Optimal Monetary and Prudential Policies

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3rd Bank of Spain−World Bank Research Conference
"Financing Growth: Levers, Boosters and Brakes"

Madrid, June 23, 2014

A forthcoming prudential policy

- The recent crisis has highlighted the need for a policy ensuring financial stability.
- The consensus [e.g. Bernanke (2011), IMF (2013)] is that it should be a new prudential policy (PP), rather than monetary policy (MP).
- One key PP instrument will be bank capital requirements set conditionally on the state of the economy [Basel Committee on Banking Supervision (2010)].

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: e.g., Angeloni and Faia (2013), Benes and Kumhof (2012), 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.

Optimal simple rules vs. locally Ramsey-optimal policies

- The literature gets jointly **optimal simple rules**:
  - the deviations of the policy instruments from their steady-state values are optimized within some parametric families of simple rules,
  - the steady-state value of capital requirements is not optimal.
- We get jointly **locally Ramsey-optimal policies**, i.e. we get a state-contingent path for the two policy instruments that locally maximizes the representative household's ex ante utility.

Volume vs. type of credit

- In the literature, the amount of risk is linked to the **volume of credit** (e.g., through a systemic-risk externality in Christensen, Meh and Moran, 2011).
- This link gives rise to a risk-taking channel of MP.
- Our model illustrates another channel of interaction between MP and PP, by linking the amount of risk to the **type of credit**.
- Banks have an incentive to make socially undesirable *risky* loans, rather than *safe* loans, because of a moral-hazard problem.
- The two policies may not affect the same margins:
  - MP affects the volume but not necessarily the type of credit,
  - PP affects both the volume and the type of credit.

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

Outline of the presentation

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),
  - banks (which finance capital goods producers),
  - a prudential authority (which imposes capital requirements on banks).

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
  - θ_t is a common (systemic) shock,
  - $\theta_t = 0$ with exogenous probability ϕ_t,
  - $\theta_t = 1$ with exogenous probability $1 - \phi_t$,
  - all realizations of η_t^R are positive,
  - $corr(\theta_t,\ other\ shocks) = 0$.

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 and η_t^R,

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

- However, because of their **limited liability**, capital goods producers have an incentive to use R ("heads I win, tails you lose"): this is the **first moral-hazard problem** in the model.

- To buy unfurbished capital, capital goods producers borrow from banks (which can *monitor* them) at the nominal interest rate R_t^i with $i \in \{S, R\}$, and those choosing R completely *default* on their loans when R fails.

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").
- This is the **second moral-hazard problem** in the model (as in the micro-banking literature, Van den Heuvel, 2008, Martinez-Miera and Suarez, 2012).
- They can hide risky loans in their portfolio from the prudential authority up to an exogenous fraction γ_t of their safe loans.

Prudential authority

- The **prudential authority** imposes a risk-weighted **capital requirement**:

$$e_t \geq \kappa_t \left(l_t^S + l_t^R \right) + \overline{\kappa} \max \left\{ 0, l_t^R - \gamma_t l_t^S \right\}.$$

- This capital requirement enables it to tackle the second moral-hazard problem: the higher banks' capital e_t, the more banks internalize the social cost of risk (as they have more "skin in the game").
- It optimally chooses $\overline{\kappa}$ high enough for $l_t^R \leq \gamma_t l_t^S$ in equilibrium.
- 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.

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:*

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

- This is because the tax on banks' profits makes them prefer debt finance to equity finance.

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 a function of shocks, made explicit in the paper).*

- 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 $1 - \phi_t$,
  - the productivity of the risky technology conditionally on its success η_t^R,
  - the maximum ratio of risky to safe loans γ_t,

  as an increase in $1 - \phi_t$, η_t^R, or γ_t raises banks' risk-taking incentives.

Monetary policy

- The MP instrument is the risk-free deposit rate R_t^D.
- κ_t^* does not depend on R_t^D: there is no risk-taking channel of MP, or equivalently 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 $(\kappa_\tau^*)_{\tau \geq 0}$.

