

Working paper



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Indian Financial  
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2007-2009



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July 2012

When citing this paper, please  
use the title and the following  
reference number:  
F-35002-INC-1

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# State Ownership and Systemic Risk: Evidence from the Indian Financial Sector during 2007-09<sup>1</sup>

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July 2, 2012

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## Abstract

We analyze the performance of banks in India during the period 2007-09 in order to study the impact of ownership structure on bank vulnerability to a crisis. We find that in the private sector, vulnerable private-sector banks -- based on ex-ante measures of exposure to a crisis -- performed worse than safer banks; however, the opposite was true for state-owned banks. We explain this puzzling result by analyzing the behavior of deposit and lending growth of banks. The vulnerable private-sector banks experienced deposit withdrawals and shortening of deposit maturity relative to other private-sector banks. In contrast, vulnerable state-owned banks relatively grew their deposit base, more so in term deposits, and increased their loan advances, at cheaper rates, and especially to public sector firms. These results are consistent with greater market discipline on private-sector banks and lack thereof on state-owned banks which are able to access credit cheaply even after underperformance as they have access to stronger government guarantees and forbearance.

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<sup>1</sup> We thank Ajay Shah, Sanjay Agarwal, Kenneth Kletzer, Urjit Patel, Renu Kohli, Dilip Mookherjee, Devesh Kapoor, Abhijit Banerjee, Arvind Panagaria, Rajnish Mehra and Suman Bery for helpful comments. We are grateful to Ajay Shah for providing us with the BSE and NSE stock market data and to RBI for providing us the deposit rates data. Acharya is grateful to Center for Japan-U.S. Business and Economic Studies for financial support for the project.

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## I. Introduction

In 2008, the global financial crisis hit India with the Indian stock market losing more than 60% of its peak valuation. Unlike the developed countries where the crisis spread from the financial sector to the real economy, the slowdown in India occurred in the real economy and then spread to the banking sector. This in turn appeared to have a deteriorating second order effect on the real economy. The government of India (GOI), fearing an even rapid deterioration of the economy, announced wide-ranging stimulus packages in 2009 that appeared to restore the economy back to its pre-2008 growth. An important observation for the Indian financial crisis of 2008 was the apparent weakness of private sector banks and the growing strength of public sector or state-owned banks. This has been attributed to public sector banks taking fewer risks during the pre-crisis period which helped them better weather the crisis. Private sector banks presumably took excessive risks and hence suffered during the crisis. However, a possible alternative explanation is that public sector banks had explicit and implicit government backing as a result of which they fared better at the expense of private sector banks. This paper aims to test whether government backing can help explain this relative outperformance of public sector banks.

As an ex ante measure of banks' potential vulnerability to a market-wide shock, we use a stock market-based measure of systemic risk, *Marginal Expected Shortfall* (MES), proposed by Acharya, Pedersen, Philippon, and Richardson (2010a). Using MES, we determine the systemic risk contribution of each Indian financial firm for the period preceding the crisis (January 2007 to December 2007). Then, for private sector banks and separately for public sector banks, we analyze the relation between pre-crisis systemic risk and emerging systemic risk during the financial crisis in 2008-2009, measured using (i) realized returns during the crisis (ii) deposit flows during the crisis and corresponding deposit rates, and finally (iii) loan advances during the crisis and the corresponding loans rates.

Our main finding is that the relationship between ex ante systemic risk exposure and ex post performance in the systemic crisis was strikingly different for public sector and private sector banks. While pre-crisis systemic risk is associated with lower stock return performance and greater deposit base contraction during crisis for private banks (as economic intuition suggests), the relationship is in fact reversed for public banks. We argue that the explicit and implicit

government guarantees for public sector banks helped them better weather the financial crisis. We find evidence that this can be attributed to risky public sector banks increasing their deposit rates in order to attract deposits away from private sector banks. We extend this analysis to advances and find that risky public sector banks were also lending aggressively at high lending rates. Possibly, the explicit and implicit government guarantees that public sector banks enjoy can explain public sector bank behavior.

This has in fact been the theme worldwide: financial institutions with greater access to government guarantees have survived the crisis or even expanded post-crisis while the ones without such access have failed or shrunk. A striking case in point has been the growth of the government-sponsored enterprises (Fannie Mae and Freddie Mac) and commercial banks in the United States – both sets of institutions with explicit government support and ready access to central bank emergency lending. These institutions expanded their holdings of mortgage-backed securities while investment banks and hedge funds de-leveraged and sold these securities (He, Khang and Krishnamurthy, 2009). Fannie Mae and Freddie Mac were hardly the better-performing institutions of this crisis; they were in fact “guaranteed to fail” (Acharya, Nieuwerburgh, Richardson and White, 2010).

Thus, even though access to government guarantees might be considered a source of financial stability during a crisis, justifying a greater presence of government institutions in the financial sector (or greater extent of government intervention in a crisis), our results suggest that this is likely associated with the misfortune of crowding out the private sector in the long run.

#### *Stable Indian banking sector with mix of public and private banks*

Barring a few hiccups, the Indian banking sector has proved to be reasonably robust during the financial crisis of 2007-09 when fragility of the financial sector, especially in Western economies, exacerbated the economic shock into severe recessions. The relative outperformance of the Indian banking sector has been attributed by some to high government regulation which prevents banks and financial firms from taking excessive risks. For example, the Reserve Bank of India (RBI) adopted countercyclical measures in the period preceding the crisis and increased

risk weights for certain sectors (notably, housing loans) to provide adequate capital buffers in the case of unexpected losses in the future (Gopinath (2009)).<sup>4</sup>

This relative stability of the Indian banks can be gauged from their high level of average capital to risk-weighted assets ratio (CRAR). Globally, this ratio has varied between 8.2% and 17.7% in 2008. In comparison, CRAR for Indian banks was 13% as opposed to a minimum regulatory requirement of 9% and a Basel minimum requirement of 8%, suggesting that Indian banks were well capitalized and thus more stable (Gopinath (2009)). The quality of assets has also been steadily improving since 2002 as can be seen by reduction in the non-performing loans ratio which decreased to 2.3% in March 2008. The provisions to non-performing loans ratio was at 52.6% compared to a global range of 24.9% to 184%. The Indian banking sector also remained fairly profitable during the crisis period as the return on assets (ROA) figures show was 1% as of March, 2008, close to the ratio for other countries. Australia, Japan and the U.S. had much smaller ROAs during this period.

Historically, Indian banks had been wholly owned by the government. In the 1990's, after economic liberalization, the government reduced its stake and allowed private banks and foreign players to enter the market. The Indian financial system still has a substantive public sector ownership. Public sector banks (PSBs) dominate the Indian banking sector and as of March, 2009 they accounted for nearly 71.9% of aggregate assets. This mixed model of public and private ownership popular in emerging markets, also referred to as the Asian model, has been credited with the relative strength of the Indian financial sector compared to its global counterparts.

Despite this relative overall strength of Indian financial firms, there has been a striking difference in the performance of public and private sector firms during the crisis. Consider the following two differences.

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<sup>4</sup> Additionally, adversely affected markets during the financial crisis such as the credit derivatives market in the US and the Europe are still in their nascent stages of development in India. Heavy regulation also restricted financial firms from investing in many of the risky financial derivatives that were responsible for the crisis in the West. Thus, the Indian banking sector had limited exposure to securitized sub-prime assets which were a primary source of losses for the financial sector in the western economies (Subbarao (2009)).

First, while the banking sector as a whole experienced a slowdown in deposit growth, private sector banks were affected to a larger extent. As per RBI estimates, public sector bank deposits grew by 26.9% in fiscal year 2009 (March 2008-March 2009) compared to 23.1% a year earlier. In comparison, private sector deposit growth slowed from 22.3% to a mere 9.1% for the same period. Credit growth showed similar trends. For public sector banks, credit grew by 20.4% (compared to 22.5% in 2008) whereas for private sector banks, it grew by only 10.9% (compared to 19.9% in 2008) (see Figure 1).

Second, market reaction to public versus private sector banks can also be gauged from the widening of CDS spreads for two illustrative firms, namely, State Bank of India (SBI, a public sector bank) and ICICI Bank (a private sector bank) during the crisis of 2008. A CDS spread represents the cost of purchasing insurance against the default of an underlying entity (such as SBI or ICICI). From Figure 2, we see that the cost of purchasing 1-year protection on SBI and ICICI Bank were within the same range in 2007, suggesting that investors viewed both firms as being equally risky. Beginning 2008, however, the difference between the spreads started widening in SBI's favor, indicating that investors possibly viewed the public sector financial firm to be healthier compared to the private sector firm.

#### *Public sector banks more stable or simply more government-guaranteed?*

The Asian model of banking assumes that public sector banks perform better during times of crisis and thus help provide stability to the banking system as a whole. It is argued that the risk-averse cautious approach of public sector firms leads to lower risk-taking during the good times, but pays off during bad times by providing steady results. Casual evidence is, however, to the contrary. Beginning 2005-06, the profitability -- as measured by the ratio of net profits to assets -- of private sector banks exceeded that of public sector banks. Simultaneously, the quality of assets -- as measured by non-performing assets (NPAs) to total assets -- for public banks has been historically lower than private sector banks, even though in recent years this ratio has improved for both sectors and the improvement has been more dramatic for public sector banks.

We conjecture that the relative underperformance of private sector banks in the crisis in spite of their superior pre-crisis risk-return profile is instead attributable to the implicit and explicit sovereign backing of public sector banks. The Indian Bank Nationalization Act provides an

explicit guarantee that all obligations of public sector banks will be fulfilled by the Indian government in the event of a failure. As a result of this guarantee, we hypothesize that during the crisis of 2008-2009 private sector banks experienced a loss of confidence and capital gravitated to PSBs – even when their exposures to an economy-wide crisis were *ex ante* similar – because investors believed that the PSBs would be bailed out by the government in the event of a failure. And that given this expectation, capital flew from the riskier private sector banks to the more stable public sector banks resulting in a decline in equity valuations of the private sector financial firms during the crisis.

Although bank deposits are covered by deposit insurance, coverage provided by the Deposit Insurance and Credit Guarantee Corporation (DICGC) for bank deposits is limited. While a larger percentage of public sector bank deposits are covered by deposit insurance (66.3%) compared to private sector banks (a mere 23%) it should be noted that the coverage provided by the DIGGC per depositor is limited. The DIGGC covers only Rs. 1,00,000 per depositor per bank and does not cover interbank deposits and deposits outside India. Recently, private sector banks have asked the government to raise this limit. They argue that the deposit insurance coverage limit has remained the same whereas incomes have been steadily increasing in the past few years. In fact, private sector banks believe that the sovereign guarantees that PSBs enjoy were responsible for the flight of funds from private banks to public sector banks (Hindu, 2009). A recent panel set up by the RBI suggested raising the deposit insurance coverage to Rs. 500,000 (Livemint, 2011). Thus, while bank deposits are covered by deposit insurance they are not enough and thus the implicit government backing for public sector banks becomes important during recessions.

As a first step of our analysis to test these hypotheses, we examine the *ex ante* (pre-2008) measures of systemic risk of public and private financial firms and relate them to their *ex post* (2008-2009) or realized performance to determine the role played by government guarantees. We use the *Marginal Expected Shortfall* (MES) measure to calculate the systemic risk of financial institutions in the Indian financial sector during the crisis of 2008-2009. The MES measure essentially captures the tail dependence of the stock return of a financial firm on the market as a whole. It estimates, in a given past period (say one year preceding a crisis), for the worst 5% days of the market or the financial sector index, the negative of the average market return of a

given financial firm. The greater the MES, the more systemically risky is the firm. The question then is whether riskier PSBs as measured by ex ante MES fared better or worse than private sector banks with similar systemic risk.

Our results suggest that PSBs performed *better* than private banks in spite of having *higher* systemic risk. While private banks with high MES prior to the crisis (such as ICICI Bank) suffered heavily during the crisis, equally systemic state-owned banks (such as the SBI) gained substantially. For example, both ICICI and SBI had an MES of 5% (refer to Appendix A). However, during the crisis period from January 2008 to February 2009, ICICI stock fell by 73% whereas SBI stock fell by a significantly lower 54%. More statistically robust regression results confirm this illustrative example and in fact show that within PSBs, banks with greater ex ante systemic risk did better ex post, not worse.

Finally, deposit base growth of banks too behaves similarly. While private sector banks with higher ex ante systemic risk experienced deposit contractions, the result reverses for PSBs. Anecdotal evidence supports this hypothesis. Following the credit crisis and the subsequent fall of Lehman, many depositors shifted capital out of private and foreign banks and moved it to government banks. Anecdotal evidence is consistent with this “flight-to-quality”: Infosys transferred nearly Rs. 10 billion of deposits from ICICI to SBI just after Lehman’s collapse in the third quarter of 2008 (Economic Times (2009)). We show that deposits, in fact, moved to the riskier PSBs and hence may not be completely consistent with this flight-to-quality story.

As further evidence of government support during the crises period, the government issued a directive ordering public sector enterprises (firms other than banks) to park their surplus funds in public sector banks (Economic Times (2008)). Anecdotal evidence also suggests that banks were increasing deposit rates in order to attract deposit flows<sup>5</sup>. This is consistent with our findings where we find that deposit growth increased for riskier banks and this growth was greater for deposits where banks had more leeway to change deposit rates. Growth in term deposits was higher because banks could hike term deposit rates whereas savings deposit growth was not affected since savings deposit rates are set by the government and are heavily regulated.

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<sup>5</sup> PSBs started raising their deposit rates in order to attract these deposits and the finance ministry directed the public sector firms from asking for competitive bids “to stop undesirable competition among banks to prevent arbitrary hikes in deposit rates” (Hindu, 2008).



One could argue that this increase in deposit base or public sector banks might be good for the economy as a whole since public sector banks may be more willing to advance loans to the real economy resulting in much needed credit in times of recession. At first glance this seems to be the case. Riskier public sector banks did in fact increase lending. However, on further investigation, the lending was predominantly to the priority and public sector firms, thereby reinforcing the government guarantees to public sector firms and priority sector as a whole.

