The Interdependence of Monetary and Macroprudential Policy under the Zero Lower Bound

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Policy Interdependence

- Macroprudential and monetary policy are interdependent (Smets, 2014; Leeper and Nason, 2014; Brunnermeier and Sannikov, 2012).
- There exist two constraints on monetary policy (MP):
  1. On one hand, MP can be constrained by the zero lower bound (ZLB): Nominal interest rate cannot fall below zero $\Rightarrow$ MP forced to be too tight in a downturn.
  2. On the other hand, MP can be constrained by weak MacroPru: Financial dominance (Lewis and Roth, 2016)$\Rightarrow$ MP forced to be too accommodating in a (credit-fuelled) boom.

Research question

- This paper investigates the implications of these two constraints on the effects and optimal conduct of MP and MacroPru policy in a DSGE model with financial frictions.
- We focus on the stability and dynamics of corporate debt
  - Macroprudential policy ⇒ bank capital ⇒ loss absorbing capacity ⇒ lending capacity ⇒ corporate debt
  - Monetary policy ⇒ inflation ⇒ real value of outstanding debt ⇒ repayment capacity ⇒ corporate debt

Our Model

Financial frictions

- Entrepreneurs with risky projects and insufficient net worth ⇒ costly state verification problem (Townsend,1970; Bernanke, Gertler, Gilchrist, 1999)
- Debt contracts with non-state-contingent return: Zhang (2009), Benes and Kumhof (2011), Clerc et al. (2015), Lewis and Roth (2016)

New Keynesian features

- Market power and price setting frictions

Policies

- **Monetary** policy: inflation target, Taylor-type interest rate rule
- **Macroprudential** policy: capital requirement rule or leaning against the wind (LATW)

Main Model Features

- **Entrepreneurs** fund investment projects using
  - Net worth
  - Bank loans

  They are subject to idiosyncratic productivity shocks.
- **Banks** fund loans to entrepreneurs using
  - Deposits (from households)
  - Equity (from bankers)
- Since the loan contract specifies an interest rate on loans that is **not state-contingent**, banks can make loan losses if a larger number of loans defaults than what was expected at the time of setting the lending rate.

Some key equations – Borrowing

- Entrepreneur's borrowing requirement

$$b_t = q_t K_t - n_t^E \tag{1}$$

- The gross return on capital is $\omega_{t+1}^E R_{t+1}^E$, where ω_{t+1}^E is an idiosyncratic disturbance to the entrepreneur's return, an i.i.d. log-normal variable with standard deviation σ_t^E.
- The lender can observe ω_{t+1}^E only by paying the monitoring cost, which is a proportion μ^E of the realized gross payoff to the entrepreneurial capital.
- The optimal financial contract specifies a cutoff value for the shock, $\overline{\omega}_{t+1}^E$, such that if $\omega_{t+1}^E \geq \overline{\omega}_{t+1}^E$ the entrepreneur is able to repay the loan. Alternatively, the borrower gets nothing, the lender pays the auditing costs.
- We define $x_t^E = \frac{Z_t^E b_t}{q_t K_t}$ the entrepreneur's leverage, where Z_t^E is the contractual loan rate.

Banks

Bank's borrowing requirement

$$n_t^B = b_t - d_t \tag{2}$$

Bank's profits

$$R_{t+1}^F b_t - R_{t+1} d_t = \left(1 - \Gamma_{t+1}^F\right) R_{t+1}^F b_t \tag{3}$$

where Γ_{t+1}^F is the share of the project return accruing to the banker after the bank has made interest payments to the depositors.
Ex-post gross return on bank loans

$$R_{t+1}^F = \left(\Gamma_{t+1}^E - \mu^E G_{t+1}^E\right) \frac{R_{t+1}^E q_t K_t}{b_t} \tag{4}$$

Bankers

Surviving bankers (fraction $1-\chi^B$) have net worth

$$n^B_{t+1} = \left(1-\chi^B\right) \mathcal{W}^B_{t+1} \tag{5}$$

Ex-post gross return on banker's equity

$$R^B_{t+1} = \left(1-\Gamma^F_{t+1}\right) \frac{R^F_{t+1} b_t}{n^B_t} \tag{6}$$

Banker net worth dynamics

$$n^B_{t+1} = \left(1-\chi^B\right) \left(\frac{R^B_{t+1}}{\Pi_{t+1}}\right) n^B_t \tag{7}$$

