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Bank capital buffers, lending growth and economic cycle: empirical evidence for Brazil

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BANK CAPITAL BUFFERS, LENDING GROWTH AND ECONOMIC CYCLE: EMPIRICAL EVIDENCE FOR BRAZIL

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Introduction

- The objective of this paper is to evaluate the impact of the economic cycle on capital buffers.
- We're interested in
  1. the relationship between the economic cycle and capital buffers in the Brazilian economy;
  2. the relationship between capital buffers and loans at the bank level.
- We estimate two baseline equations for capital buffers and loans.

Why do banks hold capital buffers ?

- Most banks have capital buffers - capital above minimum regulatory requirements. The main reasons are:
- **Market Discipline**: avoid costs related to market discipline (deposit costs).
- **Supervisory Intervention**: safeguard against violation of the minimum requirements and associated costs.
- **Adverse Shocks**: safeguard against default and the costs of financial crisis.
- **Others**: Capacity to gain from unexpected opportunities and signaling.

Bank Capital and Loans Behavior

- Bank capital influences the impact of economic shocks in bank loans due to two main mechanisms, which are based on adverse selection problems that affect bank financing:
  1. **Bank lending channel** (imperfections in the bank debt market);
  2. **Bank capital channel** (imperfections in the bank equity market).

Capital Buffers along the Economic Cycle

- There is strong evidence that capital buffers exhibit cyclical behavior under BASEL I (Ayuso et al., 2004; Lindquist, 2004; Stolz and Wedow, 2009; Brown and Davis, 2008; Fonseca and Gonzalez, 2009; Nier and Baumman, 2006; Jokipii and Milne, 2008).
- **Myopic bank behavior**: Banks expand the loans supply in booms without adequate capital reserves. During economic downturn, capital accumulation may be low. Banks are forced to increase their capital buffers through reduction in loans.

Determinant of Capital Buffers

- Following Ayuso et al., 2004; Lindquist, 2004; Stolz and Wedow, 2009; Brown and Davis, 2008; Fonseca and Gonzalez, 2009; Nier and Baumman, 2006; Jokipii and Milne, 2008, we consider three different types of costs associated to bank capital to model capital buffers:
  1. **Financing costs**;
  2. **Adjustment capital costs**; and
  3. **Bankruptcy and financial crisis costs**.

Determinants of capital buffers

- **Financing costs**: Maintaining capital implies direct costs - opportunity costs.
- Therefore, banks incentives to hold capital above the regulatory requirements depends on the relative costs.
- We employ (*return on equity* - ROE) for each bank to proxy these costs (Ayuso et al, 2004; Jokipii and Milne, 2008).

Determinant of capital buffers

- **Capital Adjustment Costs**: Banks face adjustment costs when changing their capital levels towards optimal capital level.
- The main source of these costs is related to asymmetric information in capital markets.

Determinants of capital buffers

- **Bankruptcy costs and financial crisis**: The risk profile of the bank determines it's capital buffer.
- We employ non-performing loans (*non-performing loan ratio* - NPL) to proxy these risks (credit risk).

Determinants of capital buffers

- We also include size as an explanatory variable as banks of different sizes may have different objectives.
- For example, large banks may gave facilities and advantages to access external capital if compared to smaller banks, which may be reinforced by asymmetric information in the loans markets.

Determinants of capital buffers

- We also consider ownership. Overall, the level of capital buffers is different on average.
- We test how ownership may influence capital buffers.

Determinants of capital buffers

- Finally, we include the output gap *GAP* to test the effect of the economic cycle on capital buffers.

Overview of Brazilian Banking

- Large Banking System
- State-Owned, Foreign and Private Domestic Banks
- High interest rates (and spreads) - Fixed Income x Loans
- High banking profits
- Increasing concentration (150 banks - 100 banks)

Methodology

- Our baseline equation for the determination of changes capital buffers is:

$$\begin{aligned} \Delta BUF_{i,t} &= \alpha + \beta_1 ROE_{i,t-1} + \beta_2 NPL_{i,t-1} + \beta_3 SIZE_{i,t-1} \\ &+ \beta_4 GAP_{t-1} + \varepsilon_{i,t}, \\ & i = 1, ..., N, \;\; t = 1, ..., T \end{aligned} \tag{1}$$

- We test for autocorrelation and groupwise heterokedasticity and empirical results suggest that we should employ the "Feasible Generalized Least Squares"(FGLS) estimator.
- We test for a dynamic specification using difference and system-GMM but a static model is preferred.

