Optimal Monetary and Prudential Policies

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A forthcoming prudential policy

- The recent crisis has highlighted the need for a policy ensuring financial stability.
- The consensus is that a new prudential policy (PP) should be in charge, rather than monetary policy (MP).
- One reason is that it is unclear whether MP can be effective in ensuring financial stability (e.g. Bernanke, 2010).
- One key PP instrument will be bank capital requirements set conditionally on the state of the economy (Basel Committee on Banking Supervision, 2010).

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Contribution of the paper

- This raises the issue of the interactions between
  - MP, i.e. interest-rate policy,
  - PP, i.e. state-contingent capital-requirement policy.
- Our goal is to develop a New Keynesian model with banks to study these interactions from a normative perspective.
- The literature has recently proposed models that address this issue, notably Angeloni and Faia (2011), Christensen, Meh and Moran (2011).
- We depart from this literature in two main ways:
  - by computing the jointly locally Ramsey-optimal policies,
  - by linking the amount of risk to the type of credit.

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Constrained optimal vs. locally Ramsey-optimal policies

- The literature gets jointly **constrained optimal** policies:
  - the deviations of the policy instruments from their steady-state values are optimized within some small parametric families of simple rules,
  - the steady-state value of capital requirements is not optimal.
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Volume vs. type of credit

- In the literature, the amount of risk is linked to the **volume of credit**:
  - through the bank leverage ratio in Angeloni and Faia (2011),
  - through a systemic-risk externality in Christensen, Meh and Moran (2011).
- Therefore, MP is **effective** in ensuring financial stability.
- In our model, the amount of risk is linked to the **type of credit**: as in Van den Heuvel (2008), banks have an incentive to make socially undesirable *risky* loans, rather than *safe* loans, because of their limited liability.
- The two policies may not affect the same margins:
  - MP affects the volume but not necessarily the type of credit,
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Main results

- We first develop a **benchmark model**, in which MP *cannot affect* the type of credit.

- This model implies a clear-cut optimal division of tasks between MP and PP:
  - PP should react only to shocks that affect banks' risk-taking incentives,
  - in response to these shocks, MP should move **opposite** to PP in order to mitigate its macroeconomic effects (as envisaged by some policymakers and commentators: Macklem, 2011; Wolf, 2012; Yellen, 2010).

- We then consider two **extensions** to this model: one in which MP *can affect* the type of credit, the other in which it *cannot*.

- These extensions can account for situations in which MP and PP should both move **counter-cyclically**.

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2. Model
3. Implications
4. Extensions
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Extending the New Keynesian model

- Start from the basic New Keynesian model with capital, whose agents are
  - intermediate goods producers,
  - final goods producers,
  - households,
  - a monetary authority.
- There are two inefficiencies on the intermediate goods market:
  - monopolistic competition,
  - price rigidity à la Calvo (1983),

  which give a role to monetary policy.
- Introduce, in turn, three additional types of agents:
  - capital goods producers (who have access to a risky technology),
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Capital goods producers I

- **Capital goods producers**
  - buy unfurbished capital x_t at the end of period t,
  - furbish it between period t and period $t+1$,
  - sell this furbished capital k_{t+1} at the start of period $t+1$.
- They are perfectly competitive and owned by households.
- They have access to a **safe** technology (S): $k_{t+1} = x_t$...
- ...and to a **risky** technology (R): $k_{t+1} = \theta_t \exp(\eta_t^R) x_t$, where
  - $\theta_t = 0$ with probability ϕ_t,
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Capital goods producers II

- At each period t, the timing of events is the following:
  1. all exogenous shocks are realized, except θ_t,
  2. all agents observe these realizations and make their decisions,
  3. θ_t is realized.

- R is **inefficient** in the sense that, for all realizations of ϕ_t, η_t^R and Ψ_t,

$$(1-\phi_t)\exp\left(\eta_t^R\right) \leq 1-\Psi_t,$$

where Ψ_t is the marginal resource cost of monitoring capital goods producers.

- However, because of their **limited liability**, capital goods producers have an incentive to use R ("heads I win, tails you lose").

