Macroprudential Policy Simple Rules in Small-open Economies

(Preliminary version)

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Overview

- Design of macroprudential policy and its impact on welfare and financial stability
  - Simple rules-based policy vs. "no-action" policy
  - Loan-to-value (LTV) ratio policy vs. debt-to-income (DTI) ratio policy
  - One-period loans and long-term loans
- Still in a working process.

Key Findings

1. Maximum welfare gains: activist policy of loan-to-value ratio; responding to levels of targeted variables
2. Variances: volatility of housing debt and shadow cost of the borrowing constraint is most stabilised
3. In the context of one-period loans, static debt-to-income ratio policy is as good as activist policies in achieving welfare gains and financial stability
4. In the context of long-term loans and with occasionally binding debt-to-income ratio constraint, implementing an activist policy using both instruments leads to the largest financial stability.

Introduction

- Financial factors can significantly influence the business cycle, demonstrated by the global financial crisis and the Great Recession.
- A reconsideration of the existing macroeconomic policy framework
- Macroprudential policies, with an explicit goal of maintaining financial stability and limiting its macroeconomic consequences

Literature Reviews

- "Financial frictions in DSGE models" literature:
  - financial accelerator mechanism due to Bernanke, Gertler, and Gilchrist (1999), relating interest spreads to net worth of agents
  - introducing borrowing constraints following Kiyotaki and Moore (1997), the amount loaned is tied to the value of collateral
    - Iacoviello (2005): housing as collateral assets
    - Iacoviello and Neri (2010): sectoral heterogeneity on supply side ←

Literature Reviews

- "Effectiveness and design of macroprudential policies" literature: a fast growing literature, two common approaches:
  1. cross-country panel data studies, such as Gerutti et al (2017)
  2. DSGE models
     - 2.1 LTV ratio policy and welfare: Rubio and Carrasco-Gallego (2014) ←
     - 2.2 LTV ratio policy and expectations formation: Lambertini et al (2013)

Literature Reviews

- "Long-term housing mortgages" literature:
  - Gomme, Kydland, and Rupert (2001), Kydland, Rupert, and Sustek (2016) ←
    - housing construction time and business cycle dynamics
  - Alpanda and Zubairy (2017)
    - LTV ratio policy, fiscal policy (mortgage interest deduction and property tax), monetary policy
  - Grodecka (2017) ←
    - one-period loans and long-term loans, Swedish data
  - These studies either do not consider activist policy or include no welfare analysis.

Literature Reviews

- "Occasionally binding constraints" literature:
  - Guerrieri and Iacoviello (2015) ←
  - Kulish, Morley and Robinson (2017)

Research Questions

- What could be the best performing simple rule-based policy in terms of welfare (or variances) in a small-open economy?

What does this paper do

- A small-open economy DSGE model
  - Simple one-period loan
  - Long-term loan
- Baseline: a static loan-to-value (debt-to-income) ratio policy
- Activist policies:
  - a simple rule of LTV (or DTI) ratio in response to growth rates (or levels) of housing debt and real house prices
- Welfare analysis, if possible
- Volatility of key variables
- Impulse responses to shocks of interest

Model: Households

- There are two types of households in the economy: patient households (lenders) and impatient households (borrowers).

$$W_{j,0} = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_j^t \zeta_{c,t} \left[\Gamma_j \ln \left(C_{j,t} - \Omega C_{j,t-1} \right) + J_t \ln H_{j,t} - \chi \frac{\left(L_{j,c,t}^{1+\xi} + L_{j,h,t}^{1+\xi} \right)^{\frac{1+\psi}{1+\xi}}}{1+\psi} \right],$$

where:

  - $\zeta_{c,t}$ is consumption preference shock
  - J_t is housing preference shock
  - $j = 1$ is the saver, type $j = 2$ is the borrower, $\beta_1 > \beta_2$.

Model: Patient Household

- The budget constraint of the representative patient household

$$
\begin{aligned}
& P_t C_{1,t} + P_{D,t} I_{c,t} + P_{D,t} I_{h,t} + Q_{h,t} IH_{1,t} \\
& - B_{1,t} + R^*_{t-1} S_t B^*_{t-1} \Phi_t \left(a_{t-1}, \xi_{b^*,t} \right) \\
\leq & W_{1,c,t} L_{1,c,t} + W_{1,h,t} L_{1,h,t} + r_{c,t} P_{D,t} K_{c,t-1} + r_{h,t} P_{D,t} K_{h,t-1} \\
& - R_{t-1} B_{1,t-1} + S_t B^*_t + \Pi_{c,t} + \Pi_{m,t} \\
& + \Pi_{w,1,t} - P_t T_{1,t} + P_t T_{1,land,t},
\end{aligned}
$$

where

$$
H_{1,t} = (1 - \delta_h) H_{1,t-1} + IH_{1,t}.
$$

Model: Simple One-period loans

- The budget constraint of the representative impatient household

$$\begin{aligned} & P_t C_{2,t} + Q_{h,t} IH_{2,t} + R_{t-1} B_{2,t-1} \\ \leq & W_{2,c,t} L_{2,c,t} + W_{2,h,t} L_{2,h,t} + B_{2,t} \\ & + \Pi_{w,2,t} - P_t T_{2,t} + P_t T_{2,land,t}, \end{aligned}$$

and

$$B_{1,t} + B_{2,t} = 0.$$

Model: Simple One-period Loans

Due to asymmetric information, the lender requires collateral to be posted when extending loans to the borrower. The borrowers are assumed to be subject to one of the two borrowing constraints:

- A loan-to-value borrowing constraint:

$$R_t B_{2,t} \leq \kappa_t \mathbb{E}_t \left(Q_{h,t+1} H_{2,t} \right).$$

  κ_t is the loan-to-value ratio, this borrowing constraint follows Iacoviello (2005), Iacoviello and Neri (2010).

- A debt-to-income borrowing constraint:

$$R_t B_{2,t} \leq m_t \sum^{i=c,h} W_{2,i,t} L_{2,i,t}.$$

  m_t is the debt-to-income ratio.