Estimation of Loans' growth regressions

- The main objective is to evaluate how capital buffers influence bank loans controlling for macroeconomic variables.
- In one extreme, we have the possibility that banks are restricted in their abilities to increase their loans in order to compensate for declines in capital buffers.
- In the opposite extreme, we have the case in which capital losses do not result in contraction in loans.

Estimation of Loans' growth regressions

- We also estimate a regression for loans' growth. The baseline equation is:

$$\Delta LOANS_{i,t} = \alpha + \gamma_1 GAP_{t-1} + \gamma_2 \Delta SELIC_{t-1} + \gamma_3 \Delta BUF_{i,t-1} + \varepsilon_{i,t}. \quad (2)$$

- We test for autocorrelation and groupwise heterokedasticity and empirical results suggest that we should employ the "Feasible Generalized Least Squares"(FGLS) estimator.
- We test for a dynamic specification using difference and system-GMM but a static model is preferred.

Capital Buffer Results

VARIABLES	(1) OLS FE	(2) OLS RE	(3) FGLS-AR1	(4) FGLS-AR1
GAP_{t-1}	-9.604*	-9.759*	-0.954**	-1.064***
	(5.673)	(5.325)	(0.408)	(0.365)
ROE_{t-1}	0.00116	0.00162	0.00268	
	(0.00172)	(0.00281)	(0.0118)	
NPL_{t-1}	5.886	3.780**	0.241	
	(4.612)	(1.855)	(0.170)	
$SIZE_{t-1}$	0.137*	0.0903	0.00641*	0.00513*
	(0.0723)	(0.0887)	(0.00336)	(0.00282)
Constant	-3.231*	-2.172	-0.162**	-0.123*
	(1.643)	(2.016)	(0.0763)	(0.0629)
Observations	3,397	3,397	3,395	3,395
Number of banks	134	134	132	132
F/χ^2	.0043***	.0002***	.0284**	.0032***
$AR(1)$			0.134	0.0608

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Capital Buffer Results

VARIABLES	(1) OLS FE	(2) OLS RE	(3) FGLS-AR1	(4) FGLS-AR1
GAP_{t-1}	-9.606*	-9.740*	-0.949**	-1.010***
	(5.674)	(5.319)	(0.410)	(0.355)
ROE_{t-1}	0.00117	0.00104	0.00312	
	(0.00172)	(0.00397)	(0.0118)	
NPL_{t-1}	5.886	3.782**	0.254	
	(4.612)	(1.854)	(0.176)	
$SIZE_{t-1}$	0.136*	0.0973	0.00559	
	(0.0723)	(0.0985)	(0.00362)	
FOREIGN	0	-0.0112	0.0146	
	(0)	(0.218)	(0.0206)	
PRIVATE	-0.137	0.155	0.000533	
	(0.194)	(0.182)	(0.0184)	
Constant	-3.131*	-2.400	-0.148*	-0.00865
	(1.647)	(2.247)	(0.0854)	(0.00578)
Observations	3,397	3,397	3,395	3,395
Number of bank	134	134	132	132
F/χ^2	.0081***	.0004***	.0745*	.0213**
$AR(1)$			0.137	0.0710

Capital Buffer Results

VARIABLES	(1) OLS FE	(2) OLS RE	(3) FGLS-AR1	(4) FGLS-AR1
GAP_{t-1}	-1.397	-1.408	-1.434**	-2.230**
	(1.164)	(1.024)	(0.667)	(0.928)
ROE_{t-1}	0.000281	0.000327	0.00359	
	(0.00180)	(0.00404)	(0.0123)	
NPL_{t-1}	5.769	3.757**	0.310*	0.330**
	(4.590)	(1.864)	(0.162)	(0.168)
$SIZE_{t-1}$	0.130*	0.0971	0.00754**	0.00879***
	(0.0740)	(0.0987)	(0.00329)	(0.00329)
FOREIGN	0	-0.0474	0.0162	
	(0)	(0.226)	(0.0273)	
PRIVATE	-0.144	0.167	0.00388	
	(0.235)	(0.183)	(0.0151)	
$GAP_{t-1} \times PRIVATE$	3.728*	3.257*	1.608**	2.374**
	(2.187)	(1.745)	(0.807)	(1.026)
$GAP_{t-1} \times FOREIGN$	-31.61*	-31.22*	-1.493	
	(17.01)	(16.02)	(1.629)	
Constant	-2.985*	-2.387	-0.195**	-0.220***
	(1.679)	(2.250)	(0.0784)	(0.0743)