Stability depends on

- Survival rate of bankers, $1-\chi^B$
- Ex-post real equity return, $\frac{R^B_{t+1}}{\Pi_{t+1}}$

Interest Rate Rule and Capital Requirement Rule

Monetary policy rule

$$\frac{R_t}{R} = \left(\frac{\Pi_t}{\Pi}\right)^{\tau_\Pi} \left(\frac{b_t}{b}\right)^{\tau_b} \tag{8}$$

Macroprudential policy rule

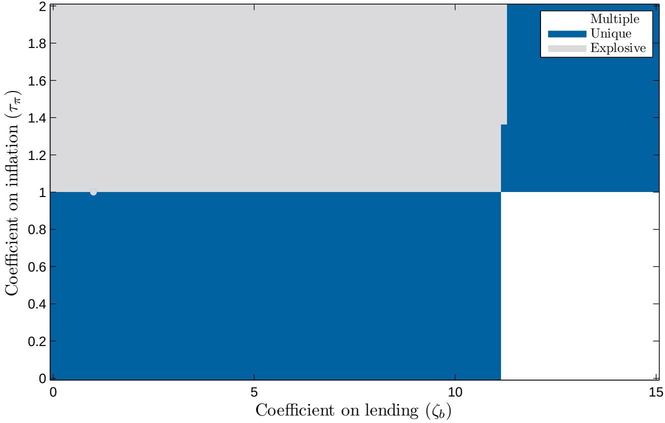
$$\frac{\phi_t}{\phi} = \left(\frac{b_t}{b}\right)^{\zeta_b}, \quad \text{where } \phi_t = \frac{n_t^B}{b_t} \tag{9}$$

We consider two special cases

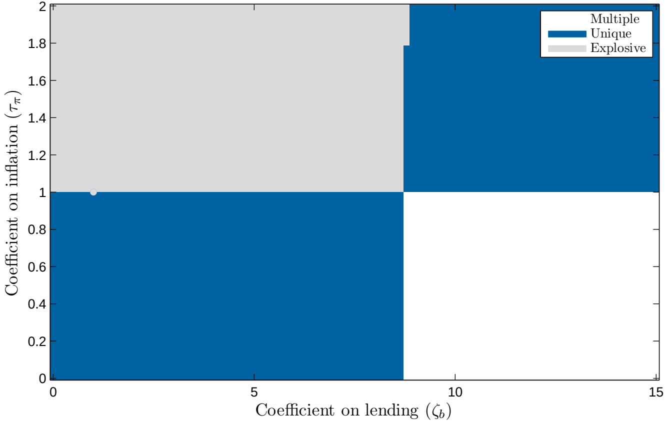
$\tau_b = 0 \quad \Leftrightarrow$ Countercyclical Capital Buffer (CCB)

$\zeta_b = 0 \quad \Leftrightarrow$ Leaning Against the Wind (LATW)

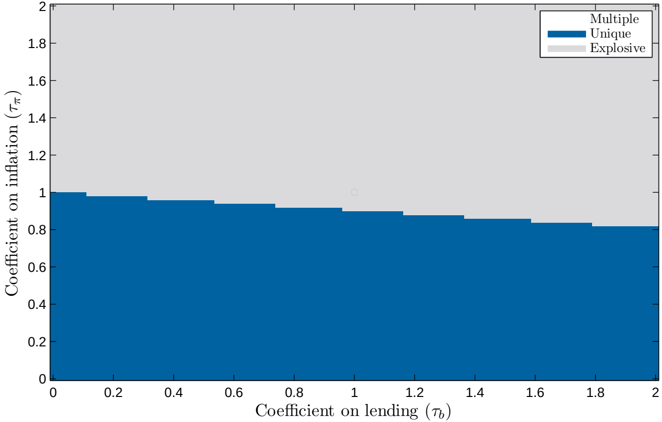
CCB Model: Steady State Capital Ratio 8%