Model: Long-term Loans

- A more realistic way to model the housing mortgage is to assume a long-term loan, such as in Kydland et al (2016).

$$\begin{aligned} & P_t C_{2,t} + Q_{h,t} IH_{2,t} + D_t \\ \leq & W_{2,c,t} L_{2,c,t} + W_{2,h,t} L_{2,h,t} + NB_t \\ & + \Pi_{w,2,t} - P_t T_{2,t} + P_t T_{2,land,t}, \end{aligned}$$

where the new loan NB_t and the debt service payment in period t is given by

$$B_{2,t} = (1 - \tau) B_{2,t-1} + NB_t.$$

$$D_t = (R_{t-1} - 1 + \tau) B_{2,t-1}.$$

τ is the (constant) average amortization rate of the outstanding mortgage, R_t is the mortgage rate, also the policy rate.

Model: Long-term Loans

- In each period, the borrower transfers a debt service payment to the lender D_t, and obtains a new loan NB_t.
- The lender imposes a loan-to-value borrowing constraint on the *new loan*:

$$NB_t \leq \kappa_t Q_{h,t} IH_{2,t}$$

- In addition, the lender could imposes a debt-service-to-income ratio on the repayment per period:

$$D_{t+1} \leq m_t \sum^{i=c,h} W_{2,i,t} L_{2,i,t}$$

Model: Long-term Loans

- The steady state debt-to-income ratio is 0.2783 while a typical debt-to-income policy ratio for the Australian housing market is 0.31.
- Hence, the debt-to-income ratio constraint, if policy imposed, binds only occasionally:

$$\Lambda_{dti,t}\left(D_{t+1} - m_t \sum^{i=c,h} W_{2,i,t} L_{2,i,t}\right) = 0$$

at steady state, $\Lambda_{dti} = 0$

Model: Long-term Loans

- In this talk, we will look at
  - welfare implication and stability under the loan-to-value and debt-to-income ratio policies under the stylised one-period loans
  - welfare implication, stability and dynamics under the loan-to-value ratio policies in long-term loan structure
  - stability under both loan-to-value and debt-to-income ratio policies in the long-term loan structure
    - welfare and dynamics are still in progress

Discussion: Mortgage Structure

- In the simple one-period loan setting, the stock and the flow of the housing loan is the same.
  - We should consider either one of the two borrowing constraints, not both.
- In the long-term loan setting, the stock and the flow of the housing loan is very different.
  - LTV ratio policy and DTI ratio policy can be appropriately differentiated.

Model: Firms

- Intermediate-goods producing firms:
  - firm i's demand function

$$Y_t(i) = \left(\frac{P_{D,t}(i)}{P_{D,t}} \right)^{-\lambda_t} Y_t.$$

  - its production function

$$Y_t(i) = K_{c,t-1}(i)^{\alpha_{c,k}} \left(A_t L_{1,c,t}(i)^{\mu} L_{2,c,t}(i)^{1-\mu} \right)^{(1-\alpha_{c,k})}$$

Model: Firms

- Intermediate-goods producing firms:
  - its profit maximisation

$$\mathbb{E}_t \sum_{k=0}^{\infty} \beta_1^k \Lambda_{1,t,t+k} \frac{\Pi_{c,t+k}(i)}{P_{t+k}},$$

where

$$\Pi_{c,t+k}(i) = P_{D,t+k}(i) Y_{t+k}(i) - MC_{t+k} P_{D,t+k} Y_{t+k}(i) - \frac{\phi}{2} P_{D,t+k} \left[\frac{P_{D,t+k}(i)}{\pi_{D,t+k-1}^{\omega} \bar{\pi}_D^{1-\omega} P_{D,t+k-1}(i)} - 1 \right]^2 Y_{t+k},$$

subject to the given demand and aggregate price and output level.

Model: Firms

- Foreign goods importing firms
- Labour unions
  - operating in similar monopolistic competitive markets as intermediate-goods firms do
  - subject to similar Rotemberg price/wage adjustment costs with indexation to past price/wage inflation

Model: Firms

- A housing construction firm

$$IH_t = K_{h,t-1}^{\alpha_{h,k}} \left(A_t \text{land}_t\right)^{\alpha_{land}} Y_{h,t}^{\alpha_y} \left(A_t L_{1,h,t}^{\nu} L_{2,h,t}^{1-\nu}\right)^{1-\alpha_{h,k}-\alpha_{land}-\alpha_y}$$

  - housing market is a monopoly market with flexible prices (markup is to ensure the match of steady state target ratios) $Q_{h,t} = \left(1+\mu^h\right) MC_{h,t}$.
  - land supply is fixed
  - intermediate-goods as inputs
  - to strengthen the link between the housing sector and the goods sector

Model: Common Technology

- A common nonstationary technology to intermediate goods sector and housing construction sector:

$$\frac{A_t}{A_{t-1}} = g_t,$$
$$\log(g_t) = \rho_g \log(g_{t-1}) + \epsilon_{g,t}.$$

Model: Aggregation and Market Clearing

- Final good consumption:

$$C_t = \left[\gamma^{\frac{1}{\sigma}} \left(C_{D,t}\right)^{\frac{\sigma-1}{\sigma}} + (1-\gamma)^{\frac{1}{\sigma}} \left(C_{M,t}\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}},$$

- Market clearing condition for domestic final consumption goods:

$$\begin{aligned} & C_{D,t} + I_{c,t} + I_{h,t} + Y_{h,t} + G_t + X_t \\ =& Y_t - \text{adj. costs} \end{aligned}$$

- The aggregate output of the economy, i.e. GDP is defined by

$$VA_t = \bar{p}_D \left(Y_t - Y_{h,t}\right) + \bar{q}_h IH_t,$$

where $\bar{p}_D$ and $\bar{q}_h$ are the steady-state prices.

