

Macroprudential regulation and bank performance: Does ownership matter?

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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.

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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 (FBs) and diversifying the ownership base of state-owned banks (SOBs). 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,^{1–3} whereas others find that the net effect of financial deregulation on the banking sector to be less than convincing.^{4–6}

The existing literature examines each macroprudential measure in isolation. For instance, there are studies that examine the impact of

removal of interest rate ceilings on the banking sector.^{7–8} Several others consider the effect of prudential regulations on bank risk and performance.^{9–12} None of the studies take a holistic view of the different macroprudential measures on bank performance. As Allen and Gale¹³ remark, as the aspects of performance, stability, efficiency and soundness of banks are interrelated, careful consideration of all important prudential measures is important for sound empirical analysis.

In this context, the article investigates how different macroprudential policies (MPPs) affect the performance of banks. More specifically, we consider the impact of three major dimensions of MPPs – 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 and a major

component of RoA, Z-score as the measure of bank stability and, finally, credit growth (Gr_Credit) 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, India has undergone significant liberalization of the banking sector. These measures were premised on the objectives of enhancing efficiency, productivity and profitability of banks.^{14–15} 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 ownership groups. Third, India is one of the few emerging economies that have a comprehensive and reliable banking database for an extended time span. The time-series, cross-sectional variation in the data makes it amenable to rigorous statistical analysis. In addition, the time period of the study, beginning in 1992, coincides with the inception of economic reforms. As a result, it permits us to clearly ascertain the impact of MPPs on the performance of Indian banks. The findings so obtained may be representative of the impact of such measures on the performance of banks across different ownership groups in other emerging markets.

The article combines several strands of literature. The first strand is the effect of MPPs on the performance of banks. Of late, several studies have emerged that examine the efficacy of MPPs. For example, cross-country studies examine the role of MPPs on bank credit and finds that, under certain circumstances, such policies are effective in moderating the procyclical behaviour of credit.¹⁶ Employing quarterly data for several Central, Eastern and South Eastern European economies for the period 1999–2011, Vandebussche and colleagues find that measures such as capital adequacy ratio and marginal reserve requirements exerted a dampening effect on house prices.¹⁷ Others have empirically investigated the impact of MPPs on bank credit off-take.¹⁸ The results suggest that

MPPs can be effective in substantially lowering the incidence of a credit boom, and especially those credit booms that might engender a financial crisis. More recently, utilizing information on over 2500 banks for 48 countries, Claessens and colleagues¹⁹ report that MPPs are effective in arresting excessive risk-taking by banks. In contrast to the cross-national studies discussed above, the present study focuses on a single country. To the best of our knowledge, this is one of the earliest studies to systematically study the impact of MPPs on bank behaviour for a leading emerging economy.

Second, the article is related to the literature on the evolution of the Indian banking sector in the post-deregulation era and on the characterization of the SOBs. In an examination of relationship lending across bank ownership, Berger and colleagues²⁰ found that SOBs are the main bank for state-owned firms, whereas FBs are less likely to lend to small and opaque firms. Thereafter, Gormley²¹ reported that cherry-picking by FBs in India might lead domestic firms to obtain less credit, because of the drop in domestic lending. As regards extension of agricultural credit, Cole²² demonstrates that the growth rate of agricultural credit provided by SOBs in India is 5–10 percentage points higher in election years. Other studies (Zhao and colleagues²³) find that, by increasing competition, greater deregulation encouraged banks to increase risk-taking. More recent research uncovers a positive effect of deregulation on total factor productivity (TFP) covering the period 1992–2004.²⁴ The present article complements these findings by focusing on the impact of several MPPs and comparing the response across bank ownership.

Finally, this study belongs to the literature that investigates the within-country effects of changes in regulation^{25–27} and to a wider literature that identifies the effects of regulation based on cross-country analysis.^{28–30} In contrast to the extant literature, this article explores the impact of several MPPs on bank performance variables. The results suggest that different



macroprudential measures exert a differential impact on bank performance.

The remainder of the article continues as follows. The second section provides an overview of Indian financial sector reforms, followed by the literature (the third section), data and methods (the fourth section), followed by a discussion of the results (the fifth section). The final section concludes.

THE INDIAN BANKING SYSTEM AND REGULATORY ENVIRONMENT

The Indian banking system is characterized by a large number of banks with mixed ownership. As in the end of 2012, the commercial banking segment comprised 87 banks, including 26 SOBs, 20 domestic private banks (DPBs), including 7 *de novo* private and 34 foreign banks (FBs). Total bank assets constituted over 90 per cent of GDP in 2011–2012, with the share of SOBs being around three-fourths. In 1991, on the eve of financial reforms, the share of SOBs in total banking assets was a little over 90 per cent.

