Monetary Policy Rules in the Presence of an Occasionally Binding Borrowing Constraint

Punnoose Jacob    Christie Smith    Fang Yao

Oct 2014, Wellington

Reserve Bank of New Zealand.
Research Question

- How does an occasionally-binding Loan-to-Value Ratio (LVR) constraint affect the conduct of monetary policy in terms of an interest rate rule?
Local Context

- New Zealand’s LVR restrictions were introduced on 1 October 2013, responding to
Local Context

- New Zealand’s LVR restrictions were introduced on 1 October 2013, responding to
  - Annual NZ house price inflation reached 10 percent, December 2013 (16% in Auckland).

  **Housing market led to financial stability concerns**

  Reluctance to use the interest rates: concerns about low inflation and elevated exchange rate.
Local Context

- New Zealand’s LVR restrictions were introduced on 1 October 2013, responding to
  - Annual NZ house price inflation reached 10 percent, December 2013 (16% in Auckland).
  - The proportion of high LVR lending exceeded 30% in early 2013.
Local Context

- New Zealand’s LVR restrictions were introduced on 1 October 2013, responding to
  
  ▶ Annual NZ house price inflation reached 10 percent, December 2013 (16% in Auckland).
  
  ▶ The proportion of high LVR lending exceeded 30% in early 2013.

- Housing market led to financial stability concerns
New Zealand’s LVR restrictions were introduced on 1 October 2013, responding to

- Annual NZ house price inflation reached 10 percent, December 2013 (16% in Auckland).
- The proportion of high LVR lending exceeded 30% in early 2013.

Housing market led to financial stability concerns

Reluctance to use the interest rates: concerns about low inflation and elevated exchange rate.
Contribution

- We start from Iacoviello (2005)
Contribution

- We start from Iacoviello (2005)
  - Housing market
Contribution

- We start from Iacoviello (2005)
  - Housing market
  - Patient and impatient households
Contribution

- We start from Iacoviello (2005)
  - Housing market
  - Patient and impatient households
  - Borrowing constraint on loans
Contribution

- We start from Iacoviello (2005)
  - Housing market
  - Patient and impatient households
  - Borrowing constraint on loans

- Our extensions
Contribution

- We start from Iacoviello (2005)
  - Housing market
  - Patient and impatient households
  - Borrowing constraint on loans

- Our extensions
  - Open economy DSGE model for NZ
Contribution

- We start from Iacoviello (2005)
  - Housing market
  - Patient and impatient households
  - Borrowing constraint on loans

- Our extensions
  - Open economy DSGE model for NZ
  - Occasionally-binding borrowing constraint
Contribution

- We start from Iacoviello (2005)
  - Housing market
  - Patient and impatient households
  - Borrowing constraint on loans

- Our extensions
  - Open economy DSGE model for NZ
  - Occasionally-binding borrowing constraint
  - We study optimal monetary policy rules
Main Findings

- Imposing an occasionally-binding LVR makes the economy respond asymmetrically to positive and negative shocks.
Main Findings

- Imposing an occasionally-binding LVR makes the economy respond asymmetrically to positive and negative shocks.
- The LVR affects macro volatilities and hence changes monetary policy.
Main Findings

- Imposing an occasionally-binding LVR makes the economy respond asymmetrically to positive and negative shocks.
- The LVR affects macro volatilities and hence changes monetary policy.
- The optimal monetary policy rule under an LVR constraint transfers welfare from savers to borrowers.
Main Findings

- Imposing an occasionally-binding LVR makes the economy respond asymmetrically to positive and negative shocks.

- The LVR affects macro volatilities and hence changes monetary policy.

- The optimal monetary policy rule under an LVR constraint transfers welfare from savers to borrowers.

