Risk and capital adjustment over the business cycle: Evidence from Indian banks

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*Employing data on Indian banks for 1997-2006, we test the behavior of capital buffers over the business cycle. The evidence indicates that capital buffers exhibit pro-cyclical behavior,
although the implied effects are small.*

1. Introduction

The role of banks in the transmission process of monetary policy and the effect of bank capitalization in this transmission process has been discussed extensively (Kashyap and Stein, 1995; Kishan and Opiela, 2000; Van den Heuvel, 2003). In contrast, their role in transmitting GDP shocks has received limited attention. More specifically, inadequately capitalized banks facing materializing credit risk in a downturn basically have two options to avert the erosion of capital below minimum levels. First, they could raise capital. This is often easier said than done, because raising external capital could be costly and time-consuming (Cornett and Tehranian, 1994; Stein, 1998), while retaining earnings may not be a viable option owing to low returns. Second, banks can increase their capital buffer by reducing risk-weighted assets. However, bank-specific assets are often not marketable or alternately, their prices are depressed in downturns to the extent that their sale implies prohibitive losses. Consequently, a lowering of risk-weighted assets occurs through a cutback in lending. If such a cutback is stronger than indicated by declining loan demand, then the downturn could be further amplified.

The empirical literature has taken two approaches in testing these hypotheses. The first has been to analyze the effects of banks' capitalization on the transmission of business cycle fluctuations to lending. Studies adopting this approach find evidence that low-capitalized banks are forced to cut their loan supply in downturns (Peek and Rosengren, 1995; Gambacorta and Misturelli, 2004). The second approach examines the effect of business cycle fluctuations on banks' capital buffers (Ayuso *et al.*, 2004; Lindquist, 2004) and finds capital buffers exhibit counter-cyclicality.

Both approaches are not without their shortcomings, either. The first approach does not internalize the effects of business cycle fluctuations on banks' capital buffers. In contrast, the second approach explicitly models banks' capital buffers. However, regressing banks' capital buffers on the business cycle cannot distinguish between *deliberate* capital buffer building (i.e., supply-side effects) and demand-side effects working through loan demand.

The present analysis exploits the second approach, but addresses the conceptual limitations. First, if one could demonstrate banks' capitalization affects behavior of capital buffers, this would indicate the existence of supply-side effects. And second, beyond analyzing the effect of business cycle fluctuation on capital buffers, the analysis examines the drivers of the detected effects. In order to do so, capital buffer is decomposed into capital and risk-weighted assets and the effect of business cycle fluctuations on these components is analyzed. Since changes in risk-weighted assets are correlated with lending, it seems likely that changes in risk weighted assets would manifest itself through changes in lending.

The analysis proceeds as follows. We first outline the empirical model (Section 2) and the data and variables (Section 3). An analysis of the results follows thereafter (Section 4) followed by concluding remarks (Section 5).

2. Empirical Model

The banking literature suggests that banks have an incentive to build capital buffers as insurance against violation of the regulatory minimum capital requirements (Milne and Whalley, 2001). This incentive derives from two assumptions. First, banks cannot adjust their capital and risk instantaneously; otherwise, there would be no need for such buffers. Second, a violation of the stipulated capital ratios triggers costly supervisory actions, with negative implications for banks' charter value. This trade-off between the cost of capital holding and the cost of failure determines the optimum capital buffer (Milne and Whalley, 2001).

We weave these hypotheses together into a partial adjustment framework, where banks aim at holding their respective optimum capital buffer. Hence, the evolution of buffer (*BUF*) for bank *i* at time *t* is given by specification (1):

$$\text{BUF}(i, t) - \text{BUF}(i, t\text{-}1) = a\,[\text{BUF}^*(i, t) - \text{BUF}(i, t\text{-}1)] + u(i, t) \qquad \textbf{(1)}$$

where the asterisk denotes optimal buffer, *a* is the speed of adjustment and *u* is the error term.