Before financial reforms beginning in 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: (i) lower statutory reserve requirements; (ii) liberalization of the interest rate regime, on both the deposit and lending sides; (iii) allowing liberal entry of FBs and permitting the establishment of *de novo* private banks; and (iv) 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 1991–1992 to less than 0.40 in 2008–2009. The banking sector has also become more diversified with an increasing number of private and foreign players.³¹ 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).

Three salient macroprudential measures have characterized the process of financial sector 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, whereas Indian banks with international presence and FBs 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 Indian central bank introduced a provisioning at 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 moderated. Finally, beginning in 1993, the norms for

Table 1: Summary of the banking industry: From 1991–1992 to 2011–2012 (Rs. billion)

Year/bank group	1991–1992			1997–1998			2011–2012		
	SOB	DPB	FB	SOB	DPB	FB	SOB	DPB	FB
Number of banks	27	25	24	27	33	42	26	20	41
Total asset	3020	143	252	5317	695	429	60 380	16 778	5836
Total deposit	2359	123	173	5317	695	429	50 020	11 746	2771
Total credit	1440	64	93	2599	354	293	38 783	9664	2298
Credit–deposit ratio (in percentage)	61.1	52.4	54.1	48.9	51.0	68.3	77.5	82.3	8.9
<i>Share (in percentage)</i>									
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 (in percentage)		50.7			50.6			93.7	

SOBs = State-owned banks; DPBs = Domestic private banks; FBs = Foreign banks.

Table 2: Evolution of prudential norms in India

Year	CRAR (percentage of Risk-weighted asset)	Non-performing loans (period overdue in months)		Provisioning requirements (percentage of corresponding loans)				
		Sub-standard loans	Doubtful loans	Standard loans	Sub-standard loans	Doubtful loans		Loss loans
						Secured portion	Unsecured portion	
1992–1993	4	12	24	0	10	20–50	100	100
1993–1994	8 ^a	9	24	0	10	20–50	100	100
1994–1995	8	6	24	0	10	20–50	100	100
1995–1996	8	6	24	0	10	20–50	100	100
1996–1997	8	6	24	0	10	20–50	100	100
1997–1998	8	6	24	0	10	20–50	100	100
1998–1999	8	6	24	0	10	20–50	100	100
1999–2000	9	6	24	0.25	10	20–50	100	100
2000–2001	9	6	24	0.25	10	20–50	100	100
2001–2002	9	6	24	0.25	10	20–50	100	100
2002–2003	9	6	18	0.25	10	20–50	100	100
2003–2004	9	3	18	0.25	10	20–50	100	100
2004–2005	9	3	12	0.40	10	20–50	100	100
2005–2006	9	3	12	1.00	10	20–50	100	100
2006–2007	9	3	12	2.00	10	20–50	100	100
2007–2008	9	3	12	2.00	10	20–50	100	100
2008–2009	9	3	12	0.40	10	20–50	100	100
2009–2010	9	3	12	0.40 ^b	10	20–50	100	100
2010–2011	9	3	12	0.40	10	20–20	100	100
2011–2012	9	3	12	0.40	10	20–50	100	100

^aFor domestic banks with international presence and foreign banks.

^bFor capital market, housing and other retail loans; for commercial real estate, it stands at 1 per cent.



recognizing a loan as non-performing were 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 MPPs on the behaviour of the banking sector.

Following Sinha,³² we code the MPPs as follows. In case there is an increase (respectively, decrease) or a tightening (respectively, weakening) of a measure in a given year, it is coded as +1 (respectively, -1). Provided there is no change in the measure during the year, it is coded as 0. The raw scores across the sub-categories under each of the MPPs are cumulated to arrive at an aggregate index in a given year. As a result, a value greater than 1 for a given MPP in a year would signify a tightening; reverse would be the case in the event the value is less than 1. The MPP is deemed neutral in case the value of the index in a year equals 0.

LITERATURE REVIEW

The theoretical literature has focused on the interrelationship among financial deregulation, market power and risk-taking by banks. Hellmann and colleagues³³ contend that capital requirements alone may not be enough to curtail bank risk, and additional requirements could be useful in reducing risk in a competitive environment. Other authors suggest that well-capitalised banks might not be conducive to liquidity creation, simply because higher capital lowers bank weaknesses.^{34–35} More recent research indicates that the relation between deregulation and bank behaviour may not be unambiguous.³⁶