- Removing the LVR results in gradual adjustment.
THE MODEL
Households’ problem

Maximise expected utility subject to

1. Budget constraint
Households’ problem

Maximise expected utility subject to

1. Budget constraint

2. Collateral constraint

\[ R_{l,t} L_t' \leq \mu \ E_t \left[ q_{h,t+1} P_{c,t+1} h_t' \right] \]
The Rest of the Model

- Banks channel savings from domestic and foreign savers to borrowers.
- Home good produced with capital and Labour
- Sold at home and abroad
- Foreign output, inflation and the interest rate: New Keynesian closed economy model
Monetary and LVR Policy

- Interest rate rule

\[
\frac{R_t}{\bar{R}} = \left( \frac{R_{t-1}}{\bar{R}} \right)^{r \pi} \left[ \left( \frac{\pi_{c,t}}{\bar{\pi}_c} \right)^{r \pi} \left( \frac{y_t}{y_{t-1}} \right)^{r \Delta y} \right]^{1-r} \exp{\omega_{r,t}}
\]
Monetary and LVR Policy

- **Interest rate rule**

\[
\frac{R_t}{\bar{R}} = \left( \frac{R_{t-1}}{\bar{R}} \right)^{r_r} \left[ \left( \frac{\pi_{c,t}}{\bar{\pi}_c} \right)^{r_{\pi}} \left( \frac{y_t}{y_{t-1}} \right)^{r_{\Delta y}} \right]^{1-r_r} \exp \omega_{r,t}
\]

- **LVR policy**

\[
R_{l,t}L'_t \leq \mu_{LVR} \; E_t \left[ q_{h,t+1}P_{c,t+1}h'_t \right]
\]
Parameter Values

- Most of structural parameters are calibrated to match NZ data.
- The rest are estimated using Bayesian methods.
- Sample period: 1993 Q4 to 2013 Q3 before the LVR restriction was introduced.
- The estimated model does not have the borrowing constraint.
- 9 data series:
  - GDP growth, Consumption growth, Residential investment growth, Business investment growth, Housing loan growth, 90-day rate, CPI inflation, House price Inflation, Mortgage spread.
Occasionally-Binding Solution
Occasionally-binding Solution

- We use the "OccBin" Toolbox developed by Guerrieri and Iacoviello (2014)
- A piecewise-linear approximation of occasionally binding constraints
- It is able to deal with large models with many predetermined variables.
Asymmetric IRFs: Monetary Policy Shock
Asymmetric IRFs: Monetary Policy Shock

**Contractary**

90-Day Rate
House Price
Loan
Output
CPI Inflation

**Expansionary**

90-Day Rate
House Price
Loan
Output
CPI Inflation

- Occasionally binding
- Perpetually binding
Stochastic Simulation
Stochastic Simulation

Graphs showing:
- Loan-to-Value Ratio
- Loan
- Consumption
- Output
## Stochastic Simulation

### Comparing Moments from the Perpetually- and Occasionally-binding Models

<table>
<thead>
<tr>
<th>LVR</th>
<th>Binding Frequency</th>
<th>Output S.D. (%)</th>
<th>CPI Inflation S.D. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Occasional</td>
<td>Perpetual</td>
<td>Occasional</td>
</tr>
<tr>
<td>0.90</td>
<td>10.4%</td>
<td>100%</td>
<td>0.77</td>
</tr>
<tr>
<td>0.70</td>
<td>12%</td>
<td>100%</td>
<td>0.75</td>
</tr>
</tbody>
</table>
Optimal Policy
# Optimal Monetary Policy Rules

<table>
<thead>
<tr>
<th>Taylor Rules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated: $\hat{R}<em>t = 0.80\hat{R}</em>{t-1} + 0.2 (1.89\hat{\pi}_{c,t} + 0.32\Delta\hat{y}_t)$</td>
</tr>
<tr>
<td>Occ. binding optimal: $\hat{R}<em>t = 0.80\hat{R}</em>{t-1} + 0.2 (1.1\hat{\pi}_{c,t} - \Delta\hat{y}_t)$</td>
</tr>
<tr>
<td>Always binding optimal: $\hat{R}<em>t = 0.80\hat{R}</em>{t-1} + 0.2 (3\hat{\pi}_{c,t} - \Delta\hat{y}_t)$</td>
</tr>
</tbody>
</table>
## Optimal Monetary Policy Rules

