The Academy of Economic Studies
The Faculty of Finance, Insurance, Banking and Stock Exchange
Doctoral School of Finance and Banking

A DSGE Model to Analyze Macroprudential Regulations and Monetary Policy for Romania

MSc Student: Ana Cristiuc
Supervisor: Professor Moisă Altăr, PhD

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Introduction

Motivation. The financial crisis has emphasized the need to develop the core conceptual frameworks, models tools (including DSGE), able to improve macro-prudential supervision in the EU.

Some new question:

- Who is responsible for financial stability in Romania? What is the macro-prudential policy? How we define the systemic risk?
- Can price stability alone safeguard financial stability and prevent financial crises from occurring?
- The separation between monetary and macro-prudential policies is necessary? An authority to supervise financial stability is needed?
- What are the objectives, tools , transmission channels of each policy and their interdependencies? Are their objectives in conflict? When? Should the competent authorities cooperate?
- Can a macro-prudential DSGE model to improve the research toolkit?

The new regulatory framework:

- **European supervisors:** The European Central Bank (ECB) and The European Systemic Risk Board (ESRB);
- **Romanian supervisors:** The National Bank of Romania, The National Committee for Macro-prudential Oversight.

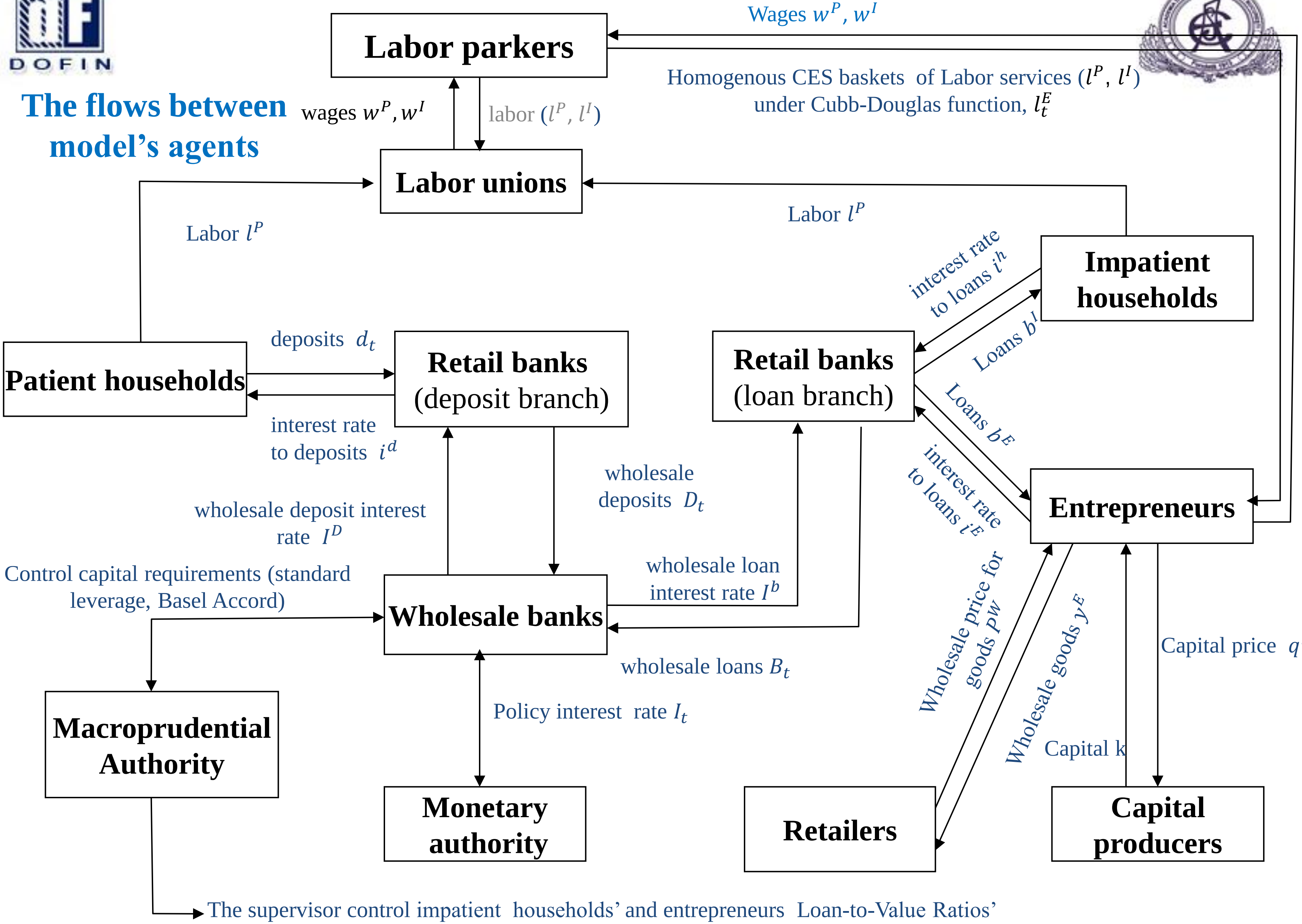
The New Keynesian Model (I)

- Starting with the baseline model of Iacoviello (2005) with the occasionally binding collateral constraints, heterogenous agents and housing sector ;
- Adding the financial accelerator of Bernanke et al.(1999);
- Adding stylized banking sector and credit frictions developed by Gerali et al. (2010) as:
  - Quadratic adjustment costs *a la* Rotemberg (for prices of goods, wages, housing price and interest rates) and non-linear Phillips curves;
  - Stochastic elasticities of substitution for interest rates;
  - Endogenous capital accumulation;
- Setting real and nominal frictions as in Christiano et al. (2005) and Smets and Wouters (2003).
- Modeling "augmented" Taylor Rules as in (Clerc et al. 2012);
- Modeling macro-prudential policy tools (contercyclycal capital requirements, the Loan-to-Value Ratios) and interactions between policies as in Angelini et al (2011, 2012);

Model used in presentation:

- **Gerali et al. (2010) :** "Credit and banking in a DSGE model of the euro area"
- **Angelini et al. (2012):** " Monetary and Macroprudential Policies"

The flows between model's agents



The New Keynesian Model (III)

Households

Patient households

The representative patient household i maximizes the expected utility:

$$E_t \sum_{t=0}^{\infty} \beta_P^t \left[(1-\rho^P)\varepsilon_t^c \ln(c_{j,t}^P - \rho^P \bar{c}_{t-1}^P) + \eta^h \varepsilon_t^h \ln(h_{j,t}^P) - \varepsilon_t^l \frac{l_{j,t}^{P\,1+\phi}}{1+\phi} \right]$$

Subject to the budget constraint: $c_{j,t}^P + q_t^h h_{j,t}^P + \frac{\kappa^h}{2}\left(\frac{h_{j,t}^P}{h_{j,t-1}^P} - 1\right)^2 h_{j,t}^P + d_{j,t}^P \leq w_j^P l_{j,t}^P + q_t^h h_{j,t-1}^P + \frac{(1+i_{t-1}^d) d_{j,t-1}^P}{\pi_t} + t_{j,t}^P$

The choice variable for the patient household s are consumtion, housing and deposits

Impatient households

The optimisation problem:

$$\max_{\{c_t^i, h_t^i, b_t^i\}} E_t \sum_{t=0}^{\infty} \beta_I^t \left[(1-\rho^I)\varepsilon_t^c \ln(c_{j,t}^I - \rho^I c_{t-1}^I) + \eta^h \varepsilon_t^h \ln(h_{j,t}^I) - \varepsilon_t^l \frac{l_{j,t}^{i\,1+\phi}}{1+\phi} \right]$$

Subject to the budget constraint: $c_{j,t}^I + q_t^h h_{j,t}^I + \frac{\kappa^h}{2}\left(\frac{h_{j,t}^I}{h_{j,t-1}^I} - 1\right)^2 h_{j,t}^I + \frac{(1+i_{t-1}^h) b_{j,t-1}^I}{\pi_t} \leq w_t^I l_{j,t}^I + q_t^h h_{j,t-1}^I + b_{j,t}^I$

Subject to the borrowing constraint: $(1+i_t^h) b_{j,t}^I \leq m_t^i E_t[q_{t+1}^h h_{j,t}^I \pi_{t+1}]$

where m_t^i is the loan-to-value ratio (LTV) for mortgages. It follows a stochastic AR(1) process: $m_t^i = (1-\rho_{m_i}) m_{ss}^i + \rho_{m_i} m_{t-1}^i + \varepsilon_{m_i t}$

- The choice variable for household s are the consumption, housing and loans: c_t^I, h_t^i, b_t^I.
- The adjustment costs capture market rigidities which attenuate the volatility of housing demand $\frac{\kappa^h}{2}\left(\frac{h_{j,t}^P}{h_{j,t-1}^P} - 1\right)^2 h_{j,t}^P$
- Housing stock is fixed $\bar{h} = h_t^p + h_t^i$
- The disturbances are: consumption (ε_t^c), housing demand (ε_t^h) and labor demand (ε_t^l) shocks, what follow a AR(1) process

The New Keynesian Model (IV)
Labor market

1. **Perfectly competitive labor parkers**

The labor "packer" maximizes profits subject to the production function

$$\max_{l_t^{E,z}(j)} l_t^{E,z} = \left(\int_0^1 \left(l_{jt}^z\right)^{\frac{\varepsilon^\tau - 1}{\varepsilon^\tau}} dj\right)^{\frac{\varepsilon^\tau}{\varepsilon^\tau - 1}} \quad \text{subject to } \int_0^1 w_{jt}^z l_{jt}^{E,z} dj \leq \bar{\mathrm{E}}$$

taking as given all differentiated labor wages w_{jt} and the wage w_t. Consequently, its maximization problem is:

$$\max_{l_{jt}} w_t^z l_t^{E,z} - \int_0^1 w_{jt}^z l_{jt}^z dj$$

FOCs are: labor demand functions $l_{jt}^z = \left(\frac{w_{jt}^z}{w_t^z}\right)^{-\varepsilon^\tau} l_t^{E,z}$, $\forall j$ and wage CES Index $w_t^z = \left(\int_0^1 \left(w_{jt}^z\right)^{1-\varepsilon^\tau} dj\right)^{\frac{1}{1-\varepsilon^\tau}}$

2. **Monopolistic labor unions**

Each monopolistic union (*s,m*) sets nominal wages $\{W_t^s(\mathrm{m})\}_{t=0}^{\infty}$ by maximizing the expected utility

$$E_0 \sum_{t=0}^{\infty} \beta_s^t \ \{U_{c_t^s(i,m)} \left[\frac{W_t^s(m)}{P_t} l_t^s(i,m) - \frac{K_w}{2}\left(\frac{W_t^s(m)}{W_{t-1}^s(m)} - \pi_{t-1}^{\tau_w} \pi^{1-\tau_w}\right)^2 \frac{W_t^s}{P_t}\right] - \frac{l_t^s(i,m)^{1+\emptyset}}{1+\emptyset}\}$$

subject to downward sloping demand $l_t^s(i,m)$=$l_t^s(m)$=$(\frac{W_t^s(m)}{W_{t-1}^s(m)})^{-\varepsilon^\tau} l_t^s$

FOC is ensuing a (non-linear) wage-Phillips curve:

$$k_w(\pi_t^{w^s} - \pi_{t-1}^{\tau_w}\pi^{1-\tau_w})\pi_t^{w^s} = \beta_s E_t[\frac{\lambda_{t+1}^s}{\lambda_t^s} K_w(\pi_{t+1}^{w^s} - \pi_t^{\tau_w}\pi^{1-\tau_w})\frac{\pi_{t+1}^{w^s\,2}}{\pi_{t+1}}] + (1-\varepsilon^\tau) l_t^s + \frac{\varepsilon_\tau l_t^{s\,1+\emptyset}}{w_t^s \lambda_t^s}$$

where w_t^s is the real wage and nominal types wage inflation is equal to $\pi_t^{w^s} = \frac{w_t^s}{w_{t-1}^s}\pi_t$

The New Keynesian Model (V)

Entrepreneurs

The entrepreneur strives to maximize its discounted utility:

$$\max_{c_t^E, k_t^E, b_t^E, l_t^E} E_0 \sum_{t=0}^{\propto} \beta_E^t \left[\left(1-q^E\right)\ln\left(c_{jt}^E - q^E \bar{c}_{t-1}^E\right)\right]$$

The budget constraint is the following:

$$c_{j,t}^E + w_t^P l_{j,t}^P + w_t^I l_{j,t}^I + \frac{(1+i_{t-1}^E) b_{j,t-1}^E}{\pi_t} + q_t^k k_{j,t}^E + \psi(u_{j,t}) k_{j,t-1}^E \le \frac{y_{j,t}^E}{x_t} + b_{j,t}^E + q_t^k (1-\delta) k_{j,t-1}^E$$

The production function: $y_{j,t}^E = a_t\left(k_{j,t}^E u_{j,t}\right)^{\alpha}\left(l_{j,t}^E\right)^{1-\alpha}$, where $a_t = (1-\rho^{\alpha})\bar{a} + \rho^{\alpha} a_{t-1} + \eta_t^{\alpha}$,$l_t^E = (l_t^{E.P})^{\gamma(l_t^{E.P})^{\gamma}} (l_t^{E.I})^{(1-\gamma)}$

The borrowing constraint: $(1+i_t^E) b_{j,t}^E \le m_t^E E_t[q_{t+1}^k \pi_{t+1}(1-\delta) k_{j,t}^E]$, $m_t^e = \left(1-\rho_{m_e}\right) m_{ss}^e + \rho_{m_e} m_{t-1}^e + \varepsilon_{m_{e,t}}$