Empirical research into the above models reports mixed findings. According to the first strand, the impact of financial deregulation is typically assessed either through a dummy variable (for example, Salas and Saurina³⁷) or by

simply examining the behaviour of banks during periods of financial deregulation (for example, Das and Ghosh³⁸). 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 report improvements in performance, post-deregulation.³⁹ However, given the difficulties inherent in cross-country comparisons,⁴⁰ studies have also been conducted at the country level. At the country level, studies have examined, among others, the performance of banks in the United States,⁴¹ Norway,⁴² Thailand,⁴³ Korea⁴⁴ and Taiwan.⁴⁵

These studies suffer from 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's⁴⁶ study for Hong Kong focused on the impact of interest rate deregulation in bank performance in Hong Kong. The study uncovered evidence that interest rate deregulation led to significant decline in bank market values. Focusing on China, Feyzioglu and colleagues⁴⁷ observed that interest rate deregulation raised the cost of capital, improved the return on savings and allowed for more efficient financial intermediation. Yet others have examined the one-off impact of changes in loan classification norms on banks' credit portfolio.⁴⁸

The second set of studies explores the impact of financial deregulation on alternate measures

of bank performance. For instance, several studies investigate the determinants of bank profitability or NIMs^{49–51} and bank stability indicators.^{52–53} These studies veer around the view that financial deregulation exerted 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 1986–1991, Bhattacharyya and colleagues⁵⁴ reported that SOBs were the best performing banks in terms of efficiency. Subsequent evidence suggests that regulatory reforms did not exert any perceptible impact on TFP growth (see, for example, Kumbhakar and Sarkar⁵⁵). More recent research by Casu and colleagues⁵⁶ observe a positive effect of deregulation on TFP for Indian commercial banks covering the period 1992–2004.

The study that comes closest to the spirit of the present analysis is IMF.⁵⁷ Employing cross-national data on 36 countries for the period 2000–2011, the analysis examined the impact of several MPPs on both financial and real variables.⁵⁸ 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 above-cited study, the present article focuses on a single country. This enables us to bypass issues of data comparability that often plague cross-country studies (Honohan⁵⁹). 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. Third, the set of MPPs is significantly different across the two sets of studies. And finally, we explore the impact of MPPs across

bank ownership, an aspect not addressed in the IMF study. This article seeks to fill the gap in the literature and to shed light on the evidence in the context of various MPPs and banking in India during 1992–2012.

THE DATABASE AND SAMPLE

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 the Indian central bank 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 1991–1992 (April–March) and so on for the other years. The data have the advantage of being perfectly comparable across banks, with the central bank acting as the regulator of the financial system requiring the financial entities to present their balance sheets in the same format and criteria.

The sample comprises all SOBs, which account for around 75 per cent of total banking assets, 20 DPBs, including 5 *de novo* private banks (that became operational after the initiation of reforms), which account for around 15 per cent of banking assets and 16 FBs, accounting for roughly 7 per cent of total banking assets. The excluded private and FBs 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 reporting banks witnessed a sharp increase thereafter. Subsequently, the banking industry also witnessed some consolidation, both domestic and internationally. We 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. With an average of 20.2 years of observations per bank, there is a total of 1307 bank-years.⁶⁰ Finally, the

Table 3: Variable description and summary statistics

Variable	Empirical definition	Data source	Number of observations	Mean	SD
<i>Bank level: Dependent</i>					
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 = standard deviation	STB	1289	1.423	0.491
Gr_Credit	$(Credit_t - Credit_{t-1})/Asset_{t-1}$	STB	1245	0.110	0.196
<i>Bank level: Independent</i>					
LTA	Log (total asset)	STB	1307	5.957	0.805
SHTA	Total assets of bank <i>b</i> in year <i>t</i> /Total banking assets in year <i>t</i>	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 <i>t</i>	HSIE	1344	0.067	0.020
<i>Ownership dummies</i>					
SOB	Unity if bank is state-owned, else 0	RTP	1344	0.438	0.496
DPB	Unity if bank is domestic private, else 0	RTP	1344	0.297	0.457
FB	Unity if the bank is foreign, else 0	RTP	1344	0.266	0.442
<i>Regulation dummies</i>					
CRAR	Coded = 1 (respectively, –1) in case of an increase (respectively, decrease) in a given year, else 0	RTP	1344	0.095	0.294
PROV	Coded = 1 (respectively, –1) in case of tightening (respectively, weakening) in a given year, else 0	RTP	1344	0.238	0.426
LOAN	Coded = 1 (respectively, –1) in case of tightening (respectively, weakening) in a given year, else 0	RTP	1344	0.143	0.467
<i>Other dummies</i>					
dy_merger	Dummy = 1 for the acquirer bank in the year of merger, else 0	Computed based on RTP and 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.

macroeconomic variables are obtained from the *Handbook of Statistics on Indian Economy*, a yearly Indian central bank publication that provides time-series information on the macroeconomic variables. Table 3 provides a description of the relevant variables, including the data source and summary statistics.

