

Traditional and matter-of-fact financial frictions in a DSGE model for Brazil: the role of macroprudential instruments and monetary policy

WORK IN PROGRESS – PRELIMINARY RESULTS

Fabia Carvalho

Research
Department

Marcos Castro

Research
Department

Silvio Costa

Research
Department

The views expressed in this work do not necessarily represent those of the Central Bank of Brazil or its members

Purpose

- Investigate and assess the full-blown effects of macroprudential policies on the Brazilian economy
 - Reserve requirements
 - Capital requirement
 - Sectoral risk weights on banks' assets for capital adequacy computation
 - Basle III



Methodology

- Dynamic stochastic general equilibrium model (DSGE) with a relevant role of the banking system
- Theoretical improvements to existing DSGE models to better represent the Brazilian banking system
- Current version is a closed economy model
- Bayesian estimation with Brazilian data



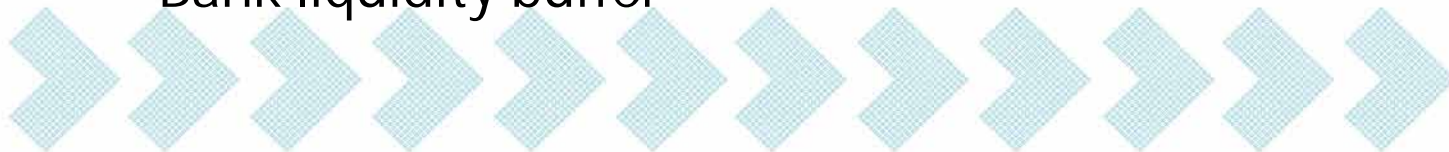
Motivation

- Brazil: active use of RR as a policy instrument
 - Existing studies based on partial-equilibrium analysis
- Brazilian agenda of convergence to the Basle-3
- Mainstream literature focuses on advanced economies
 - Full collateralization of loans through capital or housing
 - Monopolistic competition in time deposits
 - Unremunerated reserve requirements



Our main contributions

- Risky retail loan concessions based on expected labor income, not on physical collateral
 - Stylized facts:
 - 50% of retail loans are uncollateralized through physical assets
 - Another 1/3 is extended for vehicle purchases, which might or might not be collateralized
- Time-varying Loan-to-Value ratios
 - Stylized fact:
 - Income commitment with debt is trending upwards
- Ample and realistic set of reserve requirements
 - Time deposits, demand deposits, savings accounts, additional requirements, non-compliance with mandatory housing loans
- Bank liquidity buffer



Further adjustments

- Tight regulation on savings accounts and housing loans
- Return on time deposits is exogenous to the bank
- Target for the liquidity buffer
- Targets and adjustment costs for time deposits
- Endogenous lending spread
 - Markup + default + adm costs + tax + regulatory costs



The theoretical model

Households

- Savers
- Borrowers

Entrepreneurs (as in BGG)

Firms

- Intermediate goods
- Retailers/Distributers
- Final goods: private consumption, government consumption, investment, capital and housing

Government (monetary, fiscal and macroprudential policies)

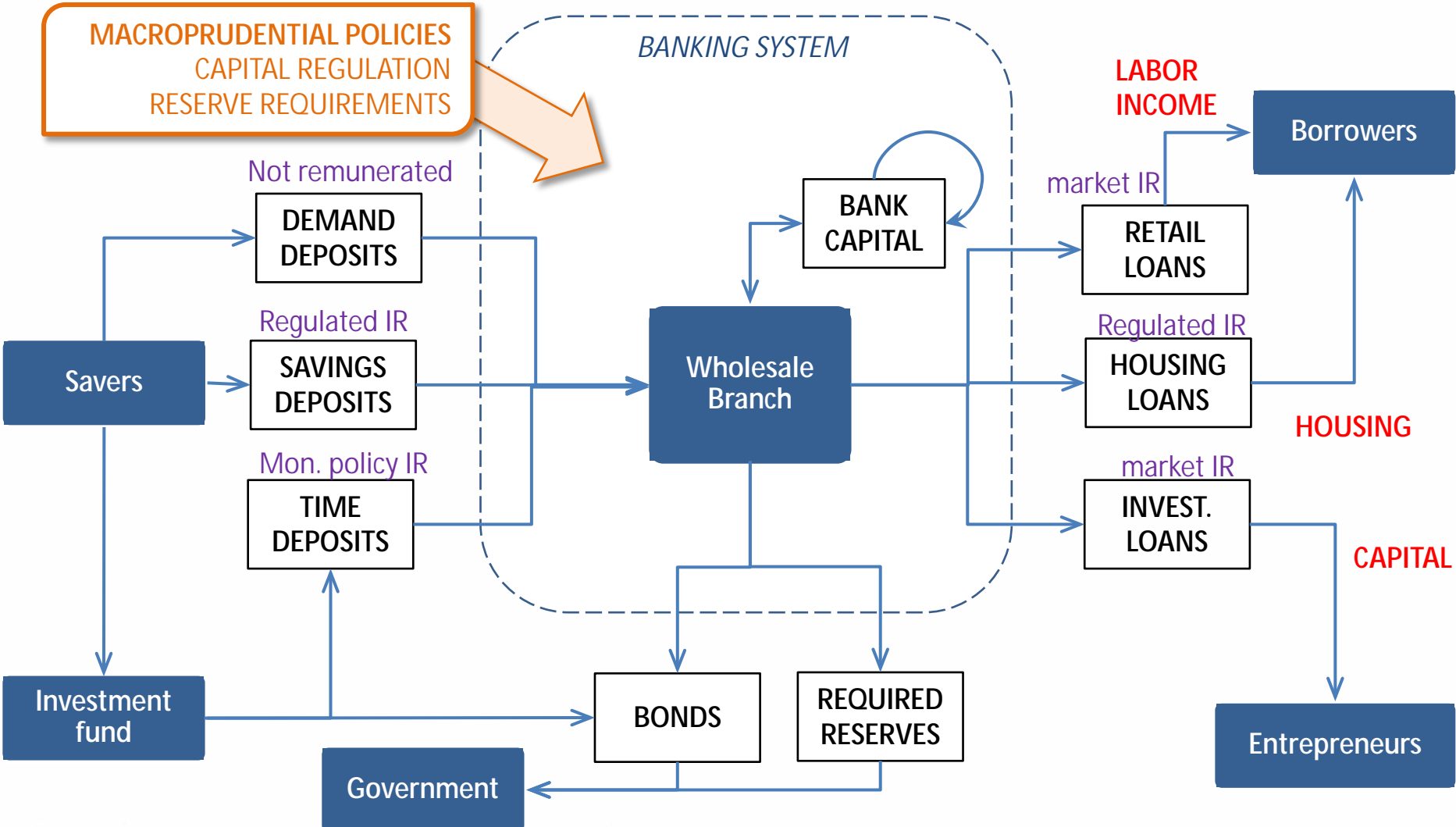
Investment fund

Bank conglomerate

- Treasury department
- Deposit branches (time deposits, savings accounts, demand deposits)
- Lending branches (retail loans, investment loans, housing loans)

