W P S (DEPR): 08 / 2013

RBI WORKING PAPER SERIES

Macroprudential Regulation and Bank Performance: Evidence from India

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SEPTEMBER 2013

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Abstract:

Employing data on Indian banks for 1992-2012, the article examines the impact of macroprudential measures on bank performance. First, it finds that state-owned banks tend to have lower profitability and soundness than their private counterparts. Next, it tests whether such differentials between state-owned and private banks are driven by macroprudential measures; it finds strong support for this hypothesis.

JEL classification: G 21; L 51; P 52

Keywords: banking; macroprudential; capital adequacy; loan classification; provisioning; ownership; India

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Introduction

In recent years, countries have put a lot of emphasis on financial sector reforms as a means to improve the overall functioning of the sector. Such reforms have encompassed a significant gamut of measures, including lowering of statutory reserve requirements, deregulation of interest rates, introduction of measures relating to income recognition, loan classification and provisioning, allowing more liberal entry of foreign banks and diversifying the ownership base of state-owned banks. The evidence emanating from empirical research is admittedly mixed. One set of studies find that financial deregulation leads to an increase in the resilience and performance of the banking sector (Boyd and De Nicolo, 2005; Das and Ghosh, 2006, 2009; Yeyati and Micco, 2007), while others find that the net effect of financial deregulation on the banking sector to be negative (Keeley, 1990; Grifell-Tatje and Lovell, 1996; Wheelock and Wilson, 1999).

The existing literature tends to look at each macroprudential measure in isolation, thereby ignoring the effect of these measures in totality on bank performance. For instance, there are studies that examine the impact of removal of interest rate ceilings on the banking sector (Kwan, 2002; Feyzioglu *et al.*, 2009). Several others consider the effect of prudential regulations on bank risk and performance (Matutes and Vives, 2000; Hellmann *et al*., 2000; Claessens and Laeven, 2004; Agoraki *et al*., 2011). None of the studies take a holistic view on the different macroprudential measures on bank performance. As Allen and Gale (2004) observe, since the aspects of performance, stability, efficiency and soundness of banks are inter-related, careful consideration of all important prudential measures is important for sound empirical analysis.

In this context, the paper investigates how various measures of macroprudential regulation affect the performance of the banking sector. More specifically, we consider the impact of three major dimensions of macroprudential regulation – capital adequacy ratio, provisioning norms and loan classification requirements - on the performance of the Indian banking system. We employ four indicators on which to assess the impact: return on asset (RoA) as the profitability measure, net interest margin (NIM) as the measure of economic efficiency, Z-score as the measure of bank stability and finally, advances growth (Gr_Advances) as a measure of bank business.

India provides a compelling case among emerging markets to examine this issue in some detail. First, beginning from the early 1990s, the country has experienced significant liberalization of the banking sector. These liberalisation measures were premised on the objectives of enhancing efficiency, productivity and profitability of banks (Government of India, 1991; 1998). Second, India is one of the largest and fastest growing emerging economies with a gamut of banks across different ownership categories. It would be of interest to examine the impact of different regulatory measures on the performance of banks across different ownership groups. Third, a comprehensive and reliable banking database for an extended time span is available for Indian banks. The time-series and cross-sectional variation in the data makes it amenable to rigorous statistical analysis. Additionally, the time period of the study, beginning 1992, coincides with the inception of economic reforms. As a result, it permits us to clearly ascertain the impact of regulatory reforms on the performance of Indian banks. These findings might provide useful leads to other emerging market banks to examine the impact of relevant measures on bank performance across different ownership groups.

The paper combines several strands of literature. The first strand is the effect of macroprudential measures on bank performance. Several papers have analyzed the impact of capital requirements on bank risk and performance variables. Employing a partial adjustment framework, Shrieves and Dahl (1992) uncovered evidence to suggest that regulation was effective in the sense that undercapitalized banks (i.e., with capital ratios of less than 7 per cent) increased their capital ratios by more than 100 basis points per annum as compared to other banks. Studies for non-US banks, including UK (Ediz *et al.*, 1998), Switzerland (Rime, 2001) and India (Ghosh *et al.*, 2003) also provide support to the efficacy of capital regulation. In contrast to these studies, we examine the impact of a whole gamut of macroprudential measures on bank behaviour. To the best of our knowledge, this is one of the earliest studies to systematically study the impact of macroprudential regulations on bank behaviour.

Second, the paper is related to the literature on the evolution of the Indian banking sector in the post-deregulation era and on the characterization of the state-owned banks in India (Banerjee *et al.,* 2004; Berger *et al*., 2008; Gormley, 2010; Zhao, 2010; Cole, 2011). The analysis by Banerjee *et al* (2004) appears to suggest that Indian state-owned banks do not provide adequate credit to the private sector. Berger *et al.* (2008) examine relationship lending across bank ownership and finds that state-owned banks to be the main bank for state-owned firms; while foreign banks are less likely to lend to small and opaque firms. Gormley (2010) finds that cherry-picking by foreign banks might lead domestic firms to obtain less credit, because of the drop in domestic lending. Cole (2011) demonstrates that the growth

rate of agricultural credit provided by state-owned banks is 5-10 percentage points higher in election years. The present paper complements these findings by focusing on the impact of several prudential measures and comparing the response across bank ownership.

Finally, this study belongs to the literature which investigates the within-country effects of changes in regulation (Shrieves and Dahl, 1992; Ediz *et al.*, 1998; Stolz, 2007) and to a wider literature which identifies the effects of regulations based on cross-country analysis (Murinde and Yaseen, 2006; Van Roy, 2008; Cosimano and Hakura, 2011). In contrast to the extant literature, this paper explores the impact of several macroprudential measures on bank performance variables. The results suggest that different macroprudential measures exert a differential impact on bank performance.

The remainder of the paper continues as follows. Section 2 provides an overview of Indian financial sector reforms. The relevant literature is covered in Section 3. The data and methods are detailed in Section 4, followed by discussion of the results. The final section concludes.