RESULTS AND DISCUSSION

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 with SOBs and DPBs. RoA 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 with FBs. All these differences are statistically significant at the 0.01 level.

The results on Z-score and credit growth⁶¹ are no less striking.⁶³ FBs have statistically significant lower Z-score as well as credit growth as compared with other bank groups. To illustrate, credit growth for FBs is roughly

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

Variable	RoA	NIM	ln (1+Z)	Gr_Credit	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
<i>t-test of difference</i>					
SOB versus DPB	-3.634***	3.157***	-2.092**	-2.991***	
SOB versus FB	3.637***	-2.190**	6.345***	2.532***	
DPB versus FB	-2.057**	-7.384***	-8.004***	4.076***	

** and *** denote statistical significance at the 5 and 1 per cent level, respectively. Standard deviation within brackets.

Table 5: Correlation matrix of relevant variables

	CRAR	PROV	LOAN	RoA	NIM	ln (1+Z)	Gr_Credit
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_Credit	-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.

9 per cent, which is significantly lower as compared with 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 correlation matrix in Table 5 shows a statistically significant association between the MPPs and bank performance. Without loss of generality, capital adequacy norms appear to exert a pronounced impact on most measures, except for margins. 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.

Multivariate regression

We control for the factors mentioned above in a multivariate regression framework. Akin to

Martinez Peria and Mody⁶⁶ and Micco and colleagues,⁶⁷ 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 according as:

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

In equation (1), $Perf$ is the performance measure, which is regressed on a set of lagged bank-level controls (X) and η_t is year fixed effects. All expressions control for the impact of mergers (dy_merger). We run the regressions with and without the ownership dummy (OD) to ascertain its impact on bank performance. Finally, ν 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. For example, it is possible that some of the control variables employed might be



endogenous with respect to the performance indicators. In that case, 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 (for example, Greene⁶⁸). 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 and colleagues,⁶⁹ 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 with other bank groups), whereas NINT accounts for banks' income diversification (FBs have higher reliance on non-interest income).

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 percentage 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 and colleagues⁷⁰ 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 in order to gain market share.

When we include bank ownership, it is observed that as compared with DPBs, FBs have

lower credit growth and stability. The effect is quantitatively important, indicating that the average FB has a credit growth that is 0.08 per cent points lower as compared with an average DPB. Considering that the average credit growth in the sample is 11 per cent, this is a sizeable difference.

The role of macroprudential regulation

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

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

In equation (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 defined in equation (1).

Our main coefficient of interest is α_3 . The coefficient measures the impact of implementation of a given MPP on SOBs (the main effect of MPPs is controlled through year effects). We control for the interaction between ownership and GDP growth, because SOBs and FBs might respond differently to the business cycle as compared with DPBs. This would not be a problem if the business cycles were uncorrelated with the prudential measures, although such a correlation cannot be ruled out (see, for instance, Micco and colleagues⁷¹).

Table 7 reports the results for RoA, 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

Table 6: Regression results: Relative performance of banks

Variables	RoA		NIM		ln (1+Z)		Gr_Credit	
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)
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)
dy_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)
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
Number of observations; Banks	1291; 64	1291; 64	1291; 64	1291; 64	1291; 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

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

Note: Standard errors (clustered by bank) are within brackets.

Table 7: Regression result: Analysis of bank performance

	<i>Dependent variable = RoA</i>			<i>Dependent variable = NIM</i>		
	(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
Number of observations; 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
<i>P</i> -value of <i>F</i> -test on joint significance of SOB*GDPGR and FB*GDPGR						
	0.50	0.49	0.44	0.00	0.00	0.00
	<i>Dependent variable = ln (1+Z)</i>			<i>Dependent variable = Gr_Credit</i>		
	(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
Number of observations; 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
<i>P</i> -value of <i>F</i> -test on joint significance of SOB*GDPGR and FB*GDPGR						
	0.00	0.00	0.00	0.28	0.30	0.19

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

Note: Standard errors (clustered by bank) are within brackets.

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 the tightening of capital standards, the differential is equal to 0.011 percentage point

[$= -0.019 + 0.067 \cdot (0.125)$]. Taking on board the impact of capital adequacy norms, the point estimates of Column 1 yield a difference of 0.023 percentage point [$= -0.019 + 0.067 \cdot (0.125) - 0.012$], 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 (Columns 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 MPPs. Again, the coefficient on the macroprudential dummy is quite large and indicates that the differential between the interest margin of SOBs and DPBs 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.

Columns 7–9 focus on bank soundness. The evidence indicates that the soundness of SOBs declines during periods of economic growth, although MPPs 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 increase their loan growth after imposition of capital norms. In Column 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 SOBs are less profitable than private banks, and the difference in performance is accentuated after imposition of macroprudential norms.