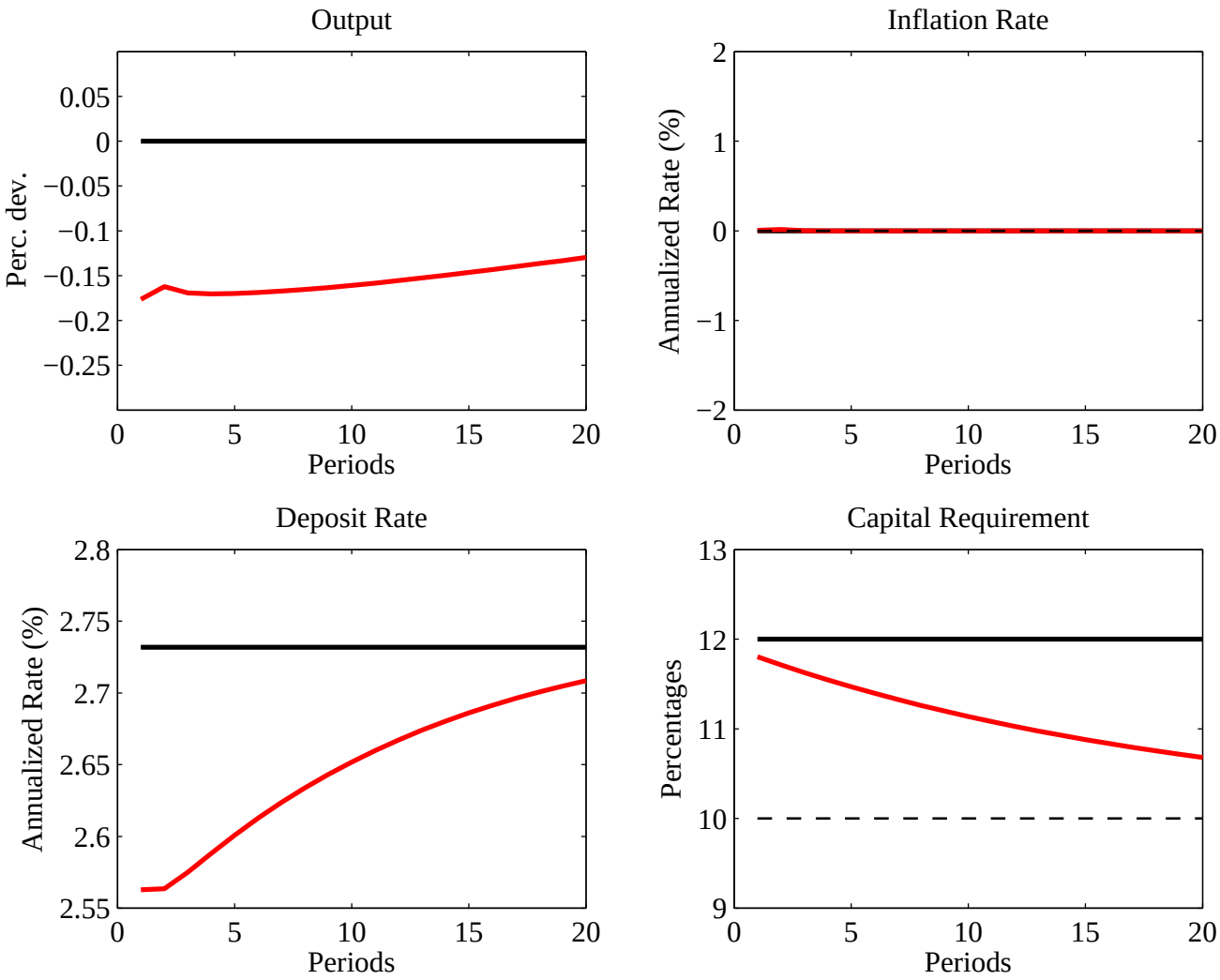
Jointly locally Ramsey-optimal policies

- **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.

