

VI Seminar on Risk, Financial Stability and Banking of the Banco Central do Brasil



Reserve Requirements and the Brazilian Bank Credit

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Preamble

- ▶ Joint work with Tony Takeda - Banco Central do Brasil - Research Department in São Paulo.
- ▶ **Disclaimer:** The views expressed here are those of the authors and do not necessarily reflect those of the Banco Central do Brasil.

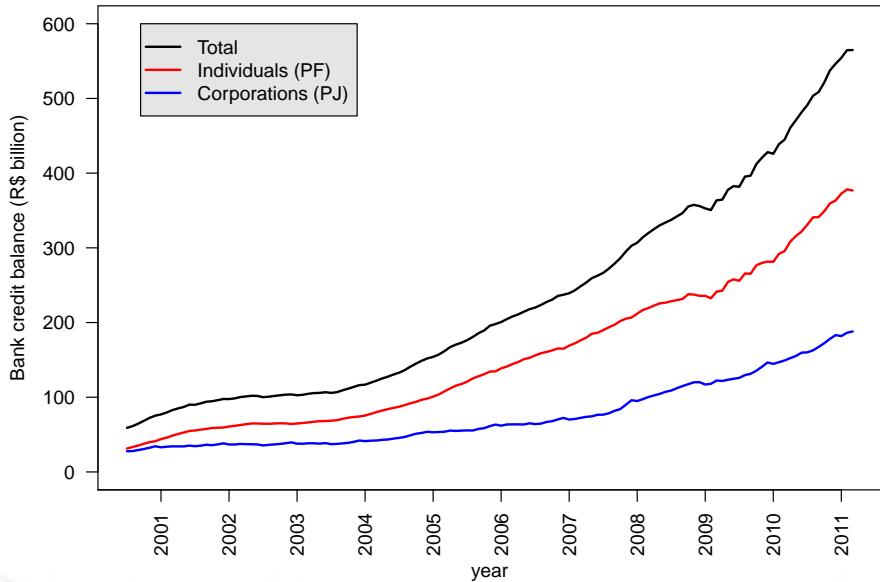
Outline

- ▶ Introduction
- ▶ Motivation.
- ▶ Three studies
- ▶ Results.
- ▶ Conclusion.

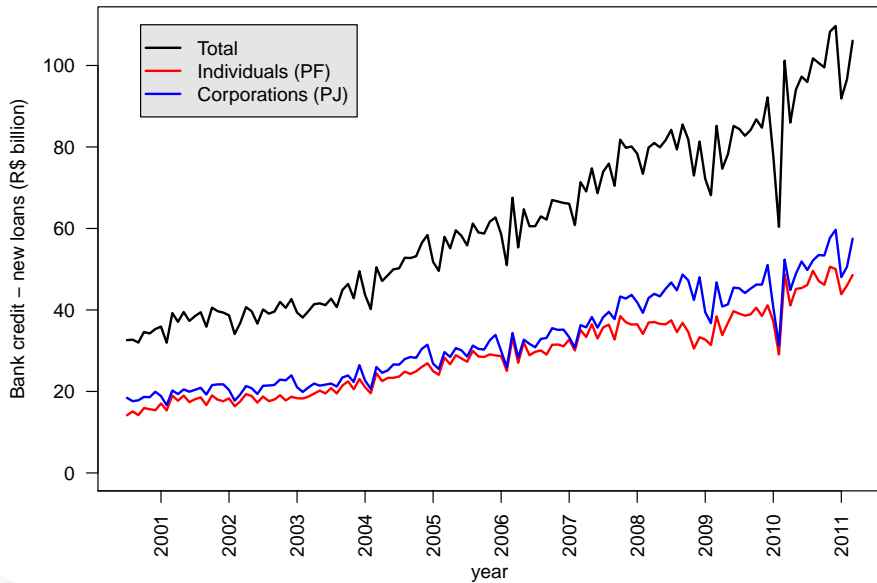
Introduction

- ▶ Credit growth: 25% of GDP in 1999 to 46.4% in March 2011.
- ▶ Fast growth of vehicle financing and personal credit (payroll) from 2004.
- ▶ Credit retaken in mid 2009 after the international financial crisis of 2008.
- ▶ Reserve requirement (RR) recomposition in 2010 - February and December.
- ▶ Other macro-prudential measures in Dec/2010: mainly on vehicle financing and personal credit.
- ▶ RR as a liquidity management and a macro-prudential instrument (to achieve a sustainable credit growth).

