Capital Controls, Monetary Policy, and Sudden Stops

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AEPC Conference, San Francisco Federal Reserve
November 2017
Macroeconomic Policy for Emerging Economies

- Capital inflows may stimulate growth, but have downside
- Booms in asset prices appreciating currency, followed by “Sudden Stops”, crashes and depreciation
Macroeconomic Policy for Emerging Economies

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- Booms in asset prices appreciating currency, followed by “Sudden Stops”, crashes and depreciation
  - Classic Case is a) sharp fall in GDP, b) big reversal of CA, c) large ER depreciation
Argentina 2001 case

Argentina Sudden Stop

- Source: WDI
Experience of EME’s pre and post GFC has been similar

Source: WEO
Policy for EMEs

- Independent monetary policy and flexible exchange rates not necessarily a solution
  - Policy ‘dilemma’ - policy effectiveness or open capital markets, not both
  - Need to supplement flexible exchange rates with capital market intervention?
Policy for EMEs

- Independent monetary policy and flexible exchange rates not necessarily a solution
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  - Need to supplement flexible exchange rates with capital market intervention?

- Complete closure of capital markets unrealistic for most EMEs
  - But selective capital controls may be needed?
  - New ‘orthodoxy’ calls for combination of capital controls and monetary policy
New orthodoxy?

- When capital flows generate financial instability and sudden stops, what can/should monetary policy do?

Yes.
When capital flows generate financial instability and sudden stops, what can/should monetary policy do?

Little...
New orthodoxy?

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- Little...
- Should monetary policy be supplemented with capital controls?
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- Yes..
- Should monetary policy/capital controls be macro-prudential (lean against the wind)?
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- Should monetary policy be supplemented with capital controls?
  - Yes..

- Should monetary policy/capital controls be macro-prudential (lean against the wind)?
  - Yes
This paper

- Small open-economy DSGE model
  - Financial frictions
  - Sudden stops associated with occasionally-binding credit constraints
  - Sticky nominal prices
- Use this to conduct a normative analysis of optimal monetary policy and capital controls
Dual roles for economic policies

- Monetary policy useful due to nominal rigidities
- Capital controls fix pecuniary externalities caused by financial frictions
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- Should monetary policy/capital controls be macro-prudential?
Preview of results

- Monetary policy: Price stability in normal times, inflation during a crisis
- Capital controls: capital inflow tax in a crisis
  - Capital controls substitutes for an active monetary policy
  - But, capital controls suffer from severe problem of time consistency
- No role for ‘macro-prudential’ policy
Related literature: Theory

- Sudden Stop Crises and Macro-prudential Policy
  - Mendoza (2010), Mendoza and Yue (2010)

- Aggregate demand externalities, exchange rate pegs

- Monetary policy

- Monetary stability vs. financial stability
  - Limited interaction: i.e., Collard, Dellas, Diba and Loisel (2013)
  - Leaning against growing financial imbalances, but secondary in monetary policy, i.e., Borio and Lowe (2002); Woodford (2012)
  - Financial stability is price stability: i.e., Brunnermeier and Sannikov (2012)
The model

- Wholesale good production
  - Imported intermediate goods, hire labor and rent capital
- Final good production
  - Use wholesale goods to produce varieties of consumption goods (sticky prices)
- Consumption composite
  - Domestically consumed or exported
- Firm-households
  - Own all domestic firms, make consumption-saving decisions
  - Accumulate capital (in aggregate fixed supply)
  - Supply labor
  - Borrow in dollars from the rest of the world
  - Face borrowing constraints (expected value of capital is collateral)
Budget Constraint

\[ P_t c_t + Q_t k_{t+1} + \frac{B_{t+1}}{R_{t+1}} + \frac{B^*_t E_t}{R^*_t} (1 - \tau_{c,t}) \]

\[ \leq W_t l_t + k_t (R_{K,t} + Q_t) + B_t + B^*_t E_t + T_t \]

\[ + [P_{M,t} M(Y_{F,t}, L_t, K_t) - (1 + \tau_N) Y_{F,t} P^*_{F,t} E_t - W_t L_t - R_{K,t} K_t] + D_t. \]