Financial flows

Selected economic segments



Specific Model Features

- Remunerated reserve requirements
- Capital requirement and bank funding cost
- Regulated savings deposits and housing loans
- Debt constraints of household loans



Reserve Requirements and the Bank Balance Sheet

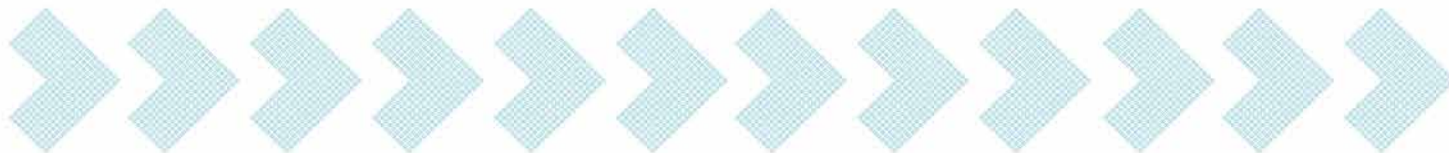
Standard model specification for reserve requirements:

- RR as a fraction of deposits;
- Unremunerated reserve requirements;

Unremunerated RR poses costs to the banking system, as they must be funded by costly deposits.

In Brazil, no mismatch between RR and time deposits remuneration.

In this situation, the standard model for RR becomes inoperative: banks may comply costlessly with any increase in RR by issuing more time deposits.



Reserve Requirements and the Bank Balance Sheet (ctd.)

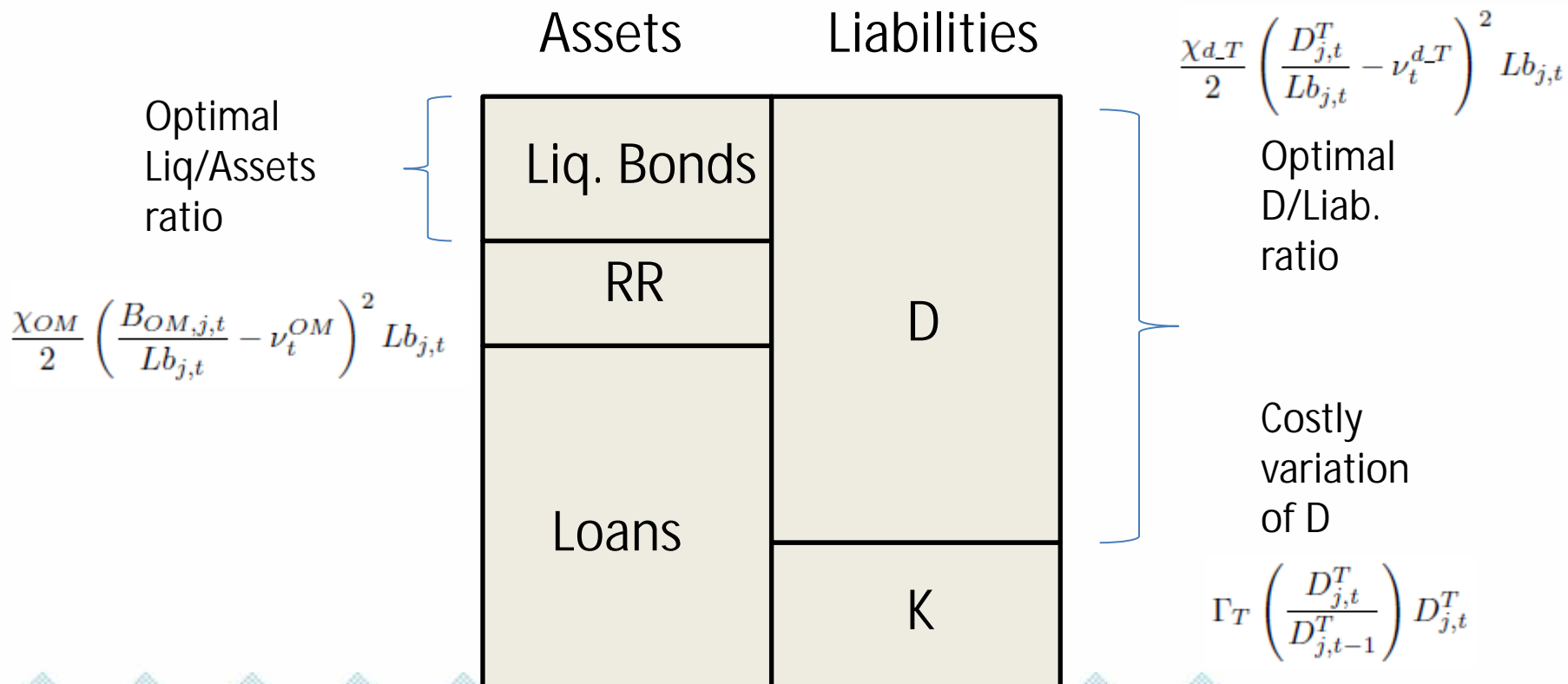
A different modeling approach was developed, taking into account the following evidence:

- Brazilian banks continuously try to avoid any exposition to RR, suggesting that even remunerated RR are costly;
- Banks acquire liquid assets that yield roughly the same interest rate as those paid on time deposits.



Reserve Requirements and the Bank Balance Sheet (ctd.)

Bank Balance Sheet (simplified):



Capital Requirement and Bank Funding Cost

A common modeling approach to relate bank capital to bank funding costs and lending rates is Gertler & Karadi (2011):

- higher bank leverage implies in higher interest rates on bank deposits. These higher funding costs are passed through to lending rates.
- This rationale derives from a moral hazard problem between banks and depositors.

This might hold true for small banks which depend mostly on wholesale deposits funding.

Not so evident for large banks, which are responsible for the bulk of the credit supply and can count on diversified and stable sources of funding.

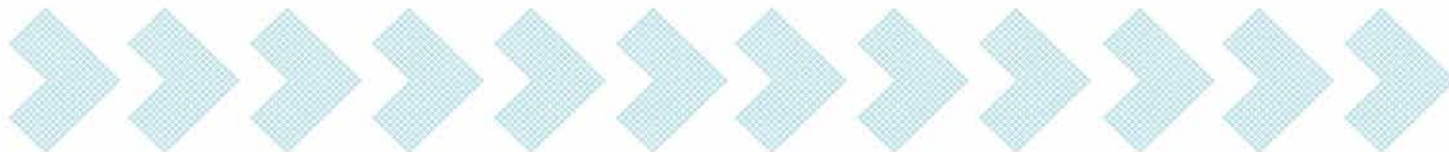


Capital Requirement and Bank Funding Cost (ctd.)