2. The Indian banking system and regulatory environment

The Indian banking system is characterized by a large number of banks with mixed ownership. As at end-2012, the commercial banking segment comprised of 87 banks, including 26 state-owned banks (SOBs), 20 domestic private banks, including seven *de novo* private and 34 foreign banks. Total bank assets constituted over 90 per cent of GDP in 2011-12. In 1991, on the eve of financial reforms, SOBs share in total banking assets was a little over 90 per cent.

Prior to financial reforms beginning 1992, the financial system in India essentially catered to the needs of planned economic development. The Government played an overarching role in every sphere of economic activity. High levels of reserve requirements pre-empted a large proportion of bank deposits. Likewise, a system of administered interest rate regime resulted in low-quality financial intermediation. The availability of concessional credit to selected sectors resulted in cross-subsidization such that the interest rates charged to borrowers were not commensurate with the underlying risks. Likewise, the inflexibilities in branch licensing and rigid management structures impeded the operational independence of banks. The overall consequence was an inefficient allocation of scarce resources.

The philosophy underlying the financial reforms was to make the banking system more responsive to changes in the market environment. Accordingly, over a

period of time, interest rates have been deregulated, competition has been enhanced and the state-owned banking system has been opened up to private participation. Salient among the measures introduced included: (a) lower statutory reserve requirements; (b) liberalisation of the interest rate regime, on both the deposit and lending sides; (c) allowing liberal entry of foreign banks and permitting the establishment of *de novo* private banks; and, (d) introduction of a wide gamut of prudential measures, in addition to internationally accepted accounting practices.

As a consequence of these measures, the competitive pressures on the banking industry have increased. For example, the five-bank asset concentration ratio has declined from over 0.50 in 1991-92 to less than 0.40 in 2008-09. The banking sector has also become more diversified with an increasing number of private and foreign players (See for instance, Prasad and Ghosh, 2005). Reflecting the efficiency of intermediation, the net interest income has declined from over 3 per cent of total assets to close to 2 per cent (Table 1).

Table 1: Summary of the Banking Industry: 1991-92 to 2011-12 (₹ billion)

Year / Bank Group	1991-92			1997-98			2011-12		
	SOB	DPB	FB	SOB	DPB	FB	SOB	DPB	FB
No. of banks	27	25	24	27	33	42	28	20	41
Total asset	3020	143	252	5317	695	429	60380	16778	5836
Total deposit	2359	123	173	5317	695	429	50020	11746	2771
Total credit	1440	64	93	2599	354	293	38783	9664	2298
Credit-deposit ratio (%)	61.1	52.4	54.1	48.9	51.0	68.3	77.5	82.3	8.9
Share (in per cent)									
Total asset	88.4	4.2	7.4	81.6	10.2	8.2	72.8	20.2	7.0
Total deposit	88.9	4.6	6.5	82.5	10.8	6.7	77.5	18.2	4.3
Total credit	90.1	4.0	5.8	80.1	10.9	9.0	76.4	19.0	4.5
Total income	344	15	38	677	95	87	5351	1585	472
of which: interest income	308	14	29	591	79	68	4847	1340	363
Total expenditure	289	12	25	574	76	62	4188	1201	287
of which: interest expenses	210	8	19	402	59	42	3285	868	152
Provisions	47	2	9	53	10	19	668	156	91
Net profit	8	1	4	5	8	6	495	227	94
Bank asset/GDP (%)	50.7			50.6			93.7		

SOB =State-owned banks; DPB= Domestic private banks; FB=Foreign banks

Three salient macroprudential measures have characterized the process of financial reforms. The first has been the tightening of capital adequacy norms for banks. Driven by the imperatives of liberalization, the capital-to risk-weighted asset ratio (CRAR) for banks was raised to 8 per cent in 1996 (Table 2). More specifically, while Indian banks with international presence and foreign banks were directed to achieve the stipulated CRAR by 1994, other banks were provided another couple of

years to achieve these norms. The capital adequacy norms were further raised to 9 per cent in 2000. Second, in 2000, the Reserve Bank of India (RBI) introduced a provisioning of a minimum of 0.25 per cent on standard loans. This measure was more in response to stimulus from domestic forces. These measures were calibrated during the crisis, wherein the provisions were raised over a period of time, initially to 0.40 per cent and thereafter to a peak of 2 per cent in January 2007 before being subsequently lowered. Finally beginning 1993, the norms for recognizing a loan as non-performing have been gradually rationalized, in line with international best practices. Accordingly, the time period for classifying a loan as "sub-standard" was gradually reduced from the initial 12 months to 3 months (90 days) by 2004. Concomitantly, the period for classifying a loan as "doubtful" was also lowered, from 24 months at the beginning of reforms to 12 months by 2005. We investigate the impact of these macroprudential measures on the performance and soundness of the banking sector.

Table 2: Evolution of prudential norms in India[2]

Year	CRAR (% of RWA)	Non-performing loans (Period overdue in months, M)		Provisioning requirements (% of corresponding loans)				
				Standard loans	Sub-standard loans	Doubtful loans		Loss loans
		Sub-standard loans	Doubtful loans			Secured portion	Unsecured portion	
1992-93	4	12	24	0	10	20-50	100	100
1993-94	8*	9	24	0	10	20-50	100	100
1994-95	8	6	24	0	10	20-50	100	100
1995-96	8	6	24	0	10	20-50	100	100
1996-97	8	6	24	0	10	20-50	100	100
1997-98	8	6	24	0	10	20-50	100	100
1998-99	8	6	24	0	10	20-50	100	100
1999-2000	9	6	24	0.25	10	20-50	100	100
2000-01	9	6	24	0.25	10	20-50	100	100
2001-02	9	6	24	0.25	10	20-50	100	100
2002-03	9	6	18	0.25	10	20-50	100	100
2003-04	9	3	18	0.25	10	20-50	100	100
2004-05	9	3	12	0.40	10	20-50	100	100
2005-06	9	3	12	1.00	10	20-50	100	100
2006-07	9	3	12	2.00	10	20-50	100	100
2007-08	9	3	12	2.00	10	20-50	100	100
2008-09	9	3	12	0.40	10	20-50	100	100
2009-10	9	3	12	0.40**	10	20-50	100	100
2010-11	9	3	12	0.40	10	20-20	100	100
2011-12	9	3	12	0.40	10	20-50	100	100

* : For domestic banks with international presence and foreign banks

** : For capital market, housing and other retail loans; for commercial real estate, it stands at 1 per cent

[2] See, for example, Sinha (2011).