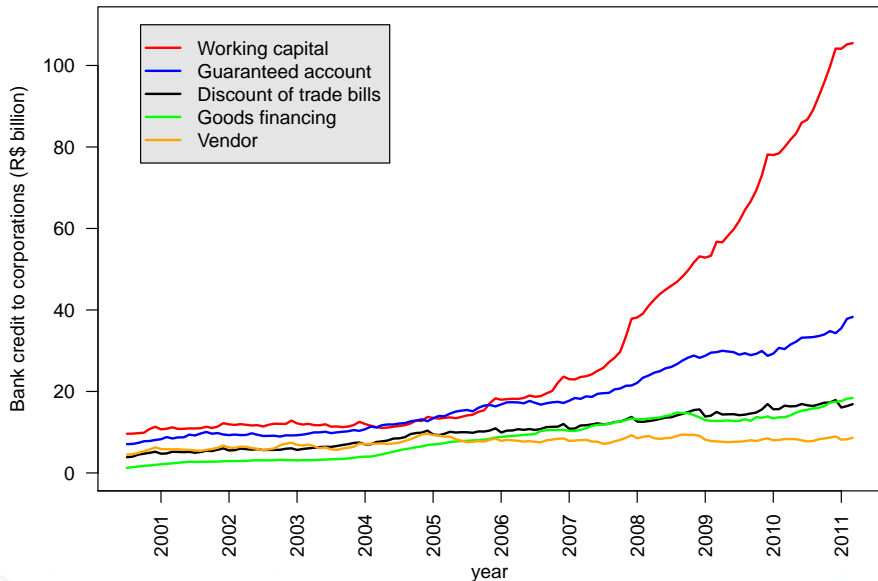
Bank credit balance



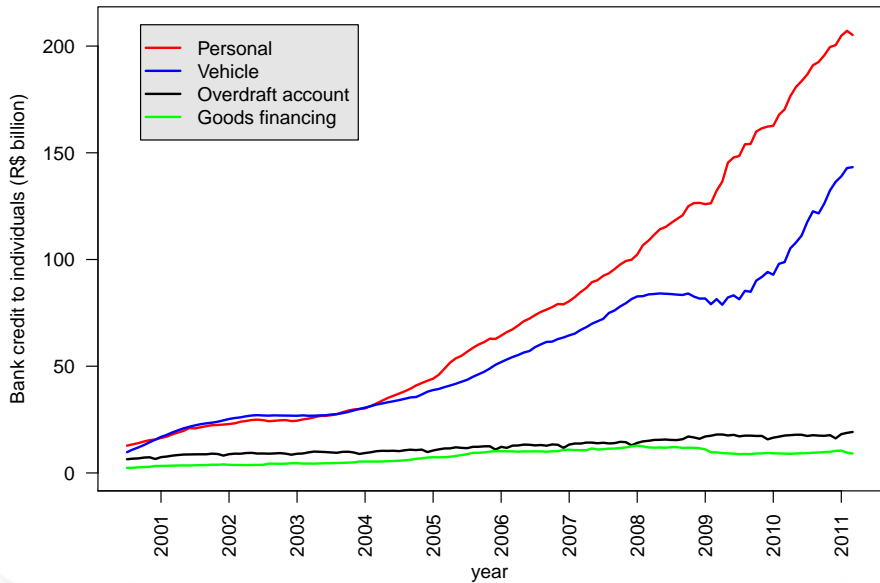
Bank credit – new loans



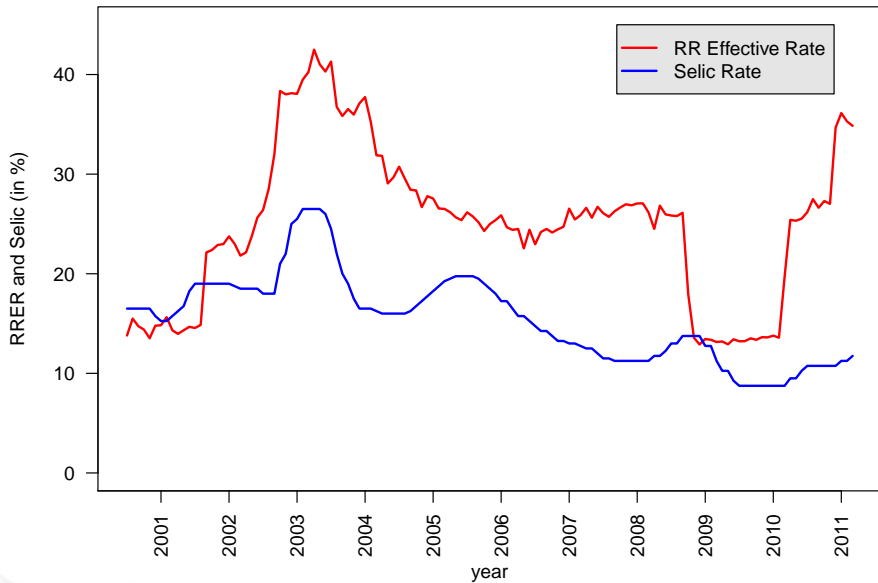
Bank credit to corporations



Bank credit to individuals



Policy rates



Motivation

- ▶ Assess the effects of the 2010 macro-prudential measures on bank lending.
- ▶ Find a long-term relationship between RR and bank credit.
- ▶ Evaluate jointly the role of other bank variables: liquidity, deposits and wholesale funding (repo and interbank deposit).

Three panel data regressions:

1. Aggregate effects of 2010 macro-prudential measures on credit (dynamic panel, GMM estimation).
2. Effects on smaller banks (event study, FE panel).
3. Long-term average relationship between RR and bank credit (FE panel, large T).

Study #1: Macro-prudential effects on credit.

Description

- ▶ **Methodology:** Dynamic panel, GMM estimation.
- ▶ **Data:** Bank-level, monthly average, from Jan/2006 to Mar/2011.