*Policy implications: Caution against delaying privatization of Indian financial sector*

We relate our results to the extent of capital support provided by the Indian government to the PSBs in the aftermath of the crisis, and compare it to PSB performance during the crisis. Evidence suggests that weaker PSBs received capital injections, supporting our hypothesis that in anticipation depositors and stock market investors reward riskier public sector banks while penalizing private sector banks with similar risk.

When the Indian government announced a number of wide-ranging stimulus plans to jumpstart the banking system, public sector banks were promised capital injections to help them maintain a CRAR (risk-adjusted capital ratio) of 12 per cent. The government launched three fiscal stimulus packages during December 2008–February 2009. As part of the second stimulus package, the government recapitalized state-run banks and infused nearly Rs. 3,100 crores in 2008-09 as tier-I capital in a few public sector banks. In order to fulfill the funding gap, the government requested financing of Rs. 1,700 crores (\$3.4 billion) from the World Bank in December 2008. Importantly, the timing and size of the capital injections was left up to the discretion of the government. Capital injections were to be determined based on public sector banks' ability to access equity markets, capital requirements for growth, and existing capital resources (World Bank 2009). An additional infusion of Rs.16,500 crores was projected for the year 2010-11 to help public sector banks maintain the minimum 8 per cent tier-I capital to risk weighted asset ratio (Government of India, press release, 2010).

With such generous backing of the Indian government, public sector banks came out in the retail sector with inexpensive housing, auto and education loans. For example, they were the lead financiers in the Tata Nano auto purchases. They were also able to offer housing loans at lower rates than those charged by other banks and mortgage companies, such as Housing Development

Finance Corporation (HDFC). Private financial firms in fact have complained that SBI schemes do not draw in new customers, but are instead targeted at existing customers and are thus targeted more to undercut competitors rather than stimulate the economy (Wharton, (2009)).

All this suggests that the state banking sector may have grown during the crisis at the expense of private banks. Measures taken by the government may have helped bolster PSBs but they have also made it difficult for private sector banks to compete with them. The resulting strength of PSBs has in fact strengthened the resolve to persist with them. Until recently, there had been a consistent trend towards privatization. However, the recent underperformance by private sector banks has raised some doubts regarding this approach.<sup>6</sup> Such sentiments have important policy implications and could alter the timeline and extent of privatization initially envisioned by the government. A recent article suggests that government ownership in PSBs will gradually decline but only after the ongoing crisis has subsided, and that it is unlikely the state-owned banks will be fully privatized as was previously envisioned (Economist, 2010).

Our results strike a note of caution against drawing such conclusions. Examining performance of state-owned banks in a systemic crisis relative to private sector banks that do not have as great an access to government guarantees is perhaps not a sound basis of assessing the overall attractiveness of state presence in the financial sector. At any rate, government bailouts – and investor and depositor anticipation of safety net for PSBs – seem to have deep consequences on competitive forces in the financial sector, potentially shaping their long-run form, and always stacking the odds against the flourishing of private banks.

The remainder of the paper is organized as follows. Section II presents the data and methodology in our analysis. Section III presents the regression specifications. In section IV analyze the crisis returns for public sector versus private sector banks during the crisis of 2008-2009 based on their pre-crisis risk exposure as measured by MES. Section V analyzes the deposit growth for public and private sector banks during the crisis period. Section VI presents the analysis for loan advances. Section VII presents results of several robustness checks. Section

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<sup>6</sup> The ruling party leader, Sonia Gandhi, claimed that “public sector financial institutions have given our economy the stability and resilience we are now witnessing in the face of the economic slowdown.” Finance minister, P. Chidambaram, echoed these sentiments when he claimed that India’s public sector banks were strong pillars in the world’s banking industry (Frontline, 2008).

VIII relates capital support provided by the government to PSB performance during the crisis. Section IX discusses the related literature. Section X concludes.

## **II. Data and methodology**

### *Data*

For our empirical analysis we use the crisis of 2008 as the crisis period. We use the 38 public and private sector banks for which stock market data is available. We exclude IDBI from our analysis. Our analysis focuses on the pre-crisis and crisis period. Based on the timeline of events described below, we use January 2008 to February 2009 as the “crisis” period for our study. Pre-crisis refers to the period from January 2007 to December 2007.

### *Crisis of 2008*

In 2008, the global financial crisis hit India with the Indian stock market losing more than 60 per cent of its peak valuation. Figure 2 shows that the stock market index—S&P CNX NIFTY index—declined sharply, starting January 2008. Index prices fell from a peak of 6,288 in January 2008 to 2,524 in October 2008, representing a decline of nearly 60 per cent. Another market index—the BSE index—similarly fell nearly 59 per cent from 20,873 in January 2008 to 8,510 in October 2008. Starting 2008, foreign institutional investors (FIIs), facing a liquidity squeeze from abroad, started pulling out capital from India resulting in a sharp decline in the stock market. In 2008–09, FIIs withdrew nearly Rs. 43,337 crores (approximately \$9–10 billion).

Experiencing a dearth of capital from overseas markets, Indian banks and corporations had to turn to domestic markets for their funding requirements. At the same time, Indian banks and financial institutions facing uncertain market conditions started cutting back on credit, resulting in a liquidity crisis in 2008. Corporations, especially ones relying on foreign funding, feared further worsening of global market conditions and withdrew from money market mutual funds (MMFs). The MMFs, which were heavily invested in non-banking financial companies, were forced to liquidate their positions. It is estimated that MMFs withdrew nearly Rs 22,355 crores in 2008–09. As a result of the capital outflows, the rupee also came under pressure. There was further liquidity tightening as the Reserve Bank of India (RBI) intervened in the Forex market to

manage rupee volatility. All these events resulted in a money market and credit squeeze which eventually spilled over into the real economy (Subbarao 2009). The global slowdown also resulted in a slump in demand for exports. This impact was felt economy-wide and the Indian GDP fell from 9 per cent in 2007 to nearly 6.1 per cent in 2008. Eventually, the Government of India, fearing an even rapid deterioration of the economy, announced wide-ranging stimulus packages in 2009 that appeared to restore the economy back to its pre-2008 growth.

#### *Marginal Expected Shortfall (MES): A measure for systemic risk*

We use the *Marginal Expected Shortfall* (MES) measure (Acharya, Pedersen, Philippon and Richardson (2010a)) to measure the ex ante systemic risk of public and private financial firms. The MES measure captures the tail dependence of the stock return of a financial firm on the market as a whole. The strength of the measure lies in its ability to predict which firms are likely to be affected the worst when a financial crisis materializes, as demonstrated by Acharya, Pedersen, Philippon and Richardson (2010a) in their analysis of the systemic risk of large U.S. financial institutions around the financial crisis of 2007-09.

Specifically, MES estimates the expected losses of a stock conditional on a crisis. Since extreme tail events such as a mild financial crisis happen once a decade and severe crisis such as the Great Depression or the Great Recession only once in several decades, the practical implementation of MES relies on "normal" tail events. We use the normal tail events as the worst 5% market outcomes at daily frequency over the pre-crisis period. In our analysis, we take the 5% worst days for the market returns as measured by the S&P CNX NIFTY index in any given measurement period, and then compute the negative of the average return for any given bank for these 5% worst days. The MES measure can also be interpreted as the contribution of each firm to the systemic risk in the event of a crisis. As such, MES is a statistical measure but Acharya, Pedersen, Philippon and Richardson (2010a) provide a theoretical justification for it in a model where financial sector's risk-taking has externalities on the economy whenever the sector as a whole is under-capitalized.

#### *Data*

In our analysis we look at all publicly listed banks in India. Of the 50 public and private sector banks for which the Reserve bank of India (RBI) provides annual deposit flow data, 39 are listed and have stock market data which is used for our measure of systemic risk, MES. We have used 38 banks (excluding IDBI) in all, 22 PSBs and 17 private sector banks. The Appendix B shows the MES measures for public and private financial firms using January 2007 to December 2007 as the measurement period. It also lists pre-crisis and crisis period measurements. Pre-crisis period measurements are beta, global beta, volatility, capitalization ratio (inverse of leverage), MES and pre-crisis returns. MES as described above is the marginal expected shortfall of a stock given that the market return is below its 5th - percentile during the period 1st January, 2007 to 31st December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Realized return or event return is the actual stock return during the crisis period for the period January 2008 to February 2009. Beta is based on the S&P CNX NIFTY index as the market return. Global beta is based in the MSCI World Index returns. Volatility is the annualized daily volatility in the pre-crisis period from January 2007 to December 2007. Crisis period measurements included in this analysis are Crisis return and deposit growth. Crisis Return is the stock return for the individual firms during the crisis period from January 2008 to February 24, 2009. Deposit growth for the crisis period is calculated from data provided by RBI for the period from 31st March, 2008 to 31st March, 2009.

### III. Testable Hypothesis

To measure the hypothesis of how depositors and market investors react differently to public and private sector banks, we run the following regression.

#### i. Dependence of Crisis returns on state ownership

*Hypothesis 1: Riskier Public sector Banks with higher risk exposure had high returns during the crisis.*

First, we document that public sector banks most exposed to aggregate risk had very different returns compared to private sector banks which were exposed to aggregate risk. To test this hypothesis, we run the following regression:

$$\text{Crisis Return}_{i,t+1} = \text{MES} + \text{PSB} + \text{Aggregate Risk} * \text{PSB} + \text{Aggregate Risk} * \text{Pvt} + e_{i,t}$$

where MES is our measure of systemic risk exposure, dummy variable Pvt is 1 if the bank is a private sector bank and PSB is 1 if the bank is a public sector bank.

For an intuition for why this might be the case, please refer to Appendix C.

#### ii. Dependence of deposit growth on state ownership

*Hypothesis 2: Higher crisis returns during the crisis is related to higher deposit returns for public sector banks with higher risk exposure but lower deposit growth for public sector banks with lower risk exposure.*

Second, we explore the question whether higher returns were in fact due deposit growth. To test the hypothesis whether public sector banks with higher risk in fact had higher deposit growth whereas private sector banks with higher deposit growth had higher returns, we run the following regression:

$$\text{Deposit Growth}_{i,t+1} = \text{MES} + \text{PSB} + \text{Aggregate Risk} * \text{PSB} + \text{Aggregate Risk} * \text{Pvt} + e_{i,t}$$

where MES is our measure of systemic risk exposure, dummy variable Pvt is 1 if the bank is a private sector bank and PSB is 1 if the bank is a public sector bank.

#### **IV. Effect of the Crisis of 2008-2009 for Public and Private Sector Banks on Stock Returns**

The aim of analysis to follow is to determine the ex ante systemic risk of banks for the period preceding the crisis (January 2007-December 2007) and use it to explain the cross-sectional variation in their performance during the crisis period (January 2008-February 2009). We examine private and public sector banks separately. Intuition suggests that banks with greater systemic risk (higher MES) should fare poorly in the event of a market wide downturn. Similarly, banks with lower systemic risk should have relatively higher realized returns.

Table 1 provides the summary statistics for pre-crisis returns, realized returns, MES, log assets, capitalization ratio, volatility, beta and global beta measures used in our analysis. The MES is calculated for the pre-crisis period of 2007, the realized return is for the crisis period from January 2008 to February 2009. Table 1 reports the univariate statistics for all banks in the analysis. Note that summary statistics is for all 39 banks used in our analysis. As shown in Appendix B, we use two broad categories of institutions: (A) Public Sector banks (22 firms) and (B) Private Sector Banks (19 firms).

The significant loss of value as suggested by the average realized return values of -65.65% during 2008 indicates how trying this period was for Indian banks overall. In fact, some private sector firms such as Development Credit Bank, Kotak Mahindra and Yes Bank lost more than 80% of their market equity value. Among the PSBs, State Bank of Bikaner and Jaipur lost nearly 97% but other PSBs such as Indian Overseas Bank and Central Bank of India both lost a lower 76% of their market value. Also, the average MES value of 4.29% is much higher when compared to the average loss of 65.65% realized return during the crisis period as it captures the average return when the market is in its left tail in "normal" times. What is important for our analysis, however, is not the level but whether a ranking of firms based on the normal-time MES works well even in extreme times.

There are some interesting observations to be made in Table 1. Average MES value is higher for public sector banks (4.29%) compared to private sector banks (3.83%). That is, public sector banks had on average negative 4.29% returns on the days the market return (S&P CNX NIFTY) was below its 5th percentile for the pre-crisis period from January 2007 to December 2007.

Indusind Bank (6.06%), Development Credit bank (4.88%) and ICICI (4.68%) had the highest MES among the private sector banks. In the public sector, IDBI bank (7.45%), Dena Bank (5.94%) and Union Bank of India (5.74%) had the highest MES.

Figure 3, Graph A shows that MES for private sector banks was able to explain a significant proportion of realized returns ( $R^2$  of 29.70%) during the crisis. There is a statistically significant negative slope, indicating that firms with higher MES were worse hit during the market-wide downturn. This makes intuitive sense since we expect riskier firms to perform poorly during the crisis. Some examples help illustrate this. Indusind Bank, which lost nearly 76% of its market value, had a relatively high pre-crisis MES of 6.06%. On the other hand, Lakshmi Vilas Bank which had a lower MES of 2.72% had a relatively lower 65% drop and ICICI Bank, with an MES of 4.68% had a 73% drop in stock price during the crisis period.

Figure 3, Graph B shows that MES might explain a large proportion of realized returns ( $R^2$  of 46.10%) for public sector banks as well. However, unlike private sector banks, public banks have, surprisingly, a *positive* and significant slope. Thus, for public sector banks, the realized returns were higher for banks with higher MES. Intuitively, we would expect that banks with higher *ex ante* systemic risk would perform worse during the crisis. Possibly, government stimulus packages may have helped public sector banks perform better. In fact banks that had a higher exposure to systemic risk as measured by MES performed better possibly because they were the weakest and (therefore) received a greater implicit government backing. For example, SBI, a PSB with an MES similar to ICICI Bank of 4.71%, had a better return of -54%. On the other hand, Union Bank, another PSB, with a higher MES of 5.74% had higher relative return of -42% (compared to -54% for SBI). Another example is Central bank of India which had a lower MES of 1.36% but had a sharp -76% drop in realized returns.

