
10 Anos do Projeto de Juros e Spread Bancário
Seminário sobre Riscos, Estabilidade Financeira e Economia Bancária do Banco Central do Brasil

LIQUIDITY SHOCK AND CREDIT RISK: A DYNAMIC STOCHASTIC GENERAL EQUILIBRIUN APPROACH

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Motivation - Economic Facts

The financial crises that occurred during '90s highlighted the following facts:

1. healthy financial institutions (solvents) had broken after being hit by crisis;
2. national economies with satisfactory macroeconomic fundamentals went into recession because of liquidity crisis originated in the financial system.

Motivation - Investigation

1. How does debtors react when the supply of credit is mitigated caused by a liquidity shock?
2. Is there a cyclical pattern to default rate?
3. Can an economic crisis be solved without a government intervention?
4. The adoption of financial stabilization policy would be able to mitigate the effects of financial crisis?
5. More precisely, can liquidity crisis be prevented?

Literature Review

1. GOODHART, SUNIRAND e TSOMOCOS, 2006, A model to analyse financial fragility, **Economic Theory**.

2. TOTZEK, 2008, **The bank, the bank-run, and the central bank: the impact of early deposit withdrawals in a new keynesian framework**, Christian-Albrechts-Universitat Kiel, Economics Working Paper.

3. De WALQUE, PIERRARD e ROUABAH, 2009, **Financial (in)stability, supervision and liquidity injection: a dynamic general equilibrium approach**. Université Catholic de Louvain, Discussion Paper.

Objectives

1. To develop a general equilibriun model with financial frictions in the credit market and in the deposits market in order to study how a financial crisis spreads to the real economy;
2. To verify how the credit risk behaves during the business cycles;
3. To evaluate prudential regulation policies applied to liquidity crisis solution;
4. To analyze the sensibilities of the structual parameters of the economic model.

Contributions

1. Evatuation of the optimum behavior of economic agents during liquidity shocks;
2. Estimation of structual parameters in the Brazilian economy, using a Bayesian approach;
3. Identification of the determinants of credit risk;
4. Evaluation of liquidity risk prevention policy.

The economy

The economy is constituted by the following agents:

1. **Households** - work, consume and invest;
2. **Firms** - take loans to finance productive investments and choose the optimum default;
3. **Banks** - make financial intermediation operations to the productive sector;
4. **Central Bank** - Provide liquidity to financial market in order to maintain financial stability.

Households

Representatative consumer's problem:

$$\max_{C_t, N_t, D_t, F_t} E_t \sum_{t=0}^{\infty} \beta^t \left(\frac{C_t^{1-\varphi}}{1-\varphi} - \chi \frac{N_t^{1+\psi}}{1+\psi} \right)$$

subject to:

$$C_t + D_t + F_t = W_t N_t + (1 + q_t r_t^F) F_{t-1} +$$
$$(1 - \tau_{t-1})(1 + r_t^D) D_{t-1} + \tau_{t-1} D_{t-1} + \pi_t$$

Households

FOC:

$$C_t^{-\varphi} = E_t\left\{\beta\left[(1-\tau_t)(1+r_{t+1}^D)+(\tau_t)\right]C_{t+1}^{-\varphi}\right\}$$

$$C_t^{-\varphi} = E_t\left\{\beta\left[(1+q_{t+1}r_{t+1}^F)\right]C_{t+1}^{-\varphi}\right\}$$

$$C_t^{-\varphi} W_t = \chi N_t^{\psi}$$

Firms

Firms'problem:

$$\max_{K_t, N_t, \theta_t} E_t \sum_{t=0}^{\infty} \beta^t \pi_t$$

subject to:

$$\pi_t = Y_t - W_t N_t - \theta_t (r_t^L + \delta) K_t - \frac{\gamma}{2} \left[(1 - \theta_{t-1})(r_{t-1}^L + \delta) K_{t-1} \right]^2$$

$$Y_t = exp(A_t) K_t^{\alpha} N_t^{1-\alpha}$$

Firms

The law of motion for capital is given by:

$$K_t = (1-\delta)K_{t-1} + I_t - \frac{\bar{\gamma}}{2}\left(\frac{K_t - K_{t-1}}{K_{t-1}}\right)^2$$