Numerical simulations

- We calibrate the model and consider two alternative PPs:
  - the optimal PP $\kappa_t = \kappa_t^*$, with a steady-state value $\kappa^* = 0.10$,
  - the passive PP $\kappa_t = 0.12$, 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.
- Following type-2 shocks, optimal MP moves **opposite** to optimal PP in order to mitigate its macroeconomic effects [as envisaged by some policymakers and commentators: Macklem (2011), Wolf (2012), Yellen (2010)].

Responses to a type-2 shock (positive η_t^R shock)

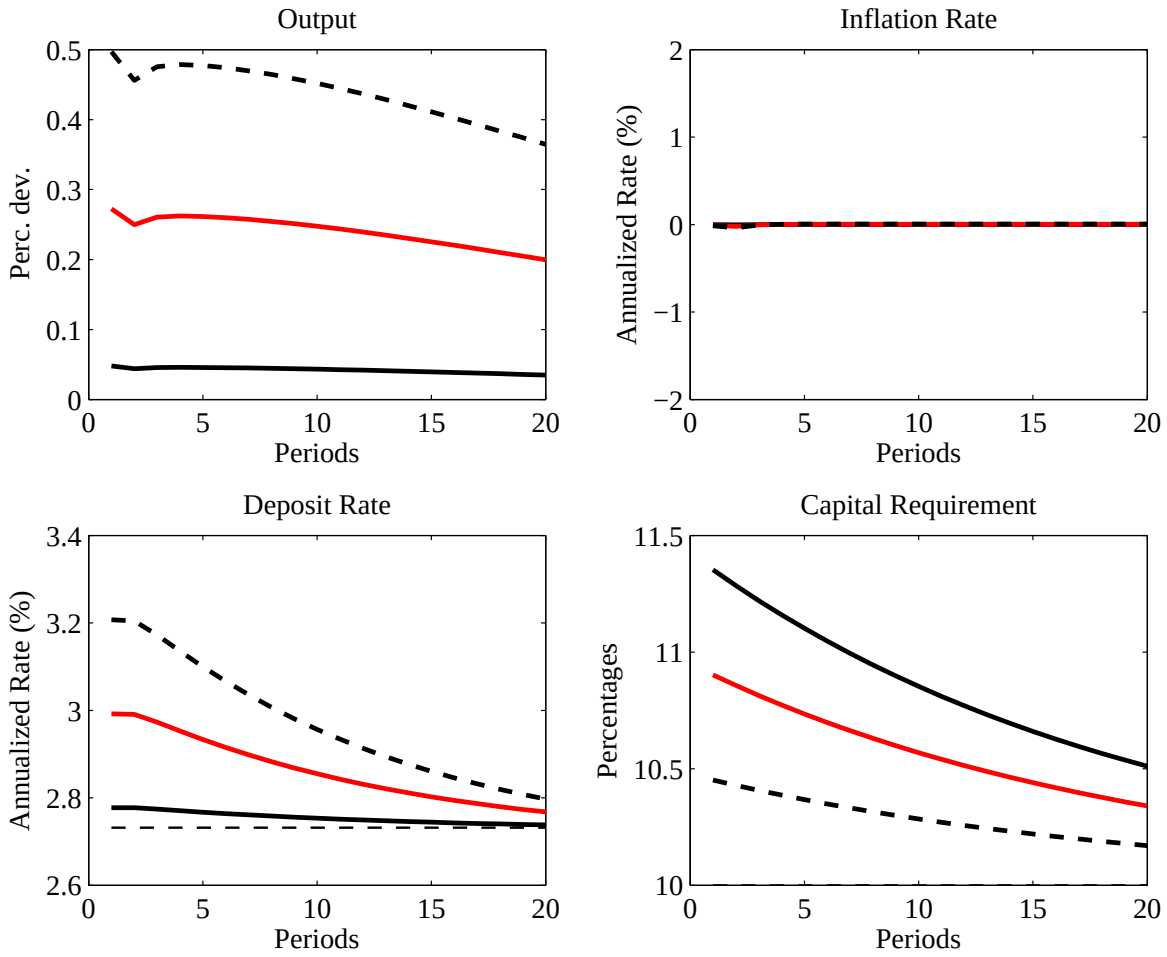


$\kappa_t = \kappa_t^*$ $\kappa_t = 0.12$ Dashed line: Steady State Level

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)]: $\log(\Psi_t) = \log(\Psi) + \varrho[\log(l_t^S) - \log(l^S)]$.
- Unlike Extension 1, Extension 2 enables MP to affect the type of credit, i.e. it gives rise to a risk-taking channel of MP, or equivalently it makes MP effective in ensuring financial stability.

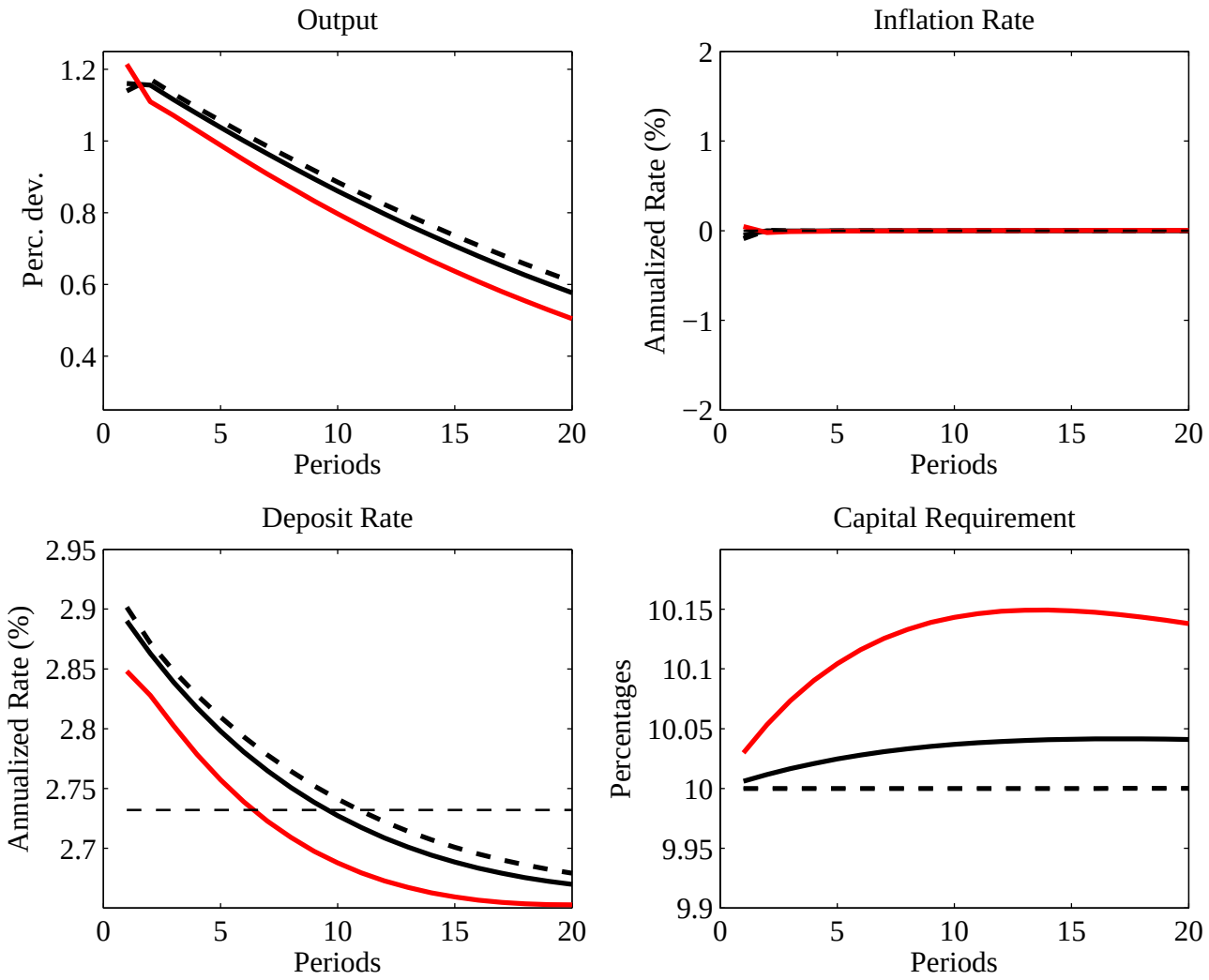
Extension 1: responses to a positive η_t^R shock