Table 2 shows the results of the regression of realized returns against the dependent variables MES and log assets. Log asset value controls for the size of the firm. The asset value is the quasi- market value of assets measured as the difference in book value of assets and book value of equity added to the market value of equity. The regressions show that MES and log assets are both economically and statistically significant. The interaction term of the dummy PSB with MES is negative and significant (-6.62, t-stat: 2.61) for private sector banks which shows that



riskier private sector banks performed worse than other private sector banks with less systemic risk exposure.

In contrast, the interaction term of the dummy variable PSB with MES is positive and significant (6.13, t-stat: 3.21) for public sector banks. Thus, contrary to what intuition would suggest, public sector with *higher* exposure to systemic risk outperformed less risky public sector banks.

We also test whether larger banks have higher returns using log assets. For both public and private sector banks, larger banks have higher returns. This can be seen from the interaction terms of log assets with the dummy for PSBs and private bank which are positive and significant (0.05, t-stat: 3.54 for private sector banks and 0.10, t-stat: 2.70 for public sector banks) indicating that larger firms performed better during the crisis as expected.

In the pooled regression with both MES and log assets, we see similar results for both categories of banks. In the pooled regression private sector firms have a negative coefficient for the interaction term with MES of -5.33 (t-stat 2.37) and a positive coefficient of 0.042 (t-stat: 3.57) for the interaction term with log assets. For public sector banks, the interaction term with MES is positive and significant (4.88, t-stat: 2.79) and positive and significant for log assets (0.06, t-stat 2.58).

The above analysis seems to suggest that riskier public sector firms had higher returns as a result of an implicit government guarantees which ensured that risky public sector firms would be bailed out as the crisis deepened. We explore this idea further in Table 3. The government of India announced bailout packages on December 8, 2008. Based on this timeline we divide the crisis into three sub-periods: pre-bailout (January 2008 to December 8, 2008), bailout (2 week period following the announcement from December 8, 2008 to December 22, 2008) and post-bailout (December 23, 2008 to February 24, 2009). Essentially we want to compare how risky public and private sector banks performed when the government guarantees were implicit, that is, before the bailout announcement and guarantees became explicit namely after the bailout announcement. From Table 3 we see that before the bailout announcement, riskier public sector banks had higher returns whereas riskier private sector banks had lower returns. Table 3 shows that MES is economically and statistically significant for both public (25.58, std. error: 1.55) and

private sector banks (-23.71, std. error: 2.79) as can be seen from the interaction terms of the public and private dummies with MES. Prior to the bailout announcement, riskier private sector banks had a higher likelihood of being bailed out and hence had higher crisis returns. Private sector banks did not have a similar implicit guarantee and hence riskier private sector banks had lower returns.

However after the announcement of the bailout risky public *and* private sector banks had higher returns. This can be seen in the positive and significant interaction terms with MES for both the private (3.395, t-stat: 3.09) and public sector (2.778, t-stat: 5.01) banks. Thus, while the market priced in the government backing of banks in the pre-announcement period, it did not price in a similar guarantee of the private sector financial firms being bailed out in the event of a systemic crisis. Since the announcement of capital infusion in public sector banks coincided with the announcement of a fiscal package, possibly the market priced in private sector banks also receiving funding after the announcement date December 8<sup>th</sup>, 2008. This would also be true if the market believed that the fiscal package was substantial and would help the economy as a whole. Post- bailout, specifically, *after* the two week period following the bailout announcement, the relationship reverted to “normal”, that is, the coefficient for the interaction term with MES was negative for both public (-4.784, t-stat: 3.65) and private sector banks (-1.92, t-stat: 0.92).

In the next section we explore whether the higher returns for riskier public sector banks can in fact be explained by a flow of deposits from private sector banks to public sector banks, as depositors fled from the risky private sector banks to the public sector banks thus accounting for riskier public sector banks outperforming during the crisis.

## **V. Effect of the Crisis of 2008-2009 for Public and Private Sector Banks on Deposit Growth**

Section IV illustrated the difference in equity performance for public sector and private sector banks by relating it to pre-crisis measure of their systemic risk exposure. In this section, we add to this evidence by focusing on the deposit flows for private and public sector banks and analyze how this relates to their pre-crisis systemic risk exposure. The question is whether

deposit flows show trends similar to realized returns. The evidence presented in this section supports our hypothesis that investors treated public and private banks differently during the crisis and shifted deposits from private to public banks. Further, it was the riskier public sector banks that were able to attract this new inflow of deposits.

Table 4 gives the summary statistics for deposit growth for the 38 banks in our analysis. Since deposit data is reported only annually, deposit growth is calculated from data provided by RBI for the fiscal year 2008, that is, for the period from 31st March, 2008 to 31st March, 2009.

Table 4, Panel A reports the univariate statistics overall for all banks and public and private banks separately. Overall, deposits grew overall by 19.04% during the crisis of 2008. This “flight to safety” is to be expected in a year of severe financial crisis such as 2008-09. Deposit growth for public sector banks was however, higher at 21.32% whereas deposits for private banks grew by 12.04%.

Table 4, Panel B gives the composition of deposits by type and by location. Panel C provides the growth rates for each class of deposits. Deposits are classified into a) demand deposits, b) term deposits and c) savings bank deposits based on type. Demand deposits and term deposits can be further broken down into deposits from other banks and non-bank deposits. Alternatively, deposits can be broken down based on location into deposits within India and deposits outside India.

Panel B shows that term deposits account for 69% of deposits whereas savings bank deposits (20%) and demand deposits (11%) account for a much smaller portion. Deposits from banks form a smaller percentage for both demand deposits (0.39%) and term deposits (3.64%). Further most of the deposits are within India (98%).

Panel C shows that average demand deposit growth was slightly higher for private sector banks (7.71%) compared to public sector banks (6.96%). Average growth rate for term deposits was higher for PSBs (16.34%) compared to private sector banks (15.18%). Demand deposits are for shorter maturities whereas term deposits are longer term deposits. Thus, possibly depositors perceived private sector banks to be riskier and shifted deposits to the lower maturity demand deposits whereas for PSBs depositors shifted to the higher maturity term deposits. Savings bank

deposits also grew at a higher 27.83% at public sector banks compared to 20.73% for private sector banks.

*Regression results for deposit growth for public versus private sector banks*

Now we ask whether deposit growth exhibits the same trend we saw in event return. That is, whether deposits for riskier public sector banks grew at a *higher* rate whereas riskier private sector banks had lower deposit growth rates. Figure 4 shows that this is indeed the case. Graph A shows the coefficient for MES is negative and significant suggesting private sector banks with high exposure to systemic risk performed poorly during the crisis. MES does a good job of explaining the growth in deposits for private sector firms ( $R^2$  of 26.5%). A few cases illustrate this point well. Development Credit Bank with a high MES of 4.88% had a deposit growth of 26.8% in the crisis period. Compared to this, Lakshmi Vilas Bank with a relatively lower systemic risk exposure (MES of 2.37%) had a higher growth rate of 27.01%.

Next, we look at public sector banks (see Graph B). Statistical analysis yields a *positive* and significant coefficient (1.44, std. error: 0.72) for MES. This trend is similar to what we saw in Section IV for event returns. Depositors should penalize firms with greater systemic risk exposure and move money from the riskier firms which are likely to fail during a crisis to firms with low systemic risk exposure. Instead sovereign backing of public sector banks distorts market behavior during systemic crisis and the market rewards public sector banks with greater systemic risk, since there is greater likelihood that these banks will be bailed out in the event of a failure during a systemic crisis and thus depositors flee to these banks.

We illustrate this with some specific examples. Deposits for Dena bank with an MES of 5.94% grew by 23% whereas in contrast deposits for State Bank of Bikaner and Travancore (with a lower MES of 1.44%) grew by only 14%.

Table 5 shows the results of the regression of realized returns against the MES, log assets, realized returns interacted with the dummy variables for PSB and private banks. As before log asset value controls for the size of the firm. The interaction terms for MES are economically and statistically significant. For public sector banks, the interaction term with MES is positive and significant (1.44, t-stat: 2.94) and for private sector firms the slope is negative and significant (-

9.07, t-stat: 1.79). The coefficient for log assets is positive and significant (0.03, t-stat: 2.64) for PSBs and insignificant for private sector banks (0.06, t-stat: 1.69) indicating that larger public sector banks performed better during the crisis.

In the deposit growth regressions, we also test whether realized returns help explain deposit growth. Regression of deposit growth against realized returns shows that the interaction term with the PSB and private sector bank dummy is positive and significant for both public (0.22, t-stat: 4.44) and private sector banks (1.07, t-stat: 3.79). Both public and private sector firms with higher realized returns during the crisis were able to attract more deposits. Thus, the higher returns of riskier public sector banks cannot be attributed to market irrationality.

The pooled regression show similar results, though with diminished statistical significance. The interaction of the public and private bank dummies with MES as the regressor variables are insignificant and positive for MES for public sector banks and negative and insignificant for private sector banks as we had previously seen and the interaction term with realized returns is positive but insignificant.

Quarterly variation of deposit flows for banks exhibit similar trends. The public sector banks account for a significant proportion of nearly 75-80% of the total deposit amounts. Figure 5 shows that initially when the crisis hit India in 2008, both public and private sector banks had similar deposit growth rates. In Q1 2008, deposits for both sectors grew by 10%. As the crisis worsened, the disparity between public and private sectors is evident. Public sector bank deposits grew by (1.7%, 5.5%, 5.2%) compared to a much lower growth of (0.0%, 1.0%, -0.3%) for private sector banks in (Q2, Q3, Q4) of 2008. Towards the end of the crisis both sectors posted relatively higher growth rates of 12.0% for the public sector and 8.2% for the private sector.

We hypothesize that this discrepancy between public and private sector firms is only during a systemic crisis, since it is only during a crisis that government guarantees become important. When the economy is doing well and the possibility of a bailout is remote, the downside protection for public banks is immaterial. Table 6 confirms this intuition.

Table 6 shows the results of the regression of the two-year deposit growth against the dependent variables MES, leverage, pre-crisis returns and assets. Deposit growth is for the two

year period from March 2008 to March 2010. We see that the negative coefficient for MES for private sector banks disappears. Instead the coefficient for MES is positive and significant for public sector banks (2.49, t-stat: 4.18) and positive but insignificant for private sector banks (1.27, t-stat: 0.40). The pooled regressions show similar results for public (1.27, t-stat: 1.49) and private sector banks (0.32, t-stat: 0.11). This makes intuitive sense since in “normal” times we would see riskier firms have higher deposit growth for both private and public sector banks.

#### *Deposit growth by type for public versus private sector banks*

We now try to explain why deposit growth for riskier public sector banks was higher compared to less risky public sector banks. Did public sector banks attract deposits by increasing deposit rates? We provide evidence by looking at deposit growth against MES for each category of deposits.

Demand deposits and term deposit rates can be set at the discretion of banks whereas savings rate is still regulated by the RBI. We hypothesize that banks increased deposit rates in order to attract deposits. Thus, we should see a variation in deposit rates for those classes of deposits where banks were able to change rates- namely for demand deposits and term deposits. Since savings rates are regulated by the RBI, we should not see such as increase in bank deposits with MES for both public and private sector banks.

Our results in Table 7 are consistent with this. Demand deposits for private sector firms are higher for firms with higher MES (coefficient 11.55, t-stat: 1.82). This is probably because firms/depositors were shifting away from term deposits (longer maturity) deposits to demand deposits. On further breaking down demand deposits into interbank and nonbank deposits (Panel B), we see that the relationship is stronger for nonbank deposits (coefficient: 11.88, t-stat:1.81). For PSBs the relationship between MES and demand deposit growth is weak (coefficient 0.44, t-stat: 1.82) as public sector banks did not experience a similar shortening of maturity for deposits.

For term deposits we see the familiar result- positive and significant interaction term for MES for PSBs (3.46, t-stat: 2.99) and significant and negative slope (-14.87, t-stat: 2.26) for private sector banks. Term deposits are further broken down into interbank and non-bank deposits. Nonbank deposits which form a larger composition of term deposits show results

consistent with our hypothesis. PSBs have positive and significant (3.18, t-stat: 3.26) MES interaction term whereas private sector banks have a negative and significant MES interaction term (-15.82, t-stat: 2.36).

For interbank term deposits the interaction term with MES is positive but insignificant for both PSBs (16.14, t-stat: 1.17) and private sector banks (1.281, t-stat: 0.07). Possibly deposit rates have a bigger effect on long-term than short-term lending as that is where borrowers would like to borrow the most in a crisis, especially if they are troubled. Inter-bank lending tends to be at short end, and as a result we may see weaker relationship in the shorter term maturities.

Savings bank deposits growth (Panel A) does not exhibit the positive relation with MES for public sector banks. In fact for savings deposits, the MES interaction term is negative and insignificant (-2.25, t-stat: 1.56). For private sector banks this coefficient is negative and insignificant (-3.52, t-stat: 1.49). Since savings deposit rates are set by the Government of India, the riskier public sector banks cannot increase their deposit rates to attract deposits. Thus, the relationship for deposit growth with MES is the same for both public and private sector banks.

Banks can set deposit rates only for deposits within India whereas NRI deposits are regulated by the RBI. Deposits for branches within India show the positive and significant MES interaction term for PSBs (1.74, t-stat: 2.91) and negative and significant term for private banks (-9.77, t-stat: 1.86).

### *Deposit rates*

We now direct evidence from deposit rates that banks did indeed increase their deposit rates as the crisis progressed. Table 8 provides the descriptive statistics for deposit rates for deposits short-term (<1 year) and long-term (>3 years) maturities.

Panel A shows that deposit rates for increased from Q1 2008 to Q4 2008 just before the bailout announcement before falling in Q1 2009. This is consistent across maturities and for the maximum and minimum deposit rates. For example, deposit rates for maturities greater than 3 years (max) overall increased from 8.67% in Q1 2008 to 9.39% in Q4 2008 before dropping to 8.44% in Q1 2009 after the bailout announcement. Private sector banks and public sector banks show similar trends.

We now analyze the deposit rates for distressed banks in Panel B. Following Acharya, Pedersen, Philippon and Richardson (2010), distressed banks correspond to the banks whose 12-month return was worse than -85% in the period preceding the crisis..