,

$$p^w / p_t = 1/x_t \qquad \psi(u_t) = \xi_1(u_t - 1) + \frac{\xi_2}{2}(u_t - 1)^2$$

FOCs provide:

$$\lambda_t^E = \frac{(1-\rho^E)}{c_{j,t}^E - \rho^E c_{t-1}^E} \qquad \lambda_t^E q_t^k = \mathrm{E}_t\{\mu_t^E m_t^E q_{t+1}^k \pi_{t+1}(1-\delta) + \beta_E \lambda_{t+1}^E [r_{t+1}^k u_{t+1} + q_{t+1}^k (1-\delta) - \psi(u_{t+1})]\} \qquad r_t^k \equiv \alpha a_t [k_{j,t-1}^E u_t]^{\alpha-1} (l_{j,t}^E)^{1-\alpha} / x_t$$

$$\lambda_t^E = \mu_t^E (1+i_t^E) + \beta_E E_t\left[\lambda_{t+1}^E \frac{(1+i_t^{bE})}{\pi_{t+1}}\right] \qquad w_t^P = (1-\alpha)\frac{y_{j,t}^E}{x_t}\frac{\gamma}{l_{j,t}^{E,P}} \qquad w_t^I = (1-\alpha)\frac{y_{j,t}^E}{x_t}\frac{(1-\gamma)}{l_{j,t}^{E,I}} \qquad r_t^k = \xi_1 + \xi_2(u_t - 1)$$

- **Frictions in good market**

  - external habit formations in consumption;
  - monopolistically competitive entrepreneurs, sell their goods with a markup over marginal cost of production;
  - variable capital utilization rate as in Schmitt – Grohé and Uribe, (2006)
  - technological progress, as a driver of economy system;

The New Keynesian Model (VI)
Capital producers and Retailers

Fully competitive capital producers are owned by entrepreneurs and face the following optimization problem subject to a capital accumulation equation:

$$\max_{j_t, k_t^e} E_0 \sum_{t=0}^{\infty} \Xi_{0,t}^{e} \left[q_t^k k_t - q_t^k (1-\delta) k_{t-1} - j_t \right]$$

Subject to , $\Delta \bar{x}_t = \Delta \bar{x}_{t-1} + \left[1 - \frac{\kappa^j}{2} \left(\frac{j_t \varepsilon_t^{qk}}{j_{t-1}} - 1 \right)^2 \right] j_t$ where $\Delta \bar{x}_t = k_t - (1-\delta) k_{t-1}$ is the flow output.

FOCs deliver the capital accumulation equation and a dynamic equation, which determine the real price of capital

$$k_t = (1-\delta) k_{t-1} + \left[1 - \frac{\kappa^j}{2} \left(\frac{j_t \varepsilon_t^{qk}}{j_{t-1}} - 1 \right)^2 \right] j_t 1$$

$$1 = q_t^k \left[1 - \frac{\kappa^j}{2} \left(\frac{j_t \varepsilon_t^{qk}}{j_{t-1}} - 1 \right)^2 - \kappa^j \left(\frac{j_t \varepsilon_t^{qk}}{j_{t-1}} - 1 \right) \frac{j_t \varepsilon_t^{qk}}{j_{t-1}} \right] + \beta_E E_t \left[\frac{\lambda_{t+1}^E}{\lambda_t^E} q_{t+1}^k \varepsilon_{t+1}^{qk} \kappa^j \left(\frac{j_{t+1} \varepsilon_{t+1}^{qk}}{j_t} - 1 \right) \left(\frac{j_{t+1}}{j_t} \right)^2 \right]$$

The optimization problem for the monopolistically competitive retailers is:

$$\max_{P_t(j)} E_0 \sum_{t=0}^{\infty} \Xi_{0,t}^{P} \left[P_t(j) y_t(j) - P_t^W y_t(j) - \frac{\kappa_p}{2} \left(\frac{P_t(j)}{P_{t-1}(j)} - \pi_{t-1}^{\tau_p} \pi^{1-\tau_p} \right)^2 P_t y_t \right]$$

Subject to downward sloping consumer demand : $y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{\varepsilon_t^y} y_t$

FOC is ensuing a (non-linear) price-Phillips curve:

$$1 - \varepsilon^y + \frac{\varepsilon^y}{x_t} - \left(\pi_t - \pi_{t-1}^{\tau_p} \pi^{1-\tau_p} \right) \pi_t + \beta_P E_t \left[\frac{\lambda_{t+1}^P}{\lambda_t^P} \left(\pi_{t+1} - \pi_t^{\tau_p} \pi^{1-\tau_p} \right) \pi_{t+1} \frac{y_{t+1}}{y_t} \right] = 0$$

Aggregate retailers' profits are instead given by:

$$j_t^R = y_t \left[1 - \frac{1}{x_t} - \frac{}{2} \left(\pi_t - \pi_{t-1}^{\tau_p} \pi^{1-\tau_p} \right)^2 \right] = 0$$

The New Keynesian Model (VII)

Loans and deposits demand

- The units of deposits and of loan contracts composite CES basket of slightly differentiated products that each bank *j* supplies.
- The stochastic elasticities affects : the value of the markups (markdowns) that banks charge when setting interest rates and, consequently, the value of the spreads between the policy rate and the retail loan (deposit) rates.

$$\varepsilon_t^d = \left(1-\rho^{\varepsilon_t^d}\right)\overline{\varepsilon}_t^d + \rho^{\varepsilon_t^d}\varepsilon_{t-1}^d + \eta_t^{\varepsilon_t^d} \qquad \varepsilon_t^i = \left(1-\rho^{\varepsilon_t^i}\right)\overline{\varepsilon}_t^i + \rho^{\varepsilon_t^i}\varepsilon_{t-1}^i + \eta_t^{\varepsilon_t^i} \qquad \varepsilon_t^e = \left(1-\rho^{\varepsilon_t^e}\right)\overline{\varepsilon}_t^e + \rho^{\varepsilon_t^e}\varepsilon_{t-1}^e + \eta_t^{\varepsilon_t^e}$$

$$\max \int_0^1 i_t^d(j) d_t(i,j)\,dj \qquad \max \int_0^1 i_t^h(j) b_t^I(i,j)\,dj \qquad \max \int_0^1 i_t^e(j) b_t^I(i,j)\,dj$$

$$\left[\int_0^1 d_t^P(\mathrm{i,j})^{\frac{\varepsilon_t^d-1}{\varepsilon_t^d}}\right]^{\frac{\varepsilon_t^d}{\varepsilon_t^d-1}} \le \overline{d_t} \qquad \left[\int_0^1 b_t^I(\mathrm{i,j})^{\frac{\varepsilon_t^i-1}{\varepsilon_t^i}}\right]^{\frac{\varepsilon_t^i}{\varepsilon_t^i-1}} \ge \overline{b_t^I}(i) \qquad \left[\int_0^1 b_t^E(\mathrm{i,j})^{\frac{\varepsilon_t^e-1}{\varepsilon_t^e}}\right]^{\frac{\varepsilon_t^e}{\varepsilon_t^e-1}} \ge \overline{b_t^E}(i)$$

$$d_t^P(j) = \left(\frac{i_t^d(j)}{i_t^d}\right)^{-\varepsilon_t^d} d_t \qquad b_t^I(j) = \left(\frac{i_t^h(j)}{i_t^h}\right)^{-\varepsilon_t^i} b_t^I \qquad b_t^E(j) = \left(\frac{i_t^e(j)}{i_t^e}\right)^{-\varepsilon_t^e} b_t^E$$

$$i_t^d = \left[\int_0^1 i_t^d(j)^{1-\varepsilon_t^d}\,dj\right]^{\frac{1}{1-\varepsilon_t^d}} \qquad i_t^h = \left[\int_0^1 i_t^h(j)^{1-\varepsilon_t^i}\,dj\right]^{\frac{1}{1-\varepsilon_t^i}} \qquad i_t^e = \left[\int_0^1 i_t^e(j)^{1-\varepsilon_t^e}\,dj\right]^{\frac{1}{1-\varepsilon_t^e}}$$

The New Keynesian Model (VIII)
Wholesale banks

A wholesale bank faces the following optimization problem:

$$\max_{D_t,B_t} E_0 \sum_{t=0}^{\infty} \Xi^{P}_{0,t}\left[(1+I^b_t)B_t - B_{t+1}\pi_{t+1} + D_{t+1}\pi_{t+1} - (1+I^D_t)D_t + (K^b_{t+1}\pi_{t+1} - K^b_t) - \frac{\kappa^b}{2}\left(\frac{K^b_t}{B_t}-\nu\right)^2 K^b_t\right]$$

is subject to the binding balance sheet identity: $B_t = D_t + K_t^b$, $K^b_t = \left(1-\delta^b\right)\frac{K^b_{t-1}}{\pi_t \varepsilon^k_t} + \varpi\frac{\Pi^b_{t-1}}{\pi_t}$

Using the balance sheet identity twice (at date t and $t+1$), the objective function boils down to period profits :

$$\max_{D_t,B_t}\left[I^b_t B_t - I^D_t D_t - \frac{\kappa^b}{2}\left(\frac{K^b_t}{B_t}-\nu\right)^2 K^b_t\right]$$

The bank pays a quadratic cost κ^b whenever the capital-to-assets ratio K_t^b/B_t moves away from an “optimal" or target value ν . The improvement: The change of capital ratio with leverage. Thus: $L_t = D_t + K_t^b$, $B_t = w^I_t b^I_t + w^E_t b^E_t$, where w^I_t and w^E_t are the weights individualized for each kind of agents.

$$w^i_t = (1-\rho_i)\overline{w}^i + (1-\rho_i)\chi_i(y_t - y_{t-4}) + \rho_i w^i_{t-1}, \quad i = I, E$$

Another macro-prudential tool is the capital requirements, following the rule:

$$v_t = (1-\rho_v)\bar{v} + (1-\rho_v)\chi_v X_t + \rho_w v_{t-1}$$

where $\bar{v}$ measure the steady state level of v_t. Capital requirements are adjusted according to the dynamics of a key macroeconomic variable X_t with a sensitivity parameter χ_v.

$$I^b_t = I^D_t - \kappa^b\left(\frac{K^b_t}{w^I_t b^I_t + w^E_t b^E_t} - v_t\right)\left(\frac{K^b_t}{w^I_t b^I_t + w^E_t b^E_t}\right)^2$$

$$S^W_t \equiv I^b_t - i_t = -\kappa^b\left(\frac{K^b_t}{w^I_t b^I_t + w^E_t b^E_t} - v_t\right)\left(\frac{K^b_t}{w^I_t b^I_t + w^E_t b^E_t}\right)^2$$

The New Keynesian Model (IX)

Retail banks. Monetary Policy. Market clearing conditions.

Loans branch: Optimisation problem

$$\underset{\{i_t^h(j),i_t^e(j)\}}{Max} E_0\sum_{t=0}^{\infty}\Lambda_{0,t}^P\left[i_t^h(j)b_t^i(j)+i_t^e(j)b_t^e(j)-I_t^bB_t(j)-\frac{\kappa_h}{2}\left(\frac{i_t^h(j)}{i_{t-1}^h(j)}-1\right)^2 i_t^hb_t^i-\frac{\kappa_e}{2}\left(\frac{i_t^e(j)}{i_{t-1}^e(j)}-1\right)^2 i_t^eb_t^e\right]$$

Subject to identity $\mapsto B_t(j)=b_t(j)=b_t^i(j)+b_t^e(j)$ $\quad b_t^I(j)=\left(\frac{i_t^i(j)}{i_t^i}\right)^{-\varepsilon_t^i}b_t^I$ $\quad b_t^E(j)=\left(\frac{i_t^e(j)}{i_t^e}\right)^{-\varepsilon_t^e}b_t^E$ $\quad D_t(j)=\mathrm{d}_t(j)$

$$1-\varepsilon_t^z+\varepsilon_t^z\frac{I_t^b}{i_t^z}-\kappa_z\left(\frac{i_t^z}{i_{t-1}^z}-1\right)\frac{i_t^z}{i_{t-1}^z}+\beta_P^tE_t\left\{\frac{\lambda_{t+1}^P}{\lambda_t^P}\kappa_z\left(\frac{i_{t+1}^z}{i_t^z}-1\right)\left(\frac{i_{t+1}^z}{i_t^z}\right)^2\frac{b_{t+1}^z}{b_t^z}\right\}=0 \qquad S_t^z\equiv i_t^z-i_t=\frac{\varepsilon_t^z}{\varepsilon_t^z-1}S_t^W+\frac{1}{\varepsilon_t^z-1}i_t$$

Deposit branch: Optimisation problem

$$\underset{\{i_t^d(j)\}}{Max} E_0\sum_{t=0}^{\infty}\Lambda_{0,t}^P\left[i_t(j)D_t(j)-i_t^d(j)\mathrm{d}_t(j)-\frac{\kappa_d}{2}\left(\frac{i_t^d(j)}{i_{t-1}^d(j)}-1\right)^2 i_t^dd_t\right] \quad \text{subiect to} \quad d_t^P(j)=\left(\frac{i_t^d(j)}{i_t^d}\right)^{-\varepsilon_t^d}d_t$$