Capital Buffer Results

VARIABLES	(1) OLS FE	(2) OLS RE	(3) FGLS-AR1	(4) FGLS-AR1
GAP_{t-1}	-1.308	-1.625	-2.019***	-2.821***
	(1.905)	(1.955)	(0.703)	(0.963)
ROE_{t-1}	0.000285	0.000363	0.00395	
	(0.00182)	(0.00406)	(0.0123)	
NPL_{t-1}	5.770	3.721**	0.306*	0.332**
	(4.581)	(1.843)	(0.162)	(0.168)
$SIZE_{t-1}$	0.129*	0.0956	0.00784**	0.00905***
	(0.0775)	(0.0974)	(0.00329)	(0.00329)
FOREIGN	0	-0.0459	0.0152	
	(0)	(0.221)	(0.0273)	
PRIVATE	-0.143	0.167	0.00405	
	(0.236)	(0.182)	(0.0151)	
$GAP_{t-1} \times PRIVATE$	3.727*	3.260*	1.582**	2.392**
	(2.185)	(1.742)	(0.806)	(1.026)
$GAP_{t-1} \times FOREIGN$	-31.62*	-31.19*	-1.561	
	(17.04)	(16.03)	(1.628)	
$\Delta SELIC_{t-1}$	-0.0734	0.175	0.499***	0.474**
	(1.507)	(1.443)	(0.192)	(0.208)
Constant	-2.974*	-2.353	-0.200**	-0.225***

Capital Buffer Results

VARIABLES	(1) OLS FE	(2) OLS RE	(3) FGLS-AR1	(4) FGLS-AR1
GAP_{t-1}	-1.086	-1.667	-1.939**	-2.821***
	(1.898)	(1.333)	(0.797)	(0.963)
ROE_{t-1}	0.000347	0.000384	0.00370	
	(0.00191)	(0.00407)	(0.0124)	
NPL_{t-1}	5.781	3.712**	0.304*	0.332**
	(4.576)	(1.837)	(0.163)	(0.168)
$SIZE_{t-1}$	0.133*	0.0957	0.00770**	0.00905***
	(0.0745)	(0.0968)	(0.00329)	(0.00329)
FOREIGN	0	-0.0475	0.0168	
	(0)	(0.219)	(0.0278)	
PRIVATE	-0.126	0.169	0.00415	
	(0.230)	(0.181)	(0.0151)	
$GAP_{t-1} \times PRIVATE$	2.305	2.517	1.422	2.392**
	(2.529)	(2.198)	(0.958)	(1.026)
$GAP_{t-1} \times FOREIGN$	-29.87*	-29.79*	-2.365	
	(15.30)	(15.43)	(1.946)	
$\Delta SELIC_{t-1}$	-0.258	0.208	0.438	0.474**
	(0.909)	(0.707)	(0.370)	(0.208)
$\Delta SELIC_{t-1} \times PRIVATE$	1.191	0.628	0.0871	

Loans' Growth Results

VARIABLES	(1) OLS FE	(2) OLS RE	(3) FGLS-AR1	(4) FGLS-AR1
GAP_{t-1}	0.456	-5.343	-0.901**	-0.700*
	(0.411)	(3.472)	(0.429)	(0.368)
NPL_{t-1}	-0.833***	4.617**	0.695***	0.697***
	(0.158)	(1.897)	(0.196)	(0.197)
$\Delta SELIC_{t-1}$	-0.457**	0.631	0.180	
	(0.201)	(1.521)	(0.189)	
ΔBUF_{t-1}	-0.00545*	-0.101	-0.259***	-0.261***
	(0.00312)	(0.113)	(0.0184)	(0.0183)
Constant	0.101***	-0.225**	-0.0311***	-0.0320***
	(0.00761)	(0.0962)	(0.00985)	(0.00984)
Observations	3,263	3,263	3,260	3,260
Number of banks	132	132	129	129
F/χ^2	0***	.1125	0***	0***
AR1			0.158	0.161

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
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Loans' Growth Results