- ▶ **Dependent variables:** New Loans to Individuals (PF) and to Corporations (PJ), and by credit types.
- ▶ **Control:** Credit Balance, Interest Rate, Default Rate (> 90 days), Term.
- ▶ **Dummy variables:** Crisis2008 (Oct/2008 - Mar/2009), Macro-prudential2010 (Feb/2010 - Mar/2011).
- ▶ Trend and seasonality considered.

Study #1: Macro-prudential effects on credit.

Basic regression:

$$\begin{aligned} \log(\text{NewLoans}_{k,i,t}) = & \alpha_1 \log(\text{NewLoans}_{k,i,t-1}) \\ & + \beta_1 \log(\text{Balance}_{k,i,t}) + \beta_{11} \log(\text{Balance}_{k,i,t-1}) \\ & + \beta_2 \log(\text{InterestRate}_{k,i,t}) + \beta_{21} \log(\text{InterestRate}_{k,i,t-1}) \\ & + \beta_3 \log(\text{Default}_{k,t}) + \beta_{31} \log(\text{Default}_{k,t-1}) \\ & + \beta_4 \log(\text{Term}_{k,i,t}) + \beta_{41} \log(\text{Term}_{k,i,t-1}) \\ & + \beta_5 \text{Crisis2008}_t + \beta_6 \text{MacroPrud2010}_t \\ & + \beta_7 t + \text{SeasonalDummies}_t \\ & + \text{FixedEffect}_{k,i} + \text{Error}_{k,i,t}. \end{aligned} \tag{1}$$

Study #1: Macro-prudential effects on credit.