Similar to overall deposit rates, Panel B shows that deposit rates for increased from Q1 2008 to Q4 2008 before falling in Q1 2009. For example, overall deposit rates for maturities greater than 3 years (max) for public sector banks increased from 8.75% in Q1 2008 to 9.17% in Q4 2008 before dropping to 8.50% in Q1 2009 after the bailout announcement. Private sector banks and public sector banks show similar trends.

Relative deposit rates are defined as the difference in deposit rates for distressed banks relative to the deposit rates for non-distressed banks. Figure 6 shows the relative deposit rates for the short (<1 year) and the long (> 3 years) maturities. The time to failure is plotted across the x-axis with time zero corresponding to the first date when the 12 month return was worse than -85%. As expected the relative deposit rates for the long term maturities show rose just prior to distress. In the quarter following distress deposit rates fell down. This is consistent across private and public sector banks. The results for the short term maturities however do not show the same trends. This is consistent with our findings in previous section. Public and private sector banks had to actively seek out long term deposits. Public sector banks did not see an increase in demand deposit growth (short term deposits) and hence probably did not increase deposit rates at the short end. The increase in demand deposit growth for private sector banks may have been as a result of maturity shortening for private sector banks, who saw an inflow if shorter term deposits despite no increase in deposit rates. Possibly, both public and private sector banks increased the longer term deposit rates prior to distress, but only public sector banks managed to translate this into a higher deposit growth in longer term maturities.

Our analysis in this section shows that deposits shifted from private sector firms to public sector banks in the crisis period.



## **VI. Effect of the Crisis of 2008-2009 for Public and Private Sector Banks on Loan Advances**

The results presented so far showed that public sector banks were able to perform better compared to private sector banks by attracting deposits from the private sector. It could be argued that the PSBs passed on this increased flow of credit to the real economy and thus were helpful in maintaining credit flow in the economy during the crisis. However, we find evidence to the contrary. In this section, we investigate whether public sector banks passed on these deposits through loan advances to the real economy. Further, we also investigate whether there was a sector-wise difference in lending.

Table 9 gives the descriptive statistics for advances by type. Security-wise composition (Panel A) at the beginning of 2008 shows that most of the advances were secured (81.05%). Public sector firms had a slighter lower proportion of 79.82% of secured advances compared to 82.57% for private sector banks. Most of the advances were within India (96.96%). Further advances to the priority sector, namely agriculture and small industries, accounted for the largest share of advances for both public (34.96%) and private sector banks (33.31%). Public sectors accounted for roughly 10.90% for public sector banks and 4.36% for private sector banks. Panel B gives the descriptive statistics for growth in advances. As expected, the average growth in advances was higher for public sector banks (24%) compared to private sector banks (19%) since the PSBs had higher inflow of deposits which we saw in Section V.

### *Regression results for growth in advances*

Table 9, Panel C gives the regression results for growth in loan advances. We see that the interaction term of the public and private dummies with MES is positive and significant (1.73, t-stat: 3.98) for public sector banks. For private sector banks the term is negative, though insignificant (-5.32, t-stat: 1.12). Thus, consistent with prior results, riskier public sector firms made more advances than private sector banks.

On further breaking down advances into priority and public sector, banks and other (miscellaneous) sectors we find that the MES interaction term was positive and significant (3.95, t-stat: 2.97) for the priority and public sector advances.

### *Lending rates*

We next examine lending rates. Table 10, Panel A shows the descriptive statistics for prime bank lending rates for each quarter of the crisis (Q1, 2008 to Q1, 2009). Average prime lending rates are lower for public sector banks, ranging between 12.94% in Q1, 2008 to 12.52 in Q1, 2009. It peaked in Q3, 2008 at 14.04%. For private sector banks, the prime lending rates ranged from 14.69 in Q1, 2008 reaching a peak of 15.94 in Q4, 2008 and fell to 15.67% in Q1, 2009. We see that prime lending rates are lower for public sector banks compared to private sector banks. In Section V, we hypothesized that riskier public sector banks were borrowing at higher rates. While public sector banks were attracting deposits by borrowing at higher rates, they did not increase lending rates to make up for these increased costs of borrowing. On the other hand, possibly, riskier private sector banks were borrowing at higher deposit rates and could only lend out at higher lending rates to make up for the cost of funds.

Table 10, Panel B confirms this intuition. Regression of advances growth against MES shows that for private sector banks, the interaction term with MES remained positive and significant throughout the crisis with coefficients 72.25 (t-stat: 4.59), 63.93 (t-stat: 5.99), 66.31 (t-stat: 5.12), 63.32 (t-stat: 4.99) and 77.50 (t-stat: 4.79) for Q1 2008, Q2 2008, Q3 2008, Q4 2008 and Q1 2009 respectively. Private sector banks had to make up for the increased costs of borrowing by increasing their lending rates. For public sector banks however, this relation is weak. The interaction term of MES is insignificant and negative in 2008 (except for Q4 2008 where it was positive) and negative and significant (-7.29, t-stat: 1.90) in Q1, 2009, just after the bailout announcement. Public sector banks did not increase their lending rates because possibly they believed that they would be bailed out when things got worse, thus they did not need to worry about survival.

In this section we showed that lending rates increased with MES for private sector banks. Government guarantees enabled high MES public sector banks to lend at lower rates. Possibly PSBs did not care about higher deposit rates eating into their profit margins because in the worst case they would be bailed out by the government. But one could argue that the effect of higher deposit rates is not so severe since consumers benefit in both cases- on one hand they get higher deposit rates, but at the same time they are not penalized with higher lending rates. However, we

saw that public sector banks were lending mostly to the priority and public sectors which have are of particular concern to the government. Thus, public sector bank lending to these sectors further reinforces the government guarantees for public sector firms.

## **VII. Capital Injections in Public Sector Banks**

In this section we relate PSB performance observed during the crisis period to the capital injections made by the government in PSBs in the period following the crisis.

A major component of the fiscal stimulus packages announced by the government since December 2008 has focused on jump-starting the banking sector. Specifically, the Indian government promised to provide capital resources to PSBs to help them maintain CRAR ratio of 12%. In order to fulfill the funding gap, the GOI requested financing of Rs. 1700 crores (\$3.4 billion) from the World Bank in December 2008. The timing and size of these capital injections was left up to the discretion of the GOI. Capital injections were to be determined based on PSBs ability to access equity markets, capital requirements for growth and existing capital resources (World Bank, (2009)).

Since December 2008, the GOI has announced a number of capital injections for PSBs. In February 2009, the government announced a capital injection in 3 PSBs, namely UCO Bank (Rs. 450 crores), Central Bank of India (Rs. 700 crores) and Vijaya Bank (Rs. 500 crores). For the 2008-2009 period the government injected a total of Rs. 250 crores into United Bank of India.

In the 2010-2011 budget, the government promised an additional Rs. 16,500 crores of capital infusion to help PSBs maintain their minimum Tier- 1 capital ratio of 8%. As part of this effort, the government has announced capital infusion of Rs. 6,121 crores in five PSBs namely IDBI Bank (Rs. 3,119 crores), Central Bank (Rs. 2,016 crores), Bank of Maharashtra (Rs. 590 crores), UCO Bank (Rs. 375 crores) and Union Bank (Rs. 111 crores)

The amount of capital injections was determined based on PSB funding requirements and the need for a capital buffer. Thus PSBs which performed the worst during the crisis resulting in high capital depletion were more likely to receive support from the government. As of March 2009, all the banks mentioned above (except Union Bank) had Tier 1 capital less than 8%. The

Tier 1 capital ratios for Bank of Maharashtra, Central Bank of India, UCO Bank, Union Bank of India, Vijaya Bank and IDBI Bank were at 6.1%, 7.0%, 6.5%, 8.2%, 7.7% and 6.8%, respectively. Based on the MES measure, these were also among the riskiest banks in our analysis. For example, IDBI had an MES of 6.67%, Union Bank of India had an MES 5.74% and Vijaya Bank had an MES of 5.27%. UCO had a relatively lower MES of 4.80%. IDBI with a high MES of 6.67% received the highest capital injection of Rs 3,119 crores.

## **VIII. Robustness checks**

This section reports the results for the robustness checks of our analysis (refer to Appendix A).

*Placebo tests outside of the crisis.* In Appendix A.1, we check for robustness assuming different crisis periods. These regressions test whether the discrepancy in returns for public versus private firms holds *only* during crisis periods or whether it is true in other periods as well. Appendix A.1 shows the regressions for public and private sector firms assuming the dependent variable to be the placebo “crisis” period returns corresponding to 2005, 2006, 2007 and 2008. The corresponding regressor variables are the “pre-crisis” period MES for the years 2004, 2005, 2006 and 2007. The slope of the coefficient is insignificant for all periods. It is negative but insignificant for all banks for the 2005 versus 2004. Thus, annual returns in the non-crisis periods, namely 2005, 2006 and 2007 are not explained by the prior year MES. However, in times of a crisis, the government guarantees start to matter and affect private and public firm returns differently as shown by the regression against 2008 returns.

Further we test whether the relationship exists in other crisis periods. We see that this is indeed the case. Appendix A.1, Panel B looks at the dotcom crash of 2001. Similar to the crisis of 2008, private sector banks exhibit strong negative returns with MES. This is reflected in the significant and negative interaction term for MES for private sector banks (-23.15, t-stat: 3.23). For public sector banks, however, the slope for MES is positive but insignificant (3.716, t-stat: 0.53).

*Stability of MES ranks over time*

A measure of systemic risk that varies substantially over time could make it difficult to determine whether banks which were systemically important in 2006 remained systemically important in 2007, from 2007 to 2008, and so on. Hence, we check whether the choice of time period affects the results obtained. Appendix A.2 plots the MES rankings from January 2006 - December 2006 against the MES ranks from January 2007 - December 2007. The high  $R^2$  of 24.1% implies MES rankings in 2006 were reflective of which firms would be systemically important during 2007.

### *Leverage and Pre-crisis returns*

Leverage is measured as the ratio of the quasi-market value of assets to the market equity. Leverage is an important predictor of returns as shown in ???. However, we see from Appendix A.3 that leverage was not a strong predictor of returns. It is not easy to measure true leverage due to infrequent and limited reporting. Instead we can think of pre-crisis returns as a proxy for leverage since returns will be higher in the pre-crisis period for highly levered firms. We use the inverse of leverage in our regressions. Leverage (inverse), while not significant is negative for both public (-0.002, t-stat: 1.19) and private (-0.002, t-stat: 0.06) sector banks indicating that firms which were highly levered performed worse during the crisis, as we would expect. Similarly pre-crisis return which is a proxy for leverage was negative and insignificant for both public (-0.51, std. error: 0.71) and private sector banks (-0.55, std. error: 0.33). The low significance could be due to measurement errors.

### *Alternative measures of risk*

Appendix A.3 repeats our analysis using other common measures of risk. The regression of event returns against beta and volatility and give similar results. Interaction term with beta for dependent variable, event return, is positive and significant for public sector firms and negative but insignificant for private sector firms. Similarly, regression with volatility as the risk measure yields a positive and insignificant term for public sector financial firms and a negative and significant term for private sector firms similar to our results in Table 2.

Regression coefficients for a two factor model containing the domestic market return and the global market return are shown in Appendix A.3. One might reason that private sector banks had

lower returns because of higher exposure to the global markets. In order to test this hypothesis, we estimate the coefficients of beta and global beta to estimate the exposure to global markets. The beta measure measures sensitivity to the NSE stock market Index. The global beta coefficient measures sensitivity to the MSCI World market index. The coefficient for global beta was insignificant and negative for both public and private sector banks. Thus, exposure to the global markets does not explain the difference in behavior of public sector versus private sector financial firms. Coefficient for beta was similar to the regression against beta alone.

Regression of risk measures against deposit growth shows similar results (refer to Appendix A.4). The regression of deposit growth against beta and volatility give similar results. Slope of regression of beta with deposit growth is positive and significant for public sector firms and negative but insignificant for private sector firms. Similarly, regression with volatility as the risk measure yields a positive but insignificant slope for public sector banks and a negative but significant slope for private sector firms.

To test whether banks were exposed to global markets we estimate the coefficients of beta in a two-factor model consisting of domestic market return (beta) and the global market return (global beta). The coefficient for global beta was negative but insignificant for both public and private sector banks. Beta coefficients are similar to the previous regression. Thus, exposure to the global markets does not explain the behavior of deposit growth for public sector versus private sector financial firms.

## **IX. Related Literature**

Our paper is related to the literature on bank bailouts and its impact on bank risk-taking behavior.

Existing literature suggests that bailout by regulators may induce banks to manage their risks differently. Penati and Protopapadakis (1988) show that banks invest inefficiently in common markets to attract deposits at cheaper costs, assuming that in the event of a system wide failure involving a large number of banks, the regulator will insure uninsured depositors. Perotti and Suarez (2002) show that in a systemic crisis, failed banks are sold to surviving banks thereby increasing the value of surviving banks. Thus banks anticipating this reduce their risks ex-ante.

Cordella and Yeyati (2003) show that the regulator by committing to bailout banks during systemic crises can encourage banks to stay solvent and thus incentivize banks to manage their risks prudently. In our analysis, we empirically examine whether the presence of such a commitment in the form of explicit guarantees by the Indian government induced public sector banks to manage risks prudently. Our analysis indicates otherwise.

Current literature also examines when regulators are likely to bailout banks. Brown and Dinç (2009) empirically show that the governments are more likely to rescue a failing bank when the banking system, as a whole, is weak. They show that thus, a too-many-to-fail effect exists and is larger for larger banks. In contrast, Acharya and Yorulmazer (2007) show that the too-many-to-fail problem exists for smaller banks and thus gives banks incentives to herd and increases the risk that banks fail together.

Veronesi and Zingales (2009) investigate the impact of government intervention on banks. They conduct an event study and specifically investigate the U.S. Government intervention in October 2008 and bailout of U.S. banks and calculate the benefits to the banks and costs to taxpayers. They find that the government intervention increased the value of banks by \$131 billion compared to a tax payer cost between \$25 to \$47 billion.