Model: Aggregation and Market Clearing

- The external sector regarding trade balance and foreign lending is given by

$$R^*_{t-1} S_t B^*_{t-1} \Phi_t - S_t B^*_t = P_{D,t} X_t - S_t P^*_t C_{M,t},$$

with $\Phi_t = \exp\left(\phi_a a_{t-1} + \xi_{b^*,t}\right)$, $a_t \equiv \frac{S_t B^*_t}{P_{D,t} Y_t}$. $\xi_{b^*,t}$ is the country risk premium shock.

- Export demand from the rest of the world is

$$X_t = \left(\frac{P_{D,t}}{S_t P^*_t}\right)^{-\lambda^*} Y^*_t.$$

Monetary Policy

- A Taylor rule for monetary policy:

$$R_t = R_{t-1}^{\rho_r} \left[\bar{R} \left(\frac{\pi_t}{\bar{\pi}} \right)^{\rho_\pi} \left(\frac{VA_t}{VA_{t-1}} \right)^{\rho_{\Delta va}} \left(\frac{VA_t}{\overline{VA}} \right)^{\rho_{va}} \right]^{(1-\rho_r)} \exp\left(\epsilon_{r,t}\right)$$

Macroprudential Policy

- We aim to study the design of macroprudential policy by investigating the welfare and dynamic differences under an activist simple-rule based policy, relative to a "no policy" baseline.
- The regimes are slightly different under a setting of one-period loans and long-term loans.

Macroprudential Policy (1)

With simple one-period loans

- in loan-to-value policy regime:
  - baseline: $\kappa_t = \bar{\kappa}$.
  - activist simple-rule based policies:

1. $\kappa_t = \kappa_{t-1}^{\rho_\kappa} \left[\bar{\kappa} \left(\frac{b_{2,t}}{b_{2,t-1}} \right)^{-\rho_b} \left(\frac{q_{h,t}}{q_{h,t-1}} \right)^{-\rho_q} \right]^{1-\rho_\kappa}$,
2. $\kappa_t = \kappa_{t-1}^{\rho_\kappa} \left[\bar{\kappa} \left(\frac{b_{2,t}}{\bar{b}_2} \right)^{-\rho_b} \left(\frac{q_{h,t}}{\bar{q}_h} \right)^{-\rho_q} \right]^{1-\rho_\kappa}$.

Macroprudential Policy (2)

With simple one-period loans

- in debt-to-income policy regime:
  - baseline: $m_t = \bar{m}$.
  - activist simple-rule based policies:

1. $$m_t = m_{t-1}^{\rho_m} \left[\bar{m} \left(\frac{b_{2,t}}{b_{2,t-1}} \right)^{-\rho_b'} \left(\frac{q_{h,t}}{q_{h,t-1}} \right)^{-\rho_q'} \right]^{1-\rho_m},$$
2. $$m_t = m_{t-1}^{\rho_m} \left[\bar{m} \left(\frac{b_{2,t}}{\bar{b}_2} \right)^{-\rho_b'} \left(\frac{q_{h,t}}{\bar{q}_h} \right)^{-\rho_q'} \right]^{1-\rho_m}.$$

Macroprudential Policy (3)

With long-term loans

- in loan-to-value policy regime:
  - baseline: $\kappa_t = \bar{\kappa}$.
  - activist simple-rule based policies:

1. $\kappa_t = \kappa_{t-1}^{\rho_\kappa} \left[\bar{\kappa} \left(\frac{b_{2,t}}{b_{2,t-1}} \right)^{-\rho_b} \left(\frac{q_{h,t}}{q_{h,t-1}} \right)^{-\rho_q} \right]^{1-\rho_\kappa}$,
2. $\kappa_t = \kappa_{t-1}^{\rho_\kappa} \left[\bar{\kappa} \left(\frac{b_{2,t}}{\bar{b}_2} \right)^{-\rho_b} \left(\frac{q_{h,t}}{\bar{q}_h} \right)^{-\rho_q} \right]^{1-\rho_\kappa}$.

Macroprudential Policy (4)

With long-term loans

- there is no solely debt-to-income regulation regime. Debt-to-income policy is a regulation *additional* to the loan-to-value policy.
- denote the actual debt-to-income ratio

$$m_t^n = \frac{D_{t+1}}{\sum^{i=c,h} W_{2,i,t} L_{2,i,t}},$$

- the debt-to-income borrowing constraint binds when $m_t^n = m_t$ which implies $\Lambda_{dti,t} = 0$, the constraint is slack when $m_t^n < m_t$.

Macroprudential Policy (4)

- baseline:

  1. $\kappa_t = \bar{\kappa}$ and $m_t = \bar{m}$.

- activist simple-rule based policies:

  2. $\kappa_t = \bar{\kappa}$ and $m_t = m_{t-1}^{\rho_m} \left[\bar{m} \left(\frac{b_{2,t}}{b_{2,t-1}} \right)^{-\rho_b'} \left(\frac{q_{h,t}}{q_{h,t-1}} \right)^{-\rho_q'} \right]^{1-\rho_m}$,

  3. $\kappa_t = \kappa_{t-1}^{\rho_\kappa} \left[\bar{\kappa} \left(\frac{b_{2,t}}{b_{2,t-1}} \right)^{-\rho_b} \left(\frac{q_{h,t}}{q_{h,t-1}} \right)^{-\rho_q} \right]^{1-\rho_\kappa}$ and $m_t = \bar{m}$,

  4. $\kappa_t = \kappa_{t-1}^{\rho_\kappa} \left[\bar{\kappa} \left(\frac{b_{2,t}}{b_{2,t-1}} \right)^{-\rho_b} \left(\frac{q_{h,t}}{q_{h,t-1}} \right)^{-\rho_q} \right]^{1-\rho_\kappa}$ and
  $m_t = m_{t-1}^{\rho_m} \left[\bar{m} \left(\frac{b_{2,t}}{b_{2,t-1}} \right)^{-\rho_b'} \left(\frac{q_{h,t}}{q_{h,t-1}} \right)^{-\rho_q'} \right]^{1-\rho_m}$.