Akin to Besley and Burgess (2004), we code the macroprudential measures as follows. In case there is an increase (resp., decrease) or a tightening (resp., weakening) of a measure in a given year, it is coded as +1 (resp., -1). Provided there is no change in the measure during the year, it is coded as zero. The raw scores across the sub-categories under each of the macroprudential measures are cumulated to arrive at an aggregate index in a given year. As a result, a value greater than one for a given macroprudential measure in a year would signify a tightening; reverse would be the case in case the value is less than one. The macroprudential measure is deemed neutral in case the value of the index in a year equals zero.

3. Literature Review

A significant body of literature has examined the impact of deregulation on bank behaviour. It is possible to broadly distinguish two strands of literature. The first is primarily theoretical in nature, while the second is more empirical in its scope.

The theoretical literature has focused on the interrelationship among financial deregulation, market power and risk-taking by banks. Hellmann *et al.* (2000) contend that capital requirements alone may not be enough to curtail bank risk and additional requirements could be useful to reduce risk in a competitive environment. Diamond and Rajan (2000, 2001) suggest that well-capitalised banks might not be conducive to liquidity creation, simply because higher capital lowers bank weaknesses. More recent research indicates that the relation between deregulation and bank behaviour may not be unambiguous (Boyd *et al*., 2006).

Empirical research into the above models report mixed findings. According to the first strand, the impact of financial deregulation is typically assessed either through a dummy variable (Salas and Saurina, 2003) or simply examining the behaviour of banks during periods of financial deregulation (Das and Ghosh, 2006). The findings indicate that the impact of deregulation on bank behaviour depends, among others, on the state of the banking system and differs significantly across bank ownership.

The second strand of the literature focuses on the impact of financial deregulation on bank performance. Cross-country studies (Maudos and Pastor, 2001) report improvements in performance, post-deregulation. However, given the difficulties inherent in cross-country comparisons (Rodrik, 2012), studies have also been conducted at the country-level. At the country level, studies have examined, among others, the performance of banks in the US (Elyasiani and Mehdian, 1995; Wheelock and Wilson, 1999), Norway (Berg *et al*., 1992), Thailand (Leightner and Lovell, 1998), Korea (Gilbert and Wilson, 1998) and Taiwan (Shyu, 1998).

These studies exhibit two major limitations. First, they focus on a catch-all measure, thereby ignoring the impact of specific policy dimensions of deregulation. Second, most studies examine the impact of financial deregulation on efficiency and productivity, neglecting other measures of bank performance, such as profitability and soundness. Partly as a response to these concerns, two sets of studies have emerged. The first examines the impact of specific regulatory reforms on various facets of bank performance. The second set examines the impact of financial deregulation on alternate measures of bank performance.

As regards the former, Kwan (2002) focused on the impact of interest rate deregulation in bank performance in Hong Kong. The study observed that interest rate deregulation led to significant decline in bank market values. Focusing on China, Feyzioglu (2009) found that interest rate deregulation would raise the cost of capital, improve the return on savings and allow for more efficient financial intermediation. Yet others have examined the one-off impact of changes in loan classification norms on banks' credit portfolio (Das and Ghosh, 2007).

The second set of studies explore the impact of financial deregulation on alternate measures of bank performance. For instance, several studies investigate the determinants of bank profitability or net interest margins (Demirguc Kunt and Huizinga, 2000; Demirguc Kunt *et al*., 2004; Maudos and Solis, 2009) and bank stability indicators (Ianotta *et al*., 2007; Beck *et al*., 2009). These studies veer around the view that financial deregulation generally has a positive effect on performance.

In the Indian case, studies have focused on the impact of financial deregulation on efficiency and productivity as also the impact of specific regulatory measures on bank performance. In an early study on Indian banks for 1986–91, Bhattacharya *et al.* (1997) found that state-owned banks were the best performing banks in terms of efficiency. Kumbhakar and Sarkar (2003) show evidence to suggest that regulatory reform did not exert any perceptible impact on total factor productivity growth. Das and Ghosh (2006) attribute the high cost inefficiency of banks to the under-utilization of resources. Zhao *et al*. (2010) reported that, by increasing competition, greater deregulation encouraged banks to increase risk-taking. More recently, Casu *et al*. (2013) report a positive effect of deregulation on total factor productivity (TFP) for Indian commercial banks covering the period 1992-2004.

The study which comes closest to the spirit of the present analysis is IMF (2012). Employing cross-national data on 36 countries for the period 2000-11, the analysis examined the impact of several macroprudential instruments on both

financial and real variables.[3] The results appear to suggest statistically significant effects for both capital requirements and reserve requirements on credit growth. In terms of real variables, the results point to the fact that limits on loan-to-value (LTV) ratio exerts a non-negligible impact on output growth.

Although there are certain similarities between that study and the present one, there are also important differences. First, unlike the IMF (2012) study, the present article focuses on a single country. This enables us to bypass issues of data comparability that often plague cross-country studies (Honohan, 2008). Second, comparing institutional and political characteristics across countries are difficult, given the wide diversity in their evolution, customs and the institutional context. As a result, focusing on a single country enables to bypass these limitations (Rodrik, 2012). Third, the set of macroprudential instruments considered across the two sets of studies is significantly different. And finally, we explore the differential impact of macroprudential variables across bank ownership, an aspect not addressed by IMF (2012). This paper seeks to fill the gap in the literature and to shed light on the evidence in the context of various measures of macroprudential regulation and banking in India during 1992–2012.

4. The database and sample

Bank-wise data on commercial banks spanning the period 1992 through 2012 are culled out from the various issues of *Statistical Tables Relating to Banks in India*. This publication by Reserve Bank of India provides the annual audited data on the balance sheet and profit and loss accounts of individual banks. The financial year for banks runs from the first day of April of a particular year to the last day of March of the subsequent year. Accordingly, the year 1992 corresponds to the period 1991–92 (April–March) and so on, for the other years. The data has the advantage of being perfectly comparable across banks, with the central bank acting as the regulator of the financial system makes it mandatory for the financial entities to present their balance sheets in the same format and criteria.