Instead, we chose to relate bank capital to a internal funding cost associated to bank leverage. The higher the bank capital excess over prudential requirement, the lower this internal funding cost.

A rationale for this can be found in Van den Heuvel (2007):

- if bank capital falls below regulatory minimum, the regulator prevents banks from distributing dividends or making new loans.
- in order to avoid that, banks accumulate capital in excess over regulatory minimum. When this buffer is small, banks are less willing to provide new loans, lest an adverse shock might reduce its capital below that minimum.



Capital Requirement and Bank Funding Cost (ctd.)

This behavior can be represented in reduced form as an internal cost of capital:

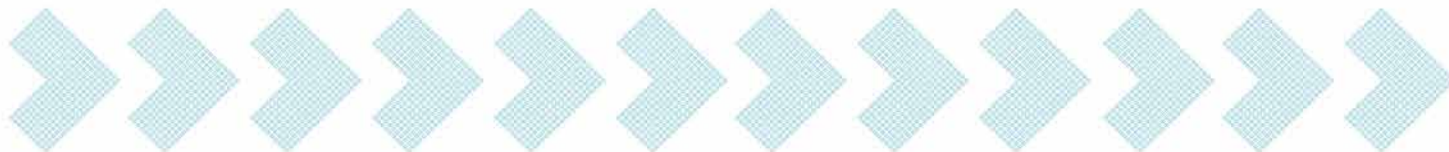
$$\Gamma_{bankK} \left(\frac{BI_t}{\gamma_{bankK}} \right) Bankcap_t$$

where

$$BI_t = \frac{BankCap_t}{\sum \tau_k B_{k,t}}$$

$$\Gamma'_{bankK} \left(\frac{BI_t}{\gamma_{bankK}} \right) < 0, \Gamma''_{bankK} \left(\frac{BI_t}{\gamma_{bankK}} \right) > 0$$

$$\frac{BI}{\gamma_{bankK}} > 1 \quad \text{in steady state}$$



The bank's program (simplified)

$$\max E_0 \left\{ \sum_{t \geq 0} \beta_{Bank}^t \left[\frac{1}{1 - \sigma_B} \left(\frac{C_{B,j,t}}{\epsilon_t} \right)^{1 - \sigma_B} \right] \epsilon_t^{\beta, B} \right\}$$

Balance sheet: $L_{j,t} + Bonds_{j,t} + RR_{j,t} = D_{j,t} + Bankcap_{j,t}$

Capital Accumulation: $Bankcap_{j,t} = Bankcap_{j,t-1} + FC_{j,t}^b - P_{C,t} C_{B,j,t} + Bankcap_{j,t} \epsilon_t^{bankcap}$

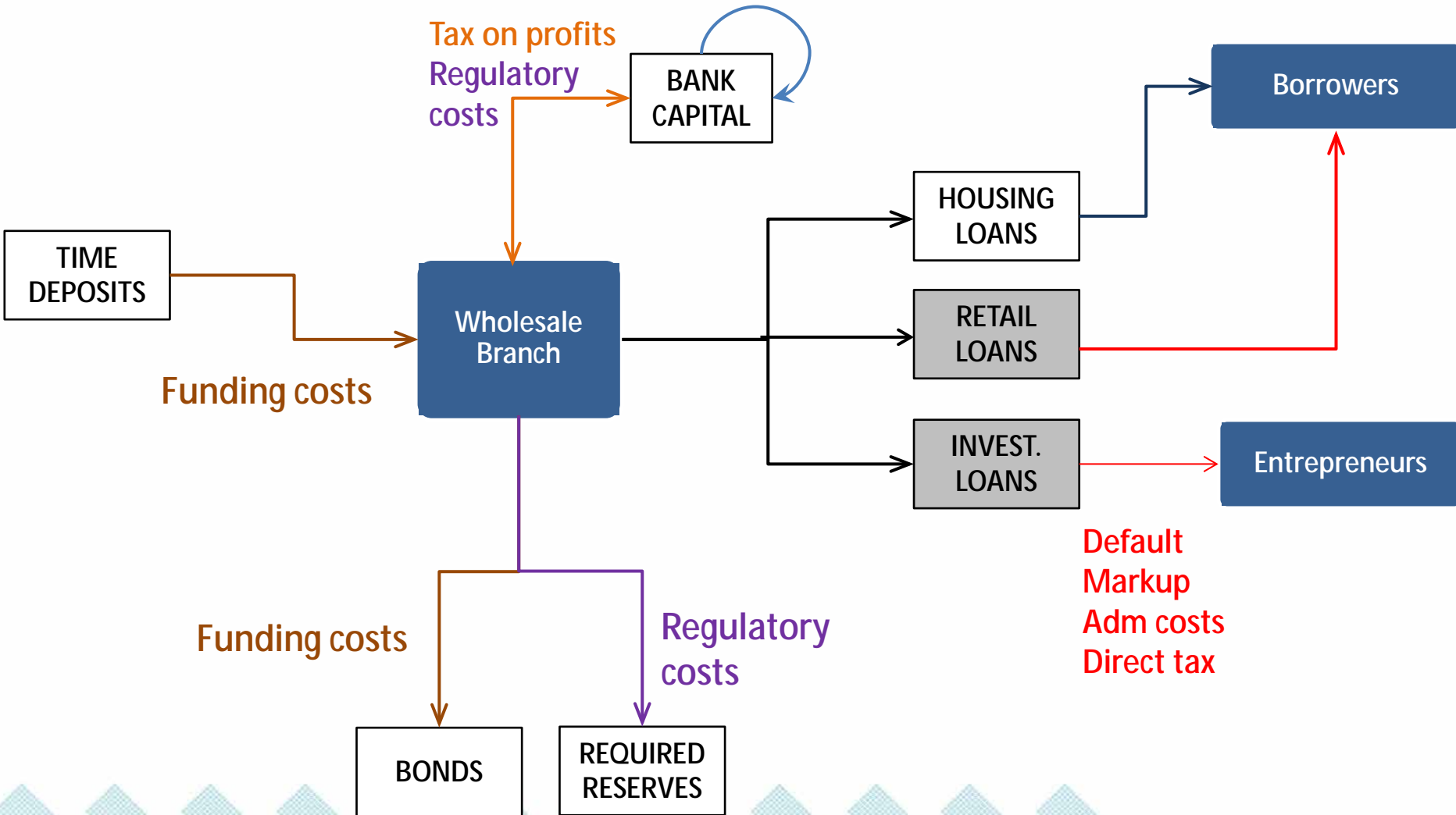
Reserve Requirement: $RR_{j,t} = \tau_{RR,T,t} D_{j,t}$