Model: Shocks, Stationarity

- 9 exogenous shocks to the small-open economy, 3 exogenous shocks originated from the foreign country
- Due to the existence of nonstationary technology, variables are first detrended by A_t and normalised by P_t.

Calibration and Estimation

- Only estimate parameters that are primary for the dynamics (shocks)
- Calibrate the rest of the parameters for the steady state ratios of model to match the sample means.
  - for most of the sectoral parameters, monetary policy parameters, we follow RBA model in Rees, Smith and Hall (2016)
  - for housing preference, we follow Iacoviello and Neri (2010), Alpanda and Zubairy (2017)
  - for housing price dynamics, standard deviation of log-difference of real house prices.

Table: Calibration of the Parameters, Quarterly

Parameter	Description	Value
β_1	Patient household discount factor	0.9987
β_2	Impatient household discount factor	0.9877
π_0	Steady state trend inflation, 2.5% annualised	1.0062
$\bar{R}$	Steady state policy rate, 3% annualised	1.0075
$\bar{J}_1$	Housing weight in patient household utility	0.05
$\bar{J}_2$	Housing weight in impatient household utility	1.0
μ^h	Markup of housing price over marginal cost	0.2
τ	Amortization rate, about 10 years of loan length	0.0186
$\bar{\kappa}$	Steady-state loan-to-valuation ratio	0.9
$\bar{m}$	Steady-state debt-service-to-income ratio	0.31

Table: Calibration of the Parameters, Quarterly

Parameter	Description	Value
ϕ, ϕ_m, ϕ_w	degree of Rotemberg adjustment costs, corresponds to 0.75 Calvo price stickiness	49
ω, ω_m, ω_w	past inflation indexation in Rotemberg pricing adjustment	0.22
χ	Coefficient associated with labour service in utility	1
ψ	Inverse Frisch elasticity	1
ξ	Intersectoral labour elasticity of substitution	0.75
$\delta_{c,k}$	Depreciation rate of capital in intermediate goods production	0.0175
$\delta_{h,k}$	Depreciation rate of capital in housing production	0.0175
δ_h	Housing depreciation rate	0.01
$\bar{a}$	Steady-state net foreign assets ratio	0

Table: Calibration of the Parameters, Quarterly

Parameter	Description	Value
ϕ_a	Interest debt sensitivity of foreign borrowing	0.001
$\alpha_{c,k}$	Capital weight in intermediate goods production	0.25
μ	Patient household labour weight in intermediate goods production	0.65
$\alpha_{h,k}$	Capital weight in housing production	0.1
α_y	Intermediate goods weight in housing production	0.1
α_{land}	Land weight in housing production	0.1
ν	Patient household labour weight in housing production	0.65
σ	Elasticity of substitution between domestic and imported goods	0.8
γ	Domestic goods share in final consumption	0.61

Table: Calibration of the Parameters, Quarterly

Parameter	Description	Value
$\bar{\lambda}$	Domestic good elasticity of substitution at the steady state	6
$\bar{\lambda}_m$	Imported good elasticity of substitution at the steady state	6
λ_l	Intrasectoral labour elasticity of substitution	4
λ^*	Price elasticity of the export	1
ρ_r	Weight on the lagged interest rate in monetary policy rule	0.8
ρ_π	Weight on inflation in monetary policy rule	1.5
$\rho_{\Delta va}$	Weight on output growth in monetary policy rule	0.05
ρ_{va}	Weight on output gap in monetary policy rule	0.12
ρ_κ, ρ_m	Weight on the lagged LTV or DTI policy ratio in macroprudential policy rule	0.8

Calibration: Steady-state ratios

Ratio	Model	Sample Mean (1993-2013)
household consumption to GDP	0.59	0.58
private business investment to GDP	0.18	0.15
residential investment to GDP	0.072	0.056
exports to GDP	0.20	0.20
labour income to GDP	0.62	0.60
housing mortgage to GDP	1.80	1.94

Welfare

- The "social" aggregate welfare:

$$W_t = (1 - \beta_1)\, W_{1,t} + (1 - \beta_2)\, W_{2,t}.$$

  Note that it is a bit tricky to define the aggregate welfare with heterogenous households as they have different discount factors about the future utility.
- One way is to define it a weighted sum of the two types of individual welfares so that all the groups receive the same level of utility from a constant consumption stream. ←
  - Mendicino and Pescatori (2007), Rubio and Carrasco-Callego (2014)

Welfare

- Following Schmitt-Grohé and Uribe (2007), welfare gains/costs in consumption units are defined by

$$\lambda_j^{cu} = \exp\left(\frac{W_{j,0}^a - W_{j,0}^b}{\Gamma_j \Theta_{\zeta,j,0}}\right) - 1$$

for individual groups of households, and

$$\lambda_{\text{aggr}}^{cu} = \exp\left(\frac{W_0^a - W_0^b}{(1-\beta_1)\,\Gamma_1 \Theta_{\zeta,1,0} + (1-\beta_2)\,\Gamma_2 \Theta_{\zeta,2,0}}\right) - 1$$

for aggregate level, where W_j^a denotes welfare of household type j under one of the activist policies, W_j^b denotes welfare of household type j under baseline LTV or DTI policy.

