# Macroeconomic Policy Games

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# Motivation

- Strategic interactions between policymakers can arise when each policymaker has distinct objectives.
- Examples include interactions between policymakers across countries as well as within a country.
- Strategic considerations can imply that deviating from full cooperation results in large welfare losses.
- To facilitate the study of strategic interactions, we develop a toolbox that characterizes the welfare-maximizing cooperative Ramsey policies under full commitment and open-loop Nash games.

# Our Toolbox

- The toolbox is designed to extend Dynare, a convenient and widely used modeling environment.
- Our work extends the single regulator framework of Levin and Lopez-Salido (2004).
- The general framework for the policy games that we consider distinguishes between two groups of actors.
  - The first group of private agents acts optimally given the (expected) path of the policy instruments.
  - The second group consists of the policymakers who determine policies taking into account the private sector's response to the implemented policies.
- Given a set of equilibrium conditions that includes simple instrument policy rules, our toolbox replaces those rules with either the Ramsey cooperative policies or the Ramsey open-loop Nash policies.

# Contributions

- No new theory here.
- The contribution of this part of the paper is to make pedestrian what can be a long sequence of tedious steps.
- New results are provided by two examples of the application of the toolbox.

# Some Preliminaries

- Define the equilibrium concepts implemented by the toolbox.

# Equilibrium Definition: Cooperation

- The welfare-maximizing Ramsey policy with full commitment is derived from the maximization program

$$\max_{\{\tilde{x}_t, i_{1,t}, i_{2,t}\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \beta^t \left[\omega_1 U_1(\tilde{x}_{t-1}, \tilde{x}_t, \zeta_t) + \omega_2 U_2(\tilde{x}_{t-1}, \tilde{x}_t, \zeta_t)\right]$$
$$s.t.$$
$$E_t g(x_{t-1}, x_t, x_{t+1}, \zeta_t) = 0.$$

- As is well-understood, this approach does not necessarily lead to time-invariant policy rules.
- To overcome this issue, we follow a sizable part of the literature in adopting the concept of optimality from a *timeless perspective*.
- This approach disregards the transitional dynamics by assuming that the optimal policy had always been in place.

# Equilibrium Definition: Open-Loop Nash (cont.)

- As under the static Nash equilibrium concept, player $j$ restricts attention to his own objective function and the maximization program is given by

$$\max_{\{\tilde{x}_t, i_{j,t}\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \beta^t U_j(\tilde{x}_{t-1}, \tilde{x}_t, \zeta_t)$$
$$s.t.$$
$$E_t g(x_{t-1}, x_t, x_{t+1}, \zeta_t) = 0$$
$$\text{for given } \{i_{-j,t}\}_{t=0}^{\infty}.$$

- Whether we consider the cooperative or the open-loop Nash equilibrium, we derive the first-order conditions of the Ramsey regulator problems analytically using symbolic differentiation.
- Each player's action is the best response to the other players' best responses.

# Examples

- In the paper we consider two examples:
  1. A two-country monetary model that closely follows BB (2006) and CDL (2010)
  2. A closed economy model with financial frictions based on Gertler and Karadi (2011).
- For the purposes of this talk, I will concentrate on the second example.

# Some Context

- The expansion and reorganization of regulatory responsibilities spurred by the Financial Crisis has been approached differently across countries. In the United States the Dodd-Frank Act substantially increased the macro prudential responsibilities of Federal Reserve.
- In the United Kingdom, the Financial Services Act 2012 established an independent Financial Policy Committee as a subsidiary of the Bank of England, with some policymakers participating in both the Monetary and Financial Policy committees.
- By contrast, in the euro area a Chinese wall will separate monetary policy tasks from macro prudential and supervisory tasks, though both functions will involve the European Central Bank.
- Can Chinese walls lead to strategic interactions in the setting of policy instruments?

# Second Example: the GK model

- We consider a policy game between a central bank and a financial regulator in a model following Gertler Karadi (2011).
- In addition to nominal rigidities, the economy features financial frictions.
- Non-financial firms are prevented from issuing equity to households directly, but have to go through financial intermediaries, referred to as banks, in order to raise funds.
- Due to an agency problem, however, banks are limited in their ability to attract deposits.
- Accordingly, credit is under-supplied, and the reactions to shocks are amplified by a familiar financial-accelerator mechanism.

