On the use of monetary and macroprudential policies for small open economies

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Roadmap

- Motivation
- Overview of the model
- Model dynamics
  - Calibration
  - Should monetary policy lean against the wind?
- Optimal policy rules and welfare evaluations
- Summary and next steps
Motivation (1)

- 'Lean versus clean' debate prior to and in the aftermath of the 2008-2009 global financial crisis (GFC).
- The conventional wisdom prior to GFC was 'better to clean up after the bubble bursts'.
- It was also argued that using interest rates towards the financial stability aim is potentially costly;
  - unclear what the impact of policy rates would have been on risk taking behaviour
  - interest rates would have needed to go up substantially with serious consequences for the real economy
  - using interest rates to de-anchor against asset price bubbles may de-anchor inflation expectations
Motivation (2)

- Prior to the crisis...

Financial stability related mandates of central banks in 2009
(The darker the shading the bigger the mandate)

Source: BIS.
Motivation (3)

- GFC $\Rightarrow$ price stability didn’t ensure overall macroeconomic and financial stability.
- Costs of financial crises pointed to the importance of preserving financial stability.
- Macroprudential measures are recommended to reduce the systemic risk—procyclical behaviour of financial markets.
- New arrangements in mature economies and EMs; a new consensus on the need to use both monetary and macroprudential policies as tools of countercyclical management.
Motivation (4)—Examples

- Caps on loan-to-value (LTV) ratio (Canada, Sweden, China)
- Caps on debt-to-income (DTI) ratio (Korea, Norway, Russia)
- Caps on foreign currency lending (Hong Kong)
- Limits on net open currency positions/currency mismatch (Brazil, Mexico)
- Limits on maturity mismatch (Singapore, New Zealand)
- Reserve requirements (Turkey, Korea, Indonesia)
- Countercyclical capital requirements (China)
- Restrictions on profit distribution (Argentina, Colombia, Turkey)
How can a policy intervention that directly affects private borrowing decisions be justified in economic terms?

- Negative externalities associated with private borrowing decisions (Jeanne and Korinek, 2009; Korinek, 2009; Bianchi and Mendoza, 2011; Benigno et al., 2013; among others).

- Role of macroprudential measures in mitigating the effects of shocks that cannot be offset with monetary/fiscal policies (Angeloni and Faia, 2009; Angelini et al., 2010, Kannan at al., 2012; Unsal, 2013; Quint and Rabanal, 2014; among others).
Motivation (6)—This paper

- Optimal monetary and macroprudential rules for a SOE in a two-country sticky-price DSGE model with financial frictions.
  - Taylor rule as a function of inflation, output and credit growth.
  - Macroprudential rule as a function of credit growth.

- An open economy dimension to analyze
  - policy issues relevant for emerging market economies (i.e. large capital outflows/inflows).
  - the role of exchange rate and the source of liabilities (foreign vs. domestic) on the use of macroprudential measures.

- Consider different shocks to provide operational suggestions for a more robust policy mix to real-time shock uncertainty.
Model (1)

A two-country NK model with the financial accelerator mechanism developed by Bernanke et al. (1999).

- The world economy consists of two economies; a domestic economy \( n \), and a foreign economy \( 1 - n \). We assume that the domestic economy is small.

Three modifications

- Macropudrential measures.
- In the extension, entrepreneurs can borrow both from domestic and foreign resources—allows to analyze the role of borrowing sources in the desirability of policy tools.
- Capital inflows reflect favorable changes in the perception of lenders. As they become “overoptimistic” about the economy, financing conditions become easier.
Model (2)—Households

- Receive utility with GHH preferences

\[ E_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{1 - \sigma} \left( C_t - \frac{\chi}{1 + \varphi} H_{t+1}^{1+\varphi} \right)^{1-\sigma}, \]

with

\[ C_t = \left[ \alpha^{\frac{1}{\gamma}} C_{H,t}^{(\gamma-1)/\gamma} + \left( 1 - \alpha \right)^{\frac{1}{\gamma}} C_{M,t}^{(\gamma-1)/\gamma} \right]^{\gamma/(\gamma-1)}, \]

where \( \alpha \equiv (1 - n) \nu \) depends on \( 1 - n \), the relative size of foreign economy, and on \( \nu \), the degree of trade openness.