The optimum buffer is not observable, but depends on the business cycle (CYCLE) due to its effect on credit risk and bank-specific variables (**X**), as suggested by the banking literature (Ayuso *et al*., 2004; Alfon *et al*., 2004). Accordingly, the optimal capital buffer is given by (2):

$$BUF^*(i, t) = a(0) + a(1)\ CYCLE\ (t) + a(2)\ X(i, t) + e\ (i, t) \qquad \textbf{(2)}$$

Combining (1) and (2) and after re-arrangement yields specification (3):

$$BUF\ (i, t) = g(0) + g(1)\ BUF\ (i, t-1) + g(2)\ CYCLE\ (t) + g(3)\ X(i, t) + v(i,.t) \qquad \textbf{(3)}$$

where g(0) = a*a(0); g(1) = (1-*a*); g(2) = a*a(1); g(3) = a*a(3) and *v* = (*a e* +*u*). The specification (3) is akin to Estrella (2004) and Ayuso *et al.* (2004), wherein it is derived from an analytical framework wherein banks minimize costs of holding and adjusting capital.

The hypothesis in terms of coefficient *g*(2) can be postulated as follows:

H1: g(2) >0 (resp., <0): The capital buffer fluctuates pro-cyclically (resp., counter-cyclically) over the business cycle.

Given the model as in (3), we employ dynamic panel data techniques. Accordingly, we report only the two-step system GMM estimates (Blundell and Bond, 1998), which is asymptotically more efficient than the one-step estimates. However, to account for the fact that the two-step estimates tend to be downward biased, we employ the finite sample correction to the two-step covariance matrix derived by Windmeijer (2005).[1]

3. The data and variables

The data for the analysis are drawn from *Statistical tables relating to banks in India*, and *Report on trend and progress of banking in India*. Taken together, these two publications account for all of the bank-level variables employed in the analysis. The macro variables for the study come from the *Handbook of Statistics on Indian economy* (RBI, 2006). Table 1 provides a definition of the variables along with their summary statistics.

With respect to *CYCLE*, we use the real output gap, which isolates the business cycle from the economic trend. The *CYCLE* is computed by subtracting a non-linear trend from real GDP using the Hodrick-Prescott (HP) filter. However, the HP filter is often known to have a bad fit for the first and last observations. To circumvent this problem, we construct the filtered GDP time series on the basis of a longer GDP time series subsuming the sample period. In this fashion, the bad fit for the first and last years of the sample are eliminated from the analysis.

The dependent variable is absolute capital buffer (*BUF*). Alternately, we also employ the standardized capital buffer (*SBUF*) to account for the fact that although two banks may have the same absolute capital buffer, their *SBUF* could differ if one bank's absolute buffer is more volatile than the other. Accordingly, a bank with less volatile capital buffer would be better insured against possible violation of regulatory CRAR.

The bank-specific variables and their rationale can be summarized as under. As raising capital is costly, retained earnings are frequently employed to improve capital buffers. Accordingly, high-profit banks need to hold lower buffers (Milne and Whalley, 2001) which suggest that the expected relation between *BUF* and *RoA* could be negative.

Bank size may affect capital buffers through manifold channels. First, if there are economies of scale in screening and monitoring, large banks should hold relatively less capital. Second, large banks may have better investment and diversification opportunities. Thus, they are subject to lower probability of a large negative shock to their capital and need to hold a lower capital buffer. And finally, the 'too-big-to-fail' hypothesis' suggests that larger banks in financial distress are more likely to be bailed out, because of potential systemic effects. Taking into account these considerations, we include size effects with an expected negative sign.

Further, banks with high liquid asset (*LIQUID*) need less insurance against possible violation of minimum capital requirements, and are therefore, more likely to require lower capital buffer, indicating a negative sign on the variable.

Finally, asset risk may have positive and negative impact on capital buffer. On the one hand, banks may have reacted to the implementation of the Basel Accord by *increasing* asset risk to compensate for having to hold more expensive capital (Koehn and Santomero, 1980), suggesting that portfolio risk exhibits a positive effect on capital buffers. On the other hand, banks may have reacted to the implementation of the Basel Accord by *decreasing* asset risk, as higher capital levels reduce incentives for risk-taking and higher levels of risk lower the incentive for decreasing capital (Furlong and Keeley, 1989). This behavior would be reflected in asset risk having a negative effect on banks' capital buffers. To capture this aspect, we use *NPL* as a proxy for risk (since credit risk is the most important component of bank risk) with an unambiguous sign. We also include a dummy variable to capture mergers as also to distinguish between different bank groups. Table 1 provides a definition of the variables and summary statistics.

