



Macroprudential tools: assessing the implications of reserve requirements in a DSGE model

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The views expressed here are those of the author and do not necessarily reflect those of the Bank for International Settlements nor those of the International Monetary Fund

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¹Co-authored work with Camilo Tovar (International Monetary Fund)



Outline

Introduction

The Model

Results

Conclusions



MOTIVATION

- Central banks: an important role in financial stability.
- Are more instruments necessary?
- In Latin America: reserve requirements have been used in some countries
... for macroprudential purposes and as a complement to monetary policy (CGFS 2010).
- Some questions that need to be answered:
 - How this instrument affects the transmission mechanism?
 - How effective is this instrument?
 - When this instrument is more effective?

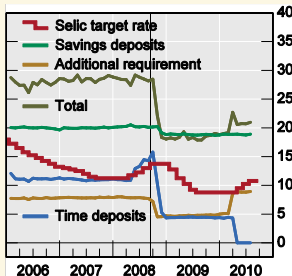


MOTIVATION

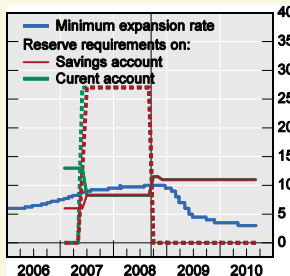
Reserve requirements have been used actively by some IT countries in Latin America

Policy rates and reserve requirements

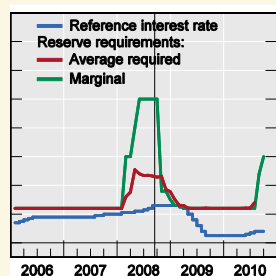
Brazil



Colombia



Peru



Sources: Bloomberg; CEIC; Central Bank of Brazil; Central Bank of Peru.



What other authors have done?

Reserve requirements (RR)

- Romer (1985): RR ineffective to control inflation.
- Edwards and Vegh (1997): countercyclical RR may help to isolate economy from foreign shocks.
- Prada (2008): RR little effect on aggregate demand.
- Vargas et al (2010): RR can reinforce transmission mechanism.



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Financial frictions

- Financial accelerator (Bernanke and Gertler, 1999).
- Liquidity constraints (Kiyotaki and Moore 2008; Del negro et.al, 2010).
- Collateral constraints (Iacovello, 2005).
- Maturity mismatches (Benes and Lees, 2010).



What do we do?

We extend an standard New Keynesian model (closed economy + capital), including:

- A banking sector.
- Interbank market subject to financial frictions.
- Multiperiod credit contracts.
- Reserve requirements on deposits (additional policy instrument).



What do we find?

Reserve requirements...

- ... act as a tax on the banking system.
- ... can complement to the interest rate as a policy instrument.
- ... can be a useful instrument when financial conditions get tighter (eg financial crisis).



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The model

Setup

1. Agents: households and entrepreneurs
2. Firms: intermediate, final, capital producers
3. Banks and interbank market.
4. Entrepreneurs finance investment with multiperiod credit contracts.
5. Banks are subject to financial constraints.
6. Central bank has two policy instruments: interest rate + reserve requirement rate.



Entrepreneurs (1)

Multiperiod credit contracts a-là Benes and Lees (2010)

- Entrepreneurs finance entirely investment from banks.
- Credit (CR_t) taken at time t is paid back in repayments proportional to the amount borrowed and decay at a fixed rate $\lambda \in (0, 1)$.
- Repayment schedule:

$$Q_t^{cr} CR_t, \lambda Q_t^{cr} CR_t, \dots, \lambda^{k-1} Q_t^{cr} CR_t, \dots$$

where Q_t^{cr} is the price associated to the cost of credit.



Entrepreneurs (2)

Multiperiod credit contracts a-là Benes and Lees (2010)

- The sum of all repayments due at t associated with all past loans is:

$$J_{t-1} = Q_t^{cr} CR_t + \lambda Q_{t-1}^{cr} CR_{t-1} + \dots + \lambda^k Q_{t-k}^{cr} CR_{t-k} + \dots$$

- J_t can be written recursively as:

$$J_t = \lambda J_{t-1} + Q_t^{cr} CR_t$$

- The stock of loans, estimated as the present value of repayments, is equal to:

$$L_t = \Omega_t J_t$$

where $\Omega_t \equiv E_t \left[\frac{1}{R_t} (1 + \lambda \Omega_{t+1}) \right]$.



Entrepreneurs (3)

First order conditions

- The expected return of capital equals the real value of the repayments:

$$E_t \left(R_{t+1}^Q \right) = E_t Q_t^{cr} \left(\frac{1 + \frac{\lambda}{Q_{t+1}^{cr}}}{\Pi_{t+1}} \right).$$

where $R_t^Q \equiv \frac{1}{Q_{t-1}} [R_t^K + (1 - \delta) Q_t]$ is the return of one unit of investment.