In a symmetric equilibrium, the FOCs for optimal deposit interest rate setting is:

$$-1+\varepsilon_t^d+\varepsilon_t^d\frac{i_t}{i_t^d}-\kappa_d\left(\frac{i_t^d}{i_{t-1}^d}-1\right)\frac{i_t^d}{i_{t-1}^d}+\beta_P^tE_t\left\{\frac{\lambda_{t+1}^P}{\lambda_t^P}\kappa_d\left(\frac{i_{t+1}^d}{i_t^d}-1\right)\left(\frac{i_{t+1}^d}{i_t^d}\right)^2\frac{d_{t+1}}{d_t}\right\}=0$$

Overall the real profits of a bank are the sum of net earnings (intermediation margins minus other costs) from the wholesale unit and the retail branches

$$\Pi_t^b=i_t^hb_t^i+i_t^eb_t^e-i_t^dd_t-\frac{\kappa^b}{2}\left(\frac{K_t^b}{w_t^Ib_t^I+w_t^Eb_t^E}-\nu_t\right)^2K_t^b-\frac{\kappa_h}{2}\left(\frac{i_t^h}{i_{t-1}^h}-1\right)^2i_t^hb_t^i-\frac{\kappa_e}{2}\left(\frac{i_t^e}{i_{t-1}^e}-1\right)^2i_t^eb_t^e-\frac{\kappa_d}{2}\left(\frac{i_t^d}{i_{t-1}^d}-1\right)^2i_t^dd_t$$

Aggregation and market clearing conditions

In a symmetric equilibrium, all agents make identical decisions, so that: $y_{jt}^E=y_t^E,\ k_{jt}^E=k_t^E,\ h_{jt}^P=h_t^P$

In the final goods market, the equilibrium condition is given by the following resource constraint:

$c_t=c_t^P+c_t^I+c_t^E, k_t=\gamma^Ek_t^E: \bar{h}=\gamma^Ph_t^P+\gamma^Ih_t^I,$ $\qquad y_t=c_t+q_t^k\left[k_t-(1-\delta)k_{t-1}\right]+k_{t-1}\psi(u_t)+\delta^b\frac{K_{t-1}^b}{\pi_t}+Adj_t$

The New Keynesian Model (X)
Policymakers – Objectives and instruments

Central Bank

Monetary policy objective: **Price and output stability**

Mocroprudential policy objective: **To preserve financial stability through reactive policies by minimizing deviations of mains targeted variables, but this entails distortions and costs.**

Instruments: **The policy interest rate is modeled via the Taylor Rule and it is evaluated via loss functions, under different setups:**

1. A tradition Taylor Rule responding to inflation and output growth

$$(1+i_t)=(1+i)^{(1-\rho_i)}(1+i_{t-1})^{\rho_i}\left(\frac{\pi_t}{\pi}\right)^{\kappa_\pi(1-\rho_i)}\left(\frac{Y_t}{Y_{t-1}}\right)^{\kappa_y(1-\rho_i)}\varepsilon_{i,t}$$

The loss function is: $L^{CB}=k_\pi\sigma_\pi^2+k_y\,\sigma_y^2+k_I\sigma_{\Delta I}^2,\quad k_z\geq 0$

2. An "augmented Taylor Rule, responding to inflation, output and housing prices

$$(1+I_t)=(1+I)^{(1-\rho_i}(1+I_{t-1})^{\rho_i}\left(\frac{\pi_t}{\pi}\right)^{\chi_\pi(1-\rho_i)}\left(\frac{Y_t}{Y_{t-1}}\right)^{\chi_y(1-\rho_i)}\left(\frac{q_t}{q_{t-4}}\right)^{\chi_q(1-\rho_i)}\varepsilon_{i,t}$$

The loss function is: $L^{CB}=k_\pi\sigma_\pi^2+k_y\,\sigma_y^2+k_I\sigma_{\Delta I}^2+k_{qh}\,\sigma_{qh}^2,\quad k_z\geq 0$

3. An "augmented Taylor Rule, responding to inflation, output, housing prices and credit growth

$$(1+I_t)=(1+I)^{(1-\rho_i)}(1+I_{t-1})^{\rho_i}\left(\frac{\pi_t}{\pi}\right)^{\chi_\pi(1-\rho_i)}\left(\frac{Y_t}{Y_{t-1}}\right)^{\chi_y(1-\rho_i)}\left(\frac{L_t}{L_{t-4}}\right)^{\chi_L(1-\rho_i)}\left(\frac{q_t}{q_{t-4}}\right)^{\chi_q(1-\rho_i)}\varepsilon_{i,t}$$

The loss function is: $L^{CB}=k_\pi\sigma_\pi^2+k_y\,\sigma_y^2+k_I\sigma_{\Delta I}^2+k_{qh}\,\sigma_{qh}^2+k_{L/Y}\,\sigma_{L/Y}^2,$
$k_z\geq 0$

Macroprudential Authority

Objective: **Avoiding "excessive" lending and extremely cyclical fluctuation**

Limit the accumulation of financial risks, in order to reduce the probability of a financial crash;

The authority seeks to maintain volatility within resonable bounds

The authority analyze credit (proxied by the loans-to output) as an important indicator of financial stability in addition to the (Basel's) leverage

Instruments: **The toolkit of decision maker can be individualized for many types of agents, also it can be modeled in a countercyclical manner in dependence of the business cycle amplitude.**

1. Constraints on leverage and penallilty cost

$$I_t^b=I_t^D-\kappa^b\left(\frac{K_t^b}{w_t^I b_t^I+w_t^E b_t^E}-\nu_t\right)\left(\frac{K_t^b}{w_t^I b_t^I+w_t^E b_t^E}\right)^2$$

2. Countercyclical capital requirements and risk weights

$$v_t=(1-\rho_v)\bar{v}+(1-\rho_v)\chi_v X_t+\rho_v v_{t-1}$$
$$w_t^j=(1-\rho_i)\bar{w}^i+(1-\rho_i)\chi_i(y_t-y_{t-4})+\rho_i w_{t-1}^j$$

3. Loan-to-Value-Ratios

$$m_t^i=(1-\rho_{m_i})m_{t,ss}^i+(1-\rho_{m_i})\chi_m X_t+\rho_{m_i}m_{t-1}^i$$

a) A Loan-to-Value Ratio taking as key variable the growth of real house prices
b) A Loan-to-Value Ratio taking as key variable the output growth

The New Keynesian Model (XI)

Interactions between the monetary and macroprudential policies

- **Cooperative scenario**

The central banks is responsable for macroprudential supervision or cooperates with the separate macroprudential authority;

The objective is stabilizing the variances of inflation, output, loans-to-output and the changes in the instruments themselves.

Instruments: the interest rate, capital requirements and LTVs

I. The joint loss function:

$$L = L^{CB} + L^{MP} = \sigma_\pi^2 + \sigma_{B/y}^2 + (k_{y,CB} + k_{y,MP})\sigma_y^2 + k_I\sigma_{\Delta I}^2 + k_v\sigma_{\Delta v}^2$$

II. Solution: a tuple of parameters $(\rho_I^{c^*}, \chi_\pi^{c^*} \chi_y^{c^*}, \rho_v^{c^*}, \chi_v^{c^*})$ such that:

$$(\rho_I^{c^*}, \chi_\pi^{c^*} \chi_y^{c^*}, \rho_v^{c^*}, \chi_v^{c^*}) = \text{argmin } L(\rho_I, \chi_\pi, \chi_y, \rho_v, \chi_v)$$

- **Non-cooperative scenario**

Each authority minimizes its own objectives, taking the other policy instrument as given.

The objective: the same as in cooperative case

Instruments: the interest rate(CB), capital requirements and LTVs (MP)

I. Loss function for Central Bank

$$L^{CB} = \sigma_\pi^2 + k_{y,CB}\sigma_y^2 + k_I\sigma_{\Delta I}^2,\ \ k_y \geq, k_I \geq 0$$

Taking as given the countercyclical capital:

$$v_t = (1-\rho_v)\bar{v} + (1-\rho_v)\chi_v X_t + \rho_w v_{t-1}$$

II. Loss function for Macroprudential Authorities

$$L^{MP} = \sigma_{L/y}^2 + k_{y,MP}\sigma_y^2 + k_v\sigma_{\Delta v}^2,\ \ k_y \geq, k_v \geq 0$$

Taking as given the policy rate:

$$(1+i_t) = (1+i)^{(1-\rho_i)}(1+i_{t-1})^{\rho_i}\left(\frac{\pi_t}{\pi}\right)^{\kappa_\pi(1-\rho_i)}\left(\frac{Y_t}{Y_{t-1}}\right)^{\kappa_y(1-\rho_i)}\varepsilon_{i,t}$$

III. Solution: yields a tuple $\rho_I^{n^*}, \chi_\pi^{n^*} \chi_y^{n^*}, \rho_v^{n^*}, \chi_v^{n^*}$ such that:

$$(\rho_I^{n^*}, \chi_\pi^{n^*} \chi_y^{n^*}, \rho_v^{n^*}, \chi_v^{n^*}) = \text{argmin} L^{CB}(\rho_I, \chi_\pi, \chi_y\ \rho_v^{n^*} \chi_v^{n^*})$$

$$(\rho_v^{n^*}, \chi_v^{n^*}) = \text{argmin} L^{MP}(\rho_I^{n^*}, \chi_\pi^{n^*} \chi_y^{n^*}, \rho_v, \chi_v)$$

III. Estimation

The data are 15 time series for the Romanian economy from 2005Q1 to 2913Q4:

1. Real consumption: Consumption of households and non-financial institutions serving households (NPISH), seasonally adjusted, not working-day adjusted, (NIS);
2. Real investment: gross fixed capital formation, seasonally adjusted, not working day adjusted, (NSI);
3. Real house prices: Nominal residential property prices based on 2005 year (NSI and Colliers);
4. Wages: hourly labor cost index - wages and salaries, the whole economy except for agriculture, fishing and government sectors, seasonally and working day adjusted (Eurostat);
5. Inflation: GDP deflator based to 2005 year, seasonally adjusted, not working day adjusted, (Eurostat);
6. Nominal policy interest rate (NBR);
7. Interest rate on outstanding loans to households (NBR);
8. Interest rate on loans to non-financial institutions (NBR);
9. Interest rate to outstanding deposits, average rate of non-financial institutions and NPISH (NBR);
10. Short-term interest rate, ROBOR, 3M, (NBR);
11. Outstanding loans to households (NPISH), (NBR);
12. Outstanding loans to non-financial institutions (NBR);
13. Outstanding deposits (sum of households and to non-financial institutions),(NBR)
14. Consumption and gross fixed capital formation deflators, (NIS);

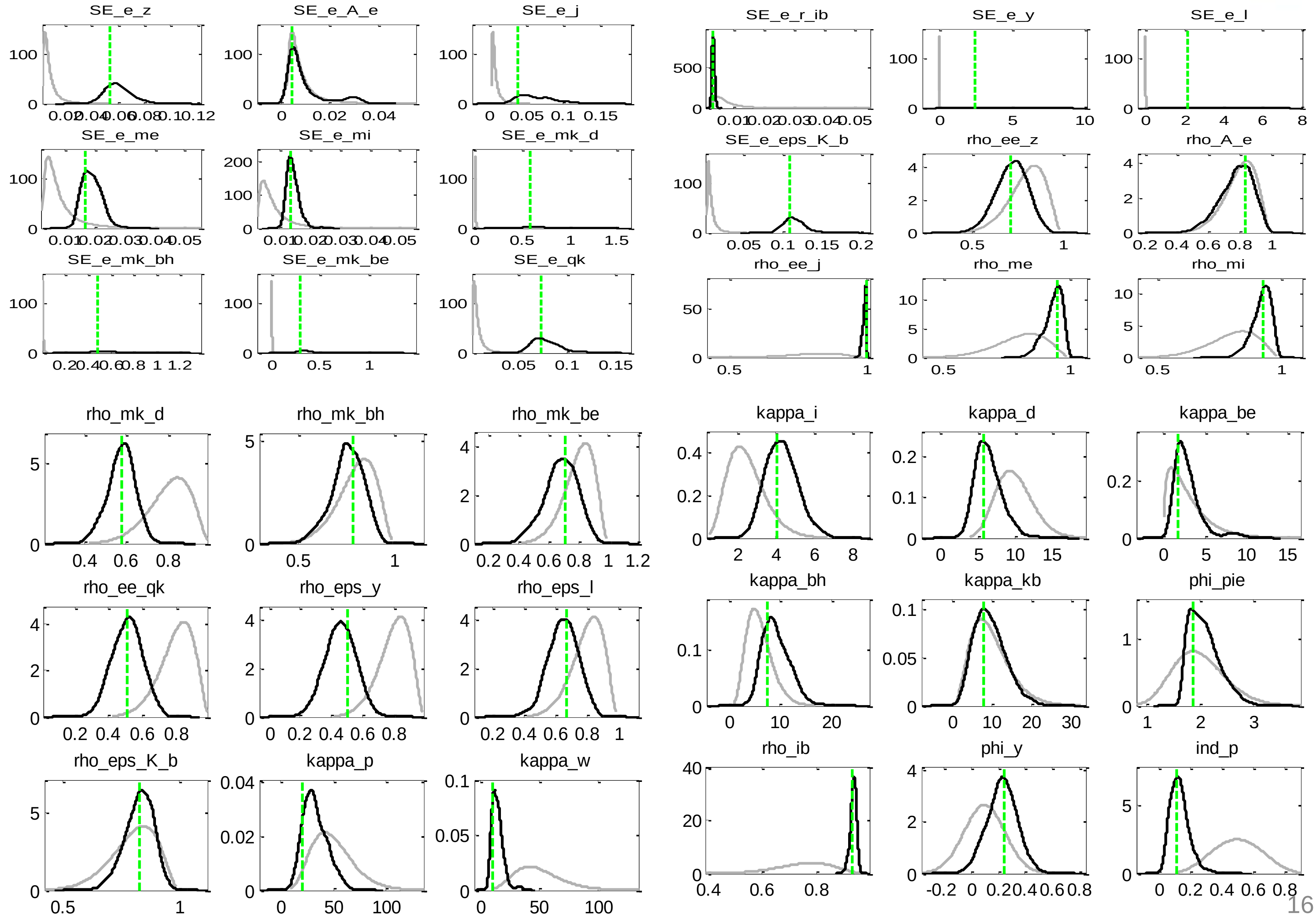
The methodology of the model estimation and of the processing of data: Gerali et al. (2010) and Angelini et al. (2012).

