Monetary Policy Responses to External Spillovers in Emerging Market Economies

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Motivation for this paper

- Experience of crises in Emerging Markets: Capital flow reversals - spillovers from AE policies
- Large crisis literature (‘sudden stops’).
  - Mostly real models
  - Downplays role of relative price (terms of trade) adjustment
  - Downplays role of exchange rate regime in evaluation
- Economic Policy Trilemma
  - With large macro spillovers, is exchange rate regime important?
  - Fixed or Flexible exchange rates equally vulnerable to external shocks?
  - Should monetary policy be ‘macro-prudential’?
Aim of this paper

- Compare exchange rate regimes in a small open-economy DSGE model
- Vulnerable to world interest rates and changes in credit conditions
  - Financial frictions
  - Sudden stops associated with occasionally-binding credit constraints
  - Sticky nominal prices
- Describe outcomes under ‘normal times’ /‘crisis times’
- Use this to conduct a normative analysis of monetary policy and the exchange rate regime
- Main contribution is to combine crisis literature with NK literature on optimal monetary policy
Set of Questions

- Is monetary policy useful in responding to large spillovers/capital flows?
  - Is the exchange rate regime important (i.e. does the Trilemma matter?)
  - Should monetary policy be prudential?
  - How different should be policy in ‘normal times’ versus ‘crisis times’?
Strategy

- Solve a quantitative SOE model with occasionally binding collateral constraints
- Describe an optimal time-consistent monetary policy
- Compare with IT policy and a peg
Outside of crises, independent monetary policy is of little benefit
Volatility very similar under a peg as in a flexible exchange rate regime
Frequency of sudden stops lower in a peg
External debt is lower under a peg
But crises much worse in a peg

Peg involves sharp deflation, spike in interest rates, large deleveraging

Key difference is ability to regain competitiveness through exchange rate adjustment
In normal times strict price stability optimal (no role for macro-prudential policies)
In crises, sharply depart from price stability
In some cases, optimal monetary policy can substantially limit the damage of crises
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)
Related Literature: Empirics

Road map

- The baseline model: sticky prices
- Calibration and numerical results
- Compare alternative monetary rules, with peg
- Model extension to wage and price stickiness
Small Open Economy 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 (sticky wages in one version)
  - Borrow in dollars from the rest of the world (capital is collateral)
Firm-households

- Wholesale good production
  \[ M_t = A_t (Y_{F,t})^{\alpha_F} L_t^{\alpha_L} K_t^{\alpha_K} \]

- Foreign demand for domestic consumption composite
  \[ X_t = \left( \frac{P_t}{\mathcal{E}_t P_t^*} \right)^{-\rho} \zeta_t^* \]

- Budget constraint
  \[ P_t c_t + Q_t k_{t+1} + \frac{B_{t+1}}{R_{t+1}} + \frac{B_{t+1}^* \mathcal{E}_t}{R_{t+1}^*} (1 - \tau_{c,t}) \leq W_t l_t + k_t (R_{K,t} + Q_t) + B_t + B_t^* \mathcal{E}_t + T_t \]
  \[ + \left[ P_{M,t} M(Y_{F,t}, L_t, K_t) - (1 + \tau_{N,t}) Y_{F,t} P_{F,t}^* \mathcal{E}_t - W_t L_t - R_{K,t} K_t \right] + D_t \]

- Collateral constraint
  \[ \vartheta Y_{F,t} P_{F,t}^* (1 + \tau_{N,t}) - B_{t+1}^* \leq \kappa_t E_t \left\{ \frac{Q_{t+1} k_{t+1}}{\mathcal{E}_{t+1}} \right\} \]
Final good production

- Consumption composite and CPI

\[ Y_t = \left( \int_0^1 (Y_t(i))^{\frac{\theta-1}{\theta}} \, di \right)^{\frac{\theta}{\theta-1}}, \quad P_t = \left( \int_0^1 (P_t(i))^{1-\theta} \, di \right)^{\frac{1}{1-\theta}} \]

- Technology

\[ Y_t(i) = M_t(i) \]

- Profits per period

\[ D_{H,t}(i) \equiv (1 + \tau_{H,t}) P_t(i)Y_t(i) - P_M Y_t(i) - \phi \left( \frac{P_t(i)}{P_{t-1}(i)} \right) Y_t P_t \]

with asymmetric price adjustment cost \( \phi \left( \frac{P_t(i)}{P_{t-1}(i)} \right) \).