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 and colleagues⁷² observed that in studying the interaction between bank performance and ownership it is important to distinguish between static, dynamic and selection effects.

The SOBs in India provide an ideal laboratory to examine this issue. As part of the process of financial reforms beginning in 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 (\approx US\$ 5 billion); the government shareholding in the divested banks range from 51 to 80 per cent. Table 8 provides the 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 1 from the year a bank is privatized. The second variable is *SELECT*, a dummy that equals 1 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 immediate effects of



Table 8: Details of public issues by state-owned banks (Rs. billion)

Year	Number of banks accessing equity market	Cumulative number of banks accessing equity market	Amount raised	Cumulative amount raised	Amount raised/GDP (in percentage)
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 banks making a follow-on public offer.

privatization, *DYN* captures the average yearly performance trend in the wake of privatization.

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

$$\begin{aligned}
 Perf_{s,t} = & \eta_t + \alpha_1 STAT_{s,t} + \alpha_2 DYN_{s,t} + \alpha_3 SEL_{s,t} \\
 & + PRU_i(\beta_1 STAT_{s,t} + \beta_2 DYN_{s,t} \\
 & + \beta_3 SEL_{s,t}) + X_{s,t-1}\gamma' + v_{s,t} \quad (3)
 \end{aligned}$$

where *STAT*, *DYN* and *SEL* are the relevant ownership variable as discussed above, and *PRU* is the macroprudential dummy. We sequentially introduce the interaction of the macroprudential measures with the ownership variables. 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, whereas that on

$\ln(1+Z)$ is positive. In other words, privatized SOBs tend to have lower margins and higher soundness. Second, macroprudential measures appear to exert a positive impact on the performance of privatized SOBs. Thus, profitability and margins improve after imposition of macroprudential measures, although soundness is adversely impacted. The latter occurs because higher provisions make a dent into their capital, thereby impacting equity, and hence soundness. Third, tightening of loan classification norms appears to exert a positive impact on loan growth. Thus, for example, the interaction term *STAT*LOAN* is positive and statistically significant in the *Gr_Credit* 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.

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 in case of SOBs selected for privatization, *MPPs* 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, *MPPs* relating to loan classification norms tend to dampen credit growth for banks selected for privatization. And finally, *CRAR* and *PROV* exert an opposite impact on

Table 9: Regression results: Static, dynamic and selection effects for state-owned banks

	<i>RoA</i>			<i>NIM</i>		
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)**
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)
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)
STAT*CRAR	0.008 (0.003)***	—	—	0.012 (0.008)	—	—
DYN*CRAR	-0.0005 (0.001)	—	—	-0.002 (0.003)	—	—
SEL*CRAR	-0.007 (0.002)***	—	—	-0.0007 (0.003)	—	—
STAT*PROV	—	0.005 (0.001)***	—	—	0.009 (0.003)***	—
DYN*PROV	—	-0.0003 (0.0001)**	—	—	-0.0008 (0.0003)***	—
SEL*PROV	—	0.001 (0.001)	—	—	0.005 (0.002)**	—
STAT*LOAN	—	—	0.005 (0.003)	—	—	0.017 (0.006)**
DYN*LOAN	—	—	-0.0001 (0.0005)	—	—	-0.0007 (0.001)
SEL*LOAN	—	—	-0.002 (0.003)	—	—	0.005 (0.004)
Controls	YES	YES	YES	YES	YES	YES
	<i>F</i> -test of the joint significance of PRU (STAT+DYN+SEL) = 0					
<i>p</i> -Value	0.00	0.00	0.35	0.44	0.00	0.04
Period	1992–2012	1992–2012	1992–2012	1992–2012	1992–2012	1992–2012
Banks; No. of Observations	28; 574	28; 574	28; 574	28; 574	28; 574	28; 574
<i>R</i> ²	0.4644	0.4635	0.4631	0.4616	0.4637	0.4666
	<i>Ln (1+Z)</i>			<i>Gr_Credit</i>		
STAT	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	0.006 (0.009)	0.006 (0.010)	0.004 (0.010)	0.002 (0.003)	0.003 (0.004)	0.003 (0.004)
SEL	-0.209 (0.089)**	-0.277 (0.091)***	-0.183 (0.104)*	0.117 (0.083)	0.124 (0.084)	0.129 (0.084)
STAT*CRAR	-0.203 (0.183)	—	—	-0.081 (0.138)	—	—
DYN*CRAR	0.032 (0.068)	—	—	0.015 (0.034)	—	—
SEL*CRAR	-0.263 (0.138)*	—	—	0.001 (0.021)	—	—
STAT*PROV	—	-0.269 (0.147)*	—	—	0.046 (0.031)	—
DYN*PROV	—	0.026 (0.012)**	—	—	0.0007 (0.002)	—
SEL*PROV	—	0.249 (0.121)**	—	—	-0.037 (0.023)	—
STAT*LOAN	—	—	-0.075 (0.159)	—	—	0.119 (0.069)*
DYN*LOAN	—	—	0.019 (0.015)	—	—	-0.006 (0.005)
SEL*LOAN	—	—	-0.208 (0.095)**	—	—	-0.047 (0.018)***
Controls	YES	YES	YES	YES	YES	YES
	<i>F</i> -test of the joint significance of PRU (STAT+DYN+SEL) = 0					
<i>p</i> -Value	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
Banks; No. of Observations	28; 574	28; 574	28; 574	28; 551	28; 551	28; 551
<i>R</i> ²	0.3645	0.3686	0.3646	0.2123	0.2133	0.2164