- Provide labor to production firms.
- Participate in domestic and foreign financial markets.

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Model (3)—Production firms

- Produce a differentiated good indexed by \( j \in [0, 1] \):
  \[
  Y_t(j) = A_t N_t(j)^{1-\eta} K_t(j)^\eta,
  \]
- Have some market power and segment domestic and foreign markets with local currency pricing.
- Subject to Rotemberg (1982) type quadratic menu cost.
- Maximize
  \[
  E_0 \sum_{t=0}^{\infty} \frac{\beta^t U_{c,t}}{P_t} [P_{H,t}(j) Y_{H,t}(j) + S_t P_{X,t}(j) Y_{X,t}(j) - MC_t Y_t(j)]
  \]
  \[
  - P_t \sum_{i=H,X} \frac{\Psi_i}{2} \left( \frac{P_{i,t}(j)}{P_{i,t-1}(j)} - 1 \right)^2,
  \]
  where \( Y_{i,t}(j) = (\frac{P_{i,t}(j)}{P_{i,t-1}(j)})^{-\lambda} Y_{i,t} \), for \( i = H, X \).
Model (4)

- Importing Firms
  — Buy foreign goods at prices $P_{X,t}^*$ (in local currency) and sell to the domestic market
  — Subject to a price adjustment cost with $\Psi_M \geq 0$, analogous to the production firms.

- Competitive Unfinished Capital Goods Producers
  — Use investment as an input, $I_t$ and combine it with rented capital $K_t$ to produce unfinished capital goods, which are then sold to the entrepreneurs.
  — Subject to an investment adjustment cost, and maximize
  $$\Xi_t(I_t, K_t) = \left[\frac{I_t}{K_t} - \frac{\Psi_t}{2} (\frac{I_t}{K_t} - \delta)^2\right] K_t$$
Model (5)—Entrepreneurs

- Transform unfinished capital goods to capital goods through \( \omega_{t+1}K_{t+1} \) and rent them.
- Finance their investment internally \((NW)\) and externally by borrowing from foreign lenders \((F)\) (extension: domestic borrowers \(D\)).

\[
P_t NW_t F(k) = Q_t K_{t+1}(k) - S_t D_{t+1}(k),
\]

- Productivity is observed by the entrepreneur ex-ante, but not by the lenders \( \omega^*_{t+1}(k) = \omega_{t+1}(k) \varrho_t \). \( \varrho_t \) is a misperception factor. Lenders can observe \( \omega_{t+1} \) ex-post at some cost.
- These factors result in an endogenous “risk premium” \((\Phi_t^F)\) as a function of leverage and investors’ perception.
Model (6)—Financial intermediaries

- Receive capital inflows from the foreign economy and lend to entrepreneurs.
- Earn zero profit. In the absence of macroprudential measures, lending rate is $E_t[(1 + i_t^*)(1 + \Phi_{t+1}^F)]$, $i_t^*$ is the foreign policy rate.

Macroprudential policy
- The macroprudential policy brings an increase in the lending rates—“regulation premium”

$$RP_t = \Psi\left(\frac{S_tD_t^F}{S_{t-1}D_{t-1}^F} - 1\right)$$

- The lending cost becomes $E_t[(1 + i_t^*)(1 + \Phi_{t+1}^F)(1 + RP_t)]$. 

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Model (8)—Monetary Policy

— We start with a standard Taylor-type monetary policy rule.

\[ 1 + i_t = \left[ (1 + i) \left( \pi_t \right)^{\epsilon_\pi} \left( \frac{Y_t}{Y} \right)^{\epsilon_Y} \left( \text{credit growth} \right)^{\epsilon_D} \right]^{\omega} \left[ 1 + i_{t-1} \right]^{1-\omega}, \]

with \( \{\epsilon_\pi\} \in (1, \infty], \{\epsilon_Y\} \in (0, \infty], \{\epsilon_D\} \in (0, \infty] \); and \( \omega \in [0, 1] \).