Software: DYNARE toolbox, version 4.1.0 in MATLAB ©R2012a.

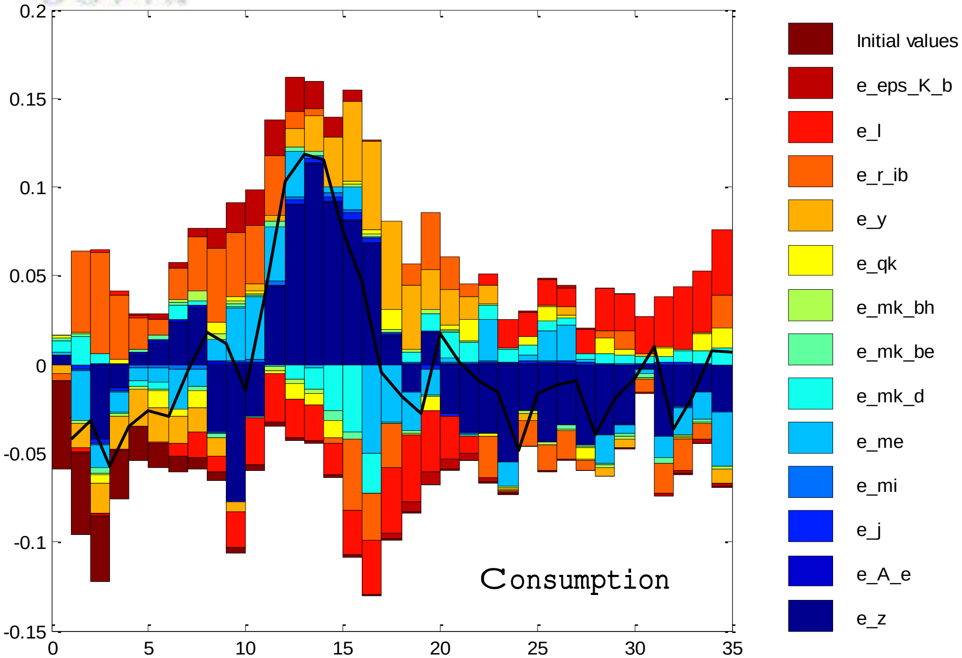
Calibrated and estimated parameters: some specific parameters are calibrated to define the model's properties, while the most are estimated a Bayesian techniques. For the simulation analysis, the model is set with the median of posterior distribution.

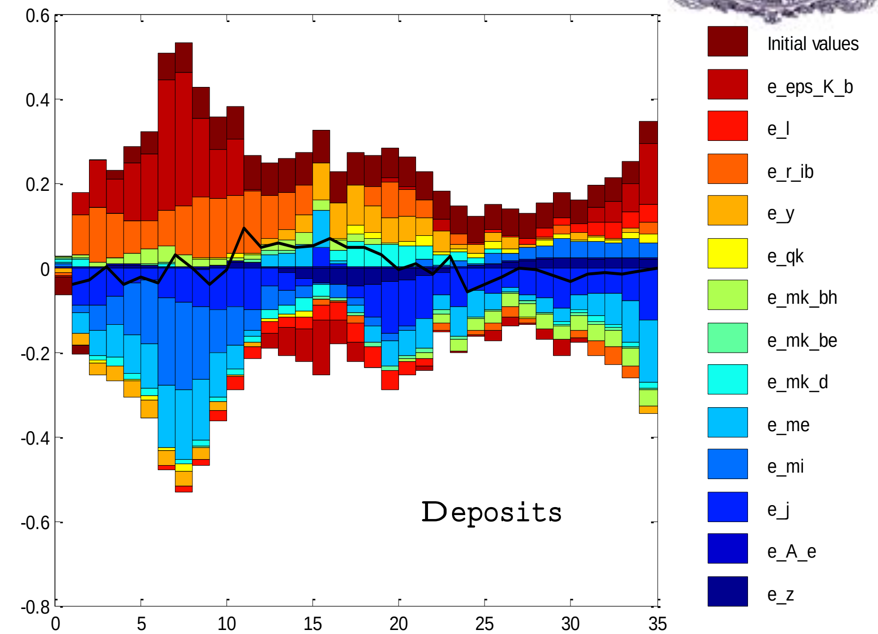
Estimated parameters

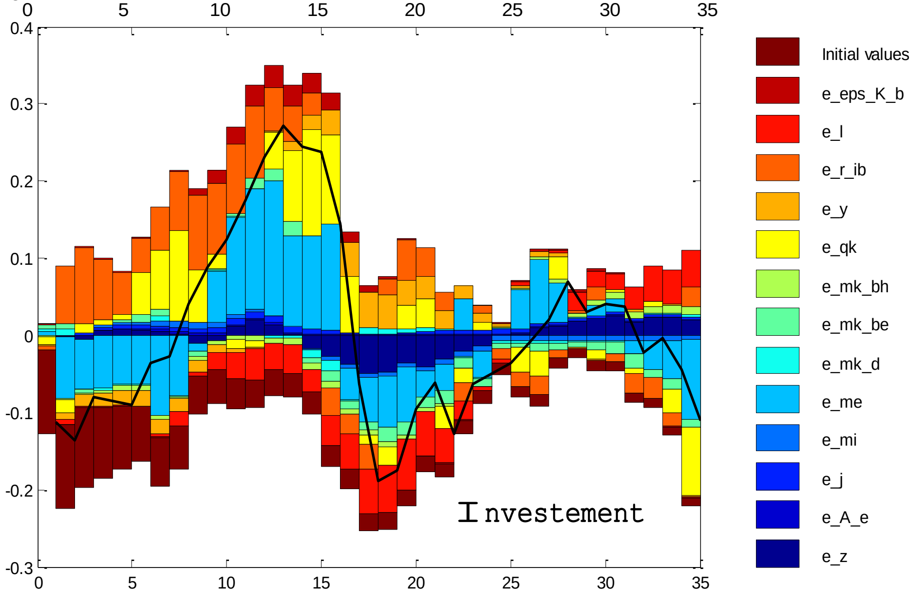
Black color means a-posteriori distribution, gray -a-priori distribution,
Green - the median of the posterior which maximize likelihood