- Inflation condition: the Phillips curve
Optimal monetary policy under discretion

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

$$V(b^*_t, Z_t) = \max_{\Xi} \left\{ U(C_t, L_t) + \beta E_t V \left( b^*_{t+1}, Z_{t+1} \right) \right\}$$

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
- No commitment - government takes future policy functions as given
Table: Parameter values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Values</th>
</tr>
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<tbody>
<tr>
<td><strong>Preference</strong></td>
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</tr>
<tr>
<td>$\beta$</td>
<td>0.975</td>
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<tr>
<td>$\sigma$</td>
<td>2</td>
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<tr>
<td>$\nu$</td>
<td>1</td>
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<tr>
<td>$\chi$</td>
<td>0.4</td>
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<tr>
<td><strong>Production</strong></td>
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<tr>
<td>$\alpha_F$</td>
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<td>$\alpha_L$</td>
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<td>$\alpha_K$</td>
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<td>$\phi_P$</td>
<td>76</td>
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<td>$\gamma$</td>
<td>-50</td>
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<td>$\vartheta$</td>
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<td>$\theta$</td>
<td>10</td>
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<tr>
<td>$\rho$</td>
<td>10</td>
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<tr>
<td>$\zeta$</td>
<td>0.117</td>
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<tr>
<td>$R^*$</td>
<td>1.015</td>
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<td>$A$</td>
<td>1</td>
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<td>$\rho_A$</td>
<td>0.95</td>
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<tr>
<td>$\sigma_A$</td>
<td>0.008</td>
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<td>$\rho_R$</td>
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<tr>
<td>$\sigma_R$</td>
<td>0.00623</td>
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<tr>
<td>$p_{H,H}$</td>
<td>0.975</td>
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<td>$p_{L,L}$</td>
<td>0.775</td>
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</table>
Steady State

- Since $\beta R < 1$ constraint will bind in a deterministic SS

Steady state collateral constraint

$$\vartheta(1 + \tau_N)Y_F(e) - b^* = \kappa \frac{q(e)k}{e}$$

Balance of payments condition

$$e^{\rho - 1} \zeta^* - Y_F(e) = -b^* \frac{R^* - 1}{R^*}$$
Steady State determination of debt and real exchange rate

Higher debt associated with RER depreciation

Figure 1: Steady State Real Exchange Rate and External Debt
Stochastic Equilibrium

- Agents engage in precautionary saving
- Shocks lead to changes in $q$ and $e$ so constraint doesn’t always bind
- Model solution for discretized economy 3 shocks, 8 exogenous states
- In flexible exchange rate, just one endogenous state variable (debt)
Price Stability vs. Ramsey: Policy Functions, worst vs. best state

Output: State 1 vs. State 8

Capital Price: State 1 vs. State 8

Real Exchange Rate: State 1 vs. State 8

Inflation: State 1 vs. State 8

Interest Rate: State 1 vs. State 8

- State1 PS
- State 1, Ram
- State 8 PS
- State 8 Ram
Implications

- Outside of crisis, negative relationship between debt, real exchange rate, capital price
- Interest rate independent of debt
- Threshold debt level, constraint binds, interest rate rises
- Ramsey policy leads to increase in inflation as constraint binds
- Crisis occurs with positive probability between 43% and 56% debt-GDP
- No macro-prudential component of policy
Exchange Rate Peg: Policy Functions are two dimensional

- Need to solve conditional on shocks, debt and lagged real exchange rate
- Arises because real exchange rate adjustment comes through domestic prices
Policy Functions in a Peg
Comparison of Ramsey vs. Peg (for average real exchange rate lag)
Implications

- At low debt levels, relationship between debt and economic variables similar
- But when debt is high enough to generate crisis, increasing debt much costlier in peg
- Bigger fall in output, much higher interest rate response
- High sensitivity of inflation to debt in a peg
Debt zone of vulnerability in peg: When currency is overvalued (high real exchange rate), crisis precipitated at very low debt levels.
Moments: Mean over the whole sample