The investment is fully financed by bank loan:

$$I_t = L_t$$

Firms

FOC:

$$W_t = (1-\alpha)exp(A_t)K_t^{\alpha}N_t^{-\alpha}$$

$$r_t^L = \frac{\alpha Y_t}{\theta_t K_t} - \delta$$

$$1 = \beta\gamma(1-\theta_t)(r_t^L + \delta)K_t$$

Banks

Representative bank problem:

$$\max_{L_t, D_t, F_t} E_t \sum_{t=0}^{\infty} \beta^t \left\{ \theta_t r_t^L L_t - (1 - \tau_t) r_t^D D_t - q_t r_t^F F_t - \vartheta D_t + M_t \right\}$$

subject to:

$$L_t = exp(\lambda_t) D_t^{\sigma} F_t^{1-\sigma}$$

Banks

FOC:

$$\sigma\theta_t r_t^L exp(\lambda_t) D_t^{\sigma-1} F_t^{1-\sigma} = (1-\tau_t) r_t^D + \vartheta$$

$$(1-\sigma)\theta_t r_t^L exp(\lambda_t) D_t^{\sigma} F_t^{-\sigma} = q_t r_t^F$$

Banking Regulation

In order to ensure financial stability, the responsable entity for banking regulation uses the following policy instruments:

1. management of market liquidity: $M_t = \omega(r_t^D - \bar{r}^D)$;
2. definition of insurance rate: ϑ.

Shocks

- Technological Shock - Productive Sector:

$$A_t = A_{t-1}^{\hat{\rho}} exp(\epsilon_t)$$

in which $\epsilon_t \sim GI\left(\alpha_\epsilon, \beta_\epsilon\right)$ e $\hat{\rho} \in (0, 1)$.

- Technological Shock - Financial Sector:

$$\lambda_t = \lambda_{t-1}^{\tilde{\rho}} exp(\xi_t)$$

in which $\xi_t \sim GI\left(\alpha_\xi, \beta_\xi\right)$ e $\tilde{\rho} \in (0, 1)$.

Shocks

- Liquidity Shock:

$$\tau_t = \tau_{t-1}^{\bar{\rho}} exp(z_t)$$

in which $z_t \sim GI(\alpha_z, \beta_z)$ e $\bar{\rho} \in (0, 1)$.

- Shock - pay equity:

$$q_t = g_t$$

in which $g_t \sim Beta(\alpha_g, \beta_g)$.