CCB Model: Steady State Capital Ratio 12%



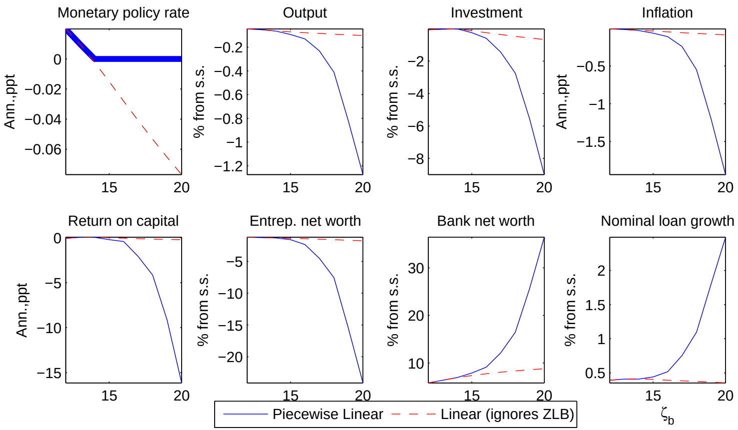
LATW Model: Steady State Capital Ratio 8%



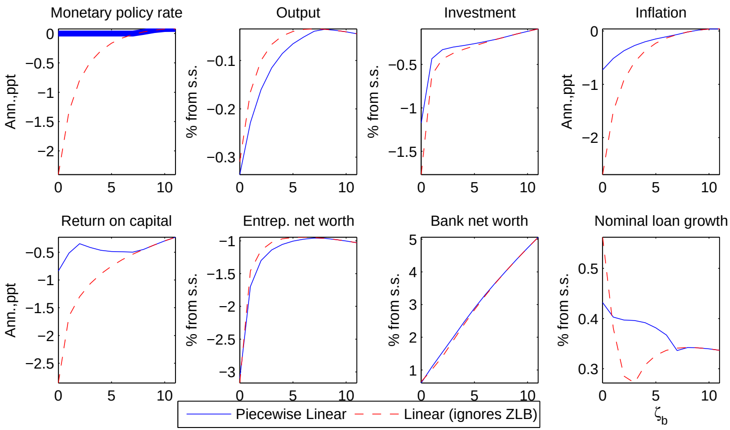
The risk shock under the ZLB

- We use the piecewise linear perturbation method by Guerrieri and Iacoviello (JME, 2015) to solve the model with ZLB constraint;
- We simulate a large risk shock (Christiano et al., 2014) so that the ZLB on the nominal interest rate is attained.
- The risk shock makes entrepreneurs more likely to declare default. Investment projects become riskier and, as a result, the external finance premium rises and investment falls.
- We consider the policy scenarios for which there is a unique stable equilibrium:
  1. CCB and active MP: $\zeta_b \in [12, 20]$, $\tau_\pi = 1.2$, $\tau_b = 0$;
  2. CCB and passive MP: $\zeta_b \in [0, 11]$, $\tau_\pi = 0.9$, $\tau_b = 0$;
  3. LATW and passive MP: $\zeta_b = 0$, $\tau_\pi = 0.9$, $\tau_b \in [0, 0.9]$;

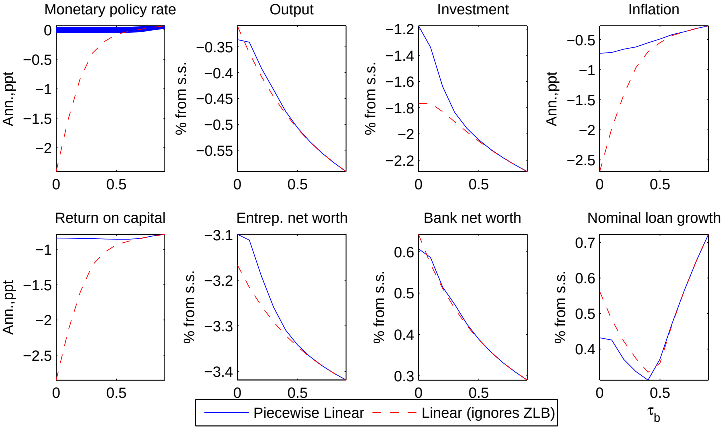
Peak responses – CCB and active MP



Peak responses – CCB and passive MP



Peak responses – LATW



Optimal simple rules

- We investigate whether the LATW policy and the CCB policy are indeed optimal.
- We follow the literature on optimal simple rules (see Schmitt-Grohe and Uribe, 2007, and Levine et al., 2008, among many others).
- We numerically search for those feedback coefficients in the two policy rules to maximize the present value of life-time utility:

$$\Omega_t = E_t \left[\sum_{s=0}^{\infty} \beta^s U\left(c_{t+s}, 1 - l_{t+s}\right) \right] \tag{10}$$