Results Estimated long-run coefficients (1% significant)

New loans to individuals (PF)

- ▶ **Positive coefficient:** Credit Balance (0.43).
- ▶ **Negative coefficient:** Interest Rate (-0.53), Default Rate (-1.60), Crisis2008 (-0.30), MacroPrudential2010 (-0.30).

New loans to Personal Credit

- ▶ **Positive coefficient:** Credit Balance (0.31).
- ▶ **Negative coefficient:** Interest Rate (-0.57), Default Rate (-2.31), Crisis2008 (-0.26), MacroPrudential2010 (-0.23).

New loans to Vehicle Financing

- ▶ **Positive coefficient:** Credit Balance (0.48).
- ▶ **Negative coefficient:** Interest Rate (-1.16), Default Rate (-0.85), Crisis2008 (-0.25), MacroPrudential2010 (-0.34).

Study #1: Macro-prudential effects on credit.

Results Estimated long-run coefficients (1% significant)

New loans to corporations (PJ)

- ▶ **Positive coefficient:** Credit Balance (0.63).
- ▶ **Negative coefficient:** Interest Rate (-0.91), Default Rate (-0.43), Crisis2008 (-0.28).
- ▶ Non significant: MacroPrudential2010.

Study #2: Macro-prudential effects on small banks.

Description

- ▶ **Methodology:** Event study, diff-in-diff, panel OLS with FE.
- ▶ **Treatment group:** small banks (liquidity constraint).
- ▶ **Control group:** large banks (liquidity providers).
- ▶ **Data:** Bank-level, monthly average, Jan/2006 to Mar/2011.
- ▶ **Dependent variables:** New Loans to Individuals (PF) and to Corporations (PJ).
- ▶ **Bank-level controls:** Credit Balance, Interest Rate, Deposits,...
- ▶ **Macroeconomic Control:** Selic Rate, Industrial Output,...
- ▶ **Dummy variables:** Crisis2008 (Oct/2008 - Mar/2009), MacroPrudential-Feb2010 (Feb/2010 - Nov/2010), MacroPrudential-Dec2010 (Dec/2010 - Mar/2011) and SmallBank Dummy (Reference net worth \leq BRL 7 bi).

Study #2: Macro-prudential effects on small banks.

Basic regression:

$$\begin{aligned}\log(\text{NewLoans}_{i,t}) = & \Phi_1 \log(\text{Balance}_{i,t}) + \Phi_2 \log(\text{InterestRate}_{i,t}) \\ & + \Phi_3 \log(\text{Term}_{i,t}) + \Phi_4 \log(\text{Default}_{i,t}) \\ & + \lambda_1 \log(\text{Deposits}_{i,t}) + \lambda_2 \log(\text{LiquidAssets}_{i,t}) \\ & + \lambda_3 \log(\text{Funding}_{i,t}) \\ & + \alpha_1 \log(\text{Selic}_t) + \alpha_2 \log(\text{IndustrialProd}_t) \\ & + \alpha_3 \log(\text{BNDES}_t^D) + \alpha_4 \log(\text{BNDES}_t^R) \\ & + \alpha_5 \log(\text{ExchangeRate}_t) + \alpha_6 \log(\text{Unemployment}_t) \\ & + \gamma_1 \text{SmallBank}_i + \gamma_2 \text{MacroPrud2010}_t \\ & + \beta_1 \text{SmallBank}_i * \text{MacroPrud2010}_t \\ & + \beta_3 \text{Crisis2008}_t \\ & + \beta_4 t + \text{SeasonalDummies}_t \\ & + \text{FixedEffect}_i + \text{Error}_{i,t}.\end{aligned}\tag{2}$$

Study #2: Macro-prudential effects on small banks.