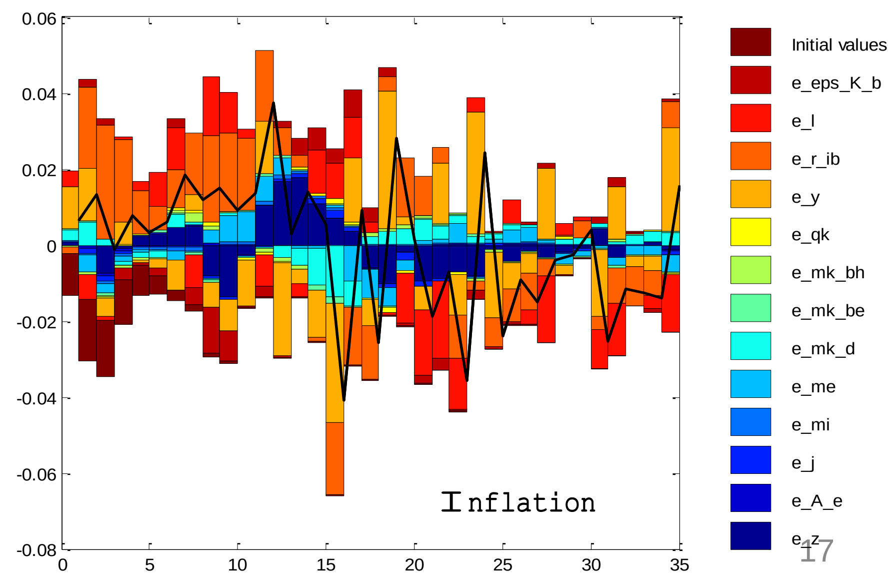


Variance decomposition of some variables

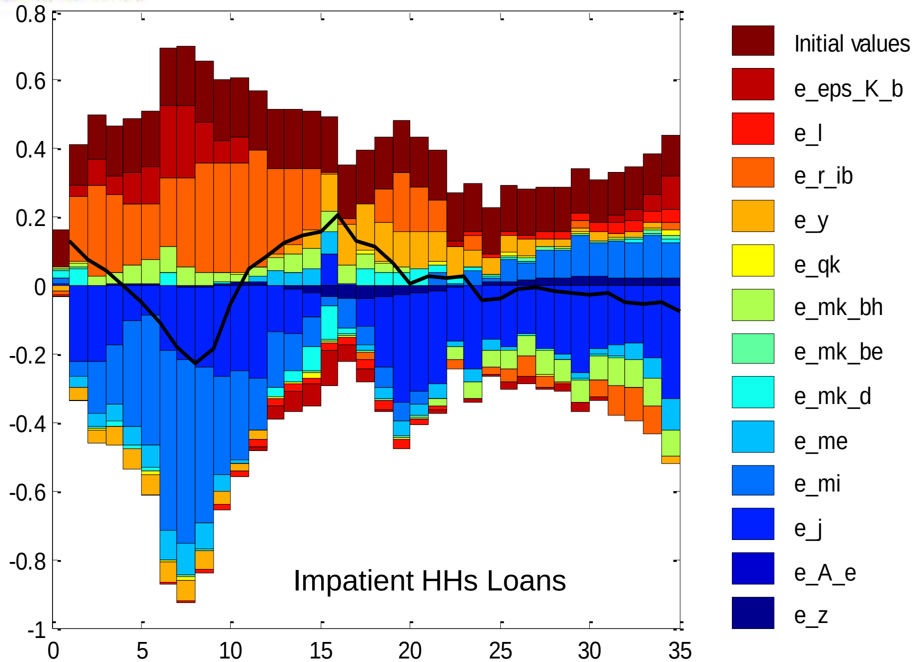


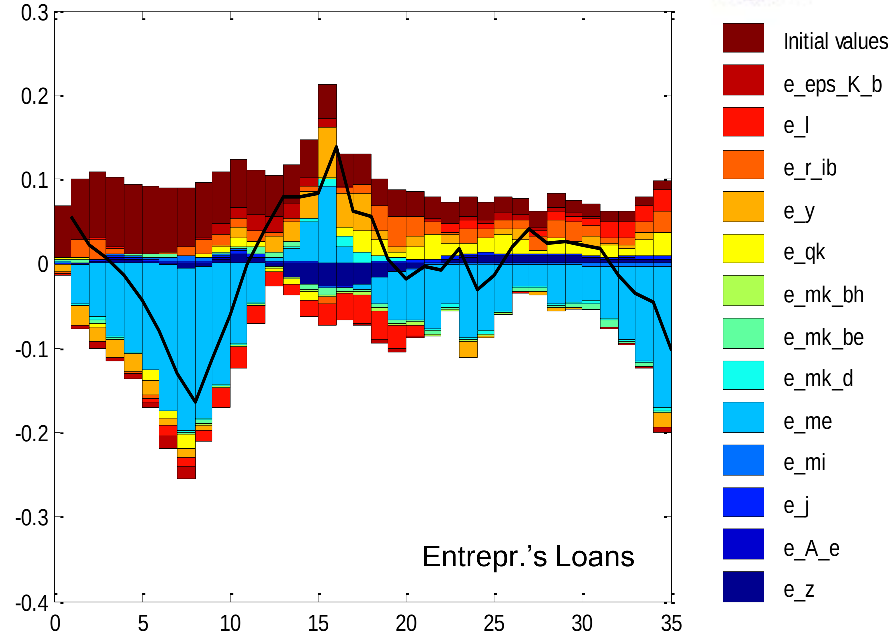


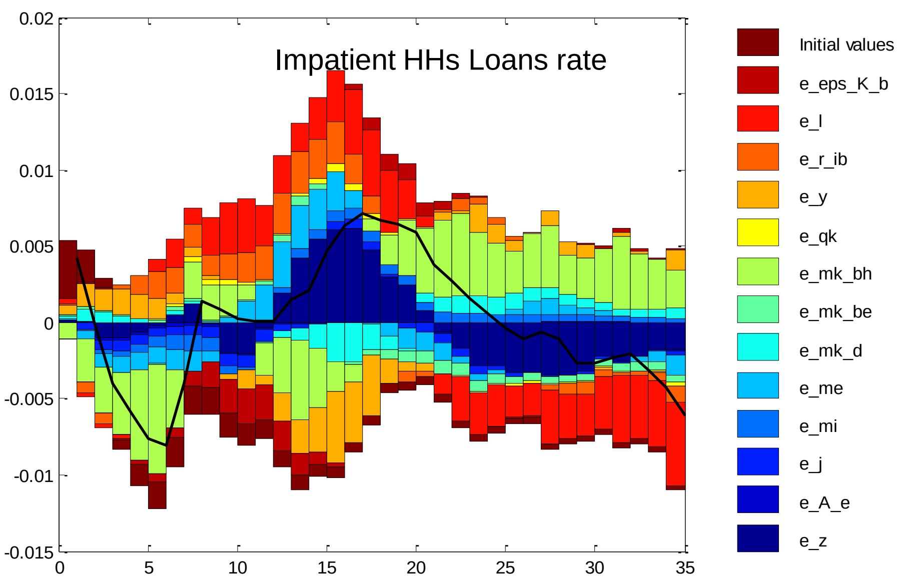


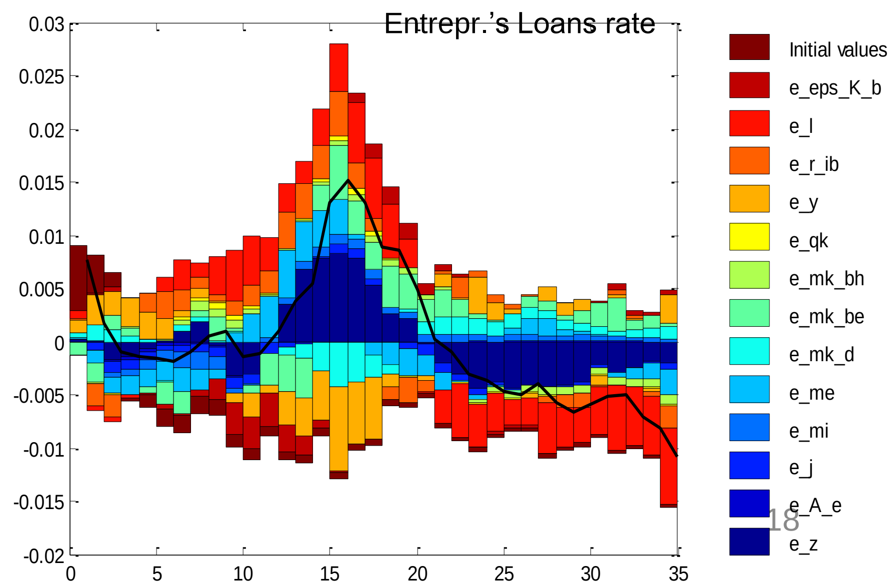


Variance decomposition of some variables









Modelling of the Taylor Rule as a macroprudential tool. Comparative analysis under technological shock

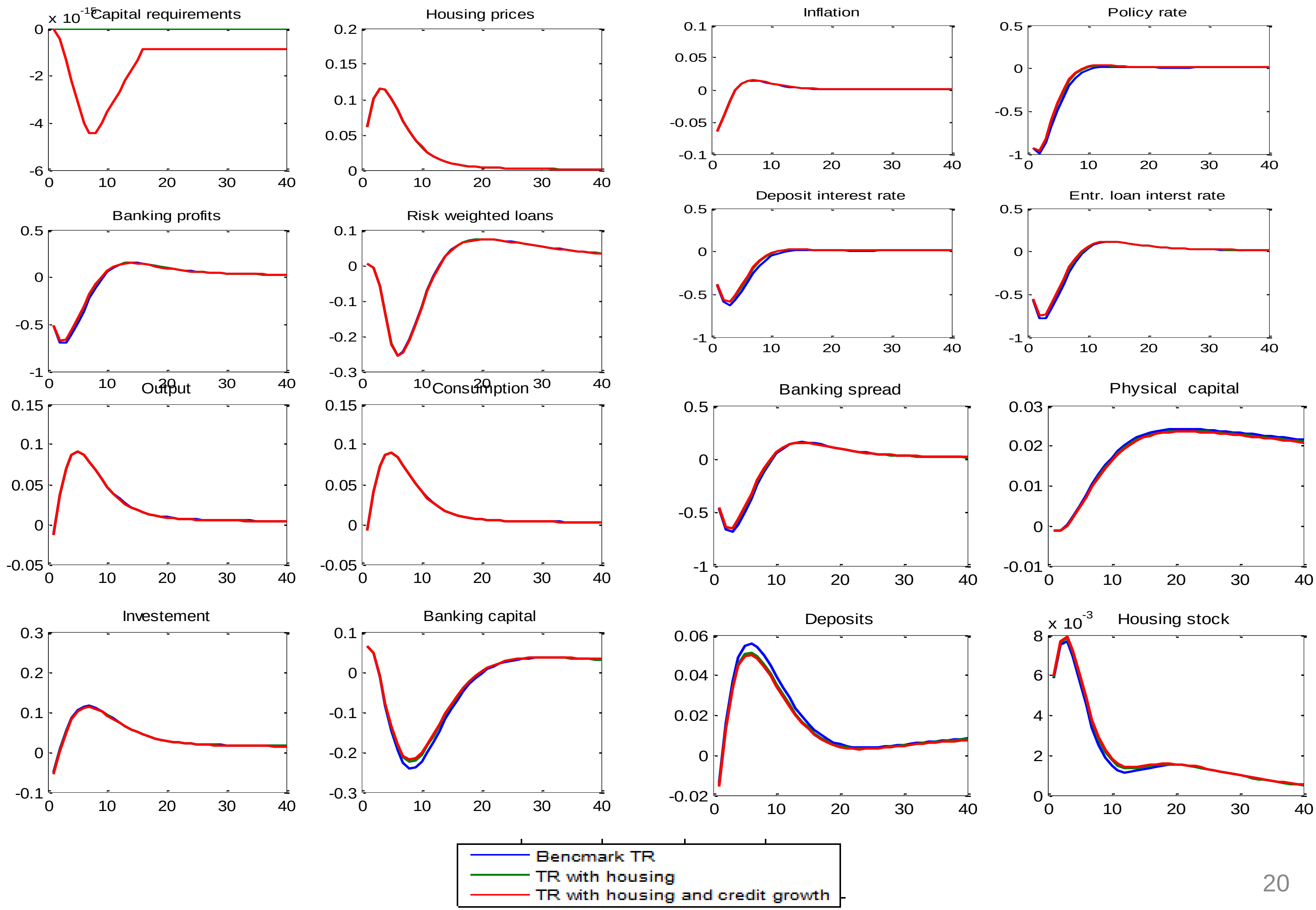
Legend: Red=the worst ; Purple=middle; Green=the best result

Table A.1

$k_{\pi} = 1, k_y = 1, k_I = 0.1$ $k_{qh} = 0.1, k_{L/Y} = 1,$		Benchmark TR	TR with housing price	TR with housing price and credit growth
Monetary policy rule	ρ_I	0.933108	0.933108	0.9331
	χ_{π}	1.80097	1.80097	1.80097
	χ_y	1.212	1.212	1.212
	χ_q	0	0.025	0.025
	χ_L	0	0	0.025
Joint loss		19.197501	19.27711630 (0.414716)	19.397697 (1.042824)
Volatilities	σ_{π}	0.0862	0.0863 (0.116009)	0.0865 (0.348028)
	σ_y	0.2286	0.2273 (-0.56868)	0.2267 (-0.83115)
	$\sigma_{L/y}$	0.1547	0.1602 (3.555268)	0.1599 (3.361345)
	$\sigma_{\Delta I}$	1.0067	1.0049 (-0.1788)	1.0126 (0.586073)
	$\sigma_{\Delta qh}$	0.2646	0.2646 (-0.03783)	0.2645 (-0.03779)
	σ_L	0.1385	0.1315 (-5.05415)	0.1246 (-10.0361)

A1.. **Impulse response function in case of technology shock. Comparative analysis across benchmark Taylor Rule, Taylor Rule with housing prices and Taylor Rule with housing prices and credit growth**

$$k_\pi = 1, k_y = 1, k_I = 0.1\ k_{qh} = 0.1,\ k_{L/Y} = 1, \chi_L = 0.025, \chi_q = 0.025,$$



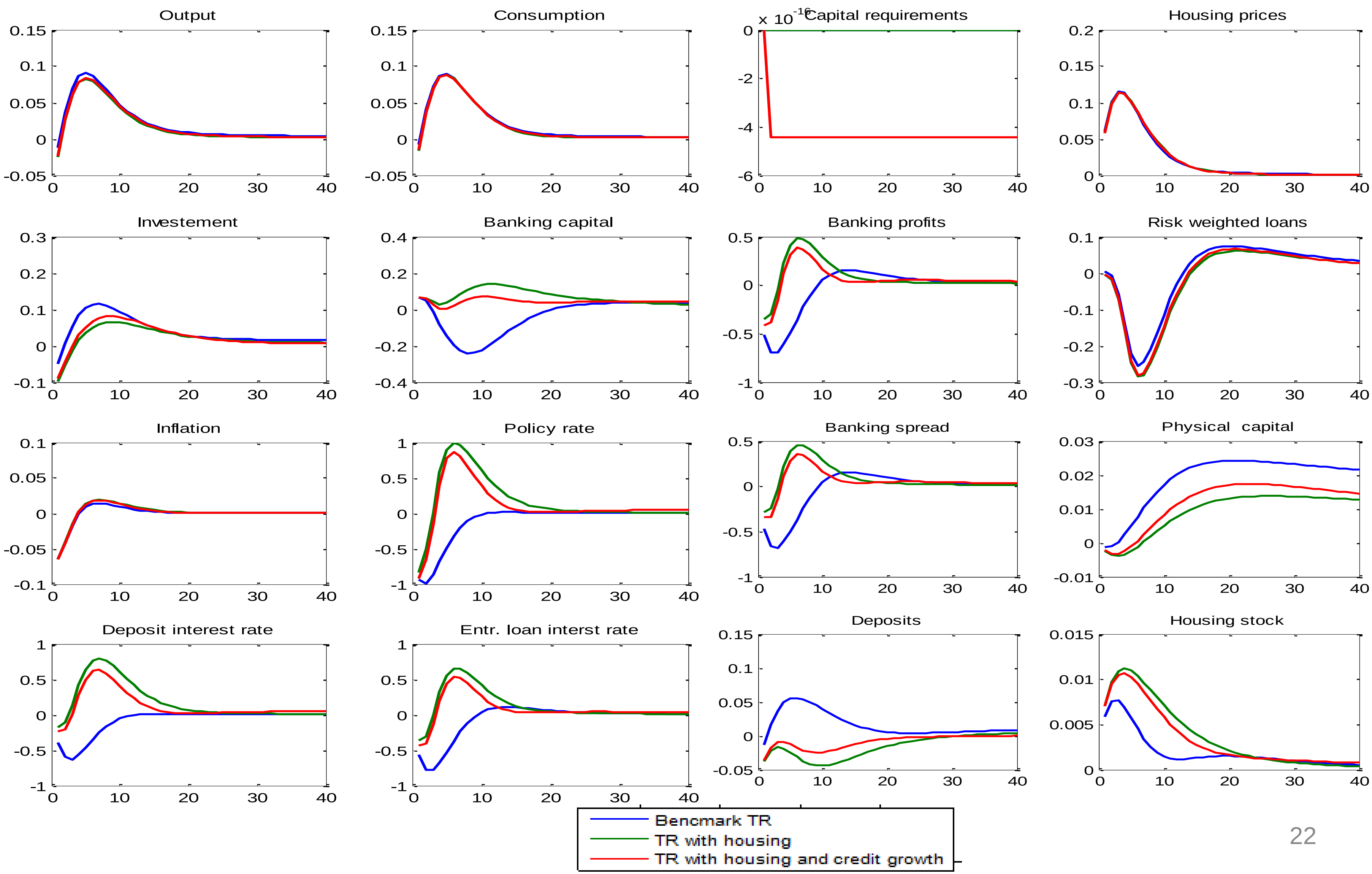
Modelling of the Taylor Rule as a macroprudential tool.
Comparative analysis under technological shock.
Robustness analysis. Different parametrisation of "augmented" TR.
Legend: Red=the worst ; Purple=middle; Green=the best result

Table A.2

$k_\pi = 1, k_y = 1, k_I = 0.1$ $k_{qh} = 0.1, k_{L/Y} = 1,$		Benchmark TR	TR with housing price	TR with housing price and credit growth
Monetary policy rule	ρ_I	0.933108	0.933108	0.9331
	χ_π	1.80097	1.80097	1.80097
	χ_y	1.212	1.212	1.212
	χ_q	0	0.5	0.5
	χ_L	0	0	0.5
Joint loss		19.1975011688	29.51646246 (53.75159)	29.28499861 (52.54589)
Volatilities	σ_π	0.0862	0.0907(5.220418)	0.0900 (4.408353)
	σ_y	0.2286	0.2039(-10.8049)	0.2091 (-8.53018)
	$\sigma_{L/y}$	0.1547	0.2835(83.25792)	0.1602 (3.555268)
	$\sigma_{\Delta I}$	1.0067	1.2567(24.83361)	1.3079 (29.91954)
	$\sigma_{\Delta qh}$	0.2646	0.2653(0.26455)	0.2645 (-0.03779)
	σ_L	0.1385	0.1086(-21.5884)	0.0622 (-55.0903)

A2. **Impulse response function in case of technology shock.** Comparative analysis across benchmark Taylor Rule, Taylor Rule with housing prices and Taylor Rule with housing prices and credit growth

$$k_{\pi} = 1, k_{y} = 1, k_{I} = 0.1\ k_{qh} = 0.1,\ k_{L/Y} = 1, \chi_{\mathrm{L}} = 0.5, \chi_{\mathrm{q}} = 0.5$$