- The welfare loss ω is implicitly defined as

$$E_t \left\{ \sum_{s=0}^{\infty} \beta^s \left[U\left(\left(1-\omega\right) c^A_{t+s}, 1 - l^A_{t+s} \right) \right] \right\} = E_t \left\{ \sum_{s=0}^{\infty} \beta^s \left[U\left(c^B_{t+s}, 1 - l^B_{t+s} \right) \right] \right\}, \tag{11}$$

Results

Table: **Optimized monetary policy rules**

τ_R	τ_π	τ_b	ζ_b	$\mathcal{W}$	100 x ω
Optimized standard Taylor-type rule					
0	0.990	–	–	-34.55670	0.26
Optimized Taylor-type rule and CCB					
–	0.990	–	0.306	-34.55622	–
Optimized augmented Taylor-type rule					
–	0.000	0.000	–	-34.55748	0.67

Note: The term ω represents the welfare loss relative to the reference regime, which is CCB. The optimized standard Taylor-type rule features interest rate smoothing and response to inflation; the optimized standard Taylor-type rule and CCB is the CCB policy coupled with a Taylor rule responding only to inflation; and the optimized augmented Taylor-type rule is LATW.

Conclusion

- A **low** feedback coefficient in the **CCB** rule forces **MP** to be **passive**. The determinacy region in which MP is active can be enlarged by raising the steady state minimum capital requirement imposed on banks.
- Irrespective on the value of the coefficient, the **LATW** policy always requires a **passive MP**.
- When monetary policy is active, an **aggressive CCB** is **detrimental** in terms of output losses in response to a risk shock. And the presence of the ZLB makes the simulated recession more severe.
- When monetary policy is passive, output trough is a decreasing function of the CCB/LATW policy. The ZLB, instead, has marginal effects.
- The **CCB** policy coupled with passive monetary policy is **optimal**, while the **LATW** policy is **detrimental** from a welfare perspective.

Contracting Problem

Default by entrepreneur: $\omega^E_{t+1} < \overline{\omega}^E_{t+1}$

- Probability $1 - F^E(\overline{\omega}^E_{t+1})$
- Entrepreneur not able to repay loan in full
- Bank gets whole return $\omega^E_{t+1} R^E_{t+1} q_t K_t$ less monitoring cost $\mu^E G^E_{t+1}$
- Entrepreneur gets nothing

Non-default by entrepreneur: $\omega^E_{t+1} > \overline{\omega}^E_{t+1}$

- Probability $F^E(\overline{\omega}^E_{t+1})$
- Entrepreneur repays loan in full
- Bank gets contractural agreed payment $\overline{\omega}^E_{t+1} R^E_{t+1} q_t K_t$
- Entrepreneur gets remainder, $(\omega^E_{t+1} - \overline{\omega}^E_{t+1}) R^E_{t+1} q_t K_t$

Financial Contract: Setup

Entrepreneur's objective

$$\max_{x_t^E, K_t} \mathbb{E}_t \underbrace{\left[1 - \Gamma^E\left(\frac{x_t^E}{R_{t+1}^E}\right)\right]}_{\text{share to entrepreneur}} R_{t+1}^E q_t K_t$$

s.t. bank's participation constraint

$$\mathbb{E}_t \left\{\Gamma^E\left(\frac{x_t^E}{R_{t+1}^E}\right) - \mu^E G^E\left(\frac{x_t^E}{R_{t+1}^E}\right) R_{t+1}^E q_t K_t\right\} = \mathbb{E}_t \left\{R_{t+1}^B (q_t K_t - n_t^E)\right\}$$

Financial Contract: FOCs

First order condition w.r.t. entrepreneur's leverage x_t^E

$$\mathbb{E}_t\{-\Gamma_{t+1}^{E\prime} + \xi_t^E \left(1 - \Gamma_{t+1}^F\right)\left(\Gamma_{t+1}^{E\prime} - \mu^E G_{t+1}^{E\prime}\right)\} = 0$$