Collateral constraint

\[ \forall Y_{F,t} P^*_{F,t} (1 + \tau_N) - B^*_{t+1} \leq \kappa_t E_t \left\{ \frac{Q_{t+1} k_{t+1}}{E_{t+1}} \right\} \]
Budget Constraint

\[ P_t c_t + Q_t k_{t+1} + \frac{B_{t+1}}{R_{t+1}} + \frac{B_{t+1}^* \varepsilon_t}{R_{t+1}^*} (1 - \tau_{c,t}) \]

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Collateral constraint

\[ \nu Y_{F,t} P_{F,t}^* (1 + \tau_N) - B_{t+1}^* \leq \kappa_t E_t \left\{ \frac{Q_{t+1} k_{t+1}}{\varepsilon_{t+1}} \right\} \]

- Two kinds of borrowing
  - Inter-temporal borrowing
  - A-temporal working capital loans
- Future expected capital price limits borrowing capacity
Optimal monetary policy under discretion

- Policy maker maximizes the representative household’s welfare
- Policy instrument: nominal interest rate $R_{t+1}$

$$V(b_t^*, Z_t) = \max \left\{ U(C_t, L_t) + \beta E_t V(b_{t+1}^*, Z_{t+1}) \right\}$$

with

$$\Xi \equiv \{ L_t, C_t, Y_t, Y_{F,t}, b_{t+1}^*, q_t, \mu_t, r_{K,t}, e_t, p_{M,t}, \pi_t \}$$

- subject to implementability constraints
- Key feature is no commitment - government takes future policy functions as given
Theoretical results

- Absent collateral constraints, price stability is optimal
- Implication - active monetary policy used only due to presence of financial frictions
Proposition 1

- Without working capital in the collateral constraint, \( \theta = 0 \), the optimal monetary policy strictly stabilizes inflation \( \pi_t = \pi \).
Intuition: Monetary policy to correct pecuniary externalities

Planner

$$1 = \lambda_t R_{t+1}^* (1 + \kappa_t \frac{\partial (q_{t+1}/e_{t+1})}{\partial b_{t+1}^*}) + E_t \left\{ \beta \frac{U_c(t+1)}{U_c(t)} e_{t+1} R_{t+1}^* \right\}$$

Private sector

$$1 = \mu_t R_{t+1}^* + E_t \left\{ \beta \frac{U_c(t+1)}{U_c(t)} e_{t+1} R_{t+1}^* \right\} ,$$
Intuition: Monetary policy to correct pecuniary externalities

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Private sector

\[ 1 = \mu_t R^*_{t+1} + E_t \left\{ \beta \frac{U_c(t + 1)}{U_c(t)} \frac{e_{t+1}}{e_t} R^*_{t+1} \right\}, \]

- When \( \mu > 0 \), want to raise \( b^*_{t+1} \) to raise \( q_{t+1} \).
- But without working capital cannot do this

\[-b^*_{t+1} \leq \kappa_t E_t \left\{ \frac{q_{t+1}}{e_{t+1}} (b^*_{t+1}) k^*_{t+1} \right\} \]
Proposition 2

- When $\mu_t = 0$ (constraint not binding), monetary policy stabilizes inflation
  - *No macro-prudential role for monetary policy*
Proposition 2

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- Intuition: Planner/Household Euler equations identical

\[
1 = E_t \left\{ \beta \frac{U_c(t + 1)}{U_c(t)} \frac{e_{t+1}}{e_t} R^*_t \right\}
\]

- *Does not depend on* $E_t \mu_{t+1}$
- Therefore, no pecuniary externality to correct
Optimal monetary and capital control policy