The sample comprises of all state-owned banks (SOBs), which account for around 75 per cent of total banking assets, 20 domestic private banks (DPBs), including 5 *de novo* private banks (which became operational after the initiation of reforms), which account for around 15 per cent of banking assets and 16 foreign banks (FBs), accounting for roughly 7 per cent of total banking assets. The excluded private and foreign banks are those which have become operational only recently and therefore, lack a consistent time series of relevant variables. The *de novo* private banks became operational only since 1996. As a result, the number of

3 The macroprudential instruments considered were capital requirements, limits on LTV, cap on debt-to-income and reserve requirements.

reporting banks witnessed a sharp increase thereafter. Subsequently, the banking industry also witnessed some consolidation, both domestic and internationally. We also include a dummy variable for take this aspect on board. As a result, we have an unbalanced panel, with a minimum of 58 banks at the beginning of the sample to a maximum of 64 banks.

Table 3: Variable description and summary statistics

Variable	Empirical definition	Data source	No. Obs	Mean	SD.
Bank-level: Dependent					
RoA	Return on asset=Net profit/Total asset	STB	1307	0.008	0.019
NIM	Net interest margin = (Interest income – interest expense)/Total asset	RTP	1307	0.031	0.026
Ln(1+Z)	Z-score of banks defined as: Z=[(K/A)+(RoA/A)]/SD(RoA) where K=capital; A=asset and SD=3-year rolling standard deviation	STB	1289	1.423	0.491
Gr_Advances	$(Adv_t – Adv_{t-1})/Asset_{t-1}$	STB	1245	0.110	0.196
Bank-level: Independent					
LTA	Log (total asset)	STB	1307	5.957	0.805
SHTA	Total assets of bank *b* in year *t*/ Total bank assets in year *t*	STB	1321	0.016	0.021
DDEP	Demand deposits/ Total deposits	STB	1304	0.105	0.054
NINT	Non-interest income/ Total asset	STB	1307	0.018	0.019
GDPGR	Real GDP growth in year *t*	HSIE	1344	0.067	0.020
Ownership: Independent					
SOB	Unity if bank is state-owned, else zero	RTP	1344	0.438	0.496
DPB	Unity if bank is domestic private, else zero	RTP	1344	0.297	0.457
FB	Unity if the bank is foreign, else zero	RTP	1344	0.266	0.442
Macroprudential: Independent					
CRAR	Coded=1 (resp.,-1) in case of an increase (resp., decrease) in a given year, else zero	RTP	1344	0.095	0.294
PROV	Coded=1 (resp., -1) in case of tightening (resp., weakening) in a given year, else zero	RTP	1344	0.238	0.426
LOAN	Coded=1 (resp.,-1) in case of tightening (resp., weakening) in a given year, else zero	RTP	1344	0.143	0.467
Other dummies: Independent					
d_merger	Dummy=1 for the acquirer bank in the year of merger, else zero	Computed based on RTP & RCF	1344	0.018	0.132

HSIE: Handbook of Statistics on Indian Economy
RCF: Report on Currency and Finance
RTP: Report on Trend and Progress of Banking in India
STB: Statistical Tables relating to Banks in India

With an average of 20.2 years of observations per bank, there are a maximum of 1307 bank-years.[4] The macroeconomic variables are obtained from the *Handbook of Statistics on Indian Economy*, a yearly Indian central bank publication which provides time-series information on the macroeconomic variables. Table 3 provides a description of the relevant variables, including the data source and summary statistics.

5. Results and Discussion

5.1 Univariate tests

Table 4 reports comparisons of various measures of performance, as indicated earlier. The results indicate a clear divergence across ownership. These differences in most cases appear to be economically important, as well. For example, the average NIM for FBs is 3.4 per cent, which is significantly higher as compared to SOBs and DPBs. Return on asset displays the greatest variation, especially for SOBs. Their average RoA is 0.6 per cent, which is around 50 per cent lower than that obtaining for DPBs and roughly half as compared to FBs. All these differences are statistically significant at 0.01 level.

Table 4: Univariate tests: Differences in performance across bank ownership

Variable	RoA	NIM	ln (1+Z)	Gr_Advances	No. banks
SOB	0.006 (0.017)	0.031 (0.036)	1.462 (0.511)	0.105 (0.199)	28
DPB	0.009 (0.007)	0.027 (0.008)	1.529 (0.453)	0.143 (0.178)	19
FB	0.012 (0.028)	0.034 (0.017)	1.259 (0.451)	0.084 (0.203)	17
t-test of difference					
SOB vs. DPB	-3.634***	3.157***	-2.092**	-2.991***	
SOB vs. FB	3.637***	-2.190**	6.345***	2.532***	
DPB vs. FB	-2.057**	-7.384***	-8.004***	4.076***	

Standard deviation in brackets

***, ** & * denote statistical significance at the 1,5 & 10 per cent level, respectively

The results on Z-score and credit growth[5] are no less striking.[6] FBs have statistically significant lower Z-score as well as credit growth as compared to other

[4] In case of Z-score, the average number of observations per year is 20; therefore, the number of bank-years is 1280. For credit growth, owing to the calculation of growth rate, one year of observation is lost from the sample. We have a maximum of 1243 bank-years corresponding to 19.4 years of observation per bank.

[5] To moderate the influence of outliers, the credit growth variable is calculated as in Dinc (2005).

[6] Consistent with the literature, risk taking is measured by the Z-score, which is a proxy for insolvency risk (Boyd and Runkle, 1993; Laeven and Levine, 2009). A higher Z-score indicates that the bank is more stable. Because the Z-score is highly skewed, we employ its natural logarithm, which is normally distributed (Laeven and Levine, 2009).

bank groups. To illustrate, credit growth for FBs is roughly 9 per cent, which is significantly lower as compared to 14.3 per cent growth obtaining for DPBs. Overall, the results in table 3 appear to suggest that FBs have the highest margins and profitability, although their stability and credit growth are the lowest across ownership.