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

Note: Standard errors (clustered by bank) are within brackets.



profitability. Most relevant for our purpose is the fact that MPPs tend to exert a discernible impact of performance.

We conduct several other robustness checks as well. First, 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 behaviour, 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 SOBs and other banks are driven by their ownership structure, or by economies of scale (especially as 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 (see, for example, Levy-Yeyati and Micco⁷³ for the advantages of this approach). Our main results remain materially unchanged in this case.

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 macroprudential regulation 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 SOBs 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. 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.

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REFERENCES AND NOTES

- 1 Boyd, J.H. and De Nicolo, G. (2005) The theory of bank risk taking and competition revisited *Journal of Finance* 60(5): 1329–1343.
- 2 Das, A. and Ghosh, S. (2009) Financial deregulation and profit efficiency: A nonparametric analysis of Indian banks. *Journal of Economics and Business* 61(4): 509–528.
- 3 Yeyati, E.L. and Micco, A. (2007) Concentration and foreign penetration in Latin American banking sectors: Impact on competition and risk. *Journal of Banking and Finance* 31(5): 1633–1647.
- 4 Keeley, M. (1990) Deposit insurance, risk and market power in banking. *American Economic Review* 80(3): 1183–1200.
- 5 Grifell-Tatje, E. and Knox Lovell, C.A. (1996) Deregulation and productivity decline: The case of Spanish savings banks. *European Economic Review* 40(5): 1281–1303.
- 6 Wheelock, D.C. and Wilson, P.W. (1999) Technical progress, inefficiency and productivity change in US banking. *Journal of Money, Credit and Banking* 31(2): 212–234.
- 7 Kwan, S.H. (2002) Impact of deposit rate deregulation in Hong Kong on the market value of commercial banks. *Journal of Banking and Finance* 27(5): 2231–2248.
- 8 Feyzioglu, T., Porter, N. and Takats, E. (2009) Interest Rate Liberalization in China. Washington DC: IMF. IMF Working Paper 171.