Interbank market (1)

- Each period commercial banks have a random lending opportunity.
- The stock of loans ($L_t(b)$) supplied by each bank evolves according to:

$$L_t(b) = \begin{cases} \lambda \frac{\Omega_t}{\Omega_{t-1}} L_{t-1}(b) + \Omega_t Q_t^{cr} CR_t(b) & \text{with probability } \chi \\ \lambda \frac{\Omega_t}{\Omega_{t-1}} L_{t-1}(b) & \text{with probability } 1 - \chi \end{cases}$$



Interbank market (2)

- The Bank's balance sheet is:

Assets	Liabilities
Loans, $L_t(b)$	Interbank borrowing, $Z_t^B(b)$
Interbank lending, $Z_t^L(b)$	Deposits, $D_t(b)$
Reserves, $RR_t(b)$	Net worth.



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- Interbank financial frictions:

$$Z_t^B(b) \leq \underbrace{\phi_t L_{t-1}(b)}_{\text{Leverage Constraint}} + \underbrace{\theta_t CR_t(b)}_{\text{Collateral Constraint}}$$



Central bank

Policy instruments

- Interest rate (simple) Taylor rule:

$$R_t = \bar{R} \left(\frac{\Pi_t}{\bar{\Pi}} \right)^{\psi_\pi} .$$

- Reserve requirements rule (2 options)

$$\tau_t = \begin{cases} \bar{\tau} \\ \bar{\tau} + \psi_{cr} \left(\frac{CR_t}{\bar{CR}} \right) \end{cases}$$

where reserve requirement are a fraction of the deposits received from the households: $RR_t = \tau_t D_t$



Financial frictions (1)

- The interest rate adjusted by reserve requirements is defined by:

$$R_t^\tau = \frac{R_t - \tau_t}{1 - \tau_t} > R_t,$$

and the interbank rate: $R_t^{ib} = R_t^\tau$.



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- Interest rate paid by entrepreneurs:

$$Q_t^{cr} = \frac{1}{\Omega_t^\tau + \Omega_t^\chi}$$

where $\Omega_t^\tau \equiv E_t \left[\frac{1}{R_t^\tau} (1 + \lambda \Omega_{t+1}^\tau) \right]$ and

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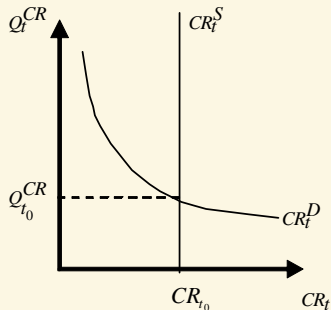
- The supply of credit give by the banks is the following:

$$CR_t = \frac{\beta_b}{(1 - \theta_t)} \chi \left\{ \left(\frac{1}{\Omega_{t-1}^\tau} + \phi_t \right) L_{t-1} - (R_{t-1} - \tau_{t-1}) D_{t-1} \right\} + (1 - \tau_t) D_t$$



Financial frictions (2)

Comparative statics - credit market equilibrium





Financial frictions (3)

Comparative statics - credit market equilibrium

(a) $\tau \uparrow$

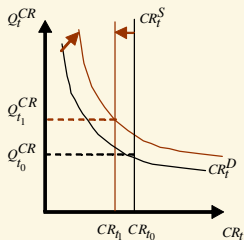
Reserve requirement rate

(b) $\theta \downarrow$

Collateral constraint

(c) $\phi \downarrow$

Leverage constraint



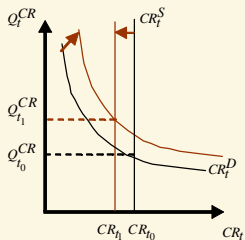


Financial frictions (3)