The raw correlations in table 5 show a statistically significant association between the prudential measures and bank performance. Without loss of generality, capital adequacy norms appear to exert a pronounced impact on most measures. On the other hand, NIM appears to be unaffected after imposition of macroprudential measures. As expected, bank stability improves while loan growth is reduced after imposition of capital and provisioning norms. These raw correlations however, do not account for bank-specific controls or changes in the economic environment.

Table 5: Correlation matrix of relevant variables

	CRAR	PROV	LOAN	RoA	NIM	Ln(1+Z)	Gr_Advances
CRAR							
PROV	0.248 (0.00)						
LOAN	0.199 (0.00)	0.069 (0.01)					
RoA	-0.084 (0.00)	-0.016 (0.56)	-0.012 (0.65)				
NIM	-0.012 (0.67)	-0.044 (0.11)	-0.031 (0.26)	0.516 (0.00)			
Ln (1+Z)	0.114 (0.00)	0.069 (0.01)	-0.106 (0.00)	0.241 (0.00)	-0.155 (0.00)		
Gr_Advances	-0.047 (0.09)	0.053 (0.06)	-0.030 (0.28)	0.099 (0.00)	-0.001 (0.95)	0.102 (0.00)	

p-Values in brackets

5.2 Multivariate regression

We control for the factors mentioned above in a multivariate regression framework. Akin to Demirguc Kunt and Huizinga (2000) and Martinez Peria and Mody (2004) and Micco *et al.* (2007), measures of performance are regressed on a set of controls (**X**) included with a lag to account for endogeneity. The regression specification for bank *s* at time *t* is specified as:

$$Perf_{s,t} = \eta_t + X_{s,t-1}\gamma' + \alpha_2 OD_{s,t} + \alpha_3[dy\_merger]_{s,t} + \upsilon_{s,t} \quad \textbf{(1)}$$

In (1), *Perf* is the performance measure, which is regressed on a set of lagged bank-level controls (**X**) and η_t are year fixed effects. All expressions control for the impact of mergers (d_merger). We run the regressions with and without the

ownership dummy (OD) to ascertain its impact on bank performance. Finally, *v* is the error term.

We estimate the impact of explanatory variables on performance by fixed effects panel regressions. This method of estimation provides better estimators than simple OLS when the explanatory variables are correlated with the error term. It is quite straightforward to argue that there is probably significant correlation between unobservable individual characteristics of banks (which are captured by the error term of the OLS regression) and some of the explanatory variables. As a result, employing OLS could render biased coefficients. Using a fixed-effects model can solve the problem of correlation. In the fixed effects specification, the differences across banks are captured by the differences in constant term (Greene, 1993). Throughout, inference is based on standard errors that are clustered at the bank level.

The bank-specific variables include (log of) total assets (LTA), bank-wise asset share (SHTA) in a given year, demand deposits (DDEP) and fee income (NINT). Following Berger *et al.* (2005), we include both LTA and SHTA. The former controls for scale economies and the latter for market power of banks. Among the other variables, DDEP takes into account for banks' funding structure (SOBs tend to rely more on retail deposits as compared to other bank groups) whereas NINT accounts for banks' income diversification (foreign banks tend to rely more on non-interest income).

5.3 Results and Discussion

In Table 6, across the first two sets of specifications, the coefficient on demand deposits is significant and positive, suggesting that banks with greater retail dependence have higher profitability and margins. In the baseline specification, it is observed that a 10 per cent increase in retail dependence improves RoA by nearly 0.3 per centage points. One reason for this could be the low (or, negligible) cost of such deposits, which enables banks to earn higher margins and profitability on such funds. Banks with higher fee incomes are able to generate higher profitability, as expected.

Bigger banks appear to exhibit greater stability. These findings are consistent with Beck *et al.* (2009) who find that bank size exerts a positive impact on stability. Credit growth is slower for big banks, suggestive of the fact that smaller banks increase credit at a faster pace to gain market share.

When we include bank ownership, it is observed that as compared to DPBs, FBs have lower credit growth and stability. The effect is quantitatively important, indicating that the average foreign bank has a credit growth that is 0.08 percentage

points lower as compared to an average domestic private bank. Considering that the average credit growth in the sample is 11 per cent, this is a sizeable difference.

Table 6: Relative performance of banks

Variables	RoA		NIM		Ln (1+Z)		Gr_Advances	
Intercept	0.014 (0.010)	0.009 (0.011)	0.007 (0.015)	0.014 (0.013)	1.029 (0.269)***	1.240 (0.258)***	0.191 (0.110)*	0.245 (0.176)
Controls								
LTA	-0.002 (0.001)*	-0.001 (0.001)	0.003 (0.002)	0.001 (0.001)	0.059 (0.035)*	0.056 (0.034)*	-0.014 (0.008)*	-0.038 (0.018)**
SHTA	0.019 (0.018)	0.019 (0.018)	-0.005 (0.043)	-0.006 (0.044)	0.557 (0.368)	0.799 (0.327)***	-0.136 (0.183)	-0.025 (0.195)
DDEP	0.033 (0.010)***	0.031 (0.009)***	0.021 (0.022)	0.025 (0.020)	0.740 (0.467)	0.774 (0.461)*	0.074 (0.171)	0.120 (0.197)
NINT	0.241 (0.113)**	0.239 (0.118)**	0.452 (0.180)***	0.442 (0.190)**	-0.344 (0.268)	-0.201 (0.154)	-0.125 (0.445)	-0.405 (0.303)
d_merger	0.003 (0.001)**	0.003 (0.001)**	0.006 (0.008)	0.006 (0.008)	0.011 (0.096)	0.020 (0.095)	0.034 (0.047)	0.028 (0.044)
Ownership								
SOB		-0.002 (0.001)*		0.001 (0.004)		-0.103 (0.060)*		0.070 (0.052)
FB		-0.0007 (0.002)		-0.007 (0.002)		-0.220 (0.061)***		-0.078 (0.023)***
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Period	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012
N.Obs;Banks	1291; 64	1291; 64	1291; 64	1291; 64	1280; 64	1280; 64	1243; 64	1243; 64
R^2	0.1527	0.1539	0.1736	0.1765	0.2283	0.2532	0.0364	0.0559

Standard errors (clustered by bank) are within brackets
***, ** and * denote statistical significance at the 1,5 and 10 per cent level, respectively

5.4 The role of macroprudential regulation

The previous discussion indicates that FBs display lower stability and exhibit lower credit growth as compared to DPBs. The analysis does not highlight how specific macroprudential measures impact bank performance. To investigate this further, we check whether macroprudential regulation affects the relationship between ownership and performance by estimating regressions of the following form:

$$Perf_{s,t} = \eta_t + SOB_{s,t}(\alpha_1 + \alpha_2 GDPGR_t + \alpha_3 PRU_t) + FB_{s,t}(\beta_1 + \beta_2 GDPGR_t) + X_{s,t-1}\gamma' + \upsilon_{s,t} \quad \textbf{(2)}$$

In (2), GDPGR measures the real GDP growth in year *t,* and *PRU* (*PRU*=CRAR, LOAN, PROV) is the particular macroprudential measure; the remaining variables are as in Eq. (1).