We start off with a sample of 60 banks comprising of state-owned, private (old and *de novo*) and foreign banks for the period 1997-2008. This comprises of 28 state-owned, 5 *de novo* private, 16 old private and 11 foreign banks account for over four-fifths of banking assets. Taking on board the mergers and acquisitions, we have an unbalanced panel of banks, with a maximum of 720 bank-years.

Table 2 provides the descriptive statistics for the sub-samples for banks with high and low capital buffers.[2] It also contains the Wilcoxon rank sum test, which tests whether the sub-samples are from the same population.[3] The test shows that, on average, least capitalized banks have higher levels of absolute and standardized capital buffers as also higher capital, although with higher variability.

4. Regression analysis

The results of the estimation are presented in table 3. With respect to *CYCLE*, the coefficient is positive and highly significant. This suggests that capital buffers exhibit pro-cyclical behavior. The implied effects are however, small: when real GDP increases by 1 percentage point, the capital buffer rise by 0.02 percentage points. Although the magnitude of the effect is in sync with the literature, the sign is contrary to the evidence obtaining for developed countries where buffers exhibit an observed counter-cyclicality.

The findings with respect to other variables are also worth mentioning. The estimated coefficient on lagged capital buffer confirms the dynamic specification at the 0.01 level of significance. In effect, the magnitude of the coefficient on lagged absolute buffer equals 0.534, indicating that the coefficient of adjustment of actual buffer to the optimal one equals 0.45.[4]

The estimated coefficient on *RoA* is significant and positive, implying that high profit banks hold high capital buffers. The estimated coefficient on SIZE is negative and highly significant, pointing to economies of scale, diversification effects and advantages in the access to capital. The estimated coefficient on *LIQUID* is significant and negative, consistent with *a priori* expectations. Finally, the coefficient on *NPL* is positive and significant, suggesting that banks with high credit risk hold higher buffers.

The results carry through when *SBUF* (instead of *BUF*) is the dependent variable. The variable *CYCLE* is positive and significant as earlier, indicating that the variability of buffers varies pro-cyclically with the business cycle. The control variables retain their sign and significance.

In Cols.(3) and (4), we decompose the buffer into capital and risk-weighted assets, respectively. The results reveal that capital varies counter-cyclically, whereas risk-weighted assets fluctuate pro-cyclically; the magnitude of the latter is roughly twice as large as the one for capital. Taken together, the stronger pro-cyclical fluctuation of risk-weighted assets *vis-à-vis* the moderate counter-cyclical movement of capital could be the reason behind the pro-cyclical behavior of the capital buffer.

5. Concluding remarks

The analysis examines the behavior of capital buffers over the business cycle and finds strong evidence of pro-cyclicality. A possible reason for such observed behavior can be traced to the stronger pro-cyclical behavior of risk-weighted assets as compared to capital.

These questions are relevant to the policy debate on the design of bank capital regulation. There has long been a concern that prudential capital requirements might exacerbate the pro-cyclicality of bank loan supply. During economic downturns, banks experience losses. An increased incidence of loan loss provisions during such periods might eat into their capital, making the bank capital requirements even more binding. Concurrently, given the uncertainty about the evolving macroeconomic environment and the prospects of any banking firm in particular, the cost of issuing equity to sustain lending during such periods could be prohibitively high. As a consequence, faced with the choice between issuing new capital and curtailing lending, banks may opt for the latter. The role of building up adequate capital buffers assumes relevance in such a situation.

Endnotes

The views expressed and the approach pursued in the paper reflects the author's personal opinion.

1. It is possible that the *BUF* series could contain a unit root, so that it would be preferable to work with changes (Δ) instead of levels, as in (3). However, the Levin-Lin-Chu (2002) unit root test rejects the null hypothesis of a unit root for *BUF*, suggesting that our specification is appropriate.

Variable	Probability

BUF	0.000***
SBUF	0.000***

2. A bank is defined to have a low capital buffer if it is among the 5 per cent least capitalized for the respective year. Otherwise, it is defined as a bank with high capital buffer.

3. Given that financial ratios are typically non-normally distributed, we employ this test which does not depend on the normality assumption.