Comparative statics - credit market equilibrium

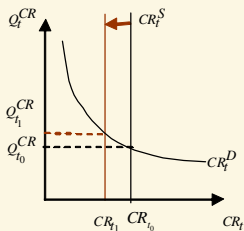
(a) $\tau \uparrow$

Reserve requirement rate



(b) $\theta \downarrow$

Collateral constraint



(c) $\phi \downarrow$

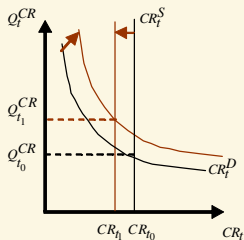
Leverage constraint



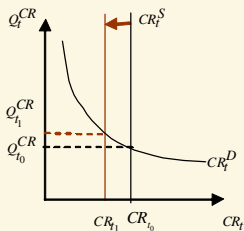
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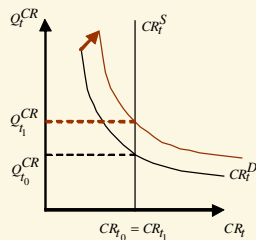
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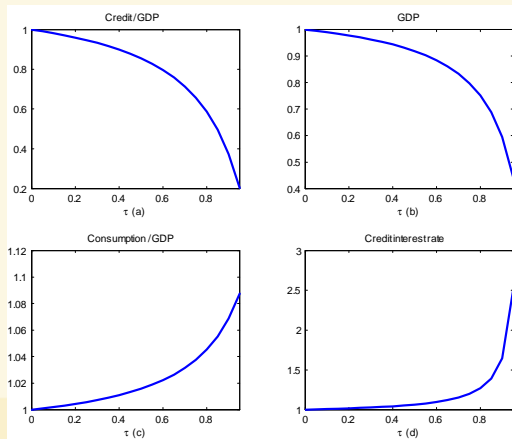
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Reserve requirements in the steady state

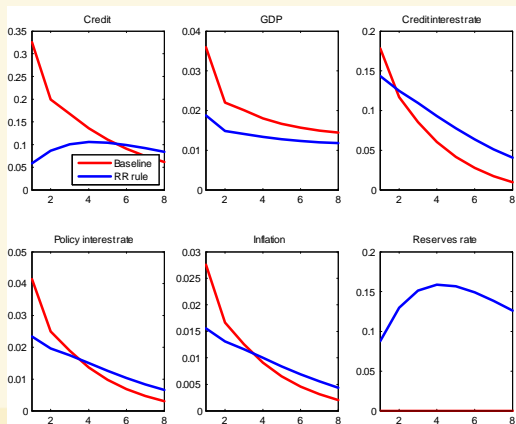
RR are a distortion in the steady state





Trans. mechanism (demand shock)

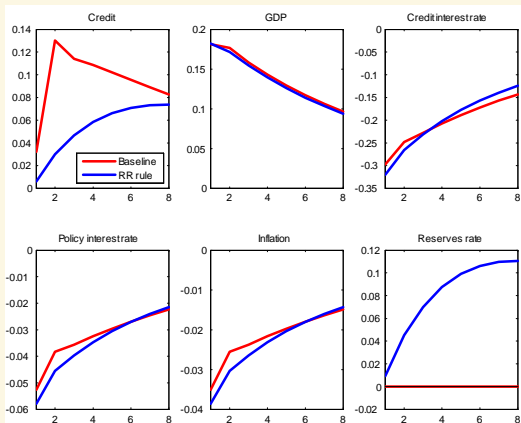
RR feedback rule improves power of the interest rate for demand shocks...





Trans. mechanism (productivity shock)

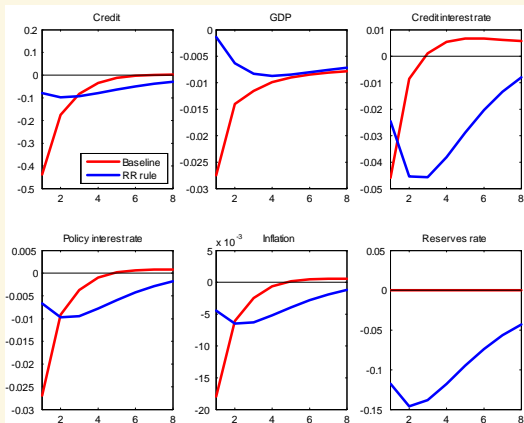
... but reduces it for productivity shocks.





T. mechanism - financial constraints

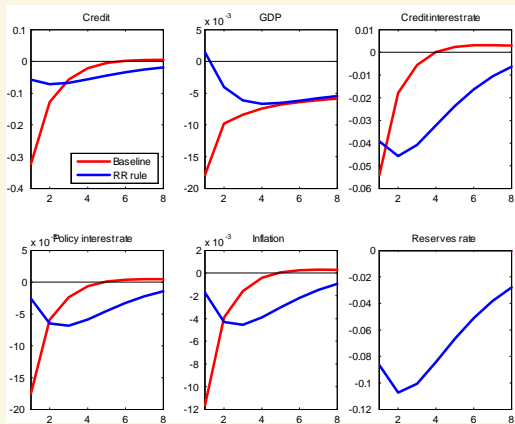
Tighter leverage constraint ($\phi \downarrow$): RR helps interest rate to stabilise.





T. mechanism - financial constraints

...also in the case of tighter collateral constraint ($\theta \downarrow$)





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Conclusions

- Model endogenise maturity mismatches and risk premium. It gives a role for reserve requirements as a policy instrument.
- Reserve requirements generate distortions (eg tax on the banking system).
- In some cases the use of RR complements and makes more effective the interest rate as a policy instrument.
- RR is an effective instrument during financial disruptions.
- Further agenda: optimal reserve requirement policy, analysis in open economy (eg implications for capital inflows).