Results Estimated coefficients

New loans to individuals (PF)

- ▶ **Positive coefficient:** Credit Balance (0.62^{***})
- ▶ **Negative coefficient:** Crisis2008 (−0.43^{***})
- ▶ MacroPrud-Feb2010 (0.21^{*}),
MacroPrud-Dec2010 (0.35^{**})
- ▶ MacroPrud-Feb2010 * SmallBank (−0.43^{***})
MacroPrud-Dec2010 * SmallBank (−0.35^{**})

New loans to corporations (PJ)

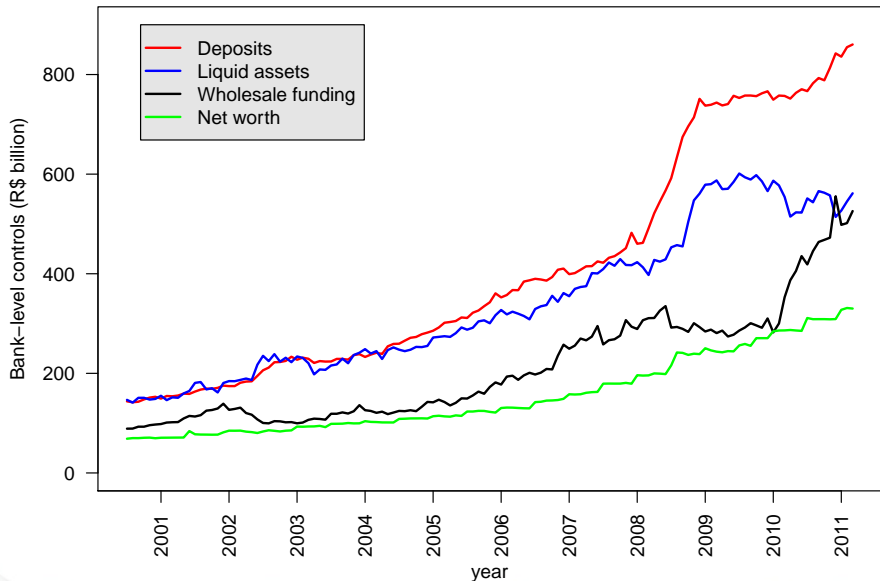
- ▶ **Positive coefficient:** Credit Balance (0.84^{***})
- ▶ **Negative coefficient:** InterestRate (−0.80^{***})

Study #3: RR in the long-run.

Description:

- ▶ **Methodology:** panel OLS with FE, robust covariance for T large [Driscoll and Kraay (1998)].
- ▶ **Data:** Bank-level, monthly, from Jul/2000 to Mar/2011.
- ▶ **Dependent variables:** Credit Balance and New Loans to Individuals (PF) and to Corporations (PJ).
- ▶ **Subgroups:** Large and small banks, main credit types.
- ▶ **RR Effective Rate** ($RRER = RR / \text{Deposits}$).
- ▶ **RRERI** = RRER at bank-level.
- ▶ **Liquid Assets** = (free securities + repo + interbank deposits).
- ▶ **Deposits** = (demand + time).
- ▶ **Funding** = (repo + interbank deposits).
- ▶ **Bank-level controls:** Spread, Term,...
- ▶ **Macroeconomic Controls:** Selic Rate, Industrial Output,...

Bank-level controls



Study #3: RR in the long-run.

Basic regression:

$$\begin{aligned} \log(\text{Balance}_{k,i,t} \text{ or } \text{NewLoans}_{k,i,t}) = & \\ & + \beta_1 \log(\text{Deposits}_{i,t}) + \beta_2 \log(\text{NetWorth}_{i,t}) \\ & + \beta_3 \log(\text{LiquidAssets}_{i,t}) + \beta_4 \log(\text{Funding}_{i,t}) \\ & + \beta_5 \log(\text{RRER}_{i,t}) + \beta_6 \log(\text{RRER}_t) \\ & + \beta_7 \log(\text{Spread}_{k,i,t}) + \beta_8 \log(\text{Term}_{k,i,t}) \\ & + \beta_9 \log(\text{Selic}_t) + \beta_{10} \log(\text{Unemployment}_t) \\ & + \beta_{11} \log(\text{ExchangeRate}_t) + \beta_{12} \log(\text{IndustrialOutput}_t) \\ & + \beta_{13} \log(\text{BNDES}_t^D) + \beta_{14} \log(\text{BNDES}_t^R) \\ & + \beta_{15} t + \text{SeasonalDummies}_t \\ & + \text{FixedEffect}_{k,i} + \text{Erro}_{k,i,t}. \end{aligned} \tag{3}$$

Study #3: RR in the long-run.