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Capital goods producers III

- Capital goods producers need to get funds to buy unfurbished capital.
- The only agents that can monitor them are banks.
- Therefore, they get funds from banks to buy unfurbished capital.
- We show in the paper that the optimal financial contracts are loans.
- That is, the capital goods producers choosing technology $i \in \{S, R\}$ borrow the funds they need at the nominal interest rate R_t^i, and those choosing R completely default on their loans when R fails.
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Banks

- **Banks** are perfectly competitive and owned by households.
- They pay a **tax** (τ) on their profits.
- They finance safe loans l_t^S and risky loans l_t^R by raising equity e_t and issuing deposits d_t, so that their balance-sheet identity is

$$l_t^S + l_t^R = e_t + d_t.$$

- Because of **deposit insurance** and their own **limited liability**, they have an incentive to make risky loans (again, "heads I win, tails you lose").
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Prudential authority

- The **prudential authority** forbids banks to choose $l_t^R > \gamma_t l_t^S$.

- This is because risky loans are socially undesirable, as
  - R is inefficient on average over θ_t,
  - θ_t is independent of the other shocks,
  - households are risk-averse.

- The prudential authority also imposes a capital requirement in the form of a minimum equity-over-loans ratio:

$$e_t \geq \kappa_t \left(l_t^S + l_t^R \right).$$

- The higher the capital requirement κ_t, the more banks internalize the social cost of risk (as they have more "skin in the game").

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Two preliminary results

- **Proposition 1:** *There are no equilibria with* $0 < l_t^R < \gamma_t l_t^S$.
- This is because banks' limited liability make their expected excess return convex in the volume of their risky loans.
- **Proposition 2:** *In equilibrium, the capital constraint is binding:*

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Prudential policy

- **Proposition 4:** *A necessary and sufficient condition for existence of an equilibrium with* $I_t^R = 0$ *is* $\kappa_t \geq \kappa_t^*$ *(where* κ_t^* *is specified in the paper as an explicit function of only parameters and exogenous shocks).*

- Starting from a situation in which all banks are at the safe corner, setting $\kappa_t \geq \kappa_t^*$ deters each bank from going to the risky corner by making it sufficiently internalize the social cost of risk.

- This threshold value κ_t^* is increasing in
  - the probability of success of the risky technology $1 - \phi_t$,
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Monetary policy

- The MP instrument is the risk-free deposit rate R_t^D.
- κ_t^* does not depend on R_t^D: MP is **ineffective** in ensuring financial stability.
- This is because, in our benchmark model with perfect competition and constant returns, R_t^D does not affect the spread between R_t^R and R_t^S, and hence does not affect banks' risk-taking incentives.
- Let $(R_\tau^{D*})_{\tau \geq 0}$ denote the MP that is Ramsey-optimal when PP is $(\kappa_\tau^*)_{\tau \geq 0}$.

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- Let $(R_\tau^{D*})_{\tau \geq 0}$ denote the MP that is Ramsey-optimal when PP is $(\kappa_\tau^*)_{\tau \geq 0}$.

Jointly locally optimal policies

- **Proposition 5:** *If the right derivative of welfare with respect to* κ_t *at* $(R_\tau^D, \kappa_\tau)_{\tau \geq 0} = (R_\tau^{D*}, \kappa_\tau^*)_{\tau \geq 0}$ *is strictly negative for all* $t \geq 0$*, then the policy* $(R_\tau^D, \kappa_\tau)_{\tau \geq 0} = (R_\tau^{D*}, \kappa_\tau^*)_{\tau \geq 0}$ *is locally Ramsey-optimal.*
- Setting κ_t **just below** κ_t^* is not optimal, because it triggers a discontinuous increase in the amount of (inefficient) risk taken by banks.
- Setting κ_t **just above** κ_t^* is not optimal, because it has a negative first-order welfare effect that cannot be offset by any change in R_t^D around its optimal steady-state value R^{D*} (as this change would have a zero first-order effect).
- We check numerically, using Levin and López-Salido's (2004) "Get Ramsey" program, that the right derivative of welfare with respect to κ_t at $(R_\tau^{D*}, \kappa_\tau^*)_{\tau \geq 0}$ is strictly negative.
- This is because increasing κ_t from κ_t^* decreases the capital stock, which is already inefficiently low due to the monopoly and tax distortions.