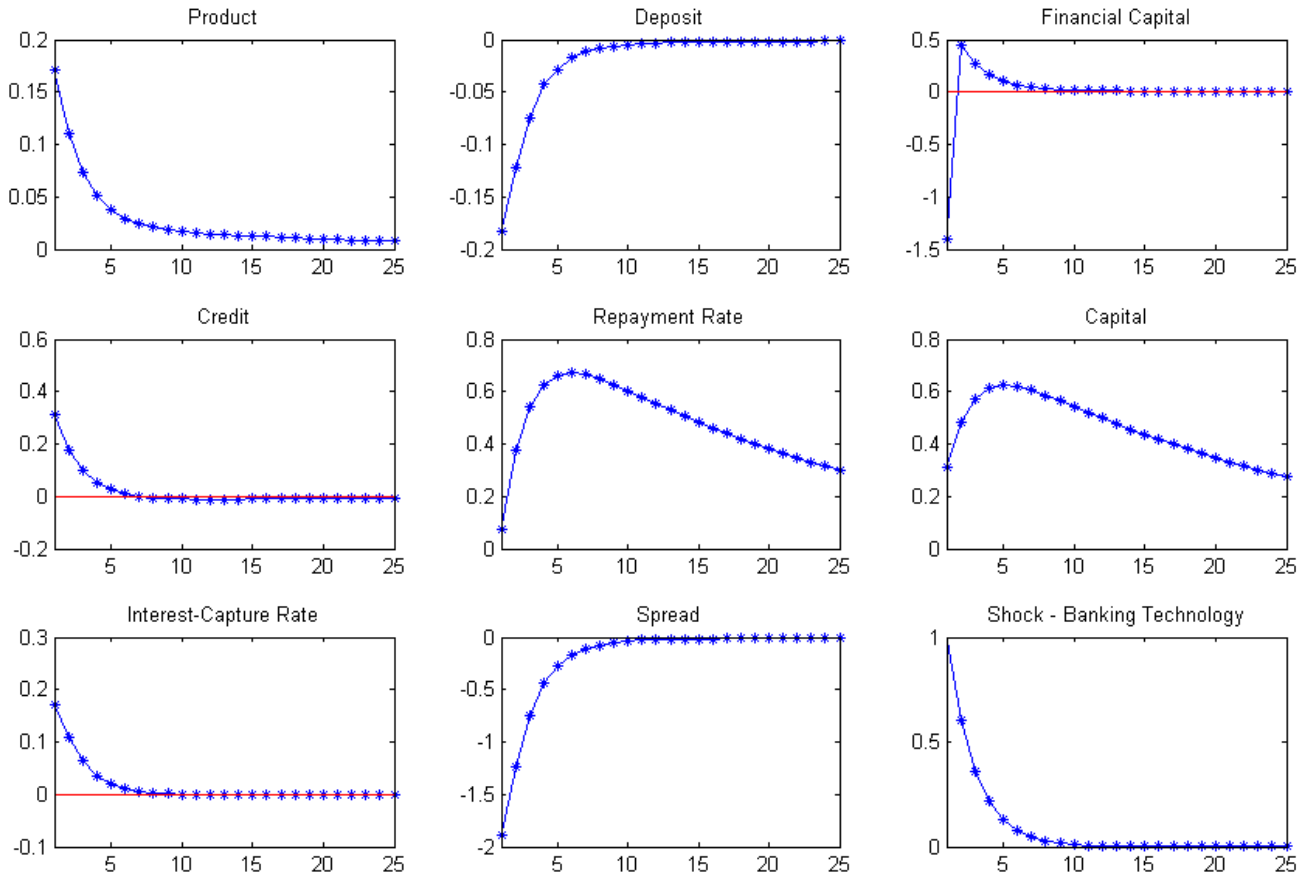
Bayesian Methods

1. It is an intermediate procedure between calibration and maximum likelihood;
2. It allows a full DSGE system estimation;
3. It incorporates non-sampling analysis information;
4. It facilitates the identification of parameters because the restricted Bayesian network structure prevents implausible values to be obtained.