Interaction between monetary and macroprudential policies(CR) under technology shocks

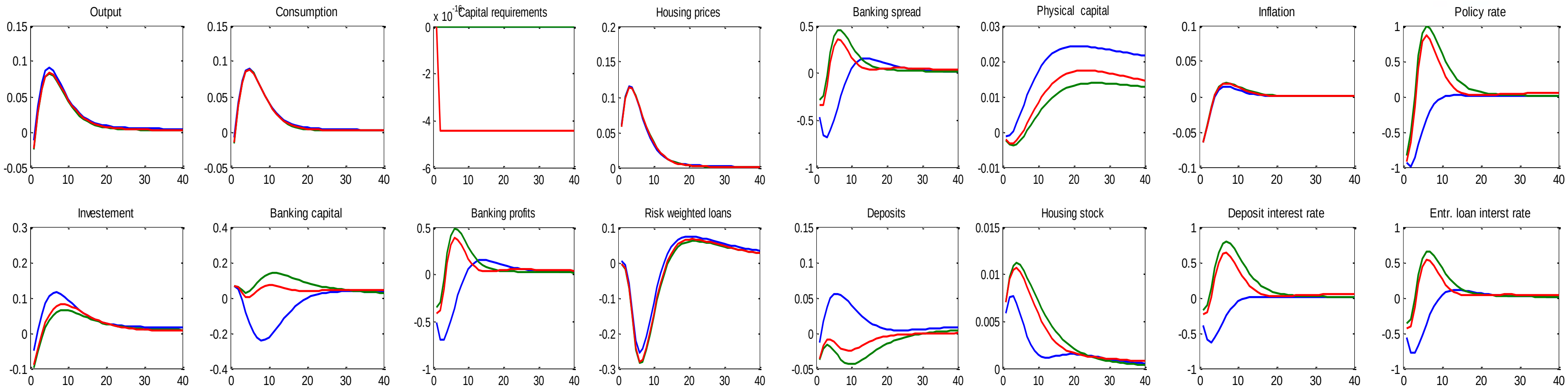
Legend: Red=the worst; **Purple**=middle; **Green**=the best result

Table B.1.

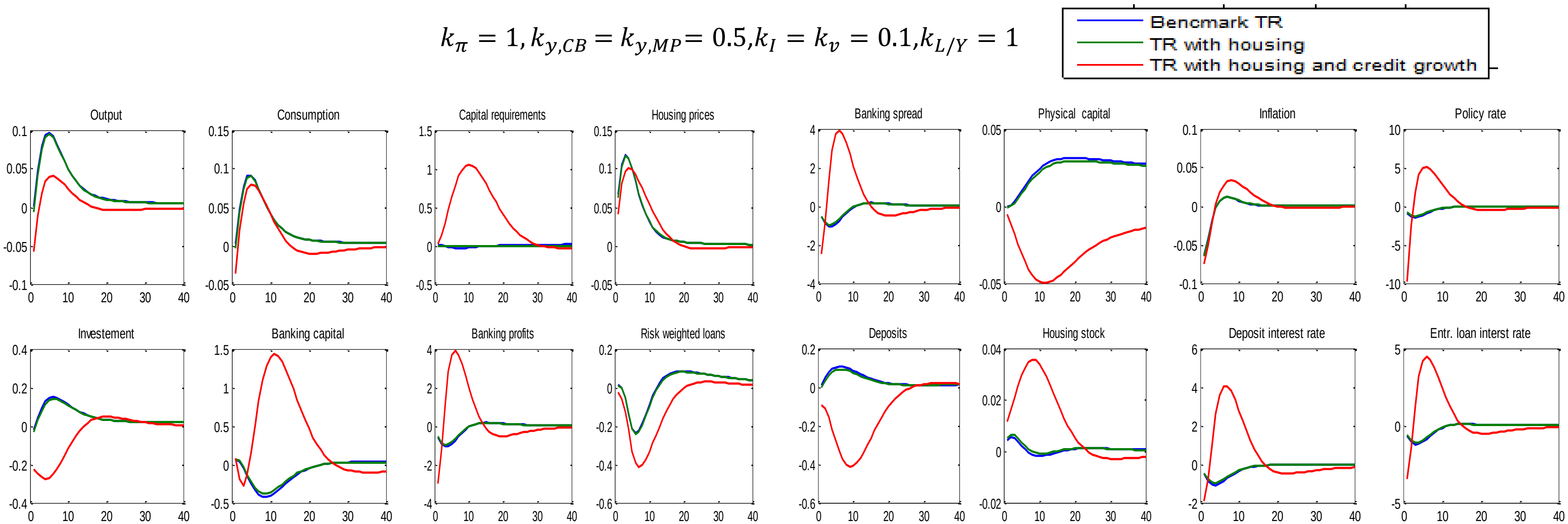
$k_\pi = 1, k_{y,CB} = k_{y,MP} = 0.5$ $k_I = k_v = 0.1, k_{L/Y} = 1$		Cooperation (a)	Non-cooperation (b)	Monetary policy only (c)
Monetary policy rule	ρ_I	0.933100	0.933100	0.932100
	χ_π	2.009700	1.800900	1.800900
	χ_y	0.242100	21.950000	0.338000
Macroprudential policy rule	ρ_v	0.750000	0.746000	0
	χ_v	0.500000	-1.029000	0
Joint loss		**20.103754**	**1837.959677 (9042.370464)**	**18.81170490 (-6.426905)**
Monetary policy loss		**15.972409**	**1752.78058008 (10873.802128)**	**14.14862747 (-11.418325)**
Macroprudential loss		**4.13134491179**	**88.4954386310 (2042.049)**	**4.6630773288 (12.87069)**
Volatilities	σ_π	**0.081900**	**0.124400 (51.892552)**	**0.084600 (3.296703)**
	σ_y	**0.246400**	**0.114000 (-53.733766)**	**0.241200 (-2.110390)**
	$\sigma_{L/y}$	**0.233700**	**0.926100 (296.277279)**	**0.132500 (-43.303380)**
	$\sigma_{\Delta I}$	**1.107500**	**13.218400 (1093.534989)**	**1.025900 (-7.367946)**
	$\sigma_{\Delta v}$	**0.023400**	**0.455200 (1845.299145)**	**0**

Impulse response functions in case of technology shock. Comparative analysis across benchmark Taylor Rule, Taylor Rule with housing prices and Taylor Rule with housing prices and credit growth

$$k_{\pi} = 1, k_y = 1, k_I = 0.5\ k_{qh} = 1,\ k_{L/Y} = 1, \chi_{\mathrm{L}} = 0.5, \chi_{\mathrm{q}} = 0.5$$



$$k_{\pi} = 1, k_{y,CB} = k_{y,MP} = 0.5, k_I = k_v = 0.1, k_{L/Y} = 1$$



Interaction between monetary and macroprudential policies(CR) under financial shocks

Legend: **Red**=the worst; **Purple**=middle; **Green**=the best result

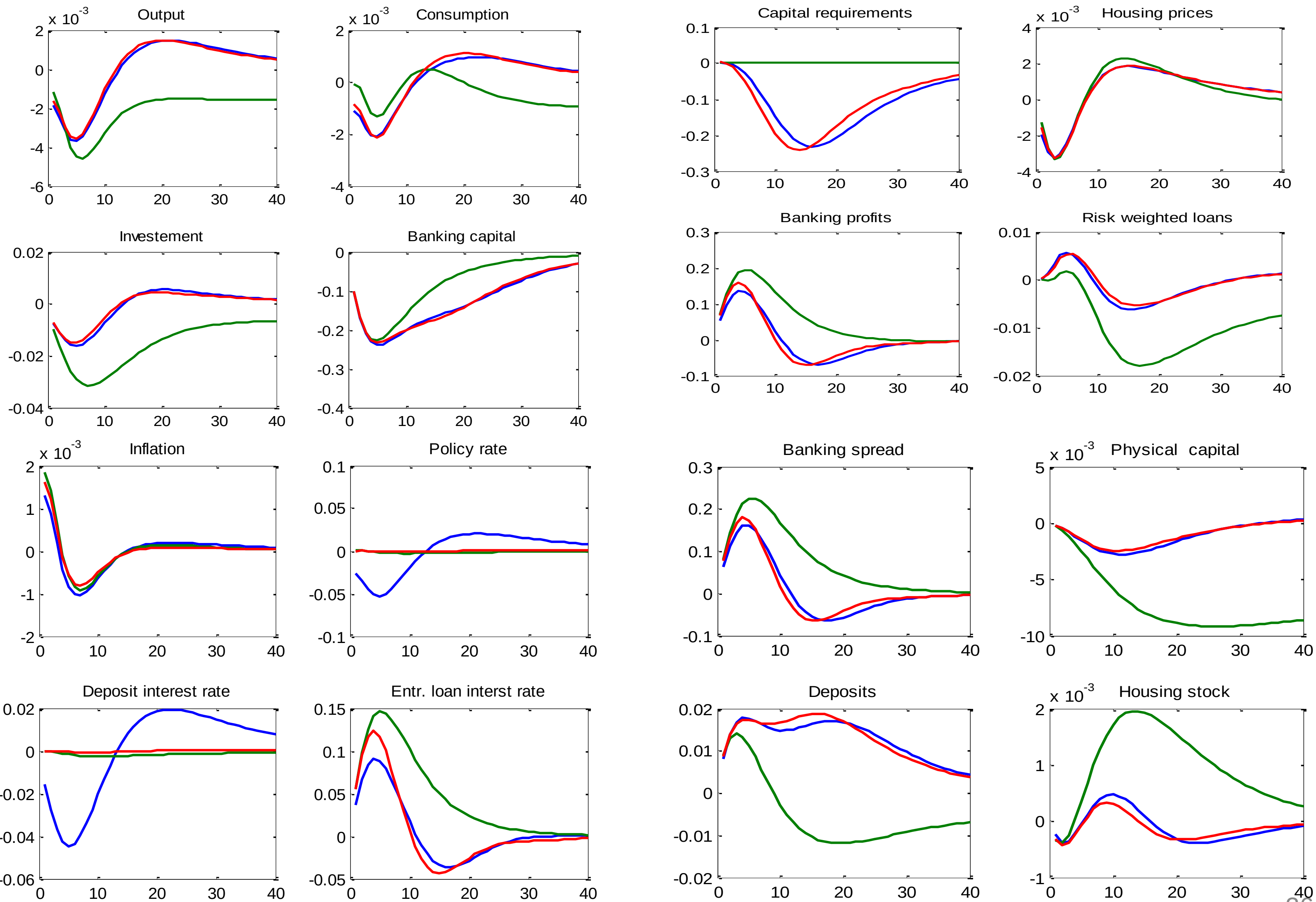
Table C.1.

$k_\pi = 1, k_{y,CB} = k_{y,MP} = 0.5$ $k_I = k_v = 0.1, k_{L/Y} = 1$		Cooperation (a)	Non-cooperation (b)	Monetary policy only (c)
Monetary policy rule	ρ_I	0.999000	0.999000	0.999000
	χ_π	4.417000	4.021000	4.822000
	χ_y	139.248000	4.592000	7.272000
Macroprudential policy rule	ρ_v	0.997000	0.999000	0.000000
	χ_v	7.897000	13.885000	0.000000
Joint loss		**0.102243**	**0.095593 (-6.504907)**	**0.619004 (505.421571)**
Monetary policy loss		**0.020349**	**0.005940 (-70.809749)**	**0.023300 (14.503977)**
Macroprudential loss		**0.081894**	**0.089653 (9.473500)**	**0.619004 (655.856161)**
Volatilities	σ_π	**0.002900**	**0.002700 (-6.896552)**	**0.003100 (6.896552)**
	σ_y	**0.010700**	**0.010200 (-4.672897)**	**0.021100 (97.196262)**
	$\sigma_{L/y}$	**0.010300**	**0.006500 (-36.893204)**	**0.077200 (649.514563)**
	$\sigma_{\Delta I}$	**0.037100**	**0.000600 (-98.382749)**	**0.001400 (-96.226415)**
	$\sigma_{\Delta v}$	**0.081000**	**0.089600 (10.617284)**	**0**

Impulse responses functions in case of the financial shock.