<table>
<thead>
<tr>
<th>Panel A: the whole sample</th>
<th>Mean Price Stability</th>
<th>Ramsey</th>
<th>Peg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>0.6877</td>
<td>0.6877</td>
<td>.6877</td>
</tr>
<tr>
<td>Debt-GDP</td>
<td>0.3185</td>
<td>0.3183</td>
<td>0.3163</td>
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<tr>
<td>Capital Price</td>
<td>0.9364</td>
<td>0.9364</td>
<td>0.9338</td>
</tr>
<tr>
<td>Domestic Interest Rate</td>
<td>1.025</td>
<td>1.025</td>
<td>1.025</td>
</tr>
<tr>
<td>External Finance Premium (\times e^2)</td>
<td>0.74</td>
<td>0.74</td>
<td>0.73</td>
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</table>
Moments: Standard Deviation over whole sample

<table>
<thead>
<tr>
<th></th>
<th>Standard Deviation</th>
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<tbody>
<tr>
<td></td>
<td>Price Stability</td>
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<tr>
<td><strong>Panel A: the whole sample</strong></td>
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<tr>
<td>Output</td>
<td>1.8</td>
</tr>
<tr>
<td>Consumption</td>
<td>1.6</td>
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<tr>
<td>Real Exchange Rate</td>
<td>0.7</td>
</tr>
<tr>
<td>Inflation</td>
<td>0.0</td>
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<tr>
<td>Capital Price</td>
<td>3.4</td>
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Moments: Mean when the constraint binds

<table>
<thead>
<tr>
<th></th>
<th>Price Stability</th>
<th>Mean</th>
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</thead>
<tbody>
<tr>
<td>Output</td>
<td>0.67</td>
<td>0.67</td>
</tr>
<tr>
<td>Debt-GDP</td>
<td>0.46</td>
<td>0.46</td>
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<tr>
<td>Capital Price</td>
<td>0.87</td>
<td>0.87</td>
</tr>
<tr>
<td>Domestic Interest Rate</td>
<td>1.11</td>
<td>1.11</td>
</tr>
<tr>
<td>External Finance Premium × e^{-1}</td>
<td>0.67</td>
<td>0.64</td>
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</table>

The table above shows the moments of various economic indicators under the constraint of Mean when the constraint binds. The indicators include Output, Debt-GDP, Capital Price, Domestic Interest Rate, and External Finance Premium × e^{-1}.
Moments: Standard Deviation with binding constraints

<table>
<thead>
<tr>
<th></th>
<th>Standard Deviation</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Price Stability</td>
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<tr>
<td><strong>Panel B: the subsample with binding constraints</strong></td>
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<tr>
<td>Output</td>
<td>1.8</td>
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<tr>
<td>Consumption</td>
<td>2.5</td>
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<tr>
<td>Real Exchange Rate</td>
<td>1.1</td>
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<tr>
<td>Inflation</td>
<td>0.0</td>
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<tr>
<td>Capital Price</td>
<td>5.7</td>
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Moments: Crisis Frequency and Welfare

<table>
<thead>
<tr>
<th></th>
<th>Price Stability</th>
<th>Ramsey</th>
<th>Peg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of crisis</td>
<td>11.1</td>
<td>10.6</td>
<td>6.8</td>
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<tr>
<td>Conditional welfare</td>
<td>0.38983</td>
<td>0.38983</td>
<td>0.3893</td>
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</tbody>
</table>
Crisis events: Price Stability vs. Ramsey
Crisis events: Ramsey vs. Peg
Results suggest that IT is approximately ok, even in crisis

- So long as exchange rate can move, should not use monetary policy actively?
- But this depends on assumption that nominal wages are flexible
- Highly unrealistic
- Now extend the model to allow for both wage and price stickiness
- Flexible exchange rate
Model solution

- Now depends on lagged real wage and debt
Policy function comparison

Inflation target

Optimal Policy

Optimal policy keeps output higher in crisis
Policy function comparison

Inflation target

Optimal Policy

Interest rate response more active
Inflation under Ramsey
Crisis event in Sticky Price and Wage Economy
Implications

- With more realistic nominal stickiness, active monetary policy is very useful
- Depart from IT in crisis
- But still almost the same as IT outside crisis (no macro-prudential)
Conclusions

- Paper combines sudden stop models with NK price rigidity
- Offers insight into monetary policy for emerging countries vulnerable to large external spillovers
- Monetary policy should generate inflation during a crisis, even though it depreciates the currency
- No role for macro-prudential monetary policy
- Peg may have less frequent crises and less volatility, but crisis experience much worse
- ‘Trilemma’ still matters
- Caveat: have not explored benefits of capital flow controls (Devereux-Young-Yu, 2016 Devereux-Yu 2016)