4. See, for instance, equation (3) where g(1) = (1-*a*). Given g(1)=0.534 in specification (2), therefore *a* equals 0.466, which from equation (1) provides the speed of adjustment.

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Table 1: Definition of bank-specific control variables

Variable	Empirical definition	Obs.	Mean	Std.dev.
BUF	(Actual CRAR – regulatory minimum CRAR)/regulatory minimum CRAR*	530	0.453	0.441
SBUF	BUF/Stdev(Actual CRAR)	530	2.691	1.778
CAP	(Equity+reserves)/Total asset	530	0.077	0.048
RISK	Risk-weighted asset/Total asset	530	0.619	0.343
RoA	Net profit/Total asset	530	0.009	0.010
SIZE	Natural log of total asset	530	9.269	1.358
LIQUID	Cash in hand *plus* balances with central bank *plus* call money/Total asset	530	0.119	0.058
NPL	Non-performing loans/Total loans	530	0.087	0.058
dy MERGER	Unity for the acquirer bank in the year of the merger, else zero	530	0.019	0.136
dy PSB	Unity if bank is state-owned, else zero	530	0.472	0.499
dy NPVT	Unity if bank is new private, else zero	530	0.094	0.292
dy OPVT	Unity if bank is old private, else zero	530	0.226	0.419
dy FB	Unity if bank is foreign, else zero	530	0.208	0.406

* Regulatory minimum CRAR was 8 per cent till 1999 and 9 per cent thereafter

Table 2: Descriptive statistics for control variables – by capitalization

Variable	5 per cent lowest capitalized banks			95 per cent highest capitalized banks			
	Obs.	Mean	Std. dev	Obs.	Mean	Std. dev	Wilcoxon test
BUF	503	0.473	0.444	27	0.084	0.046	8.271***
SBUF	503	2.809	1.746	27	0.499	0.419	7.582***
CAP	503	0.078	0.049	27	0.056	0.019	3.190***
RISK	503	0.618	0.349	27	0.637	0.219	-0.809
RoA	503	0.009	0.010	27	0.008	0.009	0.816
SIZE	503	9.301	1.378	27	8.683	1.244	2.225**
LIQUID	503	0.119	0.059	27	0.132	0.052	-1.485
NPL	503	0.087	0.056	27	0.102	0.093	-0.095
dy MERGER	503	0.019	0.139	27	0.001	0.011	0.739

Table 3: Blundell Bond estimates for the capital buffer

Variable	BUF	SBUF	CAP	RISK
	1	2	3	4
BUF(t-1)	0.534 (0.013)***			
SBUF(t-1)		0.448 (0.132)***		
CAP (t-1)			0.436 (0.212)**	
RISK (t-1)				-0.509 (0.226)**
CYCLE	0.015 (0.005)***	0.111 (0.031)***	-0.101 (0.037)***	0.213 (0.042)***
RoA	0.125 (0.019)***	0.241 (0.117)	0.202 (0.031)***	0.236 (0.033)***
SIZE	-0.093 (0.027)***	-0.336 (0.137)***	-0.263 (0.129)**	-0.237 (0.138)**
LIQUID	-0.074 (0.312)	-0.563 (0.187)***	-0.077 (0.121)	-0.084 (0.096)
NPL	0.086 (0.524)	0.165 (0.032)***	0.078 (0.027)***	0.089 (0.033)***
dy MERGER	-0.680 (0.093)***	0.886 (1.073)	-0.544 (0.136)***	-0.463 (0.212)**
dy PSB	-0.388 (0.186)**	-1.082 (0.535)***	-0.409 (0.242)*	-0.395 (0.213)*
dy NPVT	0.126 (0.147)	1.002 (0.899)	0.135 (0.101)	0.140 (0.118)
dy FB	0.234 (0.115)**	0.877 (0.529)***	0.204 (0.142)	0.194 (0.127)
Constant	0.742 (0.291)***	1.507 (1.354)	0.863 (0.351)***	0.737 (0.322)***
Observations	669	669	669	669
Hansen test	0.129	0.126	0.139	0.145
AR (1) test	0.071	0.107	0.089	0.079
AR (2) test	0.176	0.365	0.209	0.212

Standard errors within parentheses

***, ** and * denote statistical significance at 1, 5 and 10%, respectively