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

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,
  - MP should react to all shocks and, for some shocks, only to their effects on the PP instrument.
- We can account for situations in which
  - MP and PP should move opposite to each other,
  - MP and PP should move in the same (counter-cyclical) direction.

Addressing commentators' and policymakers' concerns

- Wolf (2012): "*How, in practice, will policies aimed at securing financial stability interact with monetary policy? Consider, for example, the possibility that the committee charged with the former is trying to cool lending in, say, the property sector when the committee charged with the latter is seeking to heat it up in the economy. They could find themselves operating in contradiction.*"

- Yellen (2010): "*[W]e must strive to avoid situations in which macro-prudential and monetary policies are working at cross-purposes, given that macroprudential policies affect macroeconomic performance and that monetary policy may affect risk-taking incentives.*"

Our modeling contribution

- The **moral-hazard problem** that gives banks an incentive to make socially undesirable risky loans is due to *limited liability* and *deposit insurance*, as in a branch of the micro-banking literature.
- Van den Heuvel (2008) introduces this kind of moral-hazard problem into a general-equilibrium (GE) model with
  - no systemic risk,
  - no aggregate shocks.
- Martinez-Miera and Suarez (2012) introduce it into a GE model with
  - systemic risk,
  - no aggregate shocks.
- We introduce it into a GE model with
  - systemic risk,
  - aggregate shocks,
  - sticky prices,
  - monetary policy.

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 II (more detailed version)

- 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"): this is the **first moral-hazard problem** in the model.

Capital goods producers III

- Capital goods producers need to get funds to buy unfurbished capital.
- The only agents that have the skills to **monitor** them (and thus that can solve the first moral-hazard problem) are banks.
- Therefore, they get funds from banks to buy unfurbished capital.
- We consider *loan* contracts between capital goods producers and banks.
- 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.

Capital goods producers IV

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

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

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

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

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

Banks II

- **Banks** only need to monitor the capital goods producers who borrow at the lower rate.
- This lower rate is R_t^S.
- Indeed, if we had $R_t^R < R_t^S$, then funding safe projects would strictly dominate funding risky projects as it would
  - pay more even when R is a success,
  - incur no monitoring cost.
- So banks only monitor the capital goods producers who borrow at rate R_t^S, in order to check that they use S.
- Banks last for only two periods, so that there is no durable relationship between banks and capital goods producers.