— We then numerically compute the optimal values of \( \epsilon_\pi, \epsilon_Y \) and \( \epsilon_D \) using a second order approximation to the utility function.
Calibration (1)—Parameter values for consumption, production and entrepreneurs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>0.99 Discount factor</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>2 Inverse of the intertemporal elasticity of substitution</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>1 Elasticity of substitution between domestic and foreign goods</td>
</tr>
<tr>
<td>$\varphi$</td>
<td>2 Frisch elasticity of labour supply</td>
</tr>
<tr>
<td>$(1 - \alpha)$</td>
<td>0.35 Degree of openness</td>
</tr>
<tr>
<td>$\eta$</td>
<td>0.35 Share of capital in production</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>11 Elasticity of substitution between domestic goods</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.025 Quarterly rate of depreciation</td>
</tr>
<tr>
<td>$\Omega$</td>
<td>0.01 Share of entrepreneurial labor</td>
</tr>
<tr>
<td>$\Psi_I$</td>
<td>12 Investment adjustment cost</td>
</tr>
<tr>
<td>$\Psi_D$</td>
<td>0.0075 Responsiveness of household risk premium to debt/GDP</td>
</tr>
<tr>
<td>$\Psi_i$, $\Psi_M$</td>
<td>120 Price adjustment costs for $i = H, X$</td>
</tr>
<tr>
<td>$\omega$</td>
<td>0.5 Inertia in the policy rule</td>
</tr>
<tr>
<td>$\rho_e$</td>
<td>0.5 Persistence of the domestic perception shock</td>
</tr>
<tr>
<td>$\Phi_t$</td>
<td>0.02 External risk premium</td>
</tr>
<tr>
<td>$\mu$</td>
<td>0.2 Monitoring cost</td>
</tr>
<tr>
<td>$\theta$</td>
<td>0.9933 Survival rate</td>
</tr>
</tbody>
</table>
Calibration (2)—Parameter values for monetary and macroprudential rules

<table>
<thead>
<tr>
<th></th>
<th>Monetary policy</th>
<th>Macropurudential policy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inflation</td>
<td>Output gap†</td>
</tr>
<tr>
<td>Taylor rule</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Taylor rule with credit gr.</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Taylor rule + macroprud.</td>
<td>1.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

†Output gap is calculated as a deviation of output from its steady state.
Calibration (3)—A sudden stop scenario

- We simulate an increase in investors’ perception of risk in the baseline. As financing costs increase, firms borrow and invest less.
- Lower borrowing also decreases the future supply of capital and hence brings about a decline in consumption and output.
- Weaker demand and lower asset prices damage firms’ balance sheets further. Eventually, lower leverage decreases risk premium and economy normalizes.
- Both monetary policy and macroprudential measures have a non-trivial role in mitigating the impact of the shock.
Should monetary policy lean against the wind? (1)—Taylor rule vs. macroprudential rule under a financial shock
Should monetary policy lean against the wind? (2)—Taylor rule vs. adjusted Taylor rule under a financial shock

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Should monetary policy lean against the wind? (3)—Taylor rule vs. macroprudential rule under a productivity shock
Should monetary policy lean against the wind? (4)—Taylor rule vs. adjusted Taylor rule under a productivity shock.
Welfare evaluations and optimal policy rules (1)

- Following Faia and Monacelli (2007) and Gertler and Karadi (2010),
  \[ V_t = U(C_t, H_t) + \beta E_t V_{t+1} \]
  where \( V_t \equiv E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, H_t) \) denotes the utility function.
- We take a second order approximation of \( V_t \) around the deterministic steady state.
- We calculate \( V_t \) in under alternative policy options, and compute \( \Omega \), the fraction of consumption required to equate \( V_t \) to \( V_{t}^{opt} \). Higher \( \Omega \) means lower welfare.
- We then search numerically in the grid of parameters \( \{\epsilon_\pi, \epsilon_y, \epsilon_D, \Psi\} \) that optimize \( V_t \).
Welfare evaluations and optimal policy rules (2)—Optimal rules under a financial shock