Jointly locally optimal policies

- **Proposition 5:** *If the right derivative of welfare with respect to κ_t at $(R^D_\tau, \kappa_\tau)_{\tau \geq 0} = (R^{D*}_\tau, \kappa^*_\tau)_{\tau \geq 0}$ is strictly negative for all $t \geq 0$, then the policy $(R^D_\tau, \kappa_\tau)_{\tau \geq 0} = (R^{D*}_\tau, \kappa^*_\tau)_{\tau \geq 0}$ is locally Ramsey-optimal.*
- Setting κ_t **just below** κ^*_t is not optimal, because it triggers a discontinuous increase in the amount of (inefficient) risk taken by banks.
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Numerical simulations

- We calibrate the model and consider two alternative PPs:
  - the optimal PP $\kappa_t = \kappa_t^*$, with a steady-state value $\kappa^* = 0.08$,
  - the passive PP $\kappa_t = 0.10$, which also ensures $I_t^R = 0$.
- For each PP, we compute the optimal MP using Get Ramsey.
- There are two types of shocks:
  1. shocks that do not affect banks' risk-taking incentives: η_t^f, G_t,
  2. shocks that affect banks' risk-taking incentives: η_t^R, γ_t, ϕ_t, Ψ_t.
- Following type-1 shocks, optimal PP does not move, while optimal MP moves in a standard way.
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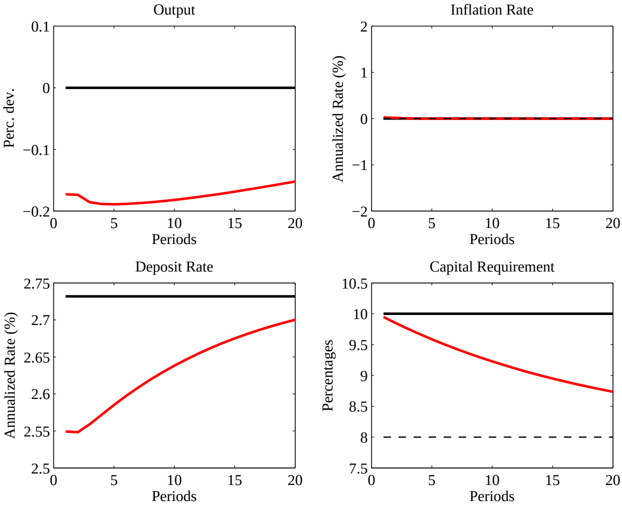
Responses to a type-2 shock (positive η_t^R shock)



$\kappa_t = \kappa_t^*$ $\kappa_t = 0.10$ Dashed line: Steady State Level

Two extensions

- In our benchmark model, optimal MP and optimal PP never move in the same direction.
- We consider two extensions to this model, which can make optimal MP and optimal PP move in the same (counter-cyclical) direction.
- **Extension 1**: we introduce productivity shocks on S that are positively correlated with productivity shocks on R.
- **Extension 2**: we introduce an externality by assuming that banks' marginal monitoring cost is increasing in the aggregate volume of loans (as in Hachem, 2010): $\log(\Psi_t) = \log(\Psi) + \varrho[\log(l_t^S) - \log(l^S)]$.
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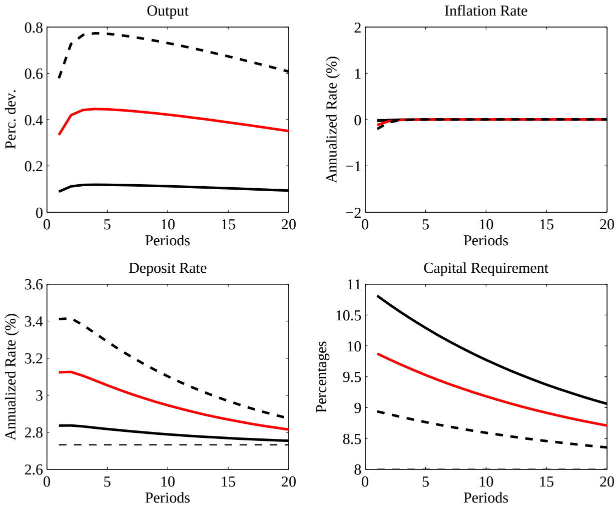
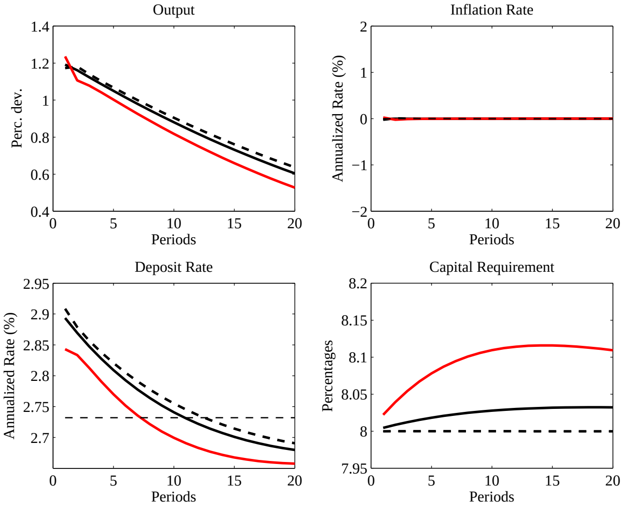
Extension 1: responses to a positive η_t^R shock