Loan Demand (plus Calvo rigidity in interest rates): $L_{j,t} = \left(\frac{R_{j,t}^L}{R_t^L} \right)^{-\frac{\mu_L^R}{\mu_L^R - 1}} L_t$

Cash flow:
$$\begin{aligned} FC_{j,t}^b = & R_{j,t-1}^L L_{j,t-1} - L_{j,t} \\ & + R_{RR,t-1} RR_{j,t-1} - RR_{j,t} + R_{t-1} Bonds_{j,t-1} - Bonds_{j,t} \\ & - R_{t-1}^T D_{j,t-1} + D_{j,t} - \Gamma_T \left(\frac{D_{j,t}}{D_{j,t-1}} \right) D_{j,t} \\ & - \Gamma_{bankK} \left(\frac{BI_{j,t}}{\gamma_t^{BankK}} \right) Bankcap_{j,t} \\ & - \frac{\chi_{OM}}{2} \left(\frac{Bonds_{j,t}}{D_{j,t} + Bankcap_{j,t}} - \nu_t^{OM} \right)^2 (D_{j,t} + Bankcap_{j,t}) \\ & - \frac{\chi_{d,T}}{2} \left(\frac{D_{j,t}}{D_{j,t} + Bankcap_{j,t}} - \nu_t^{d,T} \right)^2 (D_{j,t} + Bankcap_{j,t}) \\ & + \Pi_{j,t}^L + \Xi_{j,t}^b \end{aligned}$$

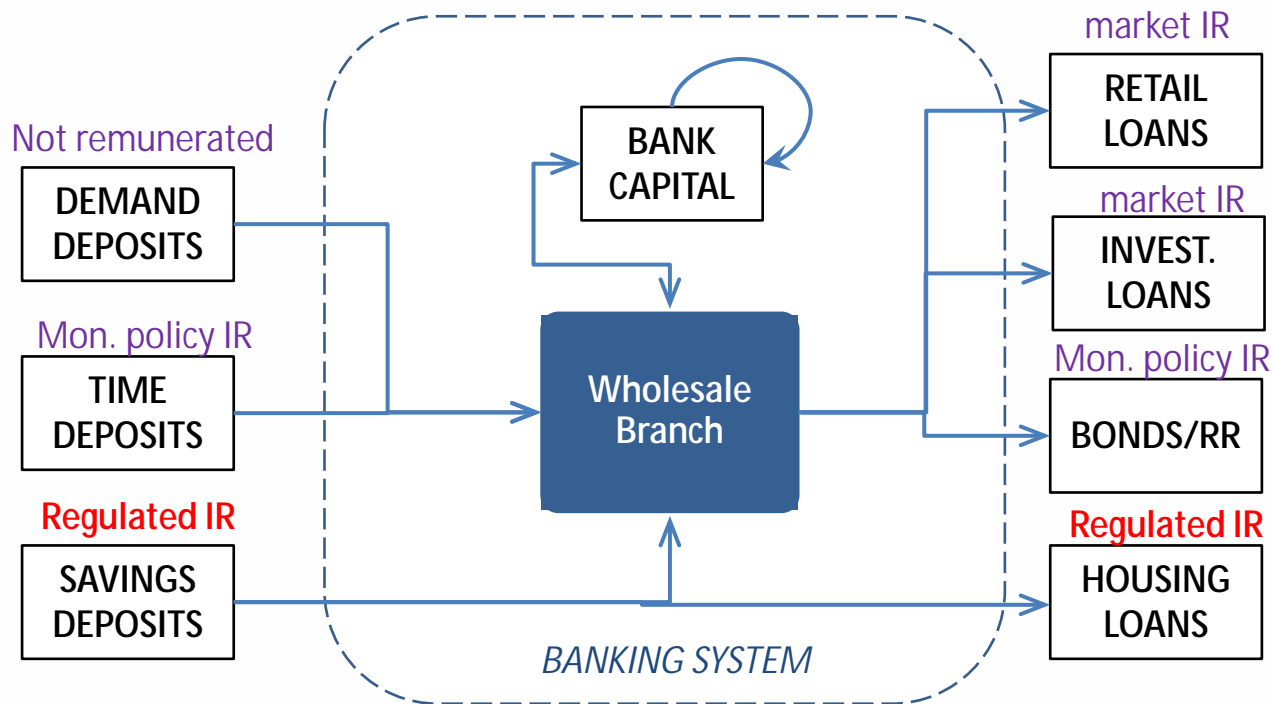
Lending spread components

BANKING SYSTEM



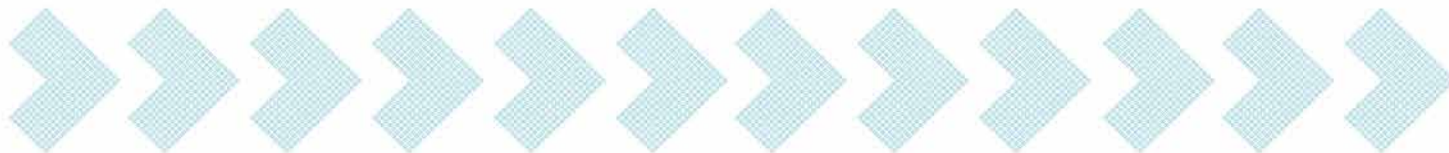
Regulated Savings Deposits and Housing Loans

- Savings deposits have government regulated remuneration lower than the base rate.
- 60% of these funds are earmarked to finance housing loans.
- Housing lending rates are also government regulated.
- Most of housing loan intermediation is performed by state-owned banks



Regulated Savings Deposits and Housing Loans (ctd.)

- Optimizing banks have no control over interest rates on savings deposits or demand deposits, and take supply as given.
 - Savings and demand deposits supply depend on household preferences.
 - Optimizing banks have no control over interest rates on housing loans, and take demand as given. However, housing loans take part on risk-weighted assets and affect banks' capital requirements.
 - Demand for housing loans depends on household preferences and housing collateral value.
- ⇒ Housing stock is of little use as collateral for non-earmarked loans.

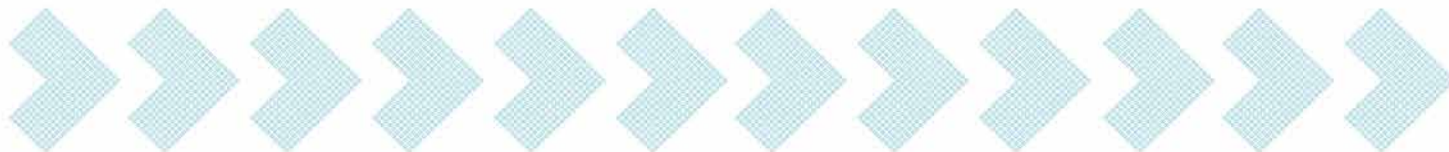


Retail Loans

Household borrowing is constrained by expected labor income.