VARIABLES	(1) OLS FE	(2) OLS RE	(3) FGLS-AR1	(4) FGLS-AR1
GAP_{t-1}	0.408	-4.143	-0.710*	-0.561
	(0.403)	(3.211)	(0.417)	(0.359)
NPL_{t-1}	-0.846***	4.971**	0.753***	0.759***
	(0.153)	(1.962)	(0.201)	(0.201)
$\Delta SELIC_{t-1}$	-0.446**	0.294	0.127	
	(0.198)	(1.514)	(0.182)	
ΔBUF_{t-1}	-0.00476	-0.129	-0.285***	-0.286***
	(0.00320)	(0.120)	(0.0183)	(0.0182)
$\Delta BUF_{t-1} \times GAP_{t-1}$	-0.163	5.163	3.964***	4.014***
	(0.187)	(3.204)	(0.942)	(0.940)
Constant	0.101***	-0.227**	-0.0312***	-0.0317***
	(0.00739)	(0.0965)	(0.00987)	(0.00987)
Observations	3,263	3,263	3,260	3,260
Number of banks	132	132	129	129
F/χ^2	0***	.1488	0***	0***
AR1			0.179	0.181

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Loans' Growth Results

VARIABLES	(1) OLS FE	(2) OLS RE	(3) FGLS-AR1	(4) FGLS-AR1
GAP_{t-1}	0.425	-4.336	-0.723*	-0.711*
	(0.411)	(3.250)	(0.429)	(0.368)
NPL_{t-1}	-0.841***	4.878**	0.695***	0.698***
	(0.154)	(1.965)	(0.201)	(0.201)
$\Delta SELIC_{t-1}$	-0.437**	-0.106	0.00377	
	(0.199)	(1.408)	(0.192)	
ΔBUF_{t-1}	-0.00573	-0.0935	-0.246***	-0.246***
	(0.00357)	(0.105)	(0.0178)	(0.0178)
$\Delta BUF_{t-1} \times \Delta SELIC_{t-1}$	-0.0695	2.675	1.805***	1.814***
	(0.0648)	(2.199)	(0.511)	(0.502)
Constant	0.101***	-0.231**	-0.0314***	-0.0313***
	(0.00741)	(0.0979)	(0.00996)	(0.00992)
Observations	3,263	3,263	3,260	3,260
Number of banks	132	132	129	129
F/χ^2	0***	.1816	0***	0***
AR1			0.166	0.166

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Loans' Growth Results

VARIABLES	(1) OLS FE	(2) OLS RE	(3) FGLS-AR1	(4) FGLS-AR1
GAP_{t-1}	0.471	-5.325	-0.814*	-0.667*
	(0.414)	(3.438)	(0.446)	(0.380)
NPL_{t-1}	-0.843***	4.740**	0.817***	0.799***
	(0.160)	(1.904)	(0.208)	(0.206)
$\Delta SELIC_{t-1}$	-0.472**	0.709	0.146	
	(0.205)	(1.515)	(0.192)	
ΔBUF_{t-1}	0.00354	-0.0530	-0.235***	-0.251***
	(0.0153)	(0.0677)	(0.0570)	(0.0267)
PRIVATE	0.0511	0.00119	-0.00290	
	(0.175)	(0.0293)	(0.0174)	
FOREIGN	0	0.0825	0.0298	
	(0)	(0.191)	(0.0202)	
$\Delta BUF_{t-1} \times PRIVATE$	0.00829	-0.210**	-0.117*	-0.104***
	(0.0235)	(0.105)	(0.0620)	(0.0361)
$\Delta BUF_{t-1} \times FOREIGN$	-0.00933	-0.0447	-0.0195	
	(0.0157)	(0.127)	(0.0643)	
Constant	0.0729	-0.258**	-0.0422**	-0.0368***
	(0.0983)	(0.106)	(0.0177)	(0.0104)

Capital Buffer - Summary

- We observe a **negative relationship** between output gap and capital buffers - pro-cyclical behavior!
- Negative coefficients for the GAP indicate that the worsening of the real economy implies in higher capital buffers.
- Therefore, banks would increase their precautionary reserves in bad times, which exacerbates economic fluctuations.
- Capital regulations that have pro-cyclical elements end up amplifying economic cycles, which may imply in further increase in non-performing loans and a decrease in credit supply, affecting adversely financial stability.
- Therefore, these results suggest that counter-cyclical capital rules may be warranted to enhance financial stability.

Loans' Growth - Summary

- Overall our estimates show that capital buffers ($\Delta BUF_{i,t-1}$) are negatively related to loans' growth.
- Hence, a high bank capitalization is associated with reduced loans.
- This is consistent with the previous evidence of the negative effect of the business cycle on capital buffers.

Conclusions

- We find that capital is pro-cyclical in the Brazilian economy.
- There are some differences across banks of different ownership.
- Financial fluctuations may exacerbate economic fluctuations.
- There seems to be room for counter-cyclical measures.

Further research

- Test for Granger causality !
- Different proxies for economic cycle ! (Robustness check)
- Evaluating loans for different sectors ! Substitution effects.