Dam and Koetter (2012) examine the bank risk taking effects there is a higher probability of a bank being bailed out. They conclude that an increase in expectation of bank bailouts results in moral hazard and banks increase their risk taking behavior.

Gropp, Hakenes and Schnabel (2010) find evidence that banks with outright public ownership increase their risk-taking behavior. Adding to this literature, our analysis explicitly examines how markets react to the possibility of a government bailout when the bailout is explicit in the form of government guarantees such as those for public sector banks during the crisis. This is then compared to private sector banks where no such guarantees exist. Our analysis indicates that when there is an explicit guarantee, banks that take greater systemic risks are rewarded.

## **X. Conclusion**

In this paper, we have made an attempt to explain the relatively strong performance of public sector banks versus their private sector counterparts. The global crisis which erupted in 2007 had its impact on the Indian economy beginning only 2008. While the global impact on the financial sectors has been severe, Indian financial firms have fared much better. Much of this has been credited to the public sector firms which lent stability during the crisis period. Our analysis shows that while this may be true, public sector firms benefitted significantly from government guarantees. At the peak of the financial crisis, the Indian government announced a series of stimulus packages with the aim of restoring the economy. As a result even some risky public sector banks performed better than their less risky public sector counterparts and overall they fared better than the private sector counterparts. Interpreting this lack of a level-playing field as the relative stability and efficiency of public sector banks relative to private sector banks appears questionable.



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# Table 1: Descriptive Statistics

This table contains the summary statistics for Pre-Crisis Return, Realized Return, MES, Log Assets, LVG, Volatility, Beta and Global Beta for the 38 banks used in our analyses. Pre-crisis return is the stock return for the period January 2007 to December 2007. Realized return is the actual stock return during the crisis period from January 2008 to February 2009. MES is the marginal expected shortfall of a stock given that the market return is below its 5<sup>th</sup> - percentile. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Log Asset is the natural logarithm of the book value of asset value measured as of March 31, 2008. Capitalization ratio measured as of March 31, 2008 is the ratio of market equity to the quasi-market value of assets measured as (book value of assets – book value of equity + market value of equity). Beta is based on the S&P CNX NIFTY index as the market return. Global beta is based in the MSCI World Index returns. Volatility is the annualized daily volatility in the pre-crisis period from January 2007 to December 2007.

	Pre-Crisis Return	Realized Return	MES	Log Assets	Capitalization Ratio	Volatility	Beta	Global Beta
<b>Overall</b>								
Number of banks	39							
Mean	91.16%	-65.65%	4.09%	13.15	0.13	20.28%	0.87	0.71
Value Weighted	71.54%	-60.14%	4.46%		0.13	18.98%	1.02	0.84
Std. Dev	63.77%	12.24%	1.33%	1.42	0.16	7.57%	0.30	0.33
<b>Public</b>								
Number of banks	22							
Mean	71.97%	-63.26%	4.29%	13.55	0.11	20.23%	0.92	0.75
Value Weighted	69.32%	-58.34%	4.56%		0.12	19.35%	1.03	0.85
Std. Dev	41.74%	12.83%	1.58%	1.25	0.20	7.18%	0.32	0.34
<b>Private</b>								
Number of banks	17							
Mean	115.98%	-68.75%	3.83%	12.64	0.14	20.36%	0.81	0.67
Value Weighted	79.82%	-66.87%	4.09%		0.15	17.58%	1.00	0.81
Std. Dev	78.80%	11.03%	0.91%	1.50	0.11	8.27%	0.26	0.30

**Table 2: Event Return versus MES and Log Assets**

The table below shows the regression results of the dependent variable event return versus the dependent variables MES and log assets. MES is the marginal expected shortfall of a stock given that the market return is below its 5<sup>th</sup> - percentile during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Realized return or event return is the actual stock return during the crisis period for the period January 2008 to February 2009. Log Asset is the natural logarithm of the book value of asset value measured as of March 31. The 38 firms for which data for all variables is available were used in the overall analysis.

t-statistics in parentheses. \*\*\*, \*\* and \* indicate significance at 1, 5 and 10% levels, respectively.

PSB	-0.629* (-22.05)	-0.883* (-10.75)	-1.788* (-4.15)	-1.507* (-5.56)
Pvt	-0.688* (-25.78)	-0.434* (-4.24)	-1.216* (-7.77)	-0.903* (-6.04)
MES*PSB		6.128* (3.21)		4.877* (2.79)
MES*Pvt		-6.617** (-2.61)		-5.328** (-2.37)
Log Assets*PSB			0.101** (2.70)	0.0591** (2.58)
Log Assets*Pvt			0.0527* (3.54)	0.0419* (3.57)
Adj. R-Square	0.967	0.979	0.975	0.982
Observation	38	38	38	38

**Table 3: Bailout Event Return versus MES for public and private sector financial firms**

The table below shows the regression results of the dependent variable realized returns (pre-bailout, bailout and post-bailout) versus the dependent variable MES. MES is the marginal expected shortfall of a stock given that the market return is below its 5<sup>th</sup> - percentile during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Pre-bailout return is the event return from 7<sup>th</sup> December 2007 to 8<sup>th</sup> December 2008 and bailout return is calculated from 8<sup>th</sup> December to 22<sup>nd</sup> December. Pre-bailout MES is calculated for the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007 and bailout period MES is calculated for the period 7<sup>th</sup> December, 2007 to 8<sup>th</sup> December, 2008. 37 banks were used in the analysis.

t-statistics in parentheses. \*\*\*, \*\* and \* indicate significance at 1, 5 and 10% levels, respectively.

	Pre-Bailout Returns		Bailout		Post-Bailout	
PSB	-0.980*	-2.114**	0.0958*	-0.0274	-0.216*	-0.00371
	(-6.62)	(-2.61)	(7.94)	(-1.04)	(-8.05)	(-0.07)
Pvt	-1.079*	-0.172	0.105*	-0.0244	-0.231*	-0.157***
	(-11.65)	(-0.57)	(6.09)	(-0.58)	(-10.35)	(-1.77)
MES*PSB		25.58		2.778*		-4.784*
		(1.55)		(5.01)		(-3.65)
MES*Pvt		-23.71*		3.395*		-1.918
		(-2.79)		(3.09)		(-0.92)
Adj. R-Square	0.763	0.829	0.720	0.813	0.803	0.842
Observation	37	37	37	37	37	37

## Table 4: Descriptive Statistics

This table contains the summary statistics for deposits, deposits growth, composition of deposits and growth of deposits by type and location. Deposit growth for the crisis period is calculated from data provided by RBI for the period from 31<sup>st</sup> March, 2008 to 31<sup>st</sup> March, 2009. The 39 firms for which both MES data and RBI deposit growth estimates are available were used in this analysis. Deposits are classified into (A) demand deposits, (B) term deposits and (C) savings. Alternatively, deposits can also be classified as deposits belonging to branches within India and outside India. Panel A shows the deposits in 2008, 2009 and deposit growth for all banks, public sector banks and private sector banks. Panel B contains the summary statistics composition of deposits on the balance sheet as of March 31, 2008. Panel C gives the descriptive statistics for deposit growth by type and by location.

t-statistics in parentheses. \*\*\*, \*\* and \* indicate significance at 1, 5 and 10% levels, respectively.

### Panel A: Overall descriptive statistics summary

	Overall			Public Sector Banks			Private Sector Banks		
	Deposits 2008 (INR million)	Deposits 2009 (INR million)	Deposit Growth	Deposits 2008 (INR million)	Deposits 2009 (INR million)	Deposit Growth (INR million)	Deposits 2008 (INR million)	Deposits 2009 (INR million)	Deposit Growth (INR million)
Number of banks	39			22			17		
Mean	738,293	920,307	19.04%	1,019,327	1,305,795	22.01%	374,602	421,440	15.19%
Value Wtd.	2,158,717	2,647,204	21.32%	2,656,229	3,583,774	24.41%	1,587,136	1,571,200	9.77%
Std. Dev.	937,816	1,240,714	12.04%	1,062,155	1,469,045	6.77%	599,119	595,617	16.01%

### Panel B: Composition of Deposits on Balance sheet as of March 31, 2008

	Type-wise							Location-wise	
	Demand deposits	(i) From banks	(ii) From others	Term deposits	(i) From banks	(ii) From others	Savings bank deposits	Deposits of branches in India	Deposits of branches outside India
	Overall								
Mean	11.17%	0.39%	10.78%	68.72%	3.64%	65.08%	20.10%	98.19%	1.81%
Value Wtd.	12.48%	0.76%	11.73%	63.92%	2.97%	60.95%	23.47%	96.11%	3.76%
Std. dev.	4.95%	0.48%	4.78%	8.81%	3.23%	8.47%	6.92%	4.30%	4.30%
	Public banks								
Mean	10.16%	0.50%	9.66%	65.99%	2.40%	63.59%	23.86%	97.03%	2.97%
Value Wtd.	11.75%	0.86%	10.89%	63.20%	2.47%	60.72%	25.06%	95.52%	4.48%
Std. dev.	3.20%	0.57%	3.04%	5.34%	2.26%	5.31%	4.44%	5.43%	5.43%
	Private Sector Banks								
Mean	12.51%	0.26%	12.25%	72.32%	5.27%	67.04%	15.17%	99.73%	0.27%
Value Wtd.	14.98%	0.41%	14.57%	66.39%	4.68%	61.71%	18.06%	98.11%	1.33%
Std. dev.	6.47%	0.30%	6.20%	11.12%	3.63%	11.29%	6.54%	0.80%	0.80%

**Panel C: Descriptive statistics by growth of deposits by type**

	Type-wise							Location-wise	
	Demand deposits	(i) From banks	(ii) From others	Term deposits	(i) From banks	(ii) From others	Savings bank deposits	Deposits of branches in India	Deposits of branches outside India
	<b>Overall</b>								
Mean	7.58%	18.29%	7.55%	15.98%	25.49%	29.01%	24.94%	20.68%	268.59%
Value Wtd.	7.27%	9.20%	7.94%	18.27%	30.79%	54.23%	29.80%	23.42%	181.30%
Std. dev	14.50%	58.08%	14.88%	8.81%	17.94%	80.84%	18.57%	12.55%	728.17%
	<b>Public Sector banks</b>								
Mean	6.96%	14.77%	7.25%	16.34%	28.22%	37.17%	27.83%	22.81%	308.08%
Value Wtd.	8.98%	0.97%	10.09%	18.94%	34.65%	63.99%	33.76%	26.85%	225.46%
Std. dev	11.42%	34.73%	11.58%	7.10%	10.10%	93.10%	9.51%	6.23%	798.44%
	<b>Private Sector Banks</b>								
Mean	7.71%	36.97%	7.14%	15.18%	21.39%	12.30%	20.73%	17.57%	71.11%
Value Wtd.	1.45%	37.25%	0.61%	15.98%	17.62%	20.98%	16.32%	11.71%	30.86%
Std. dev	11.42%	34.73%	11.58%	7.10%	10.10%	93.10%	9.51%	6.23%	798.44%



**Table 5: Deposit growth versus MES, Log Assets and event returns**

The table below shows the regression results of the dependent variable deposit growth versus the dependent variables MES, log assets and event return for public and private sector banks. MES is the marginal expected shortfall of a stock given that the market return is below its 5<sup>th</sup> - percentile during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Deposit growth (reported annually) for the crisis period is measured from 31<sup>st</sup> March, 2008 to 31<sup>st</sup> March, 2009. Log Asset is the natural logarithm of the book value of asset value measured as of March 31. Realized return or event return is the actual stock return during the crisis period for the period January 2008 to February 2009. 38 firms (excluding IDBI) for which data for all variables is available were used in this analysis.

t-statistics in parentheses. \*\*\*, \*\* and \* indicate significance at 1, 5 and 10% levels, respectively.

PSB	0.210*	0.150*	-0.175	0.350*	-0.123
	(19.34)	(8.16)	(-1.19)	(9.85)	(-0.73)
Pvt	0.152*	0.499*	-0.424	0.885*	0.0328
	(3.92)	(2.82)	(-1.16)	(4.92)	(0.10)
MES*PSB		1.439*			0.891
		(2.94)			(1.46)
MES*Pvt		-9.069***			-7.788
		(-1.79)			(-1.68)
Log Assets*PSB			0.0336**		0.0259
			(2.64)		(1.64)
Log Assets*Pvt			0.0574		0.0416
			(1.69)		(1.50)
Realized Returns*PSB				0.222*	
				(4.44)	
Realized Returns*Pvt				1.067*	
				(3.79)	
Adj. R-Square	0.727	0.785	0.760	0.861	0.797
Observation	38	38	38	38	38

**Table 6: Two year Deposit growth versus MES, Leverage, Pre-crisis returns and Log Assets**

The table below shows the regression results of the dependent variable deposit growth versus the dependent variables MES, log assets and event return for public and private sector banks. MES is the marginal expected shortfall of a stock given that the market return is below its 5<sup>th</sup> - percentile during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Deposit growth (reported annually) for the crisis period is measured from 31<sup>st</sup> March, 2008 to 31<sup>st</sup> March, 2010. Log Asset is the natural logarithm of the book value of asset value measured as of March 31. Realized return or event return is the actual stock return during the crisis period for the period January 2008 to February 2009. 38 firms (excluding IDBI) for which data for all variables is available were used in this analysis.

t-statistics in parentheses. \*\*\*, \*\* and \* indicate significance at 1, 5 and 10% levels, respectively.