The main coefficient of interest is α_3. This coefficient measures the impact of implementation of a given macroprudential measure on state-owned banks (the main effect of macroprudential norms is controlled through year effects). We control for the interaction between ownership and GDP growth, because state-owned and foreign banks might respond differently to the business cycle as compared to domestic private banks. This would not be a problem if the business cycles were uncorrelated with the prudential measures, although such a correlation cannot be ruled out (Micco *et al.*, 2007).[7]

Table 7 reports the results for return on asset, interest margins, soundness and credit growth. Take for instance, Column 1. The results suggest that, as compared with DPBs, SOBs have higher profitability during periods of economic expansion, although their profitability is reduced after imposition of capital adequacy norms. The impact of the macroprudential measure is economically meaningful, as well. To see this, consider the differential in profitability of the average SOB and the average DPB in a year in which real GDP grew by 6.7 per cent, the average growth rate in the sample. Ignoring the impact of capital standards, the differential equals 0.011 per cent points [=-0.019+0.067*(0.125)]. Taking on board the impact of capital adequacy norms, the point estimates of Col. 1 yield a difference of 0.023 per cent points [=-0.019+0.067*(0.125)-0.012], an increase of over 100 per cent with respect to the no-capital imposition benchmark. In a similar fashion, in case of both loan classification and provisioning practices (Cols. 2 and 3), the difference in profitability works out to be 85 per cent and 62 per cent, respectively.

Similar results are echoed when we focus on interest margins. More specifically, the evidence indicates that interest margins of SOBs tend to be higher during periods of economic expansion and lower after imposition of macroprudential norms. Again, the coefficient on the macroprudential dummy is quite large and indicates that the differential between the interest margin of state-owned and private banks more than quadruples after imposition of capital adequacy norms (assuming 6.7 per cent GDP growth, the two values are -0.003 and -0.015). Similar, although of slightly lower order of magnitude, are in evidence when the provisioning and loan classification norms are considered. This provides evidence that the macroprudential channel is at work: the decline in profitability is driven to an extent by the lower margins.

[7]The correlation matrix of GDP growth and macroprudential measures indicate that these correlations are of low magnitude (statistical significance at conventional levels indicated by asterisk).

	GDPGR	CRAR	PROV	LOAN
GDPGR				
CRAR	-0.097**			
LOAN	-0.077**	0.199**		
PROV	0.032**	0.248**	0.069**	

Table 7: Regression results: Analysis of bank performance

	Dep variable = RoA			Dep variable = NIM		
	(1)	(2)	(3)	(4)	(5)	(6)
SOB	-0.019 (0.004)***	-0.011 (0.001)***	-0.017 (0.003)***	-0.010 (0.002)***	-0.011 (0.003)***	-0.009 (0.001)***
FB	-0.005 (0.007)	-0.004 (0.007)	-0.004 (0.007)	0.013 (0.005)***	0.014 (0.005)***	0.014 (0.005)***
SOB* GDPGR	0.125 (0.024)***	0.129 (0.031)***	0.134 (0.023)***	0.110 (0.053)**	0.136 (0.072)*	0.117 (0.052)**
FB*GDPGR	0.064 (0.089)	0.063 (0.089)	0.063 (0.090)	-0.179 (0.074)***	-0.181 (0.074)***	-0.180 (0.074)***
SOB*CRAR	-0.012 (0.002)***			-0.012 (0.002)***		
SOB*PROV		-0.002 (0.001)**			-0.005 (0.002)**	
SOB*LOAN			-0.005 (0.001)***			-0.006 (0.002)***
Period	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012
N.Obs; N.banks	1291; 64	1291; 64	1291; 64	1291; 64	1291; 64	1291; 64
R^2	0.1662	0.1585	0.1614	0.1899	0.1854	0.1876
	p-Value of F-test on joint significance of SOB*GDPGR and FB*GDPGR					
	0.50	0.49	0.44	0.00	0.00	0.00
	Dep variable = Ln (1+Z)			**Dep variable = Gr_Advances**		
	(7)	(8)	(9)	(10)	(11)	(12)
SOB	-0.141 (0.055)***	-0.117 (0.059)*	-0.124 (0.056)**	-0.059 (0.025)**	-0.061 (0.026)**	-0.057 (0.029)*
FB	-0.401 (0.129)***	-0.403 (0.129)***	-0.407 (0.129)***	-0.077 (0.058)	-0.076 (0.059)	-0.076 (0.059)
SOB* GDPGR	-2.226 (1.109)**	-3.911 (1.524)***	-2.639 (1.537)*	0.841 (0.453)*	0.856 (0.659)	1.072 (0.683)
FB* GDPGR	2.797 (1.802)	2.827 (1.803)	2.868 (1.805)	-0.032 (0.889)	-0.035 (0.892)	-0.039 (0.891)
SOB*CRAR	0.216 (0.048)***			-0.004 (0.002)**		
SOB*PROV		0.212 (0.045)***			0.016 (0.018)	
SOB*LOAN			-0.236 (0.059)***			0.011 (0.022)
Period	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012
N.Obs; N.banks	1280; 64	1280; 64	1280; 64	1243; 64	1243; 64	1243; 64
R^2	0.2597	0.2687	0.2701	0.0604	0.0582	0.0580
	p-Value of F-test on joint significance of SOB*GDPGR and FB*GDPGR					
	0.00	0.00	0.00	0.28	0.30	0.19

Standard errors (clustered by bank) are within brackets

***, ** and * denote statistical significance at the 1,5 and 10 per cent level, respectively

All specifications include the relevant controls, but they are not reported to conserve space

Cols. (7) to (9) focus on bank soundness. The evidence indicates that the soundness of SOBs declines during periods of economic growth, although macroprudential norms exert a salutary impact. More specifically, capital adequacy and provisioning norms improve soundness, whereas loan classification norms lower it. The magnitude of the macroprudential effect in all cases is extremely large. In case of provisioning norms for example, the point estimates indicate that the differential between the soundness of SOBs and DPBs halves after imposition of such norms (with 6.7 per cent GDP growth, the two values are -0.38 and -0.17).