One-period Loans

- We first present the results under simple one-period loans
  - welfare gains/losses
  - variances of key variables
  - response parameters in simple rules are over the value range of $\rho_b,\ \rho_q \in [0,\ 2.0]$

One-period Loans: Welfare

Table: Maximum welfare gains and coefficient values, per cent

Regime	λ_1	ρ_b	ρ_q	λ_2	ρ_b	ρ_q	λ_{aggr}	ρ_b	ρ_q
ltv-growth	0	0	0	0.15	2	2	0.07	2	2
ltv-level	0	0	0	0.26	2	2	0.12	2	1.8
dti-growth	0	0	0	0	0	0	0	0	0
dti-level	0	0	0	0	0	0	0	0	0

One-period Loans: Variances

Table: Variances of the key variables in baseline model and optimalised simple rule models

Regime	var(π), $\times 10^{-5}$	var(va), $\times 10^{-4}$	var(b_2)	var(q_h)	var($\lambda_{ltv,dti}$)
ltv-baseline	1.41	1.21	0.0145	0.0011	1.12
ltv-growth	1.38	1.18	0.0037	0.0011	0.13
ltv-level	1.43	1.21	0.0006	0.0011	0.06
dti-baseline	1.42	1.21	0.0021	0.0011	0.0083

Note: the baseline regime is the one in which loan-to-value ratio is static. Optimalised simple rules are specified as in previous table.

Long-term Loans: LTV Ratio Policies Only

- We now present the results under long-term loans and in loan-to-value regulation regimes
  1. welfare gains/losses
  2. variances of key variables
  3. response parameters in simple rules are over the value range of $\rho_b,\ \rho_q \in [0,\ 2.0]$
  4. roles of responding to housing debt vs responding to real house prices
  5. impulse responses under optimalised simple rules and baseline policy

LTV Ratio Policies: 1. Welfare

Table: Maximum welfare gains and coefficient values, per cent

Regime	λ_1	ρ_b	ρ_q	λ_2	ρ_b	ρ_q	λ_{aggr}	ρ_b	ρ_q
ltv-growth	0	0	0	0.19	2	2	0.07	2	2
ltv-level	0	0	0	0.55	2	2	0.22	2	2

LTV Ratio Policies : 2. Variances

Table: Variances of the key variables in baseline model and optimalised simple rule models

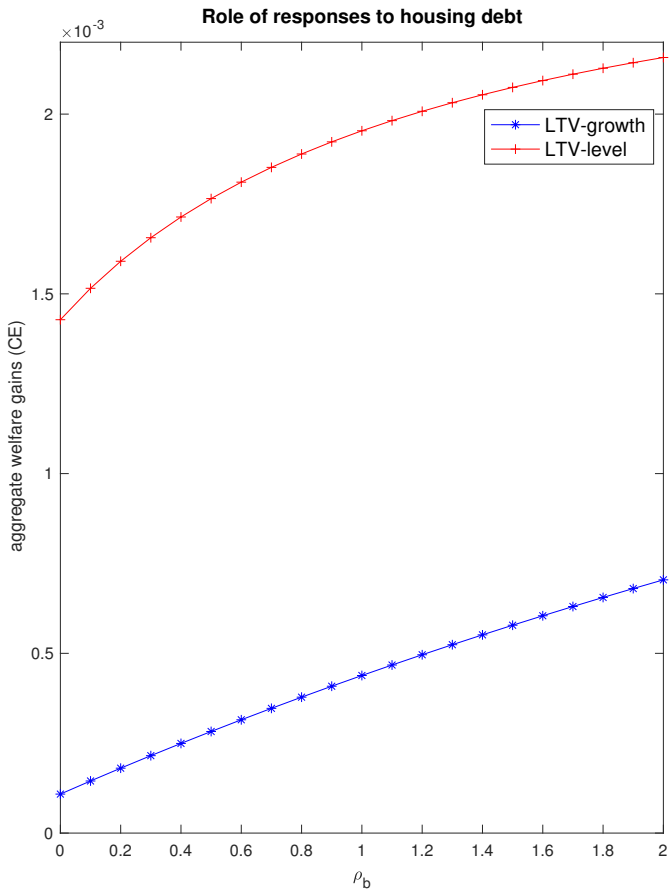
Regime	var(π), $\times 10^{-5}$	var(va), $\times 10^{-4}$	var(b_2)	var(q_h)	var(λ_{ltv})	var(nb)	var(d)
baseline	1.31	1.27	0.0169	0.0017	0.0064	0.81	0.0088
ltv-growth	1.32	1.27	0.0149	0.0017	0.0060	0.58	0.0095
ltv-level	1.40	1.30	0.0028	0.0013	0.0057	0.51	0.0116

Note: the baseline regime is the one in which loan-to-value ratio is static. Optimalised simple rules are specified by the last two columns in previous table.

LTV Ratio Policies: 3. Roles of Targeted Variables

- The results so far show different impact of activist policy on the targeted variables.
- to see which is more important in affecting welfare, housing debt or housing asset prices, we now depict welfare and variance as functions of ρ_b and ρ_q.

Figure: Role of responding to housing debt vs real house price in affecting welfare