Results

- ▶ Most estimated coefficients are significant with the expected sign.
- ▶ **Positive coefficient:** Deposits, NetWorth, Funding, IndustrialOutput.
- ▶ **Negative coefficient:** LiquidAssets (Balance), Selic, Spread, Unemployment.
- ▶ RRER presents negative coefficients (policy rate).
- ▶ RRERI presents positive coefficients (non-linear effects).
- ▶ RRER and Selic present greater impact to smaller banks.
- ▶ Greater relative importance of Funding for small banks (and Personal Credit).

Table: Total credit.

Dependent variable:	log(Credit Balance)			log(New Loans)		
	Total	Large banks	Small banks	Total	Large banks	Small banks
Independent variables						
log(Deposits)	0.291***	0.182***	0.292***	0.295***	0.224***	0.296***
log(Liquid Assets)	-0.083***	-0.120*	-0.080***	0.061***	-0.110**	0.073***
log(Funding)	0.066***	0.023	0.070***	0.028**	0.037***	0.028*
log(Net worth)	0.598***	0.832***	0.575***	0.437***	0.790***	0.398***
log(RRER)	-0.213***	-0.097**	-0.233***	0.058	-0.044	0.071
log(RRERI)	0.061***	0.093***	0.059***	0.054***	0.078***	0.053***
log(Selic)	-0.086	0.044	-0.107	-0.462**	-0.073	-0.527**
log(Unemployment)	-0.261	-0.077	-0.307	0.110	0.117	0.087
log(Exchange rate)	-0.226**	0.246***	-0.311***	-0.156	0.158**	-0.200
log(Industrial output)	0.323	0.207	0.297	0.541	0.211	0.560
log(BNDES R)	-0.641***	-0.123	-0.689***	-1.292***	-0.240*	-1.441***
log(BNDES D)	0.087	-0.347***	0.123	-0.073	-0.120	-0.103
Trend	0.007***	0.011***	0.006***	0.004	0.002	0.005
R ²	0.280	0.864	0.246	0.123	0.747	0.107
n. banks	146	11	135	145	11	134
n. obs.	9548	1163	8385	8979	1163	7816

Table: Loans to corporations.

Dependent variable:	log(Credit Balance PJ)			log(New Loans PJ)		
	Total	Large banks	Small banks	Total	Large banks	Small banks
Independent variables						
log(Deposits)	0.318***	0.710***	0.275***	0.348***	0.267***	0.311***
log(Liquid Assets)	-0.104***	-0.269***	-0.077***	0.031	-0.090	0.067**
log(Funding)	0.025**	-0.013	0.024**	0.014	0.066***	0.009
log(Net worth)	0.273***	0.332***	0.199***	0.016	0.438***	-0.072
log(RRER)	-0.125**	-0.015	-0.090*	-0.091	0.028	-0.069
log(RRERI)	0.096***	-0.041	0.071***	0.110***	0.066***	0.082***
log(Selic)	-0.388***	-0.123*	-0.473***	-0.478***	-0.144	-0.552***
log(Spread)	-0.090***	-0.373***	-0.094***	-0.318***	-0.254***	-0.344***
log(Unemployment)	-0.761***	-0.229	-0.701***	-0.767**	-0.236	-0.711**
log(Exchange rate)	-0.062	-0.185**	-0.061	0.159	0.321***	0.155
log(Industrial output)	0.555*	0.311*	0.501*	1.395***	0.809***	1.390***
log(BNDES R)	-0.422*	0.141	-0.176	-0.588	-0.781***	-0.204
log(BNDES D)	0.112	0.137	0.060	-0.172	0.260**	-0.317*
Trend	-0.003***	0.001	-0.006***	-0.008***	0.004***	-0.012***
log(Term)	0.239***	0.142**	0.253***	0.154***	0.257***	0.164***
R^2	0.276	0.847	0.215	0.089	0.692	0.086
n. banks	137	11	126	137	11	126
n. obs.	8192	998	7029	8181	1163	7018