Modeling strategy: a variant of BGG in which lending branches may seize a fraction of household labor income as collateral in case of default.

- Allows for consumption smoothing (as opposed to strict debt to income constraints).
- Allows for credit default.



Borrower's Program

$$\max E_0 \left\{ \sum_{t \geq 0} \beta^t \left[\frac{1}{1 - \sigma_X} (\mathcal{X}_{B,t})^{1 - \sigma_X} - \frac{\varepsilon_t^L \bar{L}_B}{1 + \sigma_L} (N_{B,t})^{1 + \sigma_L} + \frac{\psi_{D,B}}{1 - \sigma_D} \varepsilon_t^{D,B} \left(\frac{D_{B,t}^D}{P_{C,t} C_{B,t}} \right)^{1 - \sigma_D} \right] \varepsilon_t^\beta \right\}$$

$$\mathcal{X}_{B,t} = \left[(1 - \varepsilon_t^H \omega_{H,B})^{\frac{1}{\eta_H}} (C_{B,t} - \bar{h}_B C_{B,t-1})^{\frac{\eta_H - 1}{\eta_H}} + (\varepsilon_t^H \omega_{H,B})^{\frac{1}{\eta_H}} (H_{B,t})^{\frac{\eta_H - 1}{\eta_H}} \right]^{\frac{\eta_H}{\eta_H - 1}}$$

$$(1 + \tau_{C,t}) P_{C,t} C_{B,t} + P_{H,t} (H_{B,t} - (1 - \delta_H) H_{B,t-1}) + \gamma_t^{B,C} (1 - \tau_{\omega,t}) N_{B,t} W_t^N H(\bar{\omega}_{B,t}, 0) + D_{B,t}^D \\ \leq B_{B,t}^C + B_{B,t}^H + D_{B,t-1}^D + (1 - \tau_{\omega,t}) (W_t^N N_{B,t}) + TT_{B,t} + \Pi_{B,t}^{LU}$$

$$\gamma_t^{B,C} E_t (1 - \tau_{\omega,t+1}) N_{B,t+1} W_{t+1}^N G_{B,C}(\bar{\omega}_{B,t+1}, \bar{\omega}_{B,t+1}^H) = R_{B,t}^C B_{B,t}^C$$

$$\gamma_t^{B,C} \bar{\omega}_{B,t}^H (1 - \tau_{\omega,t}) N_{B,t} W_t^N = R_{B,t-1}^{L,H} B_{B,t-1}^H$$

$$B_{B,t}^H \leq \gamma_t^{B,H} P_{H,t} H_t^B$$

$$\gamma_t^{B,C} (\bar{\omega}_{B,t} - \bar{\omega}_{B,t}^H) (1 - \tau_{\omega,t}) N_{B,t} W_t = R_{B,t-1}^{L,C} B_{B,t-1}^C$$

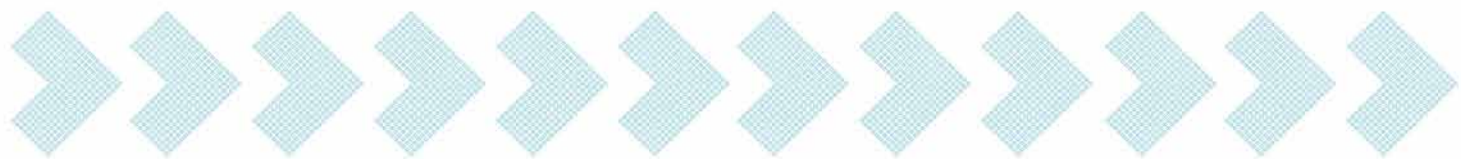
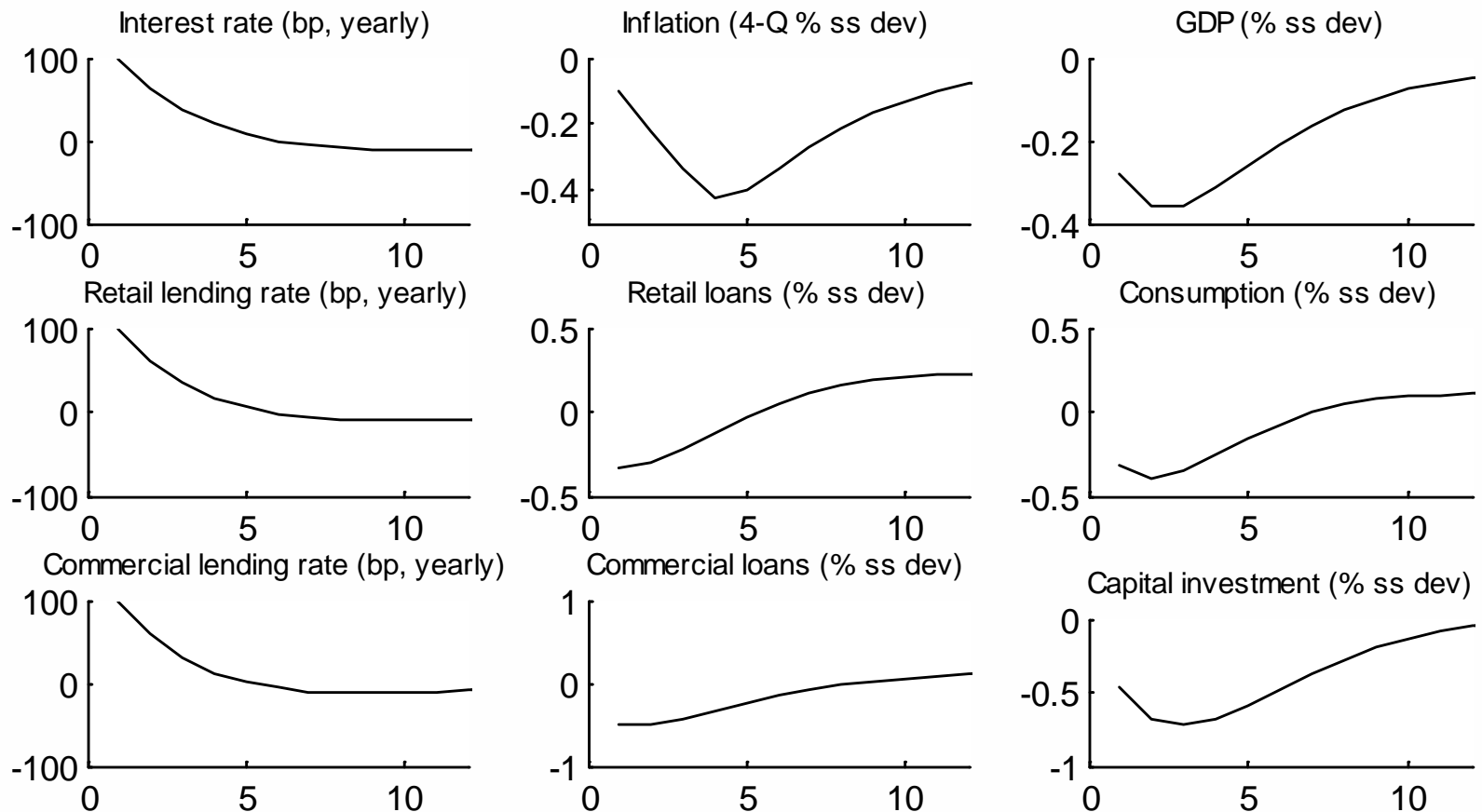