- Policy instruments: $R_{t+1}$ and ‘capital control’ $\tau_{c,t}$

\[ V(b_t^*, Z_t) = \max_{\Xi} \left\{ U(C_t, L_t) + \beta E_t V(b_{t+1}^*, Z_{t+1}) \right\} \]

with

\[ \Xi \equiv \{ L_t, C_t, Y_t, Y_{F,t}, b_{t+1}^*, q_t, \mu_t, r_{K,t}, e_t, p_{M,t}, \pi_t \} \]

- Subject to implementability constraints
- Optimal capital control
- Omit foreign bond Euler equation from the set of constraints
Proposition 3

When the social planner sets monetary policy and inter-temporal capital inflow tax without commitment:
a) The optimal monetary policy strictly stabilizes inflation \( \pi_t = \pi \),
Proposition 3

When the social planner sets monetary policy and inter-temporal capital inflow tax without commitment:

a) The optimal monetary policy strictly stabilizes inflation $\pi_t = \pi$,

b) The capital inflow tax satisfies,

$$\tau_{c,t} \equiv \frac{\mu_t R^*_{t+1}}{\rho} \left[ -1 + (\rho - 1) \kappa_t \frac{\partial (q_{t+1}/e_{t+1})}{\partial b^*_{t+1}} \right],$$

Impose a capital inflow tax when constraint is binding
Intuition

- Part a) depart from $\pi_t = \pi$ only to influence $b_{t+1}^*$ through working capital
- But capital inflow tax is perfect substitute for monetary policy
Part b) Private Euler equation

\[ 1 - \tau_{c,t} = E_t \left\{ \beta \frac{U_c(t + 1)}{U_c(t)} \frac{e_{t+1}}{e_t} R_{t+1}^* \right\} + \mu_t R_{t+1}^* \]

Planner Euler equation

\[ 1 = E_t \left\{ \beta \frac{U_c(t + 1)}{U_c(t)} \frac{e_{t+1}}{e_t} R_{t+1}^* \right\} + \lambda_t (1 + \kappa_t \frac{\partial (q_{t+1}/e_{t+1})}{\partial b_{t+1}^*}) \]

Tax corrects the pecuniary externality
Comments

- When constraint binds, planner corrects pecuniary externality through capital inflow tax - correct private sector’s ‘over-borrowing’
  - But welfare implications are questionable - see below
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  But welfare implications are questionable - see below

When constraint doesn’t bind, no gain from capital inflow tax
Comments

- When constraint binds, planner corrects pecuniary externality through capital inflow tax - correct private sector’s ‘over-borrowing’
  - But welfare implications are questionable - see below
- When constraint doesn’t bind, no gain from capital inflow tax
- With both wage and price rigidities, capital controls do not fully substitute for monetary policy
Quantitative evaluation

Data sample: 26 emerging market economies during 1980-2014

Table: Parameter values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preference</strong></td>
<td></td>
</tr>
<tr>
<td>$\beta$</td>
<td>Subjective discount factor 0.90</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Relative risk aversion 2</td>
</tr>
<tr>
<td>$\nu$</td>
<td>Inverse of Frisch labor supply elasticity 1</td>
</tr>
<tr>
<td><strong>Production</strong></td>
<td></td>
</tr>
<tr>
<td>$\alpha_F$</td>
<td>Intermediate input share in production 0.145</td>
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<tr>
<td>$\alpha_L$</td>
<td>Labor share in production 0.57</td>
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<tr>
<td>$\alpha_K$</td>
<td>Capital share in production 0.14</td>
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<tr>
<td>$\vartheta$</td>
<td>Share of working capital 1.4</td>
</tr>
<tr>
<td>$\phi_P$</td>
<td>Price adjustment cost 76</td>
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<tr>
<td>$\gamma$</td>
<td>Asymmetry of price adjustment cost -100</td>
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<tr>
<td>$\theta$</td>
<td>Elasticity of substitution among varieties 10</td>
</tr>
<tr>
<td>$\rho$</td>
<td>Trade elasticity of substitution 5</td>
</tr>
<tr>
<td><strong>Shocks</strong></td>
<td></td>
</tr>
<tr>
<td>$\rho_A$</td>
<td>Persistence of TFP shocks 0.60</td>
</tr>
<tr>
<td>$\sigma_A$</td>
<td>Standard deviation of TFP shocks 0.0295</td>
</tr>
<tr>
<td>$\rho_R$</td>
<td>Persistence of foreign interest rate shocks 0.42</td>
</tr>
<tr>
<td>$\sigma_R$</td>
<td>Standard deviation of foreign interest rate shocks 0.0133</td>
</tr>
<tr>
<td>$p_{H,H}$</td>
<td>Transitional probability of high leverage to high leverage 0.9722</td>
</tr>
<tr>
<td>$p_{L,L}$</td>
<td>Transitional probability of low leverage to low leverage 0.7323</td>
</tr>
</tbody>
</table>
Crisis ‘event’: CC binds at \( t = 0 \) Policy=price stability
Optimal monetary policy