PSB	0.250*	0.147*	-0.535***	0.404*	-0.462
	(14.72)	(7.01)	(-1.84)	(6.15)	(-1.33)
Pvt	0.165*	0.117	0.481	0.0321	0.462
	(4.12)	(0.87)	(0.96)	(0.12)	(0.81)
MES*PSB		2.490*			1.270
		(4.18)			(1.49)
MES*Pvt		1.271			0.322
		(0.40)			(0.11)
Log Assets*PSB			0.0685**		0.0576***
			(2.67)		(1.76)
Log Assets*Pvt			-0.0315		-0.0308
			(-0.63)		(-0.58)
Realized Returns*PSB				0.244**	
				(2.71)	
Realized Returns*Pvt				-0.194	
				(-0.50)	
Adj. R-Square	0.747	0.745	0.764	0.745	0.752
Observation	38	38	38	38	38

**Table 7: Deposit growth (by type) versus MES**

This table contains the regression results for each type of deposits against MES. Deposit growth for the crisis period is calculated from data provided by RBI for the period from 31<sup>st</sup> March, 2008 to 31<sup>st</sup> March, 2009. Deposits are broadly classified into demand deposits, savings and term deposits. The 38 firms (excluding IDBI) for which both MES data and RBI deposit growth estimates are available were used in this analysis. Panel A shows regression results for demand deposits, term deposits, savings deposits and deposits in India. Panel B shows regression results for interbank demand deposits, non-interbank demand deposits, interbank term deposits and non-interbank term deposits.

t-statistics in parentheses. \*\*\*, \*\* and \* indicate significance at 1, 5 and 10% levels, respectively.

**Panel A: Deposits Growth by type**

	Demand Deposits		Term Deposits		Savings Deposits		Deposits in India	
PSB	0.0747*	0.0567	0.288*	0.145*	0.166*	0.259*	0.232*	0.160*
	(2.99)	(1.13)	(13.04)	(2.82)	(10.70)	(3.76)	(17.03)	(7.12)
Pvt	0.0771***	-0.365	0.214*	0.783*	0.152*	0.287*	0.176*	0.550*
	(1.78)	(-1.64)	(3.66)	(3.15)	(5.84)	(3.12)	(4.22)	(2.95)
MES*PSB		0.436		3.461*		-2.254		1.743*
		(0.37)		(2.99)		(-1.56)		(2.91)
MES*Pvt		11.55***		-14.87**		-3.524		-9.784***
		(1.82)		(-2.26)		(-1.49)		(-1.86)
Adj. R-Square	0.176	0.326	0.671	0.757	0.760	0.780	0.736	0.791
Observation	38	38	38	38	38	38	38	38

**Panel B: Interbank and non-interbank demand and term deposit growth**

	Demand Deposits- Interbank		Demand Deposits- Non-Interbank		Term Deposits- Interbank		Term Deposits- Non- Interbank	
PSB	0.0316	0.111	0.0788*	0.0563	0.425**	-0.242	0.283*	0.152*
	(0.42)	(0.78)	(3.11)	(1.04)	(2.09)	(-0.36)	(13.63)	(3.88)
Pvt	0.370**	0.421	0.0714	-0.384	0.123	0.0739	0.207*	0.813*
	(2.04)	(0.77)	(1.59)	(-1.66)	(0.83)	(0.10)	(3.36)	(3.11)
MES*PSB		-1.913		0.542		16.14		3.178*
		(-0.47)		(0.43)		(1.17)		(3.26)
MES*Pvt		-1.332		11.88***		1.281		-15.82**
		(-0.12)		(1.81)		(0.07)		(-2.36)
Adj. R-Square	0.124	0.0743	0.166	0.319	0.101	0.0925	0.646	0.740
Observation	38	38	38	38	38	38	38	38

**Table 8: Descriptive statistics deposit rates**

This table shows the descriptive statistics and regression results for quarterly bank deposit rates. The 38 firms for which both MES data and RBI deposit growth estimates are available were used in this analysis. Minimum and maximum deposit rates for term deposits of maturity < 1 year, and >3 years are provided below are provided for Q1 2008, Q4 2008, Q1 2009. The average deposit rate for Q1 2008 is for the period from January 2008 to March 2008, Q2 2008 is for the period from April 2008 to June 2008, Q3 2008 is for the period from July 2008 to September 2008, Q4 2008 is from October 2008 to December 2008 and Q1 2009 is from the period January 2009 to March 2009. Panel A gives the descriptive statistics for deposit rates for term loans. Panel B gives descriptive statistics for the distressed banks in our sample. Note that following Acharya, Pedersen, Philippon and Richardson (2010), these distressed banks correspond to the first date when the 12-month return was worse than -85%.

**Panel A: All Banks**

	Q1 2008				Q4 2008				Q1 2009			
	< 1 yr (min)	< 1 yr (max)	>3 yrs (min)	>3 yrs (max)	< 1 yr (min)	< 1 yr (max)	>3 yrs (min)	>3 yrs (max)	< 1 yr (min)	< 1 yr (max)	>3 yrs (min)	>3 yrs (max)
	<b>Overall</b>											
Mean	4.01%	7.53%	8.53%	8.67%	4.19%	8.68%	9.17%	9.39%	3.78%	7.78%	8.36%	8.44%
Value Wtd.	3.93%	7.32%	8.45%	8.56%	3.98%	8.41%	9.09%	9.29%	3.68%	7.56%	8.27%	8.32%
Std. Dev	0.79%	0.59%	0.44%	0.45%	0.87%	0.56%	0.51%	0.50%	0.66%	0.48%	0.40%	0.40%
	<b>Public Sector Banks</b>											
Mean	3.89%	7.25%	8.55%	8.63%	3.89%	8.50%	9.05%	9.26%	3.63%	7.63%	8.26%	8.32%
Value Wtd.	4.00%	7.29%	8.52%	8.59%	4.02%	8.35%	9.06%	9.29%	3.71%	7.51%	8.28%	8.33%
Std. Dev	0.63%	0.36%	0.22%	0.20%	0.63%	0.55%	0.33%	0.30%	0.44%	0.38%	0.27%	0.26%
	<b>Private Sector banks</b>											
Mean	4.16%	7.89%	8.51%	8.73%	4.56%	8.91%	9.31%	9.55%	3.97%	7.96%	8.47%	8.59%
Value Wtd.	3.64%	7.45%	8.22%	8.45%	3.84%	8.63%	9.19%	9.28%	3.56%	7.74%	8.22%	8.28%
Std. Dev	0.96%	0.65%	0.62%	0.65%	1.01%	0.49%	0.65%	0.65%	0.83%	0.54%	0.50%	0.48%

**Panel B: Distressed Banks**

	Overall											
	< 1 yr (min)	< 1 yr (max)	>3 yrs (min)	>3 yrs (max)	< 1 yr (min)	< 1 yr (max)	>3 yrs (min)	>3 yrs (max)	< 1 yr (min)	< 1 yr (max)	>3 yrs (min)	>3 yrs (max)
Mean	4.21%	7.54%	8.54%	8.76%	4.64%	8.64%	9.29%	9.61%	4.25%	7.79%	8.54%	8.61%
Value Wtd.	4.03%	7.40%	8.51%	8.73%	4.24%	8.36%	9.01%	9.38%	4.00%	7.72%	8.49%	8.53%
Std. Dev	0.55%	0.34%	0.62%	0.56%	0.86%	0.70%	0.82%	0.72%	0.52%	0.37%	0.30%	0.24%
	<b>Public Sector Banks</b>											
Mean	4.08%	7.42%	8.67%	8.75%	4.17%	8.08%	8.92%	9.17%	3.92%	7.58%	8.50%	8.50%
Value Wtd.	3.93%	7.35%	8.60%	8.75%	3.98%	8.05%	8.85%	9.20%	3.84%	7.65%	8.50%	8.50%
Std. Dev	0.80%	0.14%	0.29%	0.25%	0.95%	0.14%	0.14%	0.14%	0.52%	0.14%	0.00%	0.00%
	<b>Private Sector banks</b>											
Mean	4.31%	7.63%	8.44%	8.78%	5.00%	9.06%	9.56%	9.94%	4.50%	7.94%	8.56%	8.69%
Value Wtd.	4.27%	7.54%	8.30%	8.67%	4.88%	9.11%	9.42%	9.80%	4.40%	7.88%	8.47%	8.62%
Std. Dev	0.38%	0.43%	0.83%	0.77%	0.71%	0.66%	1.05%	0.83%	0.41%	0.43%	0.43%	0.31%

**Table 9: Descriptive Statistics and regression results for advances by type**

This table shows the descriptive statistics and regression results for advances by type. Advance growth for the crisis period is calculated from data provided by RBI for the period from 31<sup>st</sup> March, 2008 to 31<sup>st</sup> March, 2009. Advances can be classified security-wise or sector-wise. Security-wise advances are classified into secured and unsecured advance loans. Secured advances refer to advances which are secured by tangible assets or covered by government guarantees. Advances can also be classified location-wise as advances in India and outside India. The last column gives the break-up by sectors for advances in India. The 38 firms for which both MES data and RBI deposit growth estimates are available were used in this analysis. MES is computed during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007 period versus the total realized return each quarter for the period 1<sup>st</sup> January, 2008 to 24<sup>th</sup> February, 2009. MES is the marginal expected shortfall of a stock given that the market return is below its 5<sup>th</sup> - percentile during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Panel A gives the composition of advances. Panel B gives the descriptive statistics for advance growth. Panel C gives the regression results of advance loans growth versus MES.

t-statistics in parentheses. \*\*\*, \*\* and \* indicate significance at 1, 5 and 10% levels, respectively.

**Panel A: Composition of advances (Balance sheet at the beginning of 2008)**

	Security-wise		Location-wise		Break-up within India			
	Secured	Unsecured	Advances in India	Advances outside India	Priority sectors	Public sectors	Banks	Others
	<b>Overall</b>							
Mean	81.05%	18.95%	96.96%	3.04%	34.21%	7.98%	0.36%	54.42%
Value Wtd.	78.08%	21.92%	91.61%	8.39%	32.02%	7.62%	0.39%	51.58%
Std. Dev	8.54%	8.54%	6.29%	6.29%	4.51%	5.70%	0.58%	7.81%
	<b>Public Sector Banks</b>							
Mean	79.82%	20.18%	95.94%	4.06%	34.93%	10.90%	0.51%	49.59%
Value Wtd.	77.87%	22.13%	92.37%	7.63%	33.00%	9.38%	0.48%	49.51%
Std. Dev	5.66%	5.66%	6.74%	6.74%	4.00%	3.35%	0.64%	4.57%
	<b>Private Sector banks</b>							
Mean	82.57%	17.43%	98.22%	1.78%	33.31%	4.36%	0.17%	60.38%
Value Wtd.	78.73%	21.27%	89.19%	10.81%	28.92%	2.00%	0.09%	58.18%
Std. Dev	11.22%	11.22%	5.45%	5.45%	5.42%	6.05%	0.41%	6.55%

### Panel B: Growth in Advances

		Security-wise		Location-wise		Break-up within India			
	Advances	Secured	Unsecured	Advances in India	Advances outside India	Priority sectors	Public sectors	Banks	others
	<b>Overall</b>								
Mean	21.93%	23.42%	20.18%	21.04%	320.14%	18.17%	97.29%	161.69%	24.77%
Value Wtd.	23.90%	26.85%	16.33%	21.67%	697.65%	18.47%	118.91%	300.90%	23.43%
Std. Dev	13.55%	14.27%	32.67%	13.30%	1844.23%	14.78%	408.15%	703.70%	17.56%
	<b>Public Sector Banks</b>								
Mean	24.22%	26.07%	19.51%	23.13%	574.41%	17.33%	27.32%	73.72%	27.28%
Value Wtd.	26.85%	30.73%	16.65%	24.83%	911.28%	17.62%	43.06%	165.88%	28.18%
Std. Dev	5.79%	7.97%	24.18%	4.99%	2477.91%	6.99%	54.96%	306.37%	10.41%
	<b>Private Sector Banks</b>								
Mean	19.10%	20.15%	21.02%	18.45%	6.04%	19.22%	183.74%	270.36%	21.67%
Value Wtd.	14.48%	14.50%	15.32%	11.60%	17.08%	21.16%	360.52%	731.04%	8.29%
Std. Dev	19.16%	19.26%	41.66%	19.11%	21.62%	21.03%	605.87%	1002.56%	23.65%

### Panel C: Regression results for growth in advances

	Advances		Priority+Public Sector		Banks		Others	
PSB	0.22*	0.14*	0.17*	0.008	-0.530	-0.89	0.24*	0.27*
	(20.92)	(10.1)	(8.17)	(0.14)	(-1.13)	(-0.79)	(13.4)	(5.63)
Pvt	0.16*	0.37**	0.14*	0.21	-0.183	-3.10	0.18*	0.50**
	(4.12)	(2.09)	(3.50)	(1.33)	(-0.42)	(-1.50)	(3.58)	(2.09)
MES*PSB		1.73*		3.95*		8.71		-0.78
		(3.98)		(2.97)		(0.39)		(-0.68)
MES*Pvt		-5.32		-2.00		76.10		-8.33
		(-1.12)		(-0.55)		(1.62)		(-1.23)
Adj. R-Square	0.74	0.75	0.59	0.61	-0.01	-0.01	0.67	0.69
Observation	38	38	38	38	38	38	38	38

**Table 10: Descriptive Statistics and regression results Quarterly prime lending rates**

This table shows the descriptive statistics and regression results for quarterly bank prime lending rates (BPLR). The 38 firms for which both MES data and RBI deposit growth estimates are available were used in this analysis. MES is computed during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007 period versus the total realized return each quarter for the period 1<sup>st</sup> January, 2008 to 24<sup>th</sup> February, 2009. MES is the marginal expected shortfall of a stock given that the market return is below its 5<sup>th</sup> - percentile during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Q1 2008 is the average prime lending rate (PLR) for the period from January 2008 to March 2008, Q2 2008 is for the period from April 2008 to June 2008, Q3 2008 is for the period from July 2008 to September 2008, Q4 2008 is from October 2008 to December 2008 and Q1 2009 is from the period January 2009 to March 2009. Panel A gives the descriptive statistics for Bank Prime Lending rate (BPLR). Panel B gives the regression results of PLR versus MES.

t-statistics in parentheses. \*\*\*, \*\* and \* indicate significance at 1, 5 and 10% levels, respectively.