<table>
<thead>
<tr>
<th></th>
<th>Taylor Rules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated:</td>
<td>( \hat{R}<em>t = 0.80 \hat{R}</em>{t-1} + 0.2 (1.89 \hat{\pi}_{c,t} + 0.32 \Delta \hat{y}_t) )</td>
</tr>
<tr>
<td>Occ. binding optimal:</td>
<td>( \hat{R}<em>t = 0.80 \hat{R}</em>{t-1} + 0.2 (1.1 \hat{\pi}_{c,t} - \Delta \hat{y}_t) )</td>
</tr>
<tr>
<td>Always binding optimal:</td>
<td>( \hat{R}<em>t = 0.80 \hat{R}</em>{t-1} + 0.2 (3 \hat{\pi}_{c,t} - \Delta \hat{y}_t) )</td>
</tr>
</tbody>
</table>

- Extend Taylor rule to include house price inflation and credit growth
## Welfare Evaluation

<table>
<thead>
<tr>
<th>Taylor Rules</th>
<th>Welfare Level (Gain in terms of consumption)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Saver</td>
</tr>
<tr>
<td>Estimated:</td>
<td>-84.83</td>
</tr>
<tr>
<td>Occ. binding:</td>
<td>-85.88 (−1.04%)</td>
</tr>
<tr>
<td>Always binding:</td>
<td>-75.4 (9.8%)</td>
</tr>
</tbody>
</table>
Temporary LVR Tightening

![Loan-to-Value Ratio Graph]

- **Occasionally-binding**
- **Perpetually-binding**
Conclusion

- We study macro dynamics under an occasionally-binding LVR.
- The LVR makes the economy respond asymmetrically to positive and negative shocks and hence changes macro volatilities and monetary policy.

Future Research:

- Extend monetary policy rule to include house price inflation and credit growth
- Endogenise LVR policy
- Open economy dimensions
Bank’s problem

- Bank dividend

\[
\max E_t \sum_{\tau=0}^{\infty} \beta^\tau \frac{\lambda_{t+\tau}}{\lambda_t} \frac{D_{b,t+\tau}(j)}{P_{c,t+\tau}}
\]

- Budget constraint

\[
\frac{D_{b,t}(j)}{P_{c,t}} + \frac{R_{t-1}S_{t-1}(j)}{P_{c,t}} + \frac{\Phi_{t-1}R_{t-1}^*S_{t-1}^*(j)}{\epsilon_t P_{c,t}} + \frac{L_t(j)}{P_{c,t}} \\
\leq \frac{S_t(j)}{P_{c,t}} + \frac{S_t^*(j)}{\epsilon_t P_{c,t}} + \frac{R_{l,t-1}L_{t-1}(j)}{P_{c,t}}
\]

- The bank is subject to a capital requirement constraint

\[
\frac{L_t(j) - S_t(j) - S_t^*(j)/\epsilon_t}{L_t(j)} = 1 - \mu_{b,t}
\]

where: \(\mu_{b,t} = \mu_{b,t-1}^b \frac{L_t}{P_{d,t}Y_{d,t}}^{b_l(1-b_b)}\), \(b_l > 0\), \(b_b \in [0, 1)\)
IRFs to Monetary Policy Shock

**Shock Process**

- 97.5% ile
- Median
- 2.5% ile

**Policy Rate**

**CPI Inflation**

**Output**

**Cons. Saver**

**Cons. Borrower**

**Housing Inv.**

**House Price**

**Loans**

**Lending Spread**

**Business Inv.**

**RER**
Optimal Monetary Policy Rules under LVR

- We evaluate Taylor type operational rules based on unconditional expectations of social welfare.

- Due to the occasionally binding constraint, we apply a simulation-based welfare measure.

- We simulate the model based on estimated parameters and driving forces for 500 periods, repeating it for 200 times.

- Averaging across 200 replications yields a sample approximation to the expected values of variables for the welfare measure.

- We repeat this exercise for each candidate policy rule on a grid of Taylor rule coefficients.