corr$(\eta_t^R, \eta_t^S) = 0.25$ corr$(\eta_t^R, \eta_t^S) = 0.50$ corr$(\eta_t^R, \eta_t^S) = 0.75$

Thin Dashed Line: Steady State Level

Extension 2: responses to a positive η_t^f shock



$\varrho = 0$ $\varrho = 1$ $\varrho = 5$ Thin Dashed Line: Steady State Level

Conclusion

- We develop a New Keynesian model with banks to study the interactions between MP and PP from a normative perspective.
- We depart from the literature in two main ways:
  - by linking the amount of risk to the type of credit,
  - by computing the jointly locally Ramsey-optimal policies.
- We obtain a clear-cut optimal division of tasks between MP and PP:
  - PP should react only to shocks that affect banks' risk-taking incentives,
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Our modeling contribution

- We build on Van den Heuvel's (2008) model of capital requirements.
- More precisely, we start from a variant of this model.
- We embed this variant into a DSGE framework with
  - aggregate shocks,
  - sticky prices,
  - monetary policy.
- And we introduce aggregate risk into the resulting model.

Intermediate and final goods producers

- **Intermediate goods producers** are monopolistically competitive and face a price rigidity à la Calvo (1983).
- The production function of intermediate goods producer j is

$$y_t(j) = h_t(j)^{1-\nu} k_t(j)^{\nu} \exp\left(\eta_t^f\right).$$

- **Final goods producers** are perfectly competitive.
- Their production function is

$$y_t = \left(\int_0^1 y_t(j)^{\frac{\sigma-1}{\sigma}} \mathrm{d}j\right)^{\frac{\sigma}{\sigma-1}}.$$

Households' optimization problem

- **Households** choose $(c_t, h_t, d_t, s_t, k_t, i_t, x_t)_{t\geq 0}$ to maximize

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\log(c_t) - \frac{h_t^{1+\chi}}{1+\chi}\right]$$

subject to

- the budget constraint $c_t + d_t + q_t^b s_t + q_t k_t + i_t = w_t h_t + \frac{1+R_{t-1}^D}{\Pi_t} d_{t-1} + s_{t-1}\omega_t^b + z_t k_t + q_t^x x_t + (\omega_t^k + \omega_t^f - \tau_t^h)$,
- the law of motion of capital $x_t = (1-\delta)k_t + i_t$.

Capital goods producers IV

- A producer i using technology S chooses $x_t\left(i\right)$ to maximize

$$\beta E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \left[q_{t+1} x_t\left(i\right) - \frac{1+R_t^S}{\Pi_{t+1}} q_t^x x_t\left(i\right) \right] \right\},$$

where λ_t is households' marginal utility of consumption at date t.

- A producer i using technology R chooses $x_t\left(i\right)$ to maximize

$$\left(1-\phi_t\right) \beta E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \left[q_{t+1} \exp(\eta_t^R) x_t\left(i\right) - \frac{1+R_t^R}{\Pi_{t+1}} q_t^x x_t\left(i\right) \right] \middle| \theta_t = 1 \right\}.$$

Banks II

- The representative bank chooses e_t, d_t, l_t^R and l_t^S to maximize

$$E_t \left\{ \beta \frac{\lambda_{t+1} \left(1-\tau\right) \omega_{t+1}^b}{\lambda_t} \right\} - e_t - \left(1-\tau\right) \Psi_t l_t^S,$$

where

$$\omega_{t+1}^b = \max \left\{ 0, \frac{1+R_t^S}{\Pi_{t+1}} l_t^S + \theta_t \frac{1+R_t^R}{\Pi_{t+1}} l_t^R - \frac{1+R_t^D}{\Pi_{t+1}} d_t \right\},$$

subject to

- $l_t^S + l_t^R = e_t + d_t$,
- $l_t^R \leq \gamma_t l_t^S$,
- $e_t \geq \kappa_t \left(l_t^S + l_t^R \right)$.