<table>
<thead>
<tr>
<th></th>
<th>Monetary policy</th>
<th>Macropru. policy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inflation</td>
<td>Output gap</td>
</tr>
<tr>
<td>Opt. Taylor rule (OTR)</td>
<td>1.1</td>
<td>0</td>
</tr>
<tr>
<td>OTR with CG</td>
<td>1.1</td>
<td>-</td>
</tr>
<tr>
<td>OTR + OMP</td>
<td>2.4</td>
<td>-</td>
</tr>
<tr>
<td>OTR with CG+OMP</td>
<td>1.7</td>
<td>-</td>
</tr>
</tbody>
</table>

*Output gap is calculated as a deviation of output from its steady state.*
Welfare evaluations and optimal policy rules (3)—Welfare comparisons under a financial shock

<table>
<thead>
<tr>
<th>Policy Rule</th>
<th>Welfare Loss ($\gamma$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taylor rule (TR)</td>
<td>0.2106</td>
</tr>
<tr>
<td>TR with credit growth (CG)</td>
<td>0.1593</td>
</tr>
<tr>
<td>TR + macroprud. policy (MP)</td>
<td>0.1140</td>
</tr>
<tr>
<td>Optimized Taylor rule (OTR)</td>
<td>-</td>
</tr>
<tr>
<td>OTR with CG</td>
<td>-0.0324</td>
</tr>
<tr>
<td>OTR + optimized MP (OMP)</td>
<td>-0.1098</td>
</tr>
<tr>
<td>OTR with CG+ OMP</td>
<td>-0.1178</td>
</tr>
</tbody>
</table>
Welfare evaluations and optimal policy rules (4)—Optimal rules under a productivity shock

<table>
<thead>
<tr>
<th>Monetary policy</th>
<th>Macropru. policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation</td>
<td>Output gap+</td>
</tr>
<tr>
<td>Opt. Taylor rule (OTR)</td>
<td>1.1</td>
</tr>
<tr>
<td>OTR with CG</td>
<td>1.1</td>
</tr>
<tr>
<td>OTR + OMP</td>
<td>1.1</td>
</tr>
<tr>
<td>OTR with CG+OMP</td>
<td>1.1</td>
</tr>
</tbody>
</table>
Welfare evaluations and optimal policy rules (5)—Welfare comparisons under a productivity shock

<table>
<thead>
<tr>
<th>Policy Rule</th>
<th>Welfare Loss ($\Upsilon$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taylor rule (TR)</td>
<td>0.2163</td>
</tr>
<tr>
<td>TR with credit growth (CG)</td>
<td>0.3302</td>
</tr>
<tr>
<td>TR + macroprudential policy (MP)</td>
<td>0.2411</td>
</tr>
<tr>
<td>Optimized Taylor rule (OTR)</td>
<td>-</td>
</tr>
<tr>
<td>OTR with CG</td>
<td>-</td>
</tr>
<tr>
<td>OTR + optimized MP (OMP)</td>
<td>-</td>
</tr>
<tr>
<td>OTR with CG + OMP</td>
<td>-</td>
</tr>
</tbody>
</table>
Welfare evaluations and optimal policy rules (6)—Optimal rules under a financial shock, sources of borrowing

<table>
<thead>
<tr>
<th>Sources of Borrowing</th>
<th>Welfare Loss ($\Upsilon$)</th>
<th>Opt. Coefficient of Credit Gr.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign</td>
<td>-0.0321</td>
<td>-0.1098</td>
</tr>
<tr>
<td>Domestic</td>
<td>-0.0205</td>
<td>-0.0310</td>
</tr>
<tr>
<td>Domestic and Foreign</td>
<td>-0.0262</td>
<td>-0.0447</td>
</tr>
</tbody>
</table>
Summary and next steps

▶ We explore how best to design monetary and macroprudential policies in a SOE.

▶ When macroprudential policy in place, welfare gains from responding through monetary policy is negligible under a financial shock.
▶ It is costly to respond through monetary policy under a productivity shock.
▶ In economies with sizeable foreign borrowing, using macroprudential instrument is more desirable.

▶ Next steps will include:

▶ Further analysis on robustness
▶ FX interventions and flexibility of exchange rate regime.
▶ Counterfactual policy exercise calibrated for a SOE.