# Objectives

- The representative household consists of a continuum of members. A fraction $1 - f$ of its members supplies labor to firms and returns the wage earned to the household. The remaining fraction $f$ works as bankers and do not consume until they stop working as bankers.
- The household utility function is:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[ \log(C_t - \gamma C_{t-1}) - \chi_0 \frac{L_t^{1+\chi}}{1+\chi} \right].$$

- The monetary authority has an objective function that includes household utility and an extra term reflecting a bias towards inflation stabilization:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[ \log(C_t - \gamma C_{t-1}) - \chi_0 \frac{L_t^{1+\chi}}{1+\chi} - \mu_{cb}(\pi_t - \bar{\pi})^2 \right].$$

- The financial regulator has an objective function that includes household utility and an extra term reflecting a bias towards the stabilization of spreads between loans and deposits:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[ \log(C_t - \gamma C_{t-1}) - \chi_0 \frac{L_t^{1+\chi}}{1+\chi} - \mu_{mpr} \left( R_t^s - R_{t-1} \right)^2 \right].$$

# Instruments

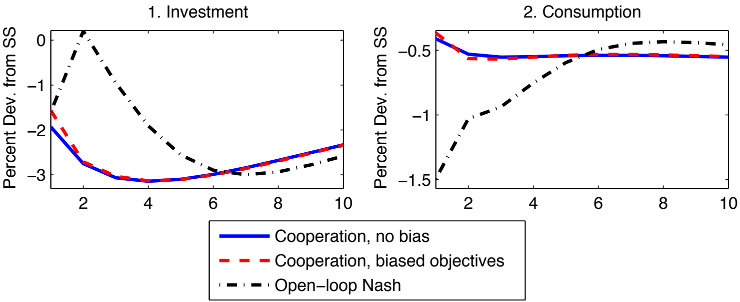
- The monetary authority uses inflation as its instrument.
- The financial regulator uses a lump-sum transfer between households and banks.
- A strength of the toolbox is that it allows for sensitivity analysis to the choice of alternative instruments easily – no costly re-derivation is needed as for the LQ approach.
- The BK conditions are not satisfied under the open-loop Nash equilibrium concept if the monetary authority uses the interest rate as an instrument.

# Cooperative Outcomes with No Biases

- Our calibration hews closely to the calibration in GK (2011), with one important exception: spreads are zero in steady state implying that the steady state is efficient (it coincides with the steady state of the frictionless RBC model).
- However after contractionary technology shocks credit is undersupplied.
- Losses are absorbed by the balance sheet of banks and the financial friction prevents banks from raising outside equity or borrowing up to the efficient level.
- The instruments we choose are so powerful that they can completely counteract the financial friction.
- The allocations from the cooperative Ramsey problem with no biases – $\mu_{mpr} = 0$ and $\mu_{cb} = 0$ – coincide with the efficient allocations of the frictionless RBC model.

# Outcomes with Biases

- We choose biases small enough so that the deterioration in utility from the the presence of these biases is trivially small under the cooperative Ramsey policies ($\mu_{mpr} = 0.5$ and $\mu_{cb} = 1$ ).



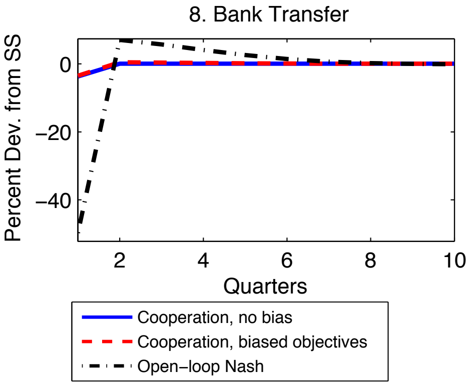

- By contrast, an open-loop Nash game with the same biased objectives yields outcomes that are drastically different.

# Strategic Interactions

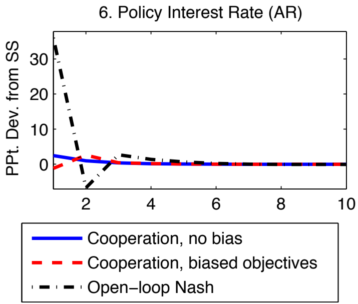
- To understand these differences, consider the side effects of a policy that, in reaction to a decline in technology, attempts to replenish the equity position of banks.
- Higher equity positions allow banks to expand credit and push up investment and aggregate demand.
- In the presence of nominal rigidities, this expansion in demand leads to higher resource utilization and higher marginal costs of production, which cause inflation to rise.
- In reaction to the same decline in technology, monetary policy will want to curb the inflationary effects of the shocks and increase policy rates.
- However, higher policy rates bring up the cost of funding for banks and by reducing profitability ultimately reduce the amount of funds available to support lending.