Gvt's budget constraint and goods market clearing cdt

- The government's budget constraint is

$$\tau_t^h = G_t + \int_0^1 \left\{ \zeta_t(j) - \tau[\omega_t^b(j) + \Psi_t l_t^S(j)] \right\} dj,$$

where losses imposed by bank j on the deposit insurance fund are $\zeta_t(j) =$

$$\max \left\{ 0, \frac{1+R_{t-1}^D}{\Pi_t} d_{t-1}(j) - \frac{1+R_{t-1}^S}{\Pi_t} l_{t-1}^S(j) - \theta_{t-1} \frac{1+R_{t-1}^R}{\Pi_t} l_{t-1}^R(j) \right\}.$$

- The goods market clearing condition is

$$c_t + i_t + G_t + \Psi_t l_t^S = y_t.$$

Prudential-policy rule

- **Proposition 6:** *Under the PP rule*

$$\kappa_t = \frac{1-\phi_t}{\phi_t}\frac{\gamma_t}{1+\gamma_t}\frac{R_t^R - R_t^S}{1+R_t^D} + \frac{1}{\phi_t}\frac{\gamma_t}{1+\gamma_t}\Psi_t - \frac{R_t^S - R_t^D}{1+R_t^D},$$

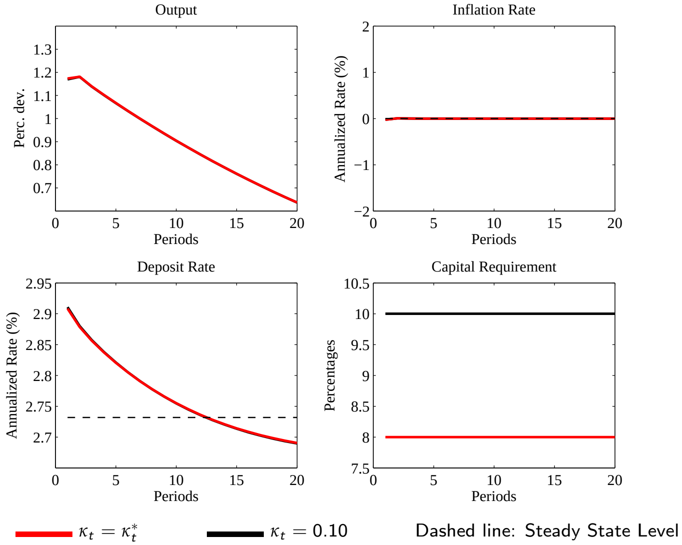
  there exists a unique equilibrium and, at this equilibrium, $I_t^R = 0$ *and* $\kappa_t = \kappa_t^*$*.*

- On the right-hand side of this feedback rule, for an individual bank moving from the safe to the risky corner,
  - the first two terms represent the **benefit** of this move: pocketing $R_t^R - R_t^S$ if risky projects succeed and saving monitoring costs Ψ_t,
  - the third term represents the **opportunity cost** of this move: losing $R_t^S - R_t^D$ if risky projects fail.

Calibration

Parameter	Description	Value
	Preferences	
β	Discount factor	0.993
χ	Inverse of labor supply elasticity	1.000
	Technology	
ν	Capital elasticity	0.340
σ	Elasticity of substitution	11.00
δ	Depreciation rate	0.025
	Nominal rigidities	
α	Price stickiness	0.750
	Banking (steady state)	
τ	Tax rate	0.023
κ^*	Capital requirement	0.080
Ψ	Marginal monitoring cost	0.006
ϕ	Failure probability	0.031
γ	Maximal risky/safe loans ratio	0.356
η^R	Risk premium	1.005
	Shock processes	
ρ	Persistence	0.950

Responses to a type-1 shock (positive η_t^f shock)



Justification of policy-induced distortions

- There are two policy-induced distortions in the model:
  - deposit insurance, which gives rise to banks' risk-taking incentives,
  - the tax on banks' profits, which makes the capital requirement binding.
- We assume that they are not decided by the mon. and prud. authorities.
- These distortions are prevalent in many countries and do not seem to be likely to be removed any time soon.
- We could probably justify deposit insurance by introducing the possibility of bank runs, at the cost of greater complexity.
- When the tax is arbitrarily small,
  - all our analytical results (from Proposition 1 to Proposition 6) still hold,
  - the condition stated in Prop. 5 (the "if" part of this prop.) may not be met,
  - our model is equivalent, at the first order, to a model with no tax and with deposits in the utility function with an arbitrarily small weight.