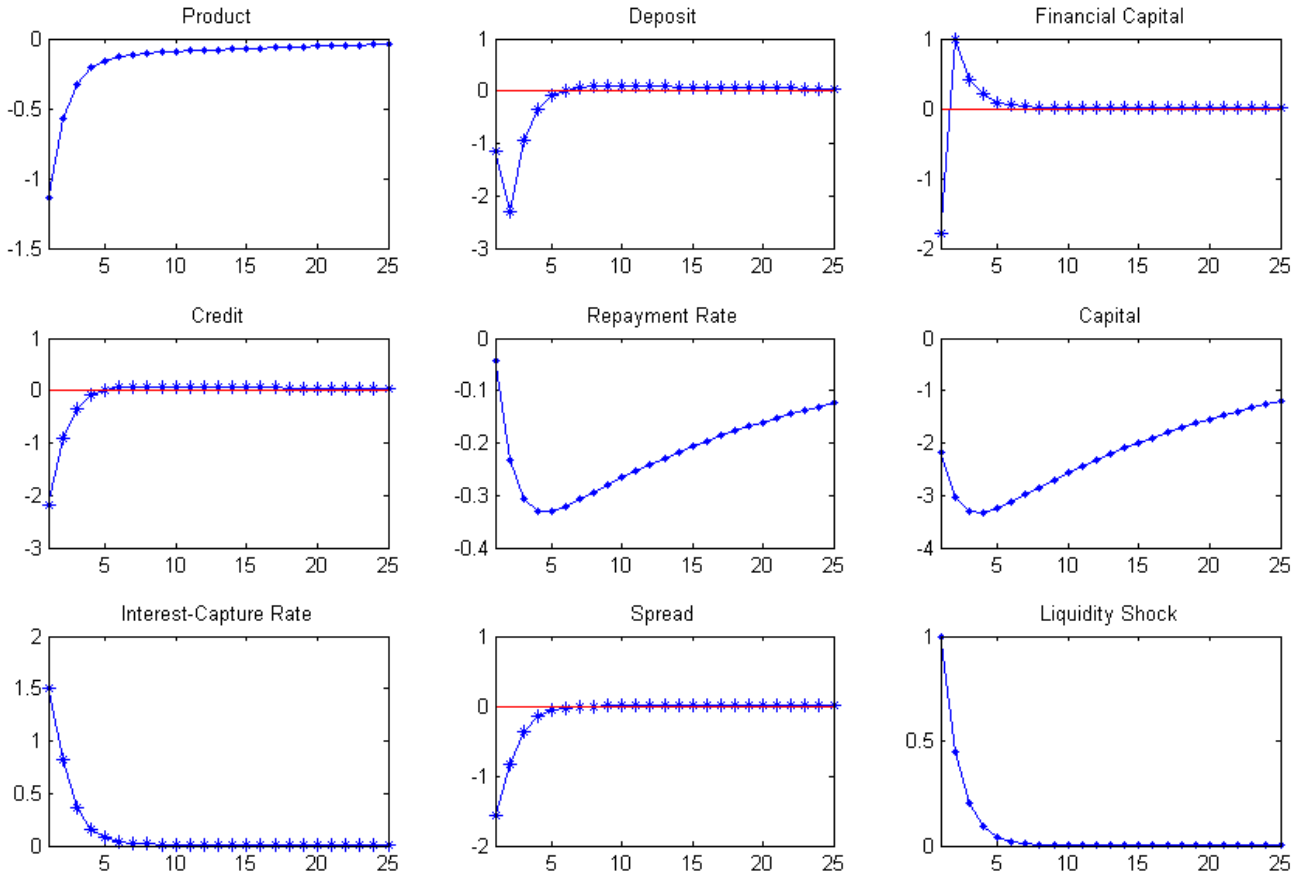
Parameter Estimations

1. As observed, we used quarterly series for: product, investiment and credit operations with free resources, for the period from 1995-2009;
2. The a priori distribution was defined from RBC (Real Business Cycles) literature and Brazilian economic history;
3. The parameter estimation was performed using Dynare.