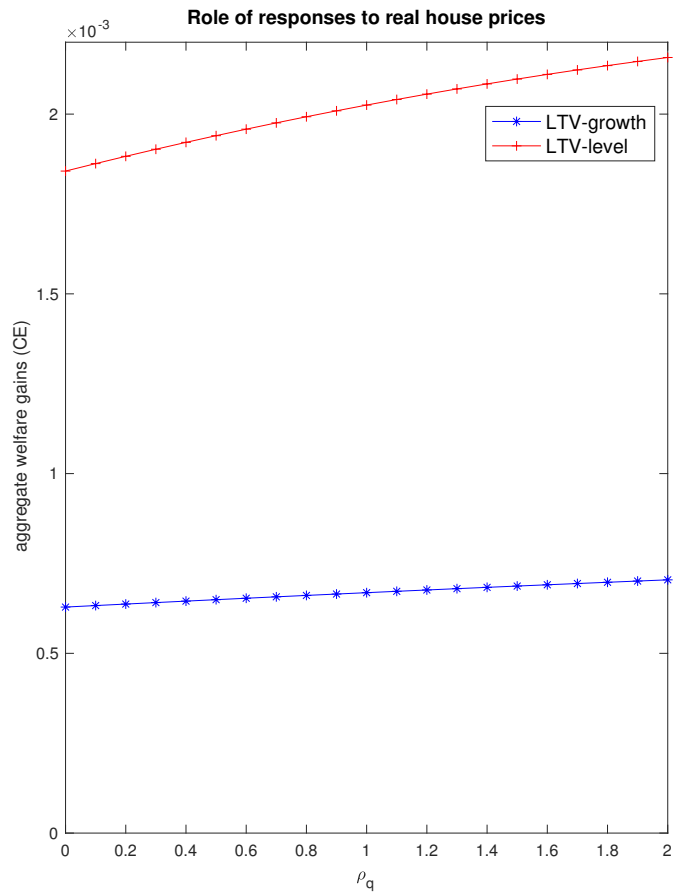
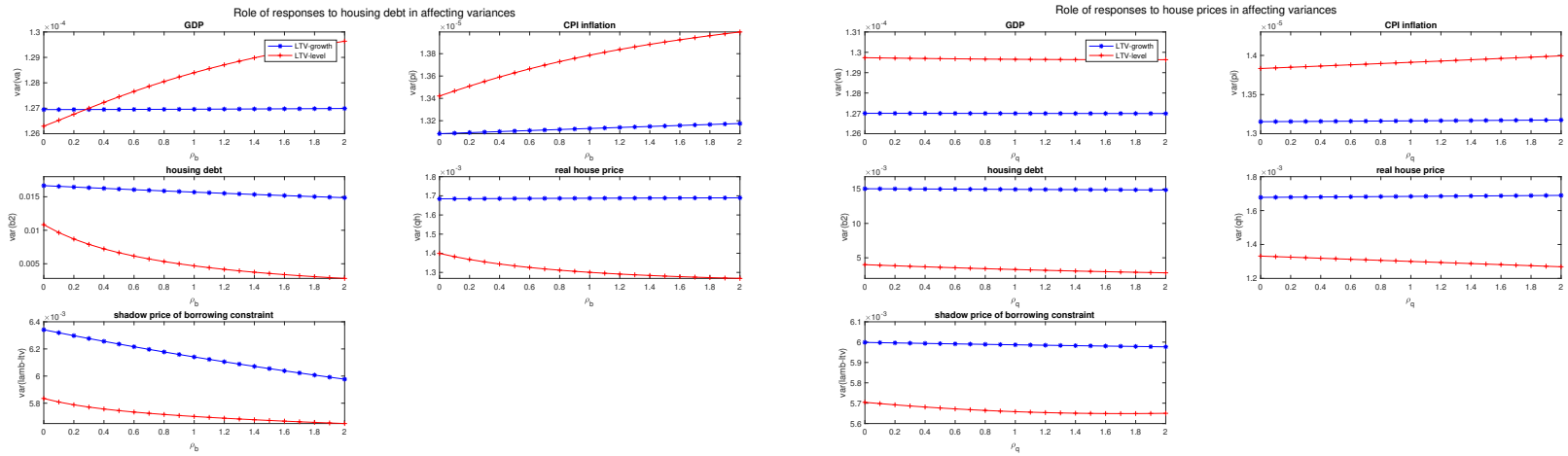


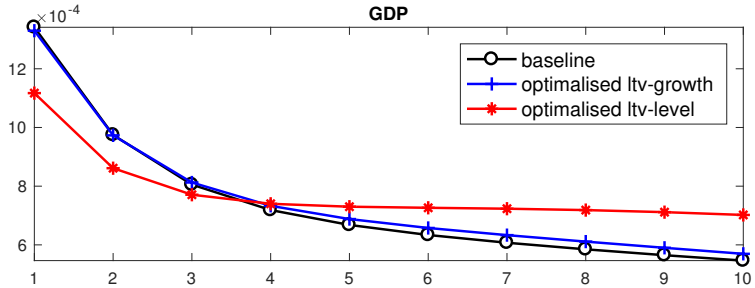
Figure: Role of responding to housing debt vs real house price in affecting variances

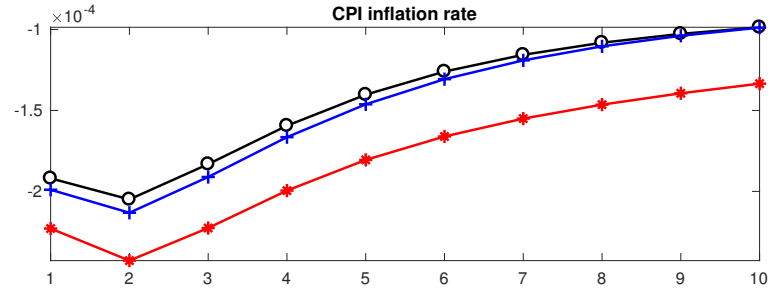


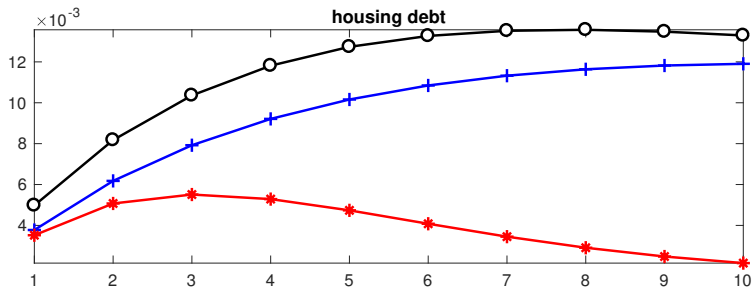
LTV Ratio Policies: 4. Dynamics

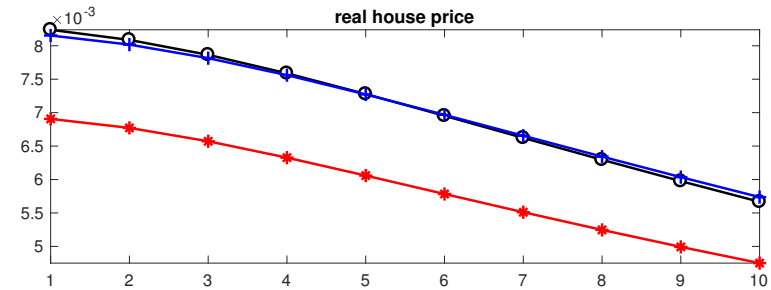
- The final part of the results show impulse responses of the key variables to a housing preference shock, a monetary policy shock and a country risk premium shock, which are consistent with the results on variances and role of responding to targeted variables.