Comparative analysis across cooperative, non-cooperative and “monetary-policy-only” cases (capital requirements as macroprudential tool)

$$k_{\pi} = 1, k_{y,CB} = 0.5\ k_{y,MP} = 0.5, k_{I} = k_{v} = 0.1, k_{L/Y} = 1$$



Interaction between monetary and macroprudential (CR)policies under housing prices shock

Legend: Red=the worst; **Purple**=middle; **Green**=the best result

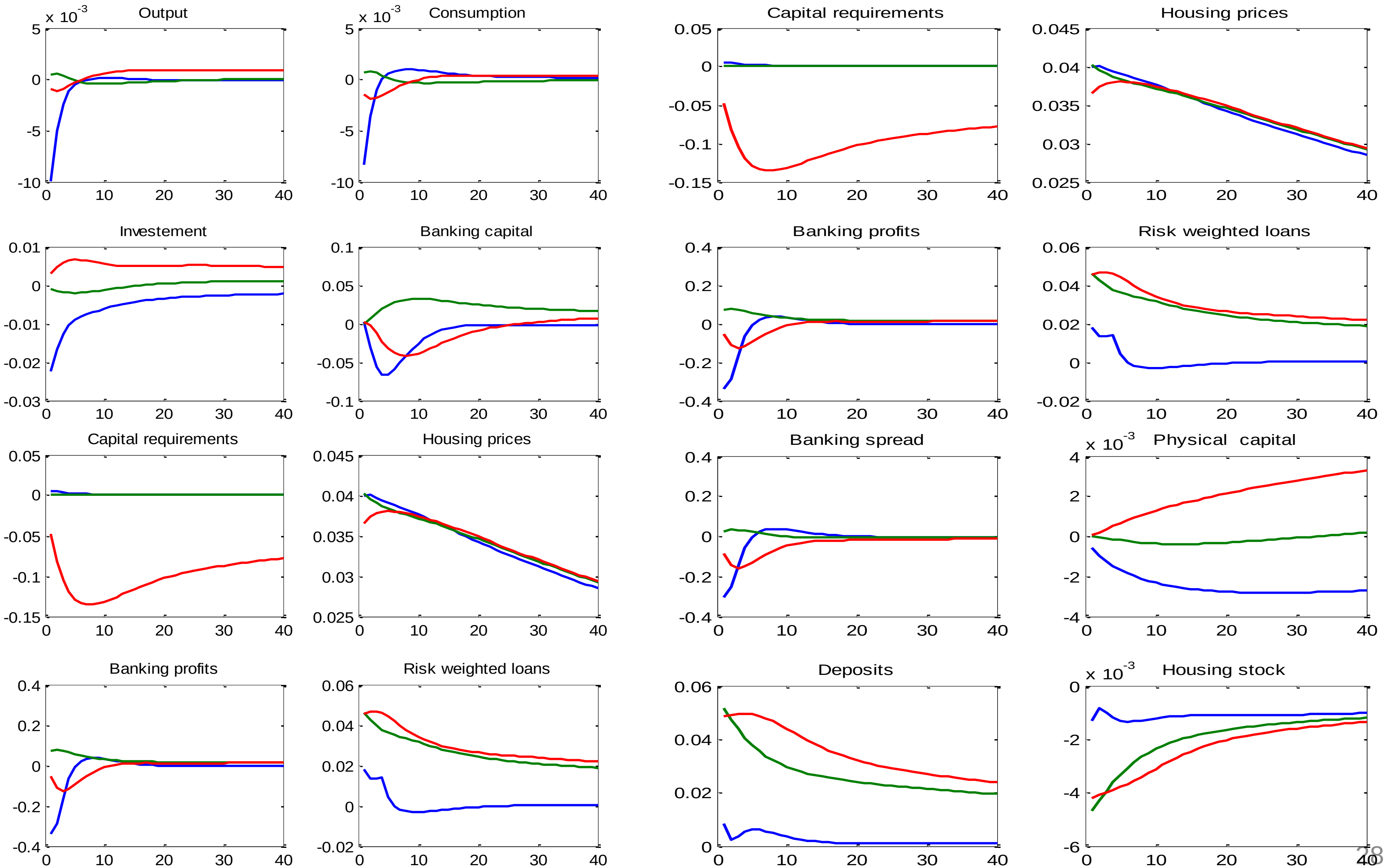
Table D

$k_\pi = 1, k_{y,CB} = k_{y,MP} = 0.5$ $k_I = k_v = 0.1, k_{L/Y} = 1$		Cooperation (a)	Non-cooperation (b)	Monetary policy only (c)
Monetary policy rule	ρ_I	0.932000	0.933100	0.933100
	χ_π	1.965000	1.800900	1.800900
	χ_y	0.924000	20.000000	1.212000
Macroprudential policy rule	ρ_v	0.750000	0.700000	0.000000
	χ_v	0.265000	-1.060000	0.000000
Joint loss		23.096151	6.631527 (-71.287307)	5.150335 (-77.700464)
Monetary policy loss		14.600246	0.312824 (-97.857407)	0.002080 (-99.985757)
Macroprudential loss		8.495906	6.318703 (-25.626491)	5.148255 (-39.403106)
Volatilities	σ_π	0.084400	0.257500 (205.094787)	0.228400 (170.616114)
	σ_y	0.236200	0.009400 (-96.020322)	0.004200 (-98.221846)
	$\sigma_{L/y}$	0.238800	0.250400 (4.857621)	0.226900 (-4.983250)
	$\sigma_{\Delta I}$	1.053500	0.174900 (-83.398196)	0.010700 (-98.984338)
	$\sigma_{\Delta v}$	0.024000	0.066800 (178.333333)	0

Impulse response functions in case of housing shock(CR).

Comparative analysis across cooperative, non-cooperative and "monetary-policy-only" cases

$$k_{\pi} = 1, k_{y,CB} = 0.5,\ k_{y,MP} = 0.5, k_{I} = k_{v} = 0.5, k_{L/Y} = 1$$



The interactions between monetary and macroprudential policies (CR), under labor market shock

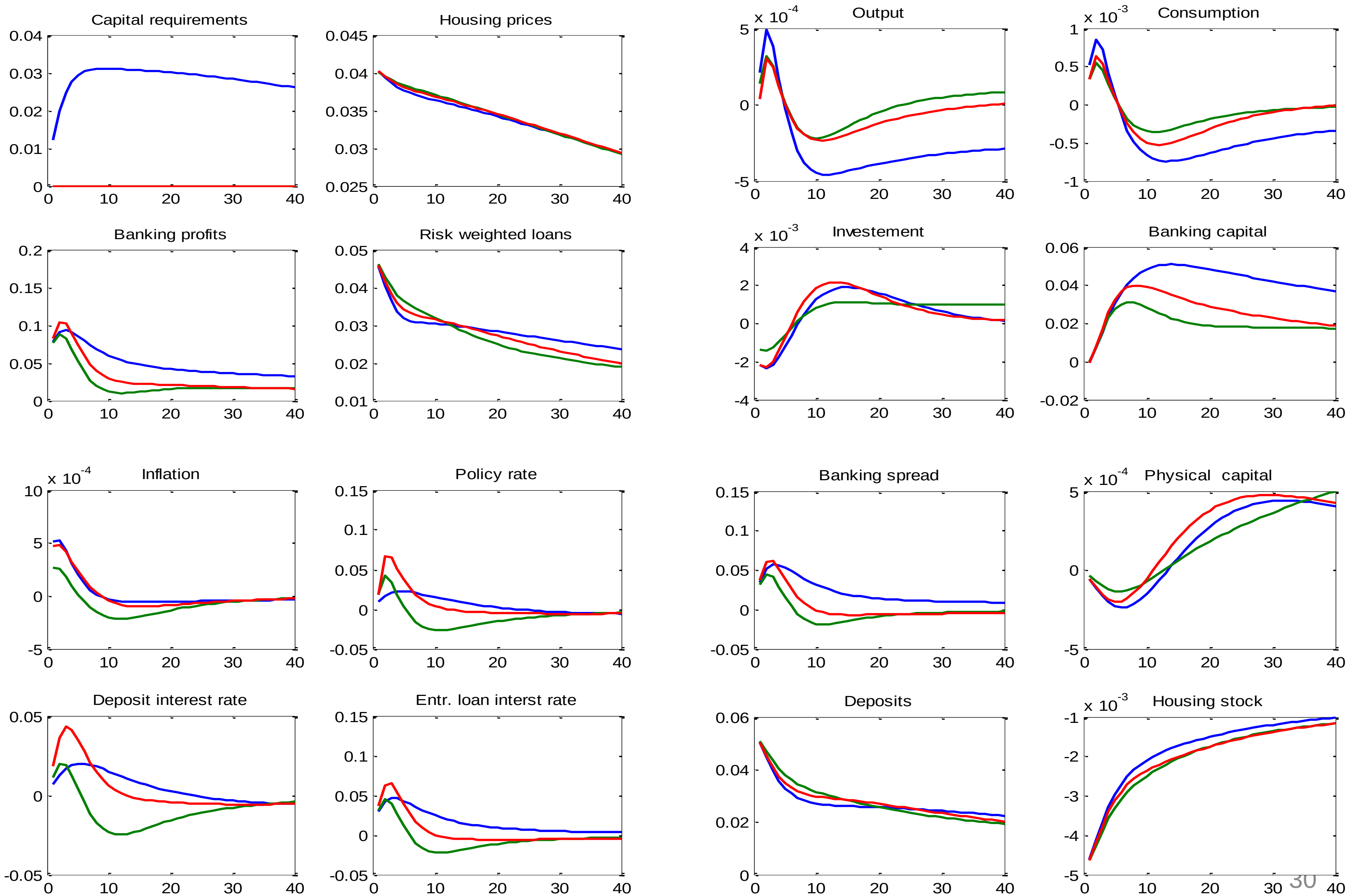
Legend: Red=the worst; **Purple**=middle; **Green**=the best result

Table E.

$k_\pi = 1, k_{y,CB} = k_{y,MP} = 0.5$ $k_I = k_v = 0.1, k_{L/Y} = 1$		Cooperation (a)	Non-cooperation (b)	Monetary policy only (c)
Monetary policy rule	ρ_I	0.999000	0.999000	0.999000
	χ_π	4.417000	4.021000	4.822000
	χ_y	139.248000	4.592000	7.272000
Macroprudential policy rule	ρ_v	0.997000	0.999000	0.000000
	χ_v	7.897000	13.885000	0.000000
Joint loss		**0.393272**	**0.135412 (-65.567796)**	**0.619004 (57.398238)**
Monetary policy loss		**0.020349**	**0.035156 (72.765907)**	**0.031869 (56.612321)**
Macroprudential loss		**0.081894**	**0.100256 (22.421254)**	**0.053864 (-34.227711)**
Volatilities	σ_π	**0.022600**	**0.008600 (-61.946903)**	**0.008800 (-61.061947)**
	σ_y	**0.022300**	**0.023500 (5.381166)**	**0.021800 (-2.242152)**
	$\sigma_{L/y}$	**0.014000**	**0.006000 (-57.142857)**	**0.017300 (23.571429)**
	$\sigma_{\Delta I}$	**0.137400**	**0.003500 (-97.452693)**	**0.005600 (-95.924309)**
	$\sigma_{\Delta v}$	**0.081000**	**0.111000 (37.037037)**	**0**

Impulse response functions in case of labor market shock.

Comparative analysis across cooperative,
non-cooperative and "monetary-policy-only" cases



Interaction between monetary and macroprudential policies under housing prices shocks (LTV-the key variable is housing prices)

Legend: Red=the worst; **Purple**=middle; **Green**=the best result

Table F.1

$k_\pi = 1, k_{y,CB} = k_{y,MP} = 0.5$ $k_I = k_m = 0.1, k_{L/Y} = 1$		Cooperation (a)	Non-cooperation (b)	Monetary policy only (c)
Monetary policy rule	ρ_I	0.932000	0.933100	0.933100
	χ_π	1.850090	3.800900	1.800900
	χ_y	13.24000	20.000000	16.212000
Macroprudential policy rule	ρ_m	0.924900 (0.936800)	0.924900 (0.936800)	0
	χ_m	-1.292000	-1.292000	0
Joint loss		**3494.435249**	**9868.811287 (182.415057)**	**5.274418 (-99.849062)**
Monetary policy loss		**204.003693**	**3543.862321 (1637.155961)**	**-99.991764 (-99.991764)**
Macroprudential loss		**3290.431556**	**6324.948965 (92.222475)**	**5.257616 (-99.840215)**
Volatilities	σ_π	**0.162500**	**0.077800 (-52.123077)**	**0.000900 (-99.446154)**
	σ_y	**0.636000**	**0.172500 (-72.877358)**	**0.001400 (-99.779874)**
	$\sigma_{L/y}$	**5.402300**	**4.460400 (-17.435167)**	**0.224800 (-95.838809)**
	$\sigma_{\Delta I}$	**4.256000**	**18.819600 (342.189850)**	**0.040800 (-99.041353)**
	$\sigma_{\Delta mi}$	**3.925900**	**3.185100 (-18.869559)**	**0**
	$\sigma_{\Delta me}$	**4.445300**	**3.664000 (-17.575867)**	**0**

Interaction between monetary and macroprudential policies under housing prices shocks (LTV-the key variable is output growth)

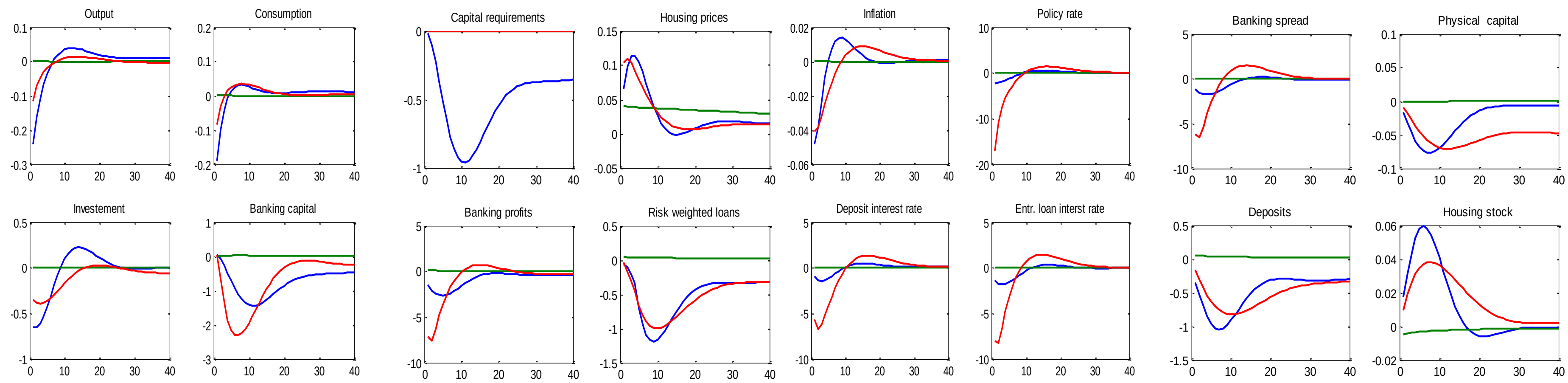
Legend: Red=the worst; **Purple**=middle; **Green**=the best result

Table F.2.