**Panel A: Descriptive statistics for bank prime lending rates**

	Overall				
	Q1 2008	Q2 2008	Q3 2008	Q4 2008	Q1 2009
Mean	13.70	13.88	14.84	14.39	13.89
Value Wtd.	13.33	13.52	14.61	13.96	13.29
Std. Dev	1.09	1.21	1.13	1.50	1.71
	Public Sector Banks				
	Q1 2008	Q2 2008	Q3 2008	Q4 2008	Q1 2009
Mean	12.94	13.00	14.04	13.21	12.52
Value Wtd.	12.74	12.88	13.96	13.13	12.39
Std. Dev	0.31	0.33	0.14	0.28	0.28
	Private Sector banks				
	Q1 2008	Q2 2008	Q3 2008	Q4 2008	Q1 2009
Mean	14.69	15.03	15.91	15.94	15.67
Value Wtd.	15.20	15.57	16.69	16.63	16.18
Std. Dev	0.92	0.93	0.96	0.89	0.94

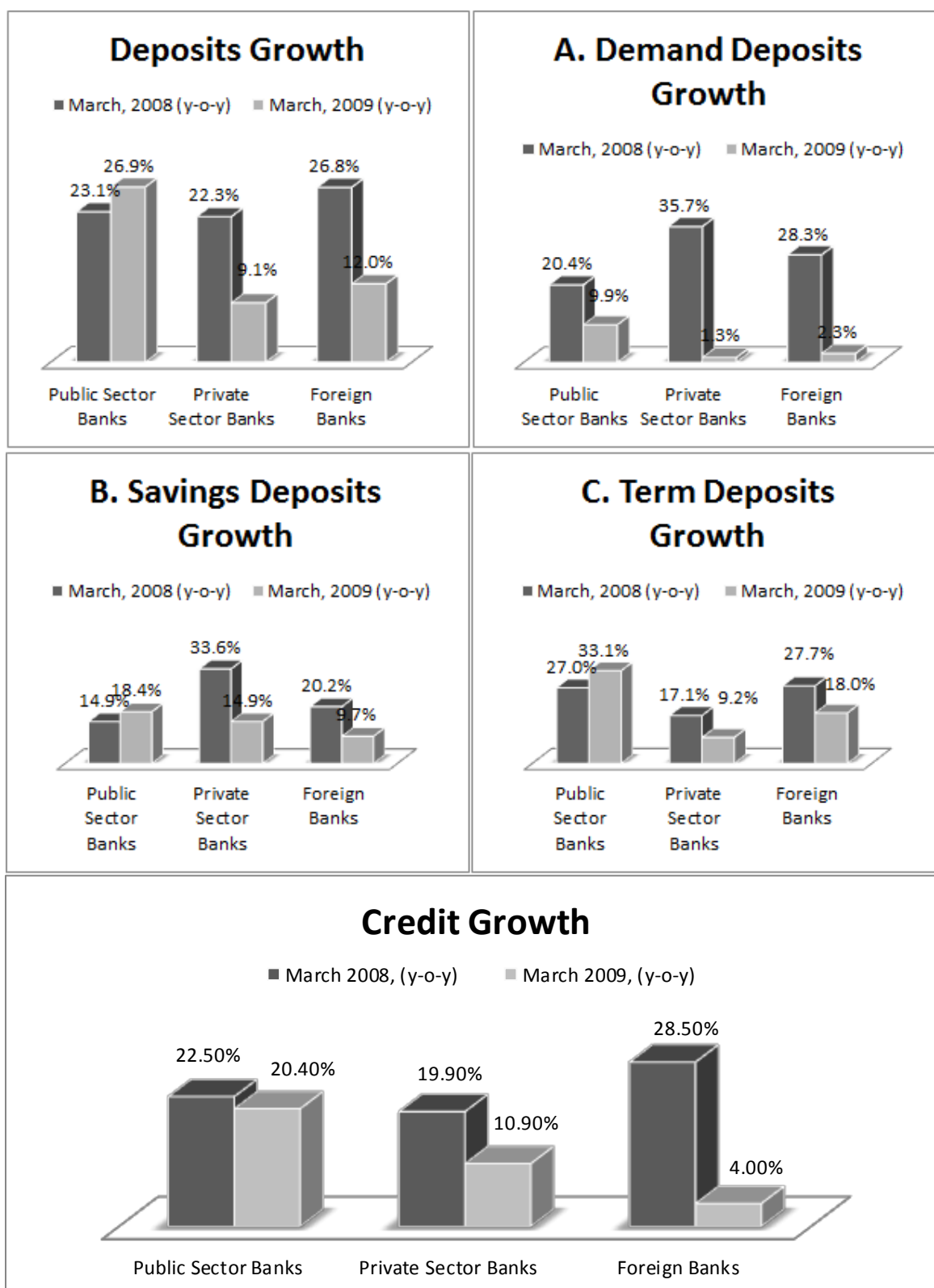
**Panel B: Regression results for bank prime lending rates**

	Q1 2008		Q2 2008		Q3 2008		Q4 2008		Q1 2009	
PSB	12.94*	13.08*	13*	13.29*	14.04*	13.98*	13.21*	13.26*	12.52*	12.80*
	(193.64)	(102.06)	(182.14)	(62.67)	(447.32)	(194.75)	(217.79)	(138.12)	(201.40)	(102.88)
Pvt	14.69*	12.06*	15.03*	12.71*	15.91*	13.49*	15.94*	13.63*	15.67*	12.85*
	(63.85)	(22.18)	(64.91)	(24.60)	(66.49)	(25.25)	(71.78)	(25.88)	(66.77)	(20.70)
MES*PSB		-3.631		-7.461		1.548		-1.184		-7.285***
		(-0.87)		(-1.40)		(0.66)		(-0.33)		(-1.90)
MES*Pvt		72.25*		63.93*		66.31*		63.32*		77.50*
		(4.59)		(5.99)		(5.12)		(4.99)		(4.79)
Adj. R-Square	0.998	0.999	0.998	0.999	0.998	0.999	0.998	0.999	0.998	0.999
Observation	37	37	37	37	37	37	37	37	37	37



## Figure 1: Deposit Growth

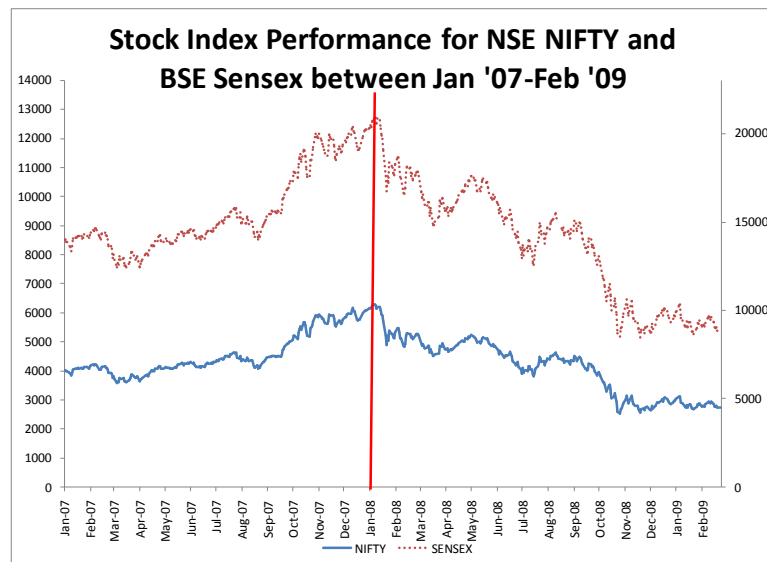
The graphs below show the group-wise growth in deposits and credit in banks. Growth rates are year-on-year as of March 28, 2008 and March 27, 2009 from RBI website.



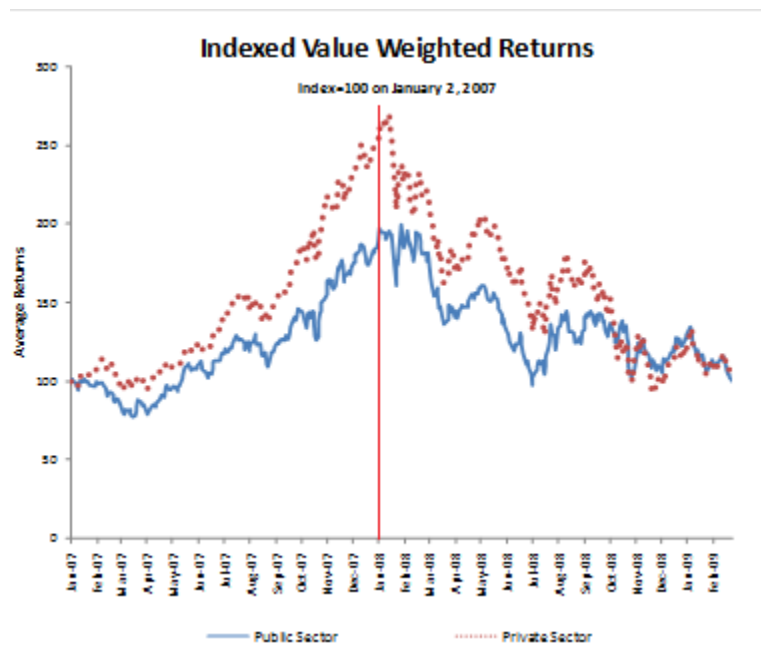
## Figure 2: Stock Index Performance

Figure A shows stock index performance for the period starting January 2007 to February 2009. Two indices, S&P NIFTY and BSE SENSEX, are represented. The S&P CNX NIFTY (or NIFTY; base level of 1000 defined as of November, 1995) is a free float market capitalization index on the National Stock Exchange and consists of 50 companies. Bombay Stock Exchange Sensitive Index (BSE Sensex or Sensex) is a value-weighted index composed of 30 stocks with a base level of 100 in 1978-1979. Figure B shows the indexed value weighted returns for the private (public) sector represents the returns weighted by the market capitalization of the private (public) sector firms used in the analysis. A base value of 100 as of January 2, 2007 is used.

**Figure A**



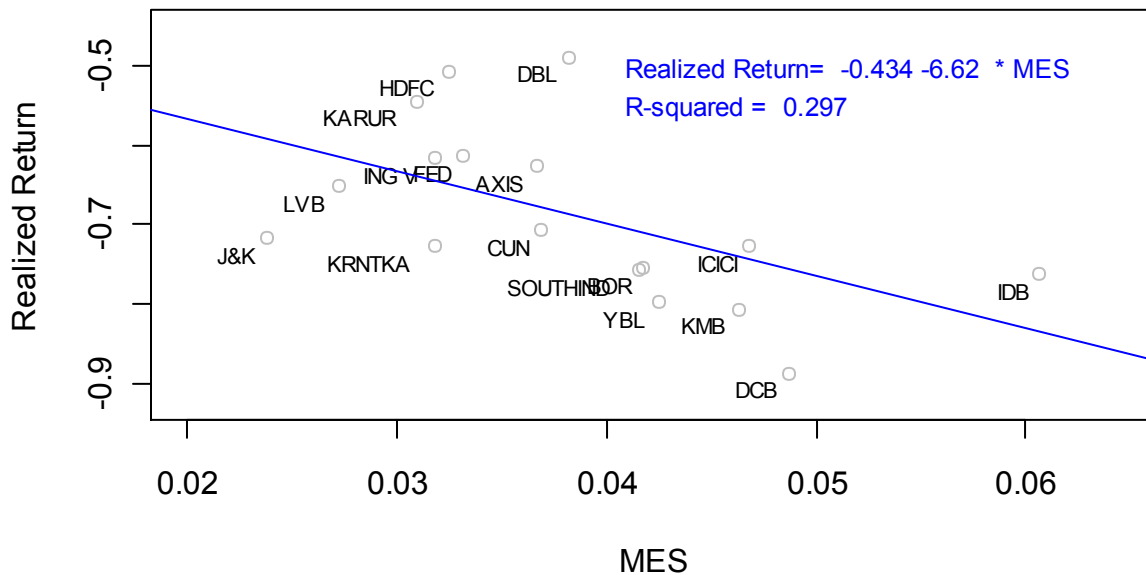
**Figure B**



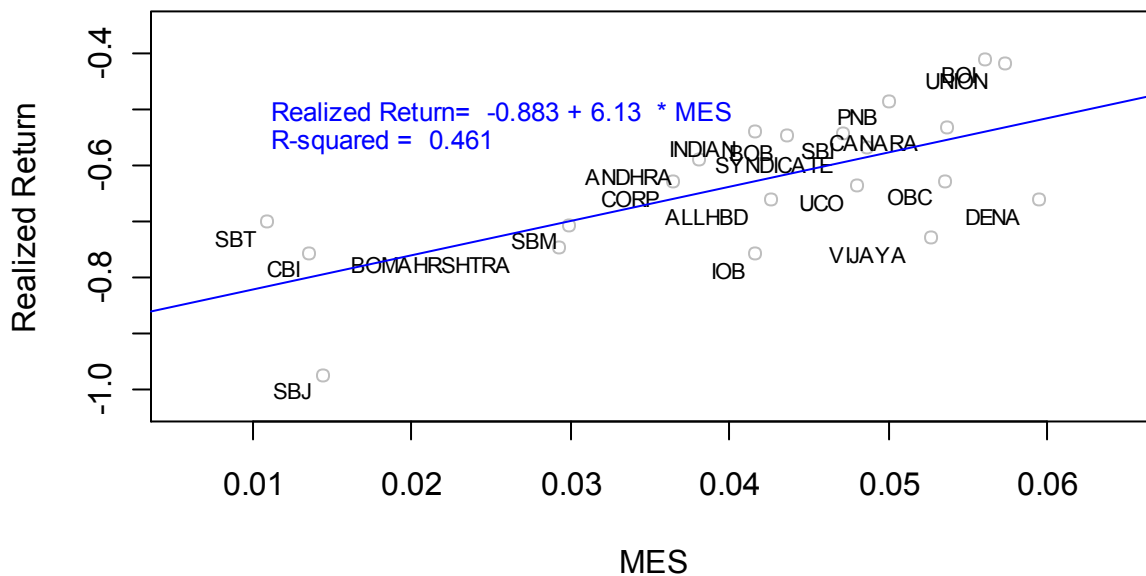
### Figure 3: Event Return versus MES

The graphs below show the scatterplot of the MES computed during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007 period versus the total realized return for the public sector banks and private sector banks during 1<sup>st</sup> January, 2008 to 24<sup>th</sup> February, 2009. MES is the marginal expected shortfall of a stock given that the market return is below its 5<sup>th</sup> - percentile during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Realized return or event return is the actual stock return during the crisis period from January 2008 to February 2009. The 38 firms for which RBI deposit data are available were used in this analysis. Graph A shows the results for private sector banks and graph B shows the results for public sector banks.