The final three columns focus on credit growth. In particular, we find that SOBs lower their loan growth after imposition of capital norms. In Col.10 for example, the differential between credit growth of SOBs and DPBs works out to be over 100 per cent (the two values are equal to -0.003 and -0.007 respectively, assuming 6.7 per cent GDP growth).

In other words, the evidence indicates that the state-owned banks are less profitable than private banks and the difference in performance is accentuated after imposition of macroprudential norms.

One possible way to interpret these findings could be the following. One of the major focus of macroprudential requirements has been to improve the resilience of the banking system by creating a cushion for expected and unexpected losses. With state-owned banks being major players in the system in terms of both size and banking space (Subbarao, 2013), this would have entailed an improvement in their soundness in the long-run, perhaps at the cost of trading-off short-term profitability considerations. When weighed on a long-term basis, it seems likely that the pros of such regulations outweigh the cons so as to provide resilience and help in nurturing a stable and sustainable financial system through the cycle.

5.5 Additional tests

In this section, we examine whether our benchmark specification is able to capture important static, dynamic and selection effects, especially for SOBs. In their study of Argentine banking system during the 1990s, Berger *et al.* (2005) observed that in studying the interaction between bank performance and ownership, it is important to distinguish between static, dynamic and selection effects.

The state-owned banks in India provide an ideal laboratory to examine this issue. As part of the process of financial reforms beginning 1991, the relevant banking Acts were amended to enhance the scope for partial private shareholding in SOBs. Over the period 1994-2012, a significant number of SOBs accessed the equity market, with several of them making a follow-on offer. The total amount raised

has been close to Rs.250 billion (≈US$ 5 billion); the government shareholding in the divested banks range from 51-82 per cent. Table 8 highlights some relevant details.

We employ three explanatory variables to decompose the causes and effects of changes in ownership on performance. The first variable is *STAT*, a dummy variable that equals one from the year a bank is privatized. The second variable is *SELECT*, a dummy that equals one throughout the whole sample for banks that were privatized at some point during the sample period. While *SELECT* controls for any selection effects associated with privatization, *STAT* measures the effect of privatization itself. The third variable, *DYN*, is equal to the number of years since the year of privatization. While *STAT* is included to capture the static effects of privatization, *DYN* captures the average yearly performance trend in the wake of privatization.

Table 8. Details of public Issues by state-owned banks (₹ billion)

Year	N.banks accessing equity market	Cumulative N.banks accessing equity market	Amount raised	Cumulative amount raised	Amount raised/ GDP (%)
1994	1	1	22.1	22.1	0.25
1995	1	2	3.6	25.7	0.03
1996	0	2	0	25.7	..
1997	3 (1)	4	29.8	55.5	0.21
1998	4	8	11.1	66.6	0.07
1999	1	9	0.7	67.3	0.004
2000	1	10	1.3	68.6	0.006
2001	3	13	3.9	72.4	0.02
2002	1	14	3.9	76.3	0.02
2003	3	17	7.7	84.1	0.03
2004	3 (1)	19	9.5	93.6	0.03
2005	2 (1)	20	33.4	126.9	0.10
2006	6 (6)	20	54.1	181	0.15
2007	1	21	7.8	188.9	0.02
2008	1	22	8.2	197	0.02
2009	0	22	0	197	..
2010	1	23	3.3	200.3	0.006
2011	3 (2)	24	43.3	243.6	0.06
2012	0	24	0	243.6	..

Figures in brackets indicate the number of SOBs making a follow-on public offer.
Two SOBs have since undergone mergers

To investigate the impact of the interlinkage between ownership and regulation, we estimate the following specification as given by (3):

$$Perf_{s,t} = \eta_t + \gamma_1 STAT_{s,t} + \gamma_2 DYN_{s,t} + \gamma_3 SEL_{s,t} + PRU_t(\theta_1 STAT_{s,t} + \theta_2 DYN_{s,t} + \theta_3 SEL_{s,t}) + X_{s,t-1}\gamma' + \upsilon_{s,t} \quad \textbf{(3)}$$

where *STAT, DYN* and *SEL* are the ownership variable2 as discussed earlier and *PRU* is the relevant macroprudential measure. We introduce the interaction of each macroprudential measures with the ownership variables in a sequential fashion. All regressions take on board the full set of controls variables including year effects and dummies for mergers, although these are not reported. The results are presented in Table 9.

Considering the static effect, we find three significant results. First, whenever significant, the coefficient on NIM is negative and that on Ln (1+Z) is positive. In other words, privatized SOBs tend to have lower margins but higher soundness. Second, macroprudential measures appear to exert a positive impact on performance. Thus, profitability and margins improve after imposition of macroprudential measures, although soundness is adversely impacted. Third, tightening of loan classification norms appears to have exerted a positive impact on their loan growth. Thus, for example, the interaction term *STAT*LOAN* is positive and statistically significant in the *Gr_Advances* equation with a point estimate equal to 0.12. Given an average advances growth of 10.5 per cent for SOBs in the sample, this entails a difference in advances growth of roughly 0.01 per cent (=0.12*0.105) between privatized and non-privatized SOBs.

The dynamic effect of privatization for SOBs is negative and statistically significant for RoA and NIM, and positive in case of soundness, although it is not statistically significant in the other regressions. This indicates that, by lowering the banks' lendable resources, provisions adversely affect profitability and margins, although it improves soundness. This finding suggests that, to some degree, the beneficial effects of privatization in the short-run on profits and bank margins are, to an extent, reversed, as time passes, especially in case of provisioning norms.