- 9 Agoraki, M.-E., Delis, M.D. and Pasiouras, F. (2011) Regulations, competition and bank risk-taking in transition economies. *Journal of Financial Stability* 7(1): 38–48.
- 10 Hellmann, T.F., Murdock, K. and Stiglitz, J.E. (2000) Liberalization, moral hazard and prudential regulation: Are capital requirements enough? *American Economic Review* 90(1): 146–165.
- 11 Matutes, C. and Vives, X. (2000) Imperfect competition, risk taking and regulation in banking. *European Economic Review* 44(1): 1–34.
- 12 Claessens, S. and Laeven, L. (2004) What drives banking competition? Some international evidence. *Journal of Money, Credit and Banking* 36(3): 563–583.
- 13 Allen, F. and Gale, D. (2004) Competition and financial stability. *Journal of Money, Credit and Banking* 36(2): 453–480.
- 14 Government of India (1991) *Report of the Committee on the Financial System*. New Delhi, India: Government of India.
- 15 Government of India (1998) *Report of the Committee on Banking Sector Reforms*. New Delhi, India: Government of India.
- 16 Lim, C. et al (2011) Macroprudential Policy: What Instruments and How to Use Them? Lessons from Country Experiences. Washington DC: IMF. IMF Working Paper 238.
- 17 Vandenbussche, J., Vogel, U. and Detragiache, E. (2012) Macroprudential Policies and Housing Prices – A New Database and Empirical Evidence for Central, Eastern and South Eastern Europe. Washington DC: IMF. IMF Working Paper 303.
- 18 Dell’Ariccia, G., Igan, D., Laeven, L. and Tong, H. (2012) Policies for Macrofinancial Stability: Options to Deal with Credit Booms. Washington DC: IMF. IMF Staff Discussion Note 126.
- 19 Claessens, S., Ghosh, S.R. and Mihet, R. (2013) Macroprudential policies to mitigate financial system vulnerabilities. In: O. Canuto and S.R. Ghosh (eds.) *Dealing with the Challenges of Macrofinancial Linkages*. Washington DC: The World Bank, pp. 155–178.
- 20 Berger, A.N., Klapper, L.F., Martinez Peria, M.S. and Zaidi, R. (2008) Bank ownership type and banking relationships. *Journal of Financial Intermediation* 17(1): 37–62.
- 21 Gormley, T. (2010) The impact of foreign bank entry in emerging markets: Evidence from India. *Journal of Financial Intermediation* 19(1): 26–51.
- 22 Cole, S. (2011) Fixing market failures or fixing elections: Agricultural credit in India. *American Economic Journal: Applied Economics* 1(1): 219–250.
- 23 Zhao, T., Casu, B. and Ferrari, A. (2010) The impact of regulatory reforms on cost structure, ownership and competition in Indian banking. *Journal of Banking and Finance* 34(2): 246–254.
- 24 Casu, B., Ferrari, A. and Zhao, T. (2013) Regulatory reform and productivity change in Indian banking. *Review of Economics and Statistics* 95(3): 1066–1077.
- 25 Shrieves, R. and Dahl, D. (1992) The relationship between risk and capital in commercial banks. *Journal of Banking and Finance* 16(3): 439–457.
- 26 Ediz, S., Michael, I. and Perraudin, W. (1998) Bank capital dynamics and regulatory policy. In: *Financial Services at the Crossroads: Capital Regulation in the 21st Century*. Federal Reserve Bank of New York Conference Volume. FRB New York: New York, pp.19–40.
- 27 Stolz, S. (2007) *Bank Capital and Risk-Taking*. New York: Springer-Verlag.
- 28 Murinde, V. and Yaseen, H. (2006) The Impact of the Basel Accord Regulations on Bank Capital and Risk Behavior: 3D Evidence from MENA Region. UK: University of Birmingham. Working Paper 22.
- 29 Van Roy, P. (2008) Capital requirements and bank behavior in the early 1990s: Cross-country evidence. *International Journal of Central Banking* 4(1): 29–60.
- 30 Cosimano, T. and Hakura, D. (2011) Bank behavior in response to Basel III: A cross country analysis. Washington DC: IMF. IMF Working Paper 119.
- 31 Prasad, A. and Ghosh, S. (2005) Competition in Indian banking. Washington DC: IMF. IMF Working Paper 141.
- 32 Sinha, A. (2011) Macroprudential policies: Indian experience. Address delivered at Eleventh Annual International Seminar on Policy Challenges for the Financial Sector on ‘Seeing both the Forest and the Trees – Supervising Systemic Risk’ co-hosted by The Board of Governors of the Federal Reserve System, International Monetary Fund, and The World Bank at Washington DC, June, <http://www.rbi.org.in/speeches>.
- 33 op. cit 10.
- 34 Diamond, D. and Rajan, R.G. (2000) A theory of bank capital. *Journal of Finance* 55(4): 2431–2465.
- 35 Diamond, D. and Rajan, R.G. (2001) Liquidity risk, liquidity creation and financial fragility. *Journal of Political Economy* 109(2): 287–327.
- 36 Boyd, J.H., De Nicolo, G. and Jalal, A.M. (2006) Bank Risk-Taking and Competition Revisited: New Theory and New Evidence. Washington DC: IMF. IMF Working Paper 297.
- 37 Salas, J. and Saurina, V. (2003) Deregulation, market power and risk-taking in Spanish banks. *European Economic Review* 47(5): 1061–1075.
- 38 Das, A. and Ghosh, S. (2006) Financial deregulation and efficiency: An empirical analysis of Indian banks during the post reform period. *Review of Financial Economics* 15(3): 193–221.
- 39 Maudos, J. and Pastor, J.M. (2001) Cost and profit efficiency in banking: An international comparison of Europe, Japan and USA. *Applied Economics Letters* 8(5): 383–387.
- 40 Rodrik, D. (2012) Why we learn nothing from regressing economic growth on policies? *Seoul Journal of Economics* 25(2): 137–151.
- 41 Elyasiani, E. and Mehdiian, S. (1995) The comparative efficiency performance of small and large US commercial banks in the pre- and post-deregulation era. *Applied Economics* 27(6): 1069–1079.
- 42 Berg, S.A., Forsund, F. and Jansen, E. (1992) Malmquist indices of productivity growth during the deregulation of Norwegian banking 1980–1989. *Scandinavian Journal of Economics* 94(2): 211–228.
- 43 Leightner, J.E. and Knox Lovell, C.A. (1998) The impact of financial liberalization on the performance of Thai banks. *Journal of Banking and Finance* 50(2): 115–131.
- 44 Gilbert, R.A. and Wilson, P.W. (1998) Effects of deregulation on the productivity of Korean banks. *Journal of Economics and Business* 2(2): 133–155.