Rest of the model

- Savers, intermediate goods producers, retailers and labor union as usual in the literature.
- Traditional monetary and fiscal rules.
- Macroprudential instruments initially represented as persistent AR(1) shocks.
- Entrepreneur as in BGG. Slight modification: fraction of capital available as collateral is variant over time. This helps to accommodate trends in total amount of loans to firms.

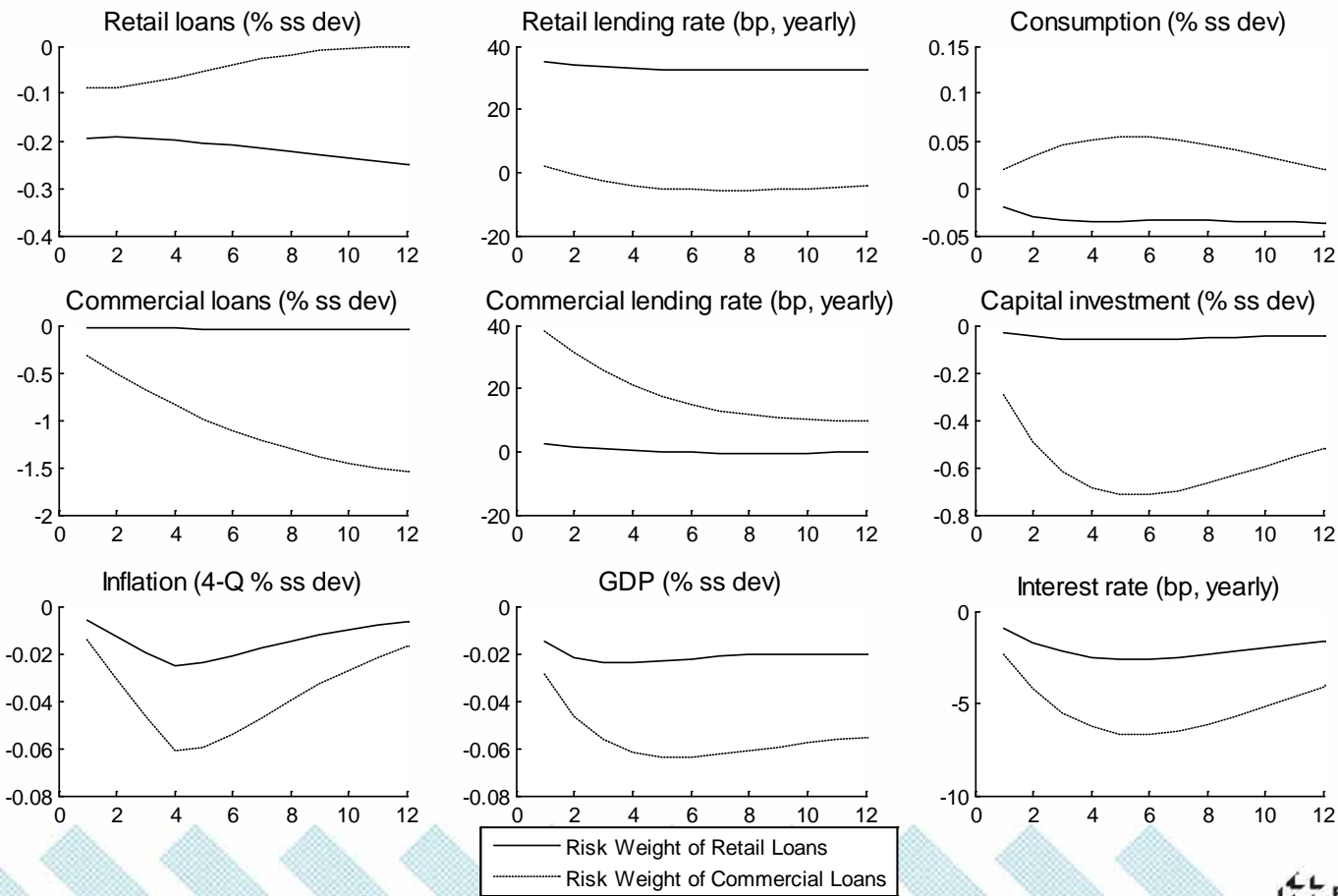


IRFs of a 1p.p. Monetary Policy Shock

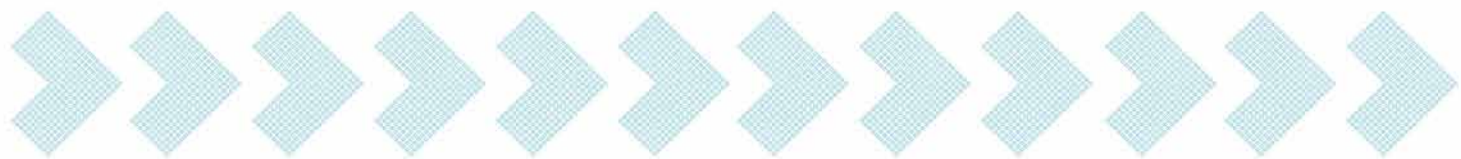
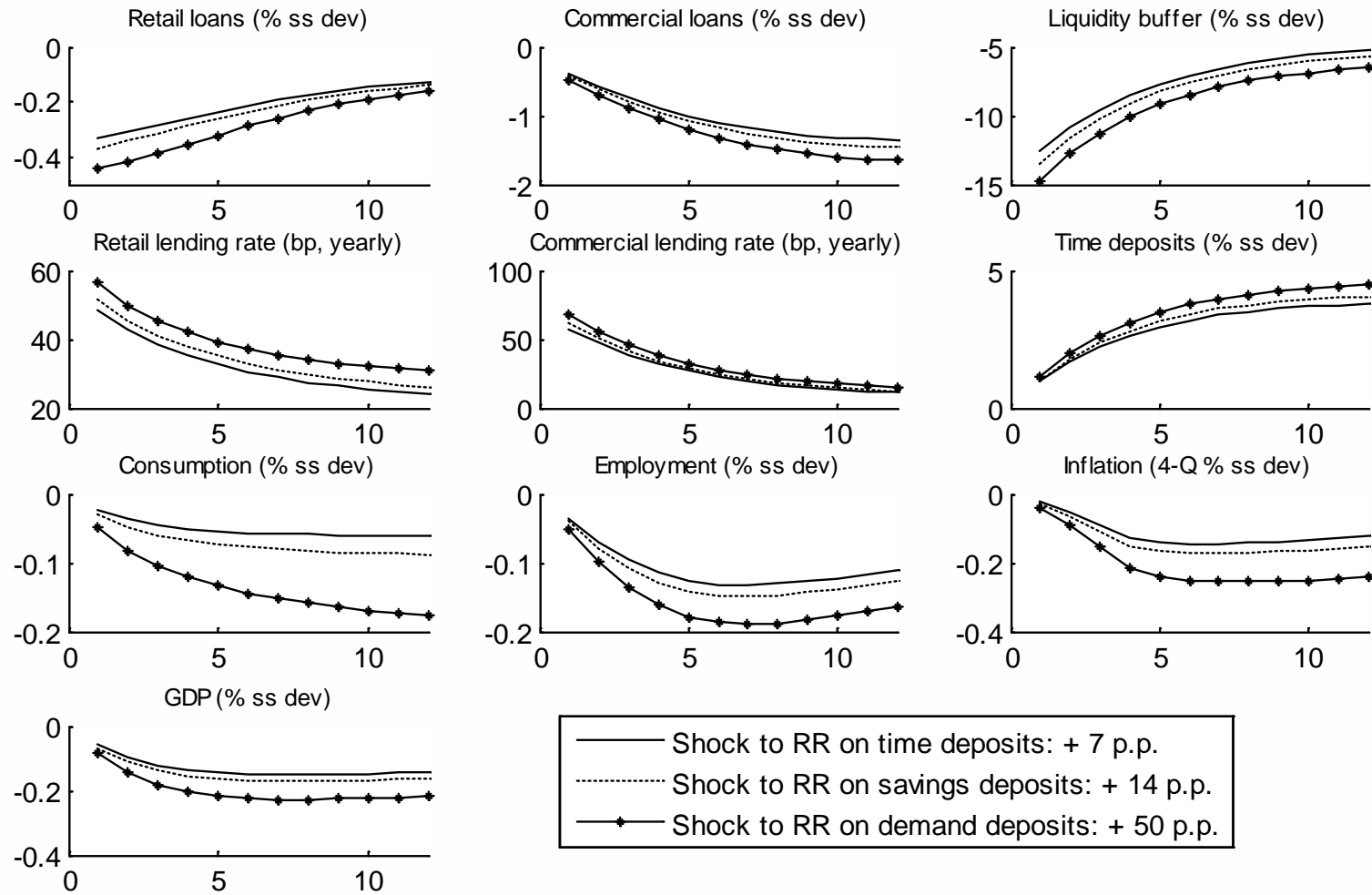


IRFs of a 10 p.p. shock to Loan Risk Weights

- Shocks in risk weights spill over to the other credit segments



Reserve Requirement: scaling the size of the shocks (*nonresponsive MP*)