Table 9: Static, dynamic and selection effects

	RoA			NIM			Ln (1+Z)			Gr_Advances		
STAT	0.0001 (0.001)	0.0008 (0.002)	-0.0002 (0.002)	-0.009 (0.005)*	-0.010 (0.005)*	-0.012 (0.006)**	0.135 (0.077)*	0.163 (0.084)*	0.136 (0.096)	0.006 (0.018)	-0.009 (0.022)	-0.025 (0.028)
DYN	-0.0002 (0.004)	-0.0001 (0.0004)	-0.0002 (0.0004)	-0.0003 (0.001)	-0.0002 (0.001)	-0.0002 (0.001)	0.006 (0.009)	0.006 (0.010)	0.004 (0.010)	0.002 (0.003)	0.003 (0.004)	0.003 (0.004)
SEL	-0.002 (0.002)	-0.003 (0.002)	-0.003 (0.002)	-0.001 (0.005)	-0.002 (0.005)	-0.003 (0.005)	-0.209 (0.089)**	-0.277 (0.091)***	-0.183 (0.104)*	0.117 (0.083)	0.124 (0.084)	0.129 (0.084)
STAT*CRAR	0.008 (0.003)***			0.012 (0.008)			-0.203 (0.183)			-0.081 (0.138)		
DYN*CRAR	-0.0005 (0.001)			-0.002 (0.003)			0.032 (0.068)			0.015 (0.034)		
SEL*CRAR	-0.007 (0.002)***			-0.0007 (0.003)			-0.263 (0.138)*			0.001 (0.021)		
STAT*PROV		0.005 (0.001)***			0.009 (0.003)***			-0.269 (0.147)*			0.046 (0.031)	
DYN*PROV		-0.0003 (0.0001)**			-0.0008 (0.0003)***			0.026 (0.012)**			0.0007 (0.002)	
SEL*PROV		0.001 (0.001)			0.005 (0.002)**			0.249 (0.121)**			-0.037 (0.023)	
STAT*LOAN			0.005 (0.003)			0.017 (0.006)**			-0.075 (0.159)			0.119 (0.069)*
DYN*LOAN			-0.0001 (0.0005)			-0.0007 (0.001)			0.019 (0.015)			-0.006 (0.005)
SEL*LOAN			-0.002 (0.003)			0.005 (0.004)			-0.208 (0.095)**			-0.047 (0.018)***
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
	F-test of the joint significance of PRU (STAT+DYN+SEL) = 0											
p - Value	0.00	0.00	0.35	0.44	0.00	0.04	0.19	0.12	0.01	0.85	0.21	0.04
Period	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012	1992-2012
N.banks; N.Obs;	28; 574	28; 574	28; 574	28; 574	28; 574	28; 574	28; 574	28; 574	28; 574	28; 551	28; 551	28; 551
R^2	0.4644	0.4635	0.4631	0.4616	0.4637	0.4666	0.3645	0.3686	0.3646	0.2123	0.2133	0.2164

Standard errors (clustered by bank) are within brackets

***, ** and * denote statistical significance at the 1,5 and 10 per cent level, respectively

All specifications include the relevant controls, but they are not reported to conserve space

Finally, when we look at selection effects, we find several significant results. The first indicates that banks with low soundness were selected for privatization: the coefficient on SEL is uniformly negative in the soundness equation. The second indicates that for SOBs selected for privatization, macroprudential norms tend to exert the most pronounced impact on soundness, the magnitudes of which are roughly equal: while capital and loan classification norms lower soundness, provisioning norms tend to improve it. Third, macroprudential norms relating to loan classification norms tend to dampen credit growth for banks selected for privatization. And finally, capital and provisioning norms exert an opposite impact on profitability. Most relevant for our purpose is the fact that macroprudential norms tend to exert a discernible impact of performance.

It might be argued that some of the control variables employed, such as non-interest income and demand deposits, might be endogenous. To circumvent this possibility, the baseline model is re-estimated after deleting these variables. The results are observed to be similar to those obtained earlier. In addition, acknowledging the importance of liquidity and capital in bank behavior, the model is augmented with measures which proxy for these factors. Our main results remain unaltered after inclusion of these variables.

Another issue of relevance is that SOBs are much larger than other banks. This raises the question of whether differences in the effects of regulation between state-owned banks and other banks were driven by the ownership structure, or by economies of scale (especially since bank size was included as a control variable). To examine this further, we re-estimate the baseline specification, weighing each observation by the bank's share of total assets (Levy-Yeyati and Micco, 2007 for the advantages of this approach). Our main results remain materially unchanged in this case.

6. Summary and conclusions

Financial sector reforms in India, undertaken as part of the overall process of reforms since the early 1990s, were aimed at improving the efficiency and productivity of the financial sector. While there have been several studies on bank performance, these papers do not pay adequate attention to the important policy dimensions of prudential deregulation and their impact on bank performance.

In this context, the present study employs panel data techniques to examine the impact of three important macroprudential measures - capital adequacy norms, provisioning requirements and tightening of loan classification norms - on the performance of Indian banks since the 1990. We focus on four major firm characteristics: profitability, margins, soundness and credit growth. The analysis

indicates that the state-owned banks are less profitable than private banks and the difference in performance is accentuated after imposition of macroprudential norms. These results are quite robust. It is apparent in simple univariate comparisons as well as in multivariate regressions that takes on board several control variables.

Summing up, the balance of evidence indicates that different measures of macroprudential regulation exert differential impact on banks across ownership. These divergences could, for example, be the outcome of differences in their business models, product sophistication, customer orientation, risk appetite as well as human and other infrastructural efficiencies. It, therefore, appears important for policymakers to take a holistic view of all prudential measures and their potential impact on the banking system in order to avoid possible pitfalls. Contextually, Rajan (2009) has argued that, in order to ensure that regulations are cycle-proof, it is important that they are premised on 3-Cs: comprehensive, contingent and cost-effective. In other words, by being applied comprehensively to all levered financial firms and being contingent on the overall state of the economy, they would discourage regulatory arbitrage and ensure cost-effectiveness and therefore, be less prone to dilution.

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