sigma-1}{\sigma}} dz \right]^{\frac{\sigma}{\sigma-1}}
\]
The model:
Relative prices and demand

Law of one price: \( p(z) = S \cdot p^*(z) \).

Home bias \( \Rightarrow \) PPP does not hold: \( Q_t \equiv S_t P^*_t / P_t \)

SOE demand

\[
y_t(h) = \left( \frac{p_t(h)}{P_{H,t}} \right)^{-\sigma} \left( \frac{P_{H,t}}{P_t} \right)^{-\theta} \left( (1 - \lambda) C_t + \lambda \left( \frac{1}{Q_t} \right) C^* \right)
\]

RoW demand

\[
y_t(f) = \left( \frac{p^*_t(f)}{P^*_t} \right)^{-\sigma} C_t^*
\]
Price-setting \textit{a la} Calvo ($\alpha$- probability of not changing prices)

\[
E_t \left\{ \sum (\alpha \beta)^k U_{c,t+k} y_{t+k,t}(h) \left[ \tilde{p}_t(h) - \mu P_{t+k} \frac{V_{y,t+k,t}}{U_{c,t+k}} \right] \right\} = 0
\]

where

\[
\mu = \frac{\sigma}{(1 - \tau)(\sigma - 1)}
\]
Internal "risk-sharing"
Financial autarky

\[ P_{H,t} Y_t = P_t C_t \]

Complete markets

\[ \frac{U_C (C_{t+1}^*)}{U_C (C_t^*)} = \frac{U_C (C_{t+1})}{U_C (C_t)} \frac{Q_{t+1}}{Q_t} \]
The model:
Asset markets (2)

Incomplete markets

\[ P_t C_t + B_{H,t} + S_t B_{F,t} \leq P_{H,t} Y_t + B_{H,t-1}(1 + i_t) \]
\[ + S_t B_{F,t-1}(1 + i^*_t)\psi\left(\frac{S_t B_{F,t}}{P_t}\right) \]

Euler equations

\[ U_C(C_t) = (1 + i_t)\beta E_t \left[ U_C(C_{t+1}) \frac{P_t}{P_{t+1}} \right] \]
\[ U_C(C^*_t) = (1 + i^*_t)\beta E_t \left[ U_C(C^*_{t+1}) \frac{P^*_t}{P^*_{t+1}} \right] \]
\[ U_C(C_t) = (1 + i^*_t)\psi\left(\frac{S_t B_{F,t}}{P_t}\right)\beta E_t \left[ U_C(C_{t+1}) \frac{S_{t+1} P_t}{S^*_t P_{t+1}} \right] \]