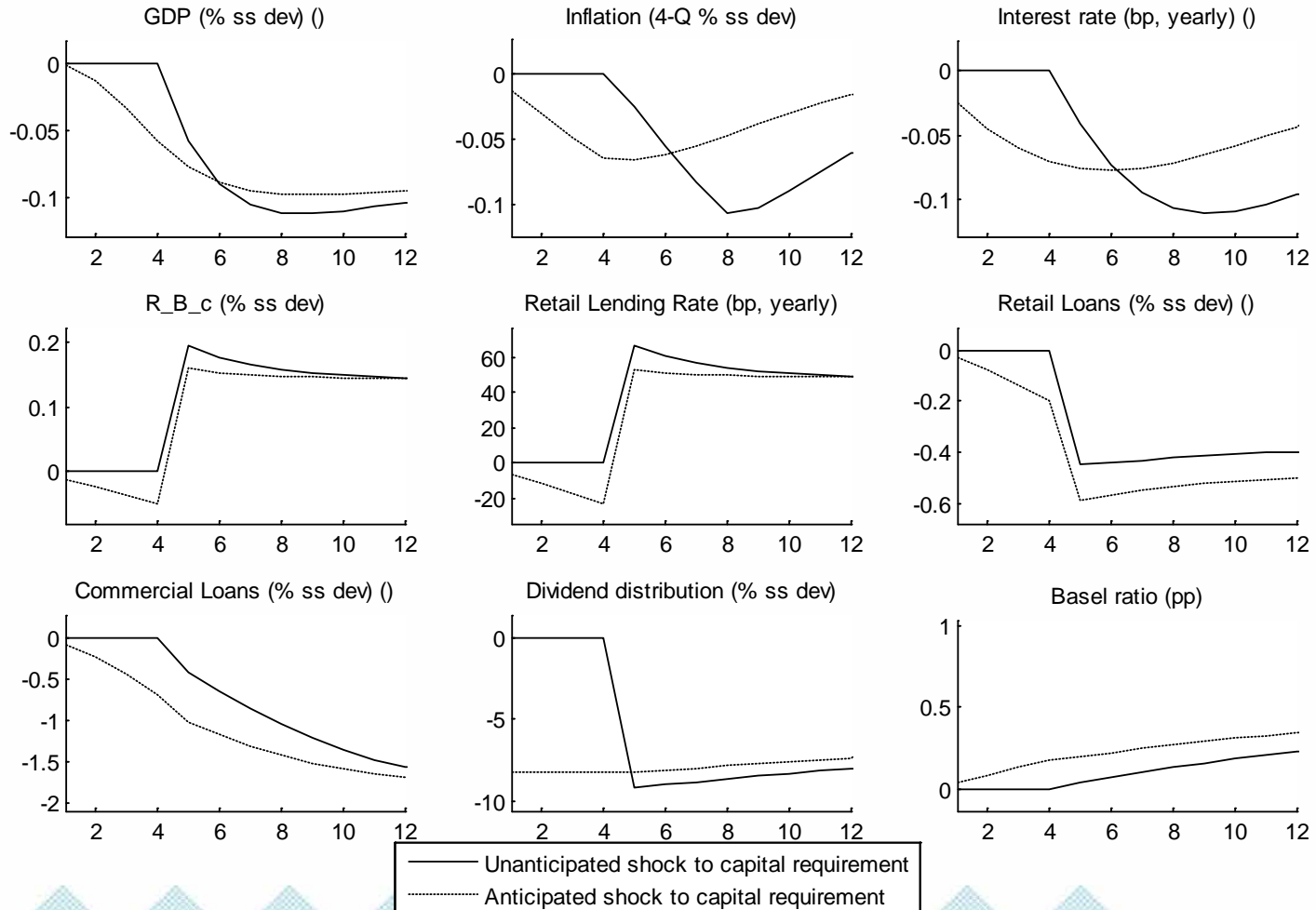


Values calibrated from historical averages

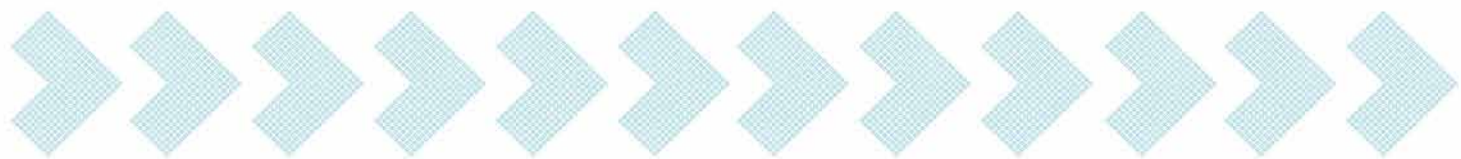
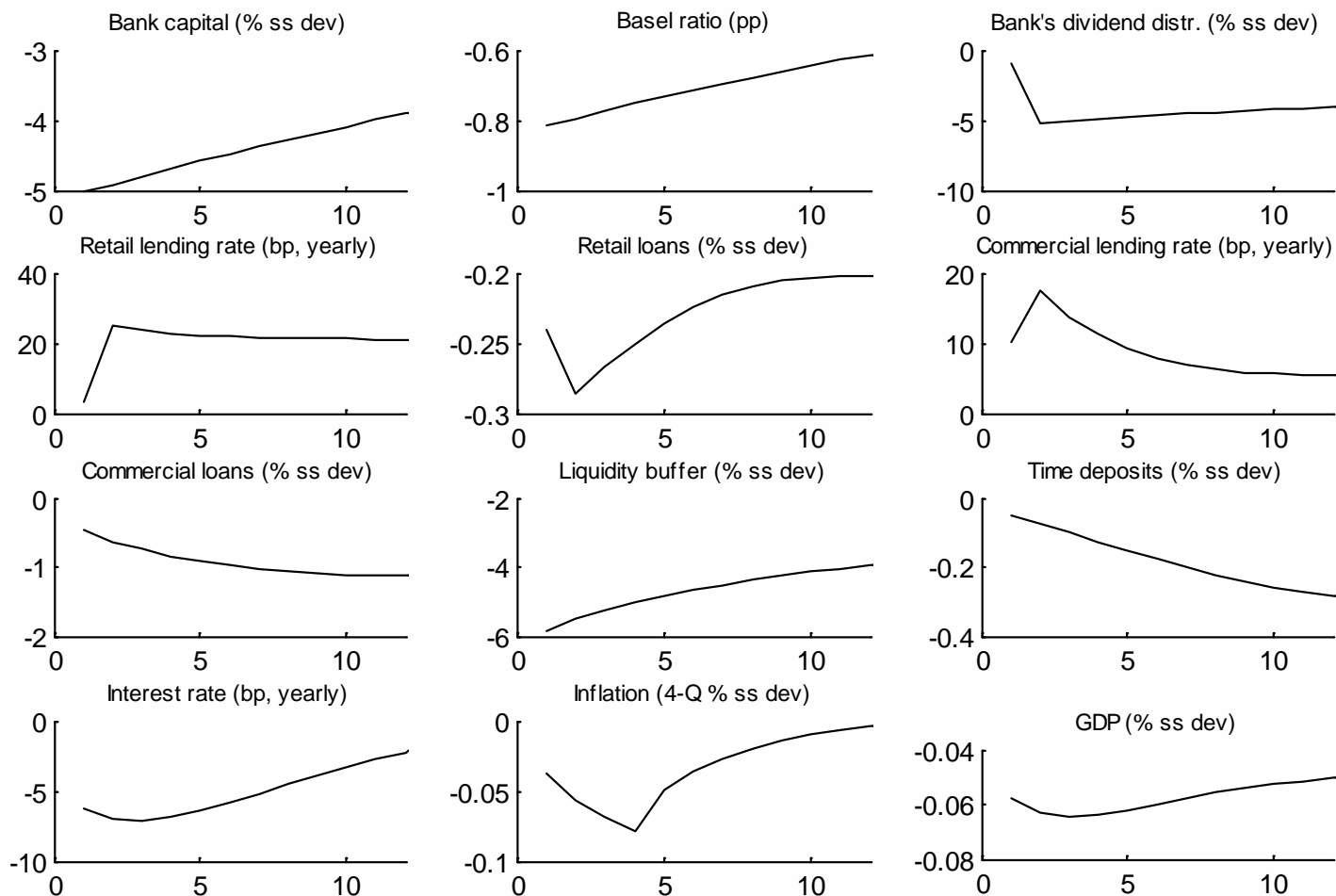
	Demand Deposits	Time Deposits	Savings Accounts
Balances (% of GDP)	3%	21.5%	10%
RR ratio	49%	11.2%	11.7%



IRFs to a 1p.p. Capital Requirement Shock



IRFs to a 5% Loss of Bank Capital



Concluding remarks

- Model with financial frictions both on the demand and the supply side of the banking sector
 - Theoretical set-up tailored to Brazil
 - Transmission mechanism of macroprudential policy
 - Endogenous lending spread: matter-of-fact decomposition
- Changes in reserve requirement ratios
 - Impact banks' liquidity buffer, affecting lending rates and credit
 - Affect the real economy
 - Impact of remunerated RR (base-effect)

Concluding remarks

- Changes in capital requirement have a smaller yet more prolonged effect on credit-to-GDP with milder impact on output compared to MP shock
- Shocks on sectoral risk weight on CAR induce banks to reshuffle their credit portfolio towards less risky loans.
- Next steps:
 - Open economy
 - Phase-in implementation of Basle 3
 - Bank heterogeneity (public vs. private, small vs. big)



Thank you!

fabia.carvalho@bcb.gov.br

marcos.castro@bcb.gov.br

silvio.costa@bcb.gov.br



Traditional and matter-of-fact financial frictions in a DSGE model for Brazil: the role of macroprudential instruments and monetary policy

WORK IN PROGRESS – PRELIMINARY RESULTS

Fabia Carvalho

Research
Department

Marcos Castro

Research
Department

Silvio Costa

Research
Department