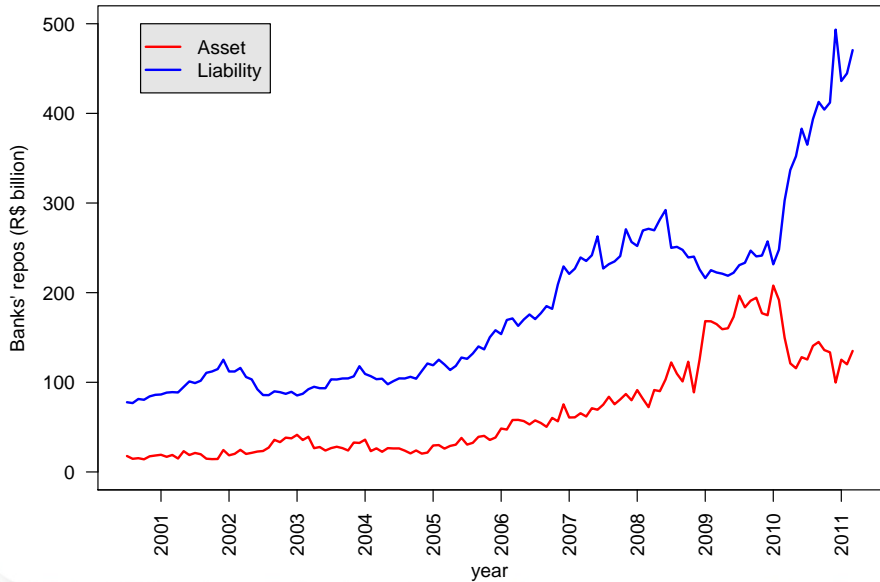
Fonte: Banco Central do Brasil.

Table: Loans to individuals.

Dependent variable:	log(Credit Balance PF)			log(New Loans PF)		
	Total	Large banks	Small banks	Total	Large banks	Small banks
Independent variables						
log(Deposits)	0.297***	0.262**	0.293***	0.215***	0.477**	0.199***
log(Liquid Assets)	-0.110***	-0.098	-0.107**	-0.024	-0.105*	-0.022
log(Funding)	0.094***	0.019	0.105***	0.014	0.048**	0.015
log(Net worth)	0.419***	0.865***	0.378***	0.395***	0.955***	0.348***
log(RRER)	-0.130*	-0.049	-0.128	-0.017	0.090	-0.012
log(RRERI)	0.065***	0.066***	0.063***	0.025*	-0.006	0.034**
log(Selic)	0.084	0.009	0.067	-0.396**	-0.132	-0.483**
log(Spread)	0.088	-0.557***	0.104*	-0.040	-0.476	-0.029
log(Unemployment)	0.268	-0.190	0.252	0.283	0.176	0.183
log(Exchange rate)	-0.207**	0.591***	-0.329***	-0.041	0.495***	-0.105
log(Industrial output)	-0.122	0.621***	-0.265	-0.153	0.485	-0.211
log(BNDES R)	0.000	0.177	0.086	-1.583***	0.135	-1.975***
log(BNDES D)	-0.191	-0.631***	-0.227	-0.323	-0.412**	-0.371
Trend	0.009***	0.008***	0.008***	0.016***	-0.004	0.019***
log(Term)	0.503***	0.197***	0.507***	0.279***	-0.121	0.282***
R^2	0.365	0.859	0.334	0.158	0.638	0.151
n. banks	127	11	116	127	11	116
n. obs.	7851	1163	6688	7851	1163	6688

Fonte: Banco Central do Brasil.

Banks' repurchase operations



Conclusion

- ▶ Effects of the macro-prudential measures on lending to individuals. Greater impact on smaller banks.
- ▶ Deposits are the main source of credit.
- ▶ Wholesale funding (repo) as a complementary source, mainly for Personal Credit.
- ▶ RRER has negative coefficients in the long-term study, relevance to credit supply.
- ▶ RRER and Selic present greater impact to smaller banks.