First order condition w.r.t. capital K_t

$$\mathbb{E}_t\{\left(1 - \Gamma_{t+1}^E\right) R_{t+1}^E + \xi_t^E \left[\left(1 - \Gamma_{t+1}^F\right)\left(\Gamma_{t+1}^E - \mu^E G_{t+1}^E\right) R_{t+1}^E - R_{t+1}^B \phi_t\right]\} = 0$$

where ξ_t^E Lagrange multiplier on bank's PC

Bank's Expected Return

Expected return to bank

$$\mathbb{E}_t \left\{ \left(\Gamma^E_{t+1} - \mu^E G^E_{t+1} \right) R^E_{t+1} q_t K_t \right\}$$

where share of gross return accruing to bank is

$$\Gamma^E_{t+1} \equiv \Gamma^E(\overline{\omega}^E_{t+1}) = \int_0^{\overline{\omega}^E_{t+1}} \omega^E_{t+1} f^E(\omega^E_{t+1}) \mathrm{d}\omega^E_{t+1} + \overline{\omega}^E_{t+1} \int_{\overline{\omega}^E_{t+1}}^{\infty} f^E(\omega^E_{t+1}) \mathrm{d}\omega^E_{t+1}$$

Monitoring costs are $\mu^E G^E_{t+1}$, with $0 < \mu^E < 1$ and

$$G^E_{t+1} \equiv G^E(\overline{\omega}^E_{t+1}) = \int_0^{\overline{\omega}^E_{t+1}} \omega^E_{t+1} f^E(\omega^E_{t+1}) \mathrm{d}\omega^E_{t+1}$$

fraction of return lost due to entrepreneurial defaults

Calibration

Parameter	Value	Description
β	0.99	Household discount factor
η	0.2	Inverse Frisch elasticity of labour supply
α	0.3	Capital share in production
ε	6	Substitutability between goods
κ_p	20	Price adjustment cost
δ	0.025	Capital depreciation rate
κ_I	2	Investment adjustment cost
χ^E	0.06	Consumption share of wealth entrepreneurs
χ^B	0.06	Consumption share of wealth bankers
μ^E	0.3	Monitoring cost entrepreneurs
σ^E	0.12	Idiosyncratic shock size entrepreneurs
ϕ	0.08	Bank capital requirement
σ^A	0.0716	Size technology shock
ρ^A	0.8638	Persistence technology shock
σ^ς	0.0867	Size firm risk shock
ρ^ς	0.8033	Persistence firm risk shock

Implied Steady State Values

Variable	Value	Description
Interest Rates		
R	1.0152	Policy rate
R^D	1.0152	Return on deposits (earned by depositors)
R^F	1.0195	Return on loans (earned by banks)
R^E	1.0335	Return on capital (earned by entrepreneurs)
R^B	1.0692	Return on equity (earned by bankers)
Annualised Spreads and Default Probability		
$400 \cdot (R^F - R)$	1.73	Loan return spread p.a., in %
$400 \cdot (R^E - R)$	7.36	Capital return spread p.a., in %
$400 \cdot (R^B - R)$	21.6	Equity return spread p.a., in %
$400 \cdot F^E$	2.6	Default probability p.a., in %
Leverage		
x^E	0.7621	Leverage entrepreneurs
$1 - \phi$	0.92	Leverage banks

Determinacy Analysis

Figure with determinacy regions

- x-axis: MacPru rule coefficient ζ_b
- y-axis: Taylor Rule coefficient τ_Π

four quadrants

- Taylor Principle: satisfied ($\tau_\Pi > 1$) or violated ($\tau_\Pi < 1$)
- MacPru Policy: stabilizing or not stabilizing

Result

- Determinacy if both policies similarly accommodating or aggressive

Financial Dominance Regions

'Active' MacPru policy: ζ_b low

- *Upper left*: TP satisfied ($\tau_\Pi > 1$). Fischer debt-deflation increases real value of outstanding debt $\Rightarrow$ debt unsustainable $\Rightarrow$ explosive
- *Lower left*: TP violated ($\tau_\Pi < 1$). MP allows financial stability concerns to override price stability objective $\Rightarrow$ determinacy

'Passive' MacPru policy: ζ_b high

- *Upper right*: TP satisfied ($\tau_\Pi > 1$). Sufficient bank capital to compensate debt-deflation channel $\Rightarrow$ debt sustainable $\Rightarrow$ determinacy
- *Lower right*: TP violated ($\tau_\Pi < 1$). Bank capital rises strongly with borrowing, but MP passive $\Rightarrow$ indeterminacy

IRF of the monetary policy rate