**Graph A: Private Sector banks**



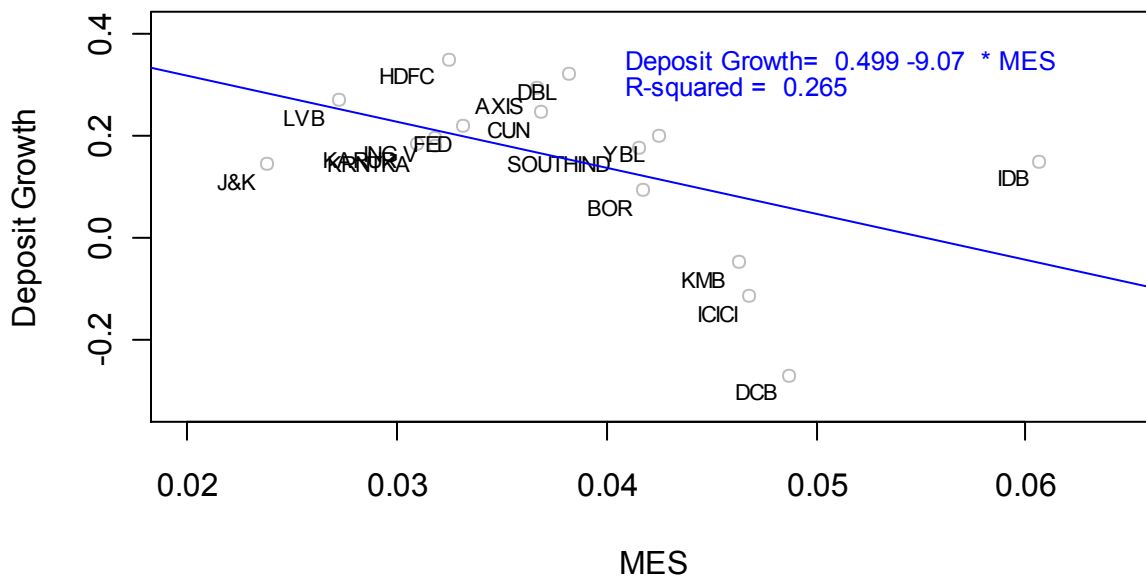
**Graph B: Public Sector banks**



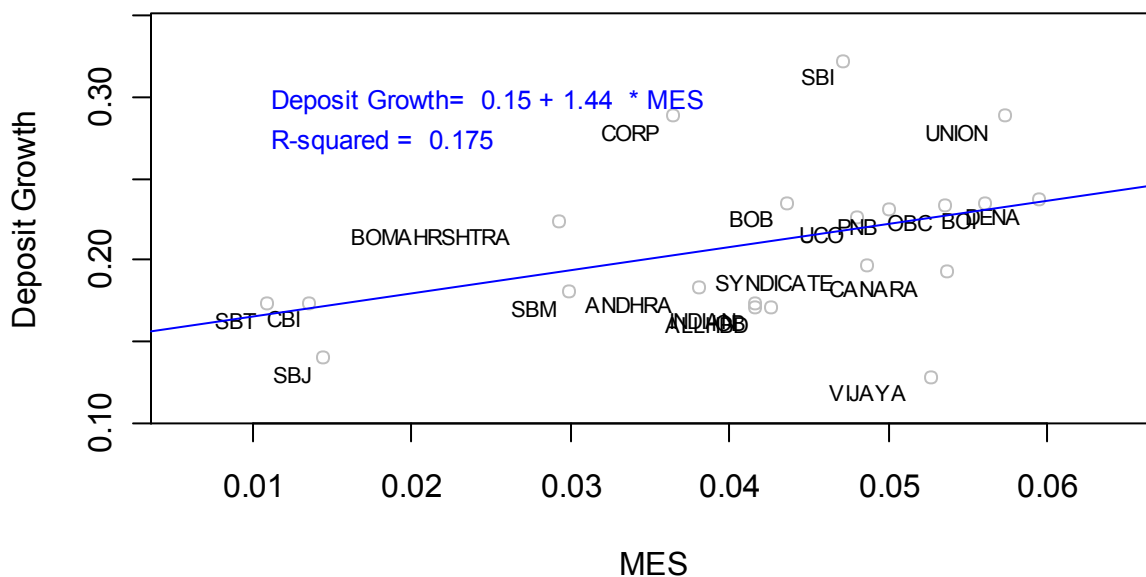
## Figure 4: Deposit growth versus MES for Private and Public Banks

The graphs below shows the scatterplot of the MES computed during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007 period versus the deposit growth for public sector banks from 31<sup>st</sup> March, 2008 to 31<sup>st</sup> March, 2009. MES is the marginal expected shortfall of a stock given that the market return is below its 5th - percentile during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Deposit growth for the crisis period is measured from 31<sup>st</sup> March, 2008 to 31<sup>st</sup> March, 2009. The 38 firms for which both MES data and RBI deposit growth estimates are available were used in this analysis.

### Graph A: Private Banks

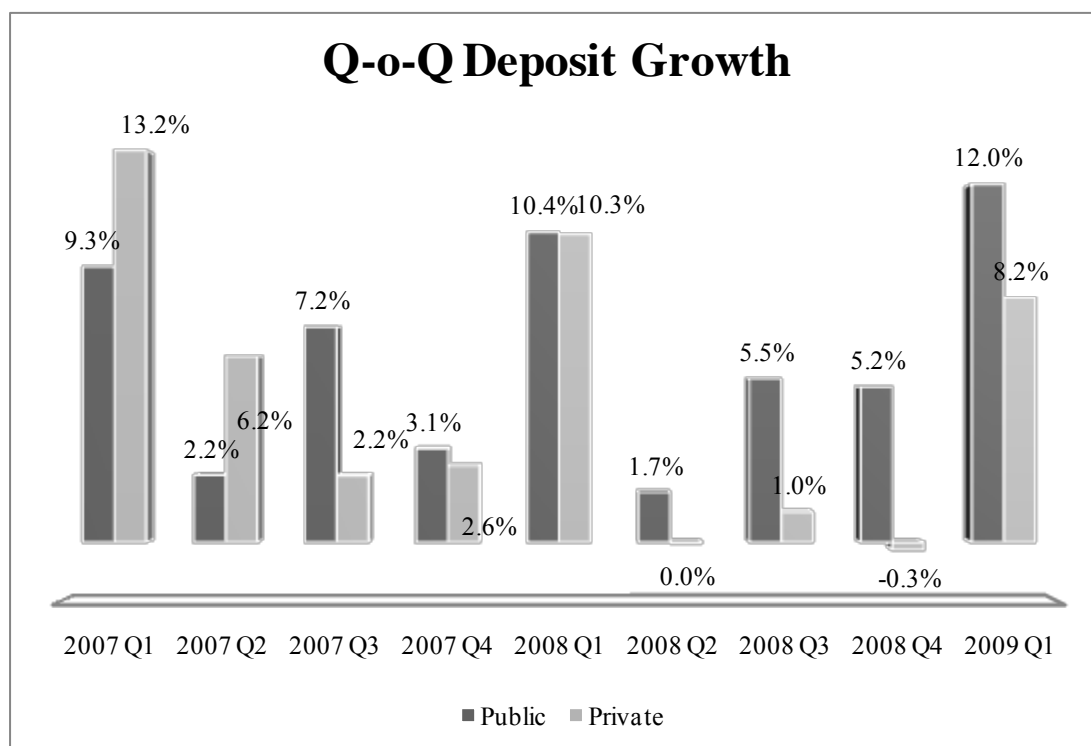


### Graph B: Public Banks



**Figure 5: Q-o-Q Deposit growth for public and private sector banks**

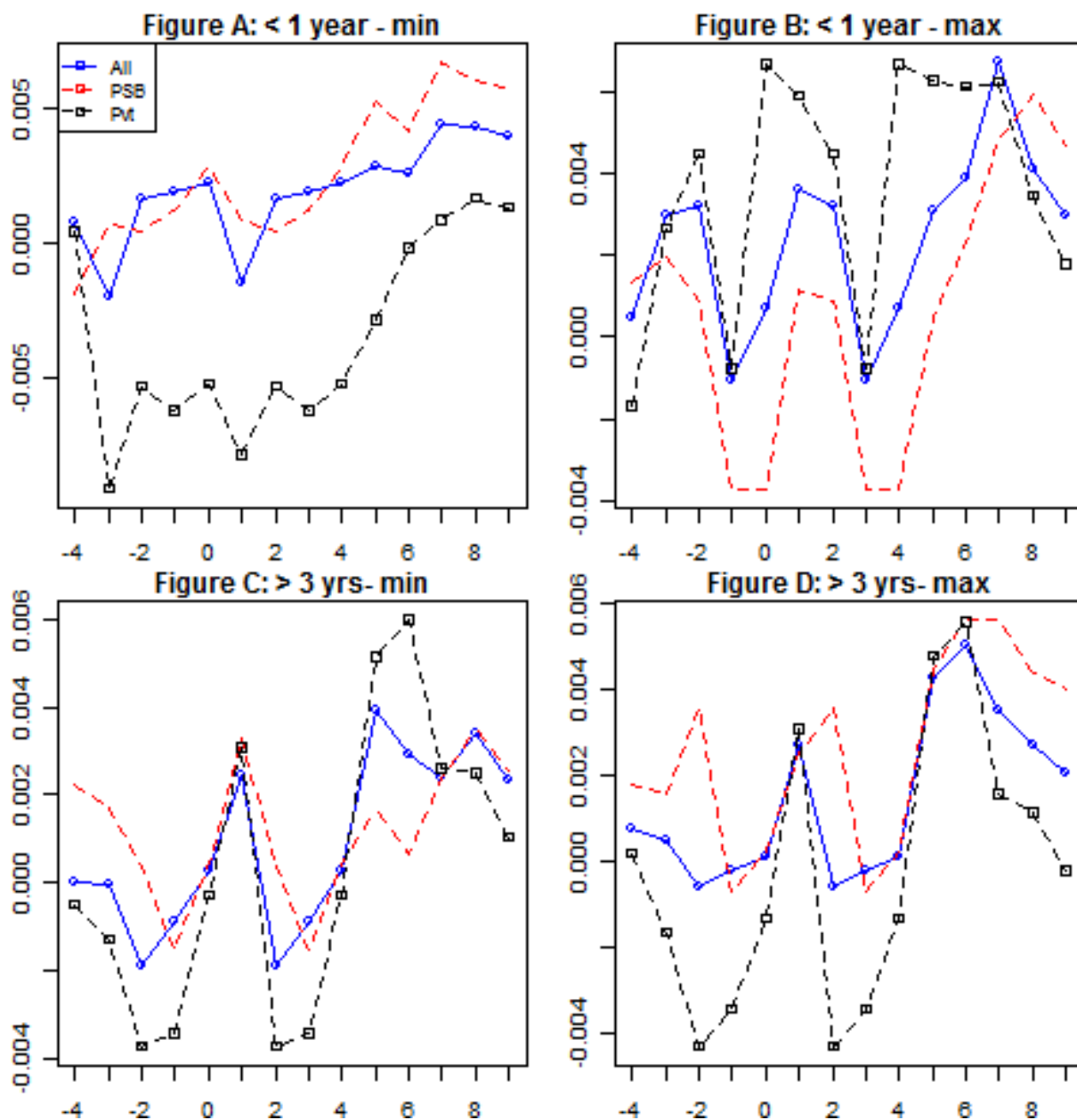
The graph below shows the quarter over quarter changes in deposit amounts for public and private sector banks. Deposit growth for Q1 2008 is the deposit growth from January 2008 to March 2008, Q2 2008 is for the period from April 2008 to June 2008, Q3 2008 is for the period from July 2008 to September 2008, Q4 2008 is from October 2008 to December 2008 and Q1 2009 is from the period January 2009 to March 2009.



Source: (RBI)

## Figure 6: Deposit Rates

The figures below show the minimum and maximum deposit rates for short maturity (< 1 year) and long maturity (> 3 years) term loans of distressed banks adjusted for the deposit rates of non-distressed banks. Figure A and Figure B show the deposit rates relative to non-distressed banks within the particular group (for example, distressed PSB deposit rates relative to non-distressed PSB deposit rates) for short maturities. Similarly Figure C, D show the relative deposit rates for term loans with long maturity. The x-axis is the time to failure in quarters with 0 corresponding to the quarter in which the bank reached distress. Note that following Acharya, Pedersen, Philippon and Richardson (2010), these distressed banks correspond to the first date when the 12-month return was worse than -85%.



Source: (RBI)

## Appendix A.1: Robustness checks for crises periods:

Panel A shows the regression results of the placebo tests for crises returns versus MES. MES is the marginal expected shortfall of a stock given that the market return is below its 5th - percentile during the period 1st January, 2007 to 31st December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Placebo crises returns are calculated from 1<sup>st</sup> January to 31<sup>st</sup> December of the crises period. For example, 2005 versus 2004 regression results are carried out using crisis period returns from January 1<sup>st</sup> to December 31<sup>st</sup>, 2005 against pre-crisis period returns calculated from January 1<sup>st</sup> to December 31<sup>st</sup>, 2004. Returns are similarly calculated for 2006 versus 2005, 2007 versus 2006 and 2008 versus 2007. We use the 38 banks publicly listed firms for which data is available from RBI. Panel B shows the regression results of event return versus MES during the Dotcom crash. The internet bubble burst in March 2001. MES is the marginal expected shortfall of a stock given that the market return is below its 5<sup>th</sup> - percentile during the period March, 1999 to March, 2001. Market return is based on the S&P CNX NIFTY for the pre-crisis period from 1<sup>st</sup> March, 1999 to 28<sup>th</sup> February, 2001. Realized return or event return is the actual stock return during the crisis period for the period March 2001 to February 2009. We use 27 financial firms for which data is available for this period.

t-statistics in parentheses. \*\*\*, \*\* and \* indicate significance at 1, 5 and 10% levels, respectively.

### Panel A: Regressions of realized returns versus MES