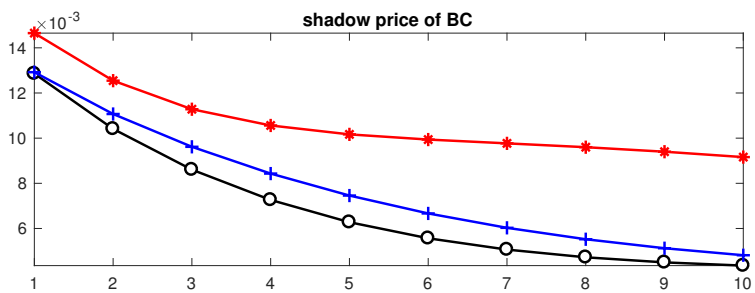
Housing Preference Shocks, +1 S.D.



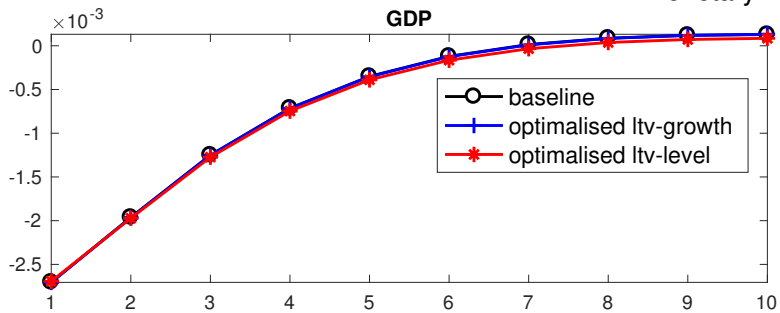


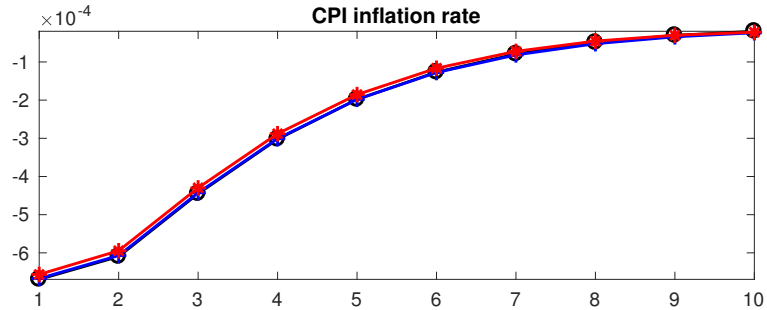


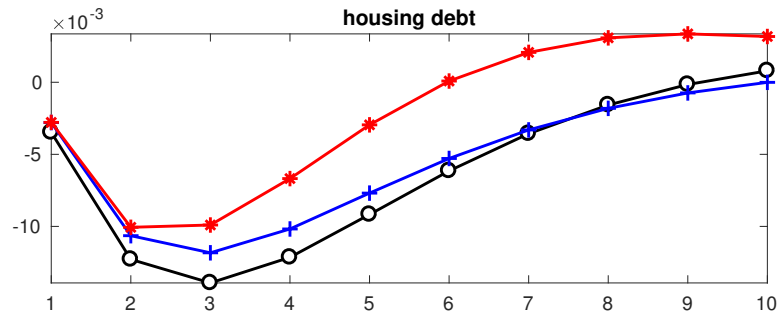


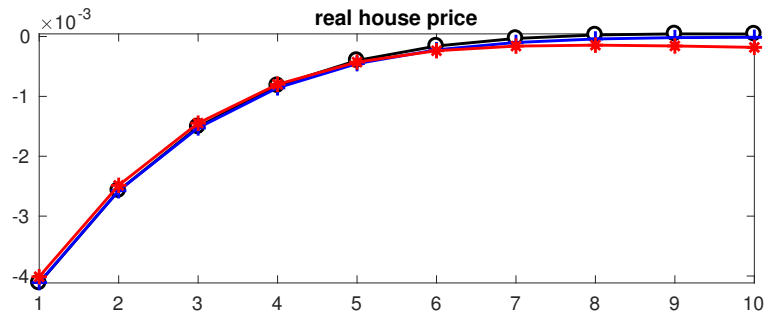


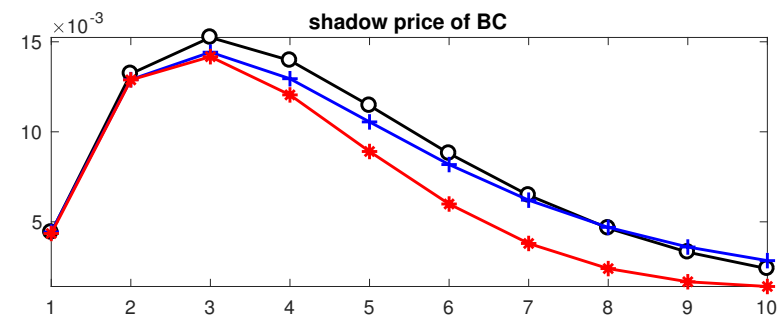
Monetary Policy Shocks, +1 S.D.