- 45 Shyu, J. (1998) Deregulation and bank operating efficiency: An empirical study of Taiwan banks. *Journal of Emerging Markets* 3(1): 27–46.
- 46 op. cit 7.
- 47 op. cit 8.
- 48 Das, A. and Ghosh, S. (2007) Determinants of credit risk in Indian state-owned banks: An empirical investigation. *Economic Issues* 12(1): 27–46.
- 49 Demircug-Kunt, A. and Huizinga, H. (2000) Financial Structure and Bank Profitability. Washington DC: The World Bank. Working Paper 2430.
- 50 Demircug-Kunt, A., Laeven, L. and Levine, R. (2004) The Impact of Bank Regulations, Concentration and Institutions on Bank Margins. Washington DC: The World Bank. Working Paper 3030.
- 51 Maudos, J. and Solis, L. (2009) The determinants of net interest income in the Mexican banking system: An integrated model. *Journal of Banking and Finance* 33(5): 1920–1931.
- 52 Ianotta, G., Giacomo, N. and Sironi, A. (2007) Ownership structure, risk and performance in the European banking industry. *Journal of Banking and Finance* 31(6): 2127–2149.
- 53 Beck, T., Hesse, H., Kick, T. and van Westermhagen, N. (2009) Bank Ownership and Stability: Evidence from Germany. Germany, Bonn: Deutsche Bundesbank. Working Paper No. 22.
- 54 Bhattacharyya, A., Knox Lovell, C.A. and Sahay, P. (1997) The impact of liberalization on the productive efficiency of Indian commercial banks. *European Journal Operational Research* 98(2): 332–345.
- 55 Kumbhakar, S. C. and Sarkar, S. (2003) Deregulation, ownership and productivity growth in the banking industry: Evidence from India. *Journal of Money, Credit, and Banking* 35(2): 403–414.
- 56 op. cit 24.
- 57 International Monetary Fund (2012) The Interaction of Monetary and Macprudential Policies: Background Paper. Washington DC: IMF.
- 58 The macroprudential instruments considered were capital requirements, limits on LTV, cap on debt-to-income and reserve requirements.
- 59 Honohan, P. (2008) Cross-country variation in household access to financial services. *Journal of Banking and Finance* 32(6): 2493–2500.
- 60 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.
- 61 To moderate the influence of outliers, the credit growth variable is calculated as in Dinc (2005)⁶².
- 62 Dinc, I.S. (2005) Politicians and banks: Political influences on government-owned banks in emerging markets. *Journal of Financial Economics* 77(3): 453–479.
- 63 Consistent with the literature, risk-taking is measured by the Z-score, which is a proxy for insolvency risk (Boyd and Runkle, 1993⁶⁴; Laeven and Levine, 2009⁶⁵). A higher Z-score indicates that the bank is more stable. Because the Z-score is highly skewed, we employ the natural logarithm of the Z-score, which is normally distributed (Laeven and Levine, 2009).
- 64 Boyd, J.H. and Runkle, D.E. (1993) Size and performance of banking firms: Testing the predictions of theory. *Journal of Monetary Economics* 31(1): 47–67.
- 65 Laeven, L. and Levine, R. (2009) Bank governance, regulation and risk taking. *Journal of Financial Economics* 93(2): 259–275.
- 66 Martinez Peria, M.S. and Mody, A. (2004) How foreign participation and market concentration impact bank spreads: Evidence from Latin America. *Journal of Money, Credit and Banking* 36(Special Issue): 511–537.
- 67 Micco, A., Panizza, U. and Yanez, M. (2007) Bank ownership and performance: Does politics matter? *Journal of Banking and Finance* 31(2): 219–241.
- 68 Greene, W.H. (1993) *Econometric Analysis*, 2nd edn. Upper Saddle River, NJ: Prentice Hall.
- 69 Berger, A.N., Clarke, G., Cull, R., Klapper, L.F. and Udell, G. (2005) Corporate governance and bank performance: A joint analysis of the static, selection, and dynamic effects of domestic, foreign, and state ownership. *Journal of Banking and Finance* 29(6): 2179–2221.
- 70 op. cit 53.
- 71 The correlation matrix as GDP growth and macroprudential measures indicate that these correlations are as 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**	

**statistically significant at 0.05 level

72 op. cit 69.

73 op. cit 3.