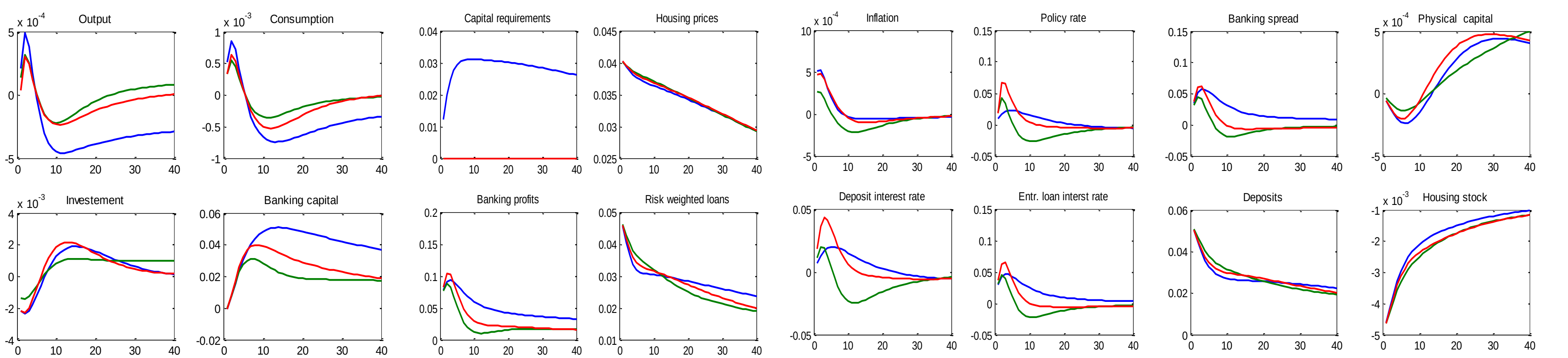
$k_\pi = 1, k_{y,CB} = k_{y,MP} = 0.5$ $k_I = k_v = 0.1, k_{L/Y} = 1$		Cooperation (a)	Non-cooperation (b)	Monetary policy only (c)
Monetary policy rule	ρ_I	0.932000	0.933100	0.933100
	χ_π	1.85 0090	3.800900	1.800900
	χ_y	13.240000	20.000000	16.212000
Macroprudential policy rule	ρ_m	0.924900	0.924900	0
	χ_m	-1.292000	-1.292000	0
Joint loss		**785.583637**	**5.213991 (-99.336291)**	**5.274418 (-99.328599)**
Monetary policy loss		**34.451261**	**5.180536 (-84.962710)**	**0.016802 (-99.951230)**
Macroprudential loss		**751.132376**	**5.180536 (-99.310303)**	**5.257616 (-99.300041)**
Volatilities	σ_π	**0.118800**	**0.001000 (-99.158249)**	**0.000900 (-99.242424)**
	σ_y	**0.168600**	**0.001100 (-99.347568)**	**0.001400 (-99.169632)**
	$\sigma_{L/y}$	**2.583800**	**0.221900 (-91.411874)**	**0.224800 (-91.299636)**
	$\sigma_{\Delta I}$	**1.778100**	**0.057700 (-96.754963)**	**0.040800 (-97.705416)**
	$\sigma_{\Delta mi}$	**1.884200**	**0.014700 (-99.219828)**	**0**
	$\sigma_{\Delta mi}$	**2.159100**	**0.017000 (-99.212635)**	**0**

Impulse response functions in case of housing demand shock (LTV)

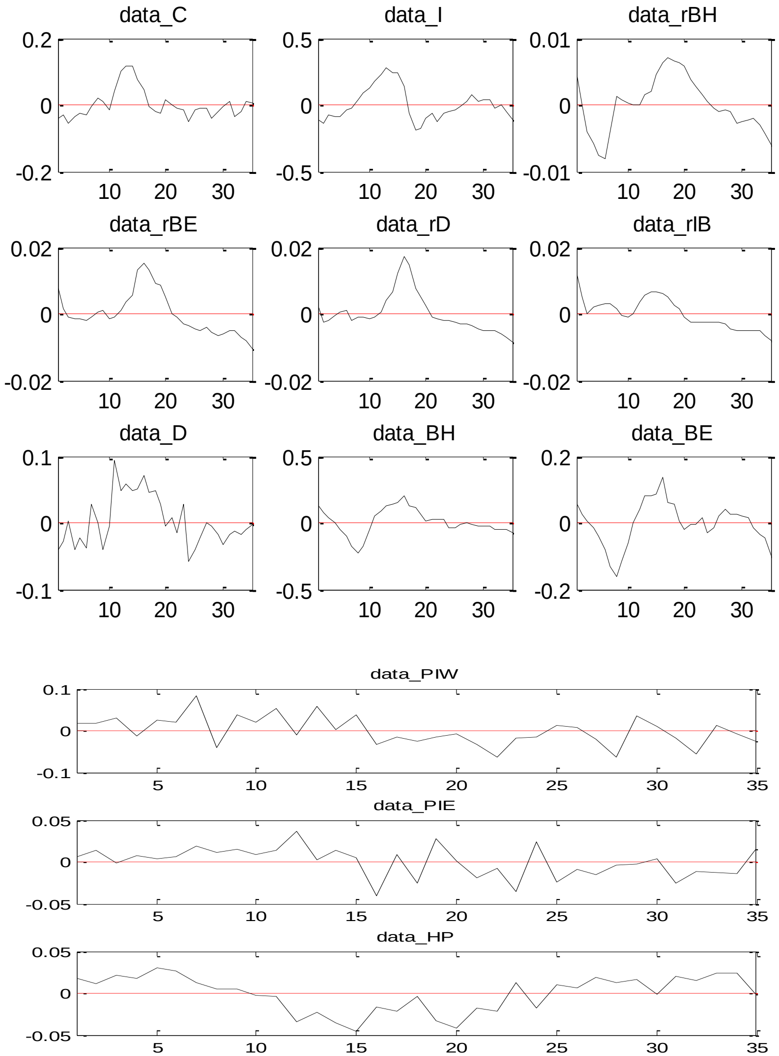
Case 1.Housing prices

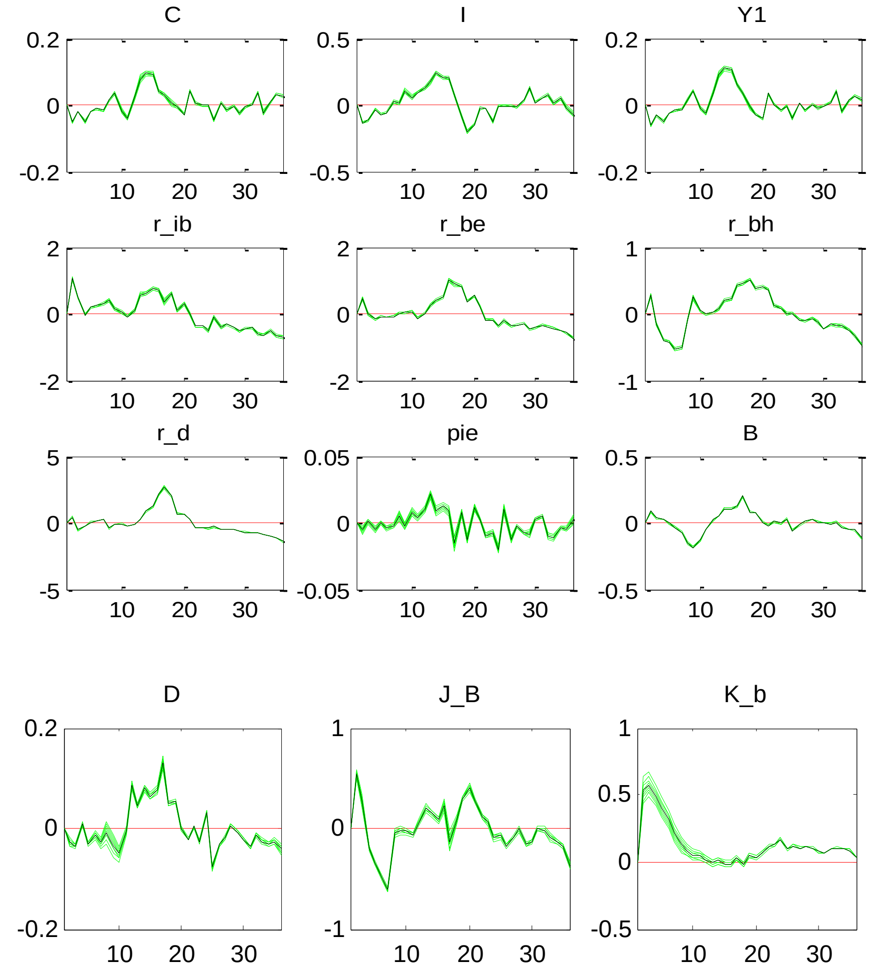


Case 2. Output growth



Historical data and forecast





Conclusions(I)

1. The financial and employment frictions added in the model improve the capacity in matching the standard deviations of data series, which are extremely volatile in the crisis period. The analysis of the transmission mechanism of shocks to the real economy, through the variance decomposition method, explains the innovations' contributions to business cycle fluctuations.

- All interest rates are conditioned by the stochastic elasticities in their CES setup and by the demand fluctuations;
- The consumption dynamic is affected mostly by the shocks in agents' consumption preferences, and also, by changes in total factors' productivity and in housing demand (so, the action of financial accelerator process is found in empirical analyze);
- The stochastic loan-to-value ratios and the changes in accumulation processes of housing and capital stocks have the bigger causality in the dynamics of both kinds of loans. The LTV's and loans' identical direction of movement tells us about the countercyclical effect of such tool's implementation (when the LTV are decreasing more and more the loans follow the same steeps).

2. The augmenting of interest rate tools is not sufficient for reducing social loss. In both parameterization versions the results weaken when we add an additional targeted variable (the overall losses are increasing), therefore a traditional Taylor Rule brings the best performances in terms of total deviations. if the authorities are interested in the stabilization of output and loans, the most "augmented" Taylor Rules give the smaller losses, and they can "lean again the wind", acting in a countercyclical manner, but the prices paid for this stabilization, is a loss in the price stability objective of decision maker. Thus, it is a conflicting situation, and the authority can act discretionary.

3. **The main results of the interactions between countercyclical macroprudential policy and monetary policy,** assuming the different cooperation behaviors for authorities and different setup for their tools, are heterogenous in situation of each kinds of shock.

- **A techological shock:** the cooperation between decision makers brings a smaller social loss and a smaller volatilities than in a non-cooperation case. The result is not surprising, since in a Stackelberg game, the Nash equilibrium is not achieved, thus, the results are suboptimal and a conflictual coordination problem is arising.
- **A financial shock:** both supervisors act countercyclicaly to reach their primary objectives. There isn't a conflict situation between policies, because, the tools act in the same direction, so a non-cooperative case gives a less joint loss compared to the cooperative scenario. Also, we understand what in a regime when the monetary policy act individually, the joint social loss is 5 times greater than in the cooperative case, thus, it is weakening the stabilization effect on the macro-economic variables
- **A shock in labor demand:** the gains from a separate macroprudential policy are greater in non-cooperative case than in other policies.

Conclusions(II)

- **A housing demand shock** can be managed by an “only monetary policy” regime. The joint loss is smaller by 70% than in the cooperative case, instead, the opportunity cost paid for this result is an increase in the volatility of inflation (this is 1.7 times greater than in the cooperative case). This is an important lack, since the rising of assets price triggers an accelerator effect in the economy. Thus, the welfare gains of collateral’s owners relax borrowing constraints and, therefore, can generate a credit boom.

- **LTV (housing prices) vs. LTV(output growth):**when macroprudential authority is assuming a LTV rule, the benefits of their policy are negligible in comparison with the “monetary policy-only” scenario, taking in consideration, consecutively the housing prices and output growth as key variables for stability safeguarding. Also, by comparing the effectiveness of the LTV in opposition to capital requirements, the macroprudential authority reaches the best performances in the second setup of their policy tools.
- **Comparative results with the other papers.** The above conclusions of the simulation exercises is almost appropriate with exercised performed by Angelini et al. 2012. Their outcomes can be formulated as follows: the macroprudential policy has little to contribute in normal times (when the economy is driven by supply shocks) but much to contribute in facing sector-specific shocks to the financial sector or the housing market.
- In these cases, enhancing the policymakers’ arsenal with an instrument specifically targeted to the relevant sector generates substantial macroeconomic improvement. In addition to offering an explanation for this institutional evolution, the analysis suggests that macroprudential policy should not be treated as a substitute for monetary policy, nor an all-purpose tool for stabilization, but as a useful complement to the traditional macroeconomic policies for coping with financial or sector-specific shocks.

- **Improvements.**A possible directions for the future developments of this DSGE model can be the next: the introduction of external sector (responding at many globalization problems for the countries with a high degree of openness); the modeling of liquidity requirements as in Vlceck and Roger (2011) or the enhancing of policies setups for their tools.

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Thank you!