Impulse-response function to a positive shock in banking technology



Impulse-response function to a liquidity shock



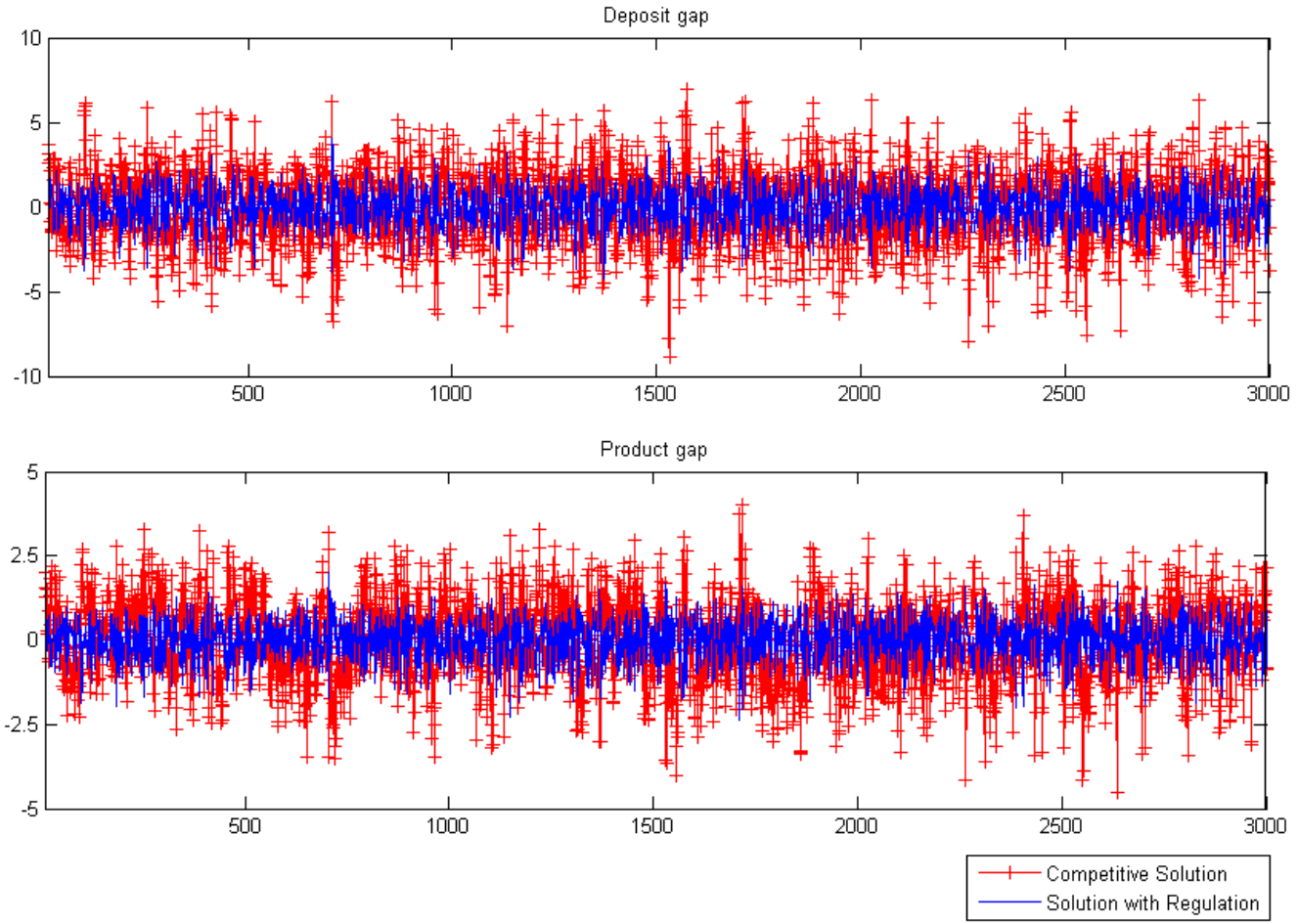
Reserve Requirements

Variable	ϑ=0	ϑ=0,024%	Perda
Consumption	0,4076	0,3896	4,42%
Investment	0,0741	0,0655	11,61%
Product	0,4817	0,4551	5,52%
Repayment Rate	0,8755	0,8589	1,89%
Interest-Capture Rate	0,0204	0,0204	0,00%
Interest-Application	0,0336	0,0387	0,49%
Interest-Banking Capital	0,0227	0,0227	0,00%
Deposit	0,0941	0,0817	13,18%
Financial Capital	0,0127	0,0127	0,00%
Spread	0,0132	0,0183	0,49%

Liquidity Injection Effects on Financial Stability

Variable	ω=0	ω=0,115%	ω=0,116%
Investment	-1,896%	-0,005%	0,015%
Product	-1,042%	-0,003%	0,009%
Employment	-0,631%	-0,002%	0,005%
Capital	-1,894%	-0,005%	0,015%
Deposit	-1,496%	-0,004%	0,012%

Liquidity Injection Effects on Financial Stability



Conclusion - Market Solution

1. The rate of credit repayment presents a pro-cyclical behavior;
2. A liquidity shock leads to economic recession and increased credit risk;
3. The default rate is sensitive to default cost and to consumer's risk aversion.

Conclusion - Central Bank Intervention

1. The reserve requirements (or compulsory) mitigate the effects of financial crisis. However, the product (consumption) in stationary equilibrium is sub-optimal;

2. The provision of liquidity injection by Central Bank can prevent liquidity crises and it does not alter the steady-state found for the competitive solution. Therefore, this policy can be classified as Pareto-efficient.

Research Extension

1. Inclusion of sticky price and wages in order to examine the compatibility between financial stability and monetary stabilization policies;

2. Examination of the behavior of other instruments of banking regulation: capital requirements, limits on expansion of credit supply, control of bank's return on equity;

3. Introduction of banking firms with market power, to assess the possible trade-off between cost of monopoly and financial stability.