Inflation when the constraint binds
Event analysis: CE vs. optimal monetary policy

- Output
- Real exchange rate
- Import-GDP ratio
- Bond-GDP ratio

Graphs showing the comparison between CE with PI targeting, Monetary and Data.
Key findings

- Outside of crises, price stability is optimal
  - No macro-prudential interest rate activity
- During crisis (when $\mu_t > 0$) generate inflation
- But has only small effect on real economy
- Small effects on $q$ or $b^*$
Now allow for capital Controls

- When $\mu_t > 0$, policy maker imposes capital inflow tax?
- In baseline calibration, this raises $E_t \frac{q_{t+1}}{e_{t+1}}$, relaxes constraint
Optimal monetary vs. monetary & capital control policies

- Inflation
- Capital inflow tax
- Output
- Bond-GDP ratio

Optimal M
Optimal M and C
Data
Capital inflow taxes reduce the fall in output during a crisis

- By reducing borrowing, relax the credit constraint
- But in a time-consistent equilibrium, borrowing turns out to be inefficiently low
Equilibrium time consistent policy functions

Lower equilibrium capital price

- Inflation (%)
- Labor
- Capital price
- Expected price-RER ratio
- Bond
- Capital flow tax

M worst shock
M and C worst shock
Equilibrium time consistent policy functions

In equilibrium, lower borrowing, and tighter borrowing constraints.

Graphs showing:
- Inflation (%)
- Labor
- Capital price
- Expected price-RER ratio
- Bond
- Capital flow tax

Legend: M worst shock, M and C worst shock
Conditional welfare gains

(a) Welfare gains (%) relative to CE (Worst state)

(b) Welfare gains (%) relative to CE (Best state)
Conclusion: time consistent capital controls reduce welfare

- Policymaker corrects current pecuniary externality - ‘overborrowing’ in order to raise $E(q_{t+1})$ and relax constraint
  - But ignores the effect on $q_t$
- In equilibrium, lower $q_t$ and inefficiently low debt
  - In equilibrium, the economy is ‘underborrowing’

- But what taxes are optimal with commitment?
Policy under commitment: A simplified perfect foresight model

- Consider a special path with

  \[ \mu_{t-2} = \mu_{t-1} = 0, \quad \mu_t > 0, \quad \mu_{t+1} = \mu_{t+2} = 0 \]

- Optimal Policy:
  - Tax inflows in period \( t \)
    \[ \tau_{c,t} > 0 \]
  - Subsidize inflows at period \( t + 1 \)
    \[ \tau_{c,t+1} < 0 \]
Policy under commitment: Ad hoc capital inflow subsidies

Let’s conjecture simple rule $\tau_{c,t} = -\varsigma \mu_t$ with $\varsigma = 0.2$
Policy under commitment: Ad hoc capital inflow subsidies

Figure: $\tau_{c,t} = -\zeta \mu_t$ with $\zeta = 0.2$
Conclusions

- Monetary policy should generate inflation during a crisis, even though it depreciates the currency.
- Capital controls are welfare-reducing and should be kept out of the control of the central bank.
- Arguments for prudential policymaking depend critically on nature of borrowing constraint.