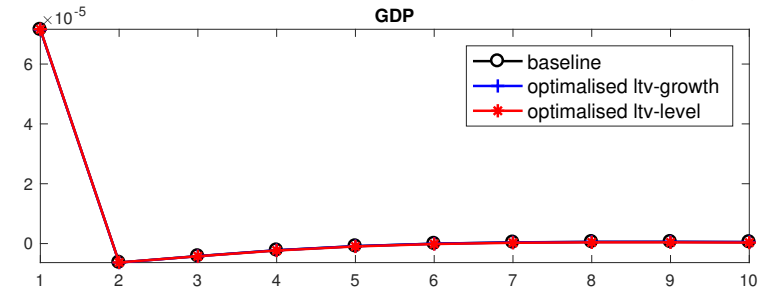


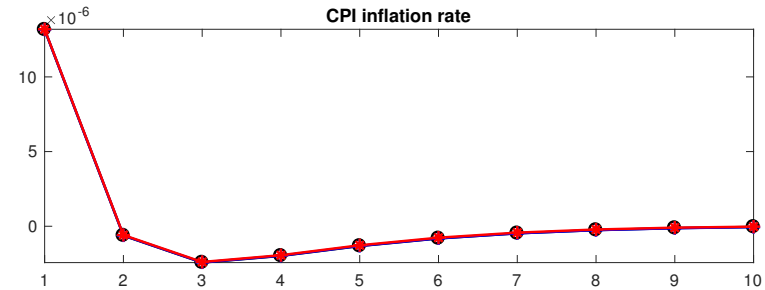


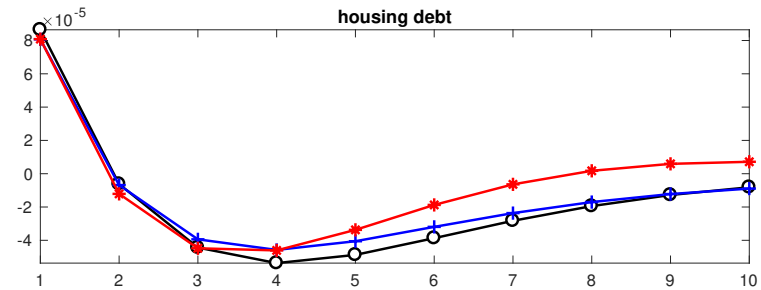


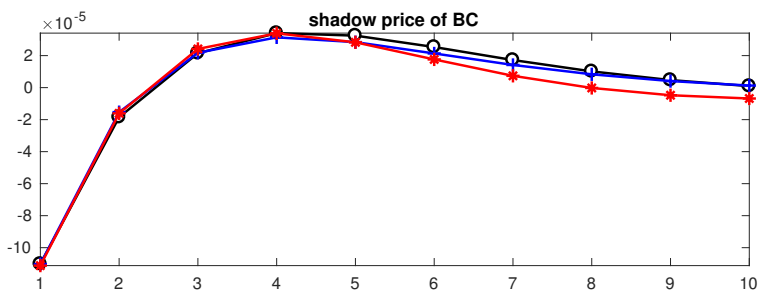


Country Risk Premium Shocks, +1 S.D.









LTV Ratio Policies: Intuitions

- welfare results: activist vs no-policy; levels vs growth rates
- variances: stabilization of debt and BC
- intuition: existence of the borrowing constraint
- a small change in the tightness/relaxation of the BC can have significant impact on the volatility of the loans, and hence welfare.
- policy does the best in stabilising those is the best performing policy in welfare improvement.
- this is evidenced by results on responding to credit, rather than real house price, responding to levels, rather than growth rates, everything else equal, in inducing the larger welfare.

LTV Ratio Policies: Intuitions

- For the debt-to-income ratio policy in one-period loans.
  - wage is much less volatile than asset prices, so setting the ratio of debt to a much less volatile wage is already effective in stabilising the loan and thus switching to an activist policy does not contribute much in welfare improvement.
- For savers, they are not credit constrained.
  - what matters to them is the amount of resource made available through interest payments.
  - they would always prefer to increase

Long-term Loans: LTV and DTI Ratio Policies

- We now present the variances of key variables under both loan-to-value and debt-to-income ratio policies
  - ρ_b and ρ_q is calibrated to its respective optimalised value from the LTV ratio policy only cases
  - ρ_b' and ρ_q' is calibrated to 0.8 for the simulation purpose
- Note the debt-to-income ratio constraint binds infrequently

LTV and DTI Ratio Policies: Variances

Table: Variances of the key variables

Regime	π, $\times 10^{-5}$	va, $\times 10^{-4}$	b_2	q_h, $\times 10^{-4}$	λ_{ltv}	$\lambda_{dti,t}$	binding frequency
dti-static, ltv-static	1.00	1.67	0.0082	5.29	0.066	3.88	7%
dti-growth, ltv-static	1.00	1.71	0.0075	5.21	0.076	4.55	3%
dti-static, ltv-growth	1.02	1.60	0.0062	5.14	0.018	0.74	4%
dti-growth, ltv-growth	1.02	1.60	0.0059	5.10	0.021	1.14	2%

LTV and DTI Ratio Policies

- It shows that implementing an activist simple rule policy using both DTI and LTV ratio instruments can lead to more stablised housing credit, a pattern which has been seen in the LTV ratio policy only cases.
- Given the findings in the LTV only policies, it is not unreasonable to expect that welfare of the economy may be linked to the stability of the financial market, which is predominately represented by the volatility of housing credit, $b_{2,t}$.
- Note that the real house prices are also stabilised the most by implementing both DTI and LTV ratio simple rule policies.

Conclusions (1)

1. This paper studies the design and evaluation of activist macroprudential policies in simple rules
2. It finds that a simple rule in form of the loan-to-value ratio in response to levels of the housing debt and real house prices is the best performing in in terms of both welfare and financial stability.
3. The key to understand the results is to the very existence of the borrowing constraint.
4. Activist loan-to-value policies that stabilise the volatility of the housing debt are those that generate welfare gains for the borrowers at the social level.

Conclusions (2)

1. A static debt-to-income ratio in one-period loan setting is found to be as good as activist policies as it stabilises the debt to a much less volatile wage income.
2. When the occasionally binding debt-to-income ratio constraint is considered, implementing an activist rule of both loan-to-value and debt-to-income ratio policies stabilised the financial sector, i.e. housing debt and real house prices, the most.

What Next

1. If possible, welfare implications in occasionally binding constraint in DTI
2. Consider coordination of monetary policy with macroprudential policy