# Strategic Interactions (cont.)

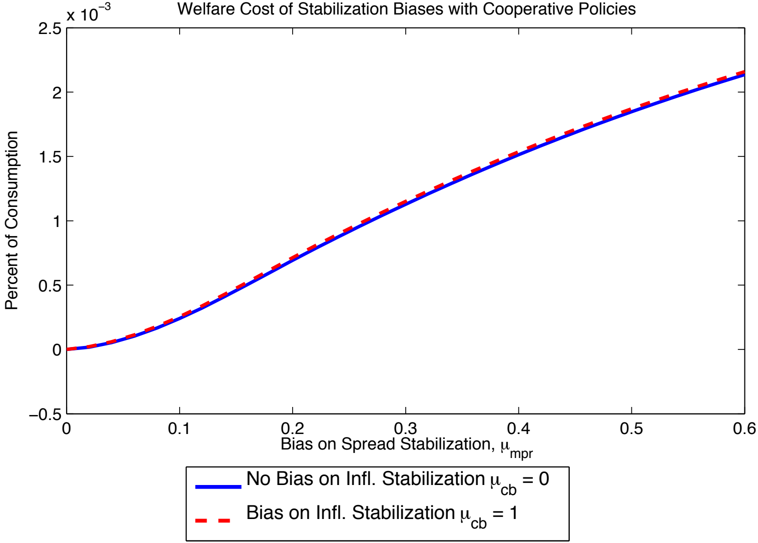
- The macroprudential regulator recognizes that the monetary policy regulator will move to push up rates and counteracts that action by pushing up the transfer from households to banks (shown as a negative movement).

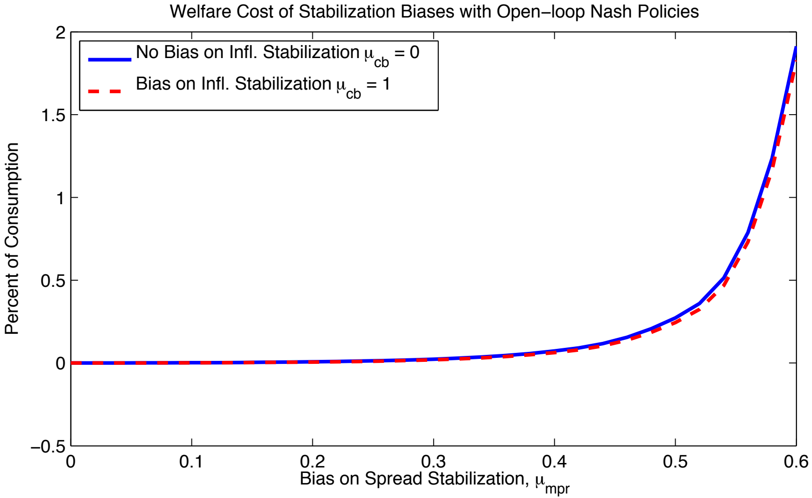


- In turn, the monetary policy regulator will have an incentive to increase policy interest rates by more, realizing that the macro prudential regulator will step up the recapitalization of banks.




- Effectively, the different biases in the objectives push each regulator to discount the reverberations of his own actions onto the objectives of the other regulator.
- Ultimately, the strategic interactions lead to an excessive recapitalization of banks and overly aggressive tightening of monetary policy.


Welfare Cost of Stabilization Biases with Cooperative Policies
x 10^-3
2.5
2
1.5
1
0.5
0
−0.5
0
0.1
0.2
0.3
0.4
0.5
0.6
Percent of Consumption
Bias on Spread Stabilization, μ_mpr
No Bias on Infl. Stabilization μ_cb = 0
Bias on Infl. Stabilization μ_cb = 1


Welfare Cost of Stabilization Biases with Open−loop Nash Policies
No Bias on Infl. Stabilization μ_cb = 0
Bias on Infl. Stabilization μ_cb = 1
Percent of Consumption
Bias on Spread Stabilization, μ_mpr
2
1.5
1
0.5
0
−0.5
0
0.1
0.2
0.3
0.4
0.5
0.6

# Institutional Design

- Our results point to two implications for the design of institutional arrangements.
  1. Bringing different regulatory functions under the same institution fosters the recognition of alternative objectives and avoids potentially large welfare losses from strategic interaction.
  2. When this solution is politically infeasible, our results argue for devising broader objectives for each regulator as a way to minimize the welfare loss driven by strategic interactions.

# Conclusions

- Our toolbox simplifies the analysis of strategic interactions between policymakers.
- In closed economies, strategic interactions can distort allocations and imply welfare losses well above the cost of business cycles computed by Lucas (2003).
- Returning to a canonical open economy monetary model, we show that the choice of policy instrument can affect the size of the gains from cooperation.
- We have successfully deployed the toolbox to solve an open-loop Nash game between two monetary policy authorities in two-country model with multiple sectors and numerous real and nominal distortions in and out of steady state.
- In case you want to give the toolbox a try, our codes are available from http://www.lguerrieri.com