Banks III

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

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

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*

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

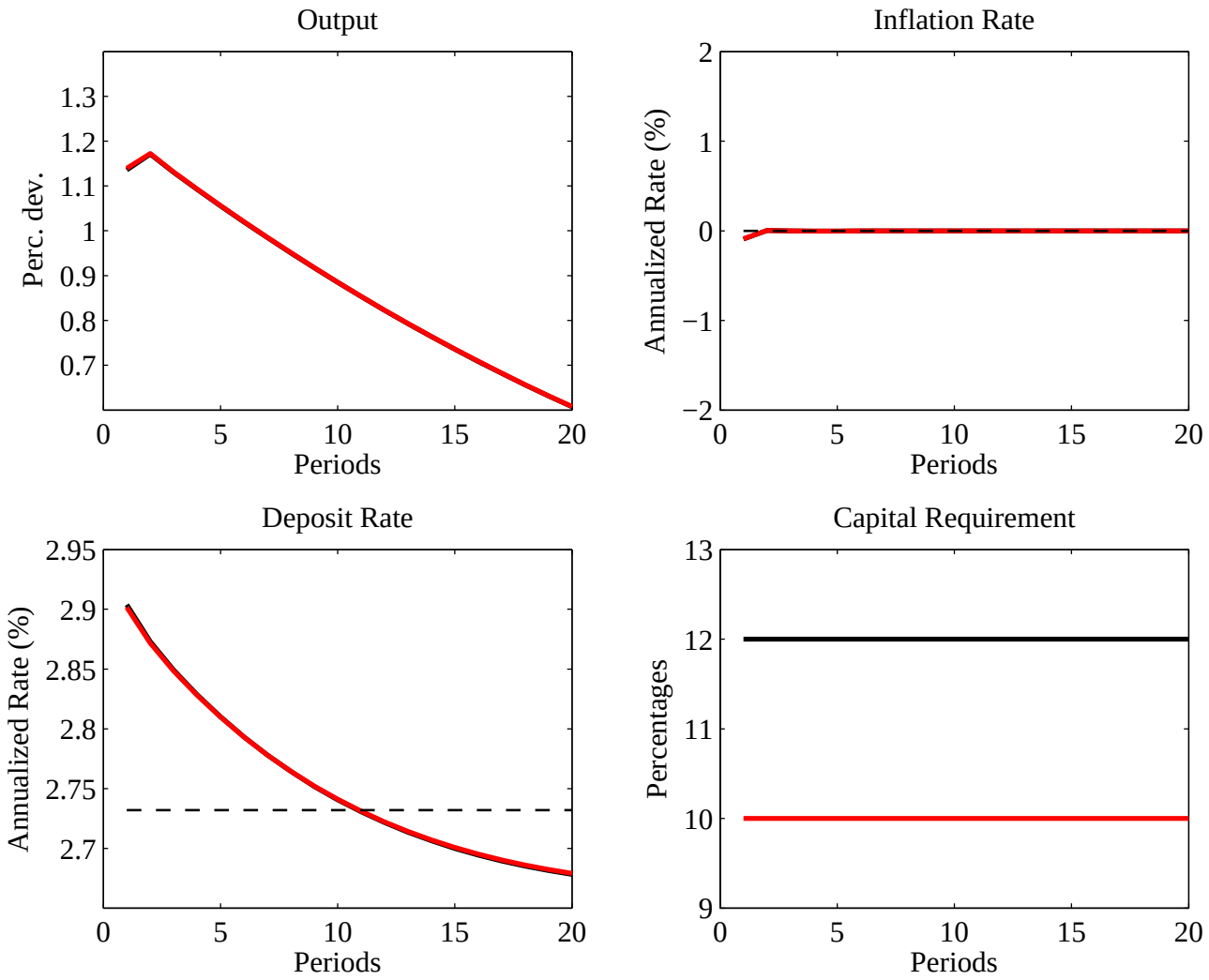
there exists a unique equilibrium and, at this equilibrium, $I_t^R = 0$ *and* $\kappa_t = \kappa_t^*$.

- 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	0.300
σ	Elasticity of substitution	7.000
δ	Depreciation rate	0.025
	Nominal rigidities	
α	Price stickiness	0.667
	Banking (steady state)	
τ	Tax rate	0.023
κ^*	Capital requirement	0.100
Ψ	Marginal monitoring cost	0.006
ϕ	Failure probability	0.029
γ	Maximal risky/safe loans ratio	0.427
$exp(\eta^R)$	Productivity of the risky technology	1.005
	Shock processes	
ρ	Persistence	0.950

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



$\kappa_t = \kappa_t^*$ $\kappa_t = 0.12$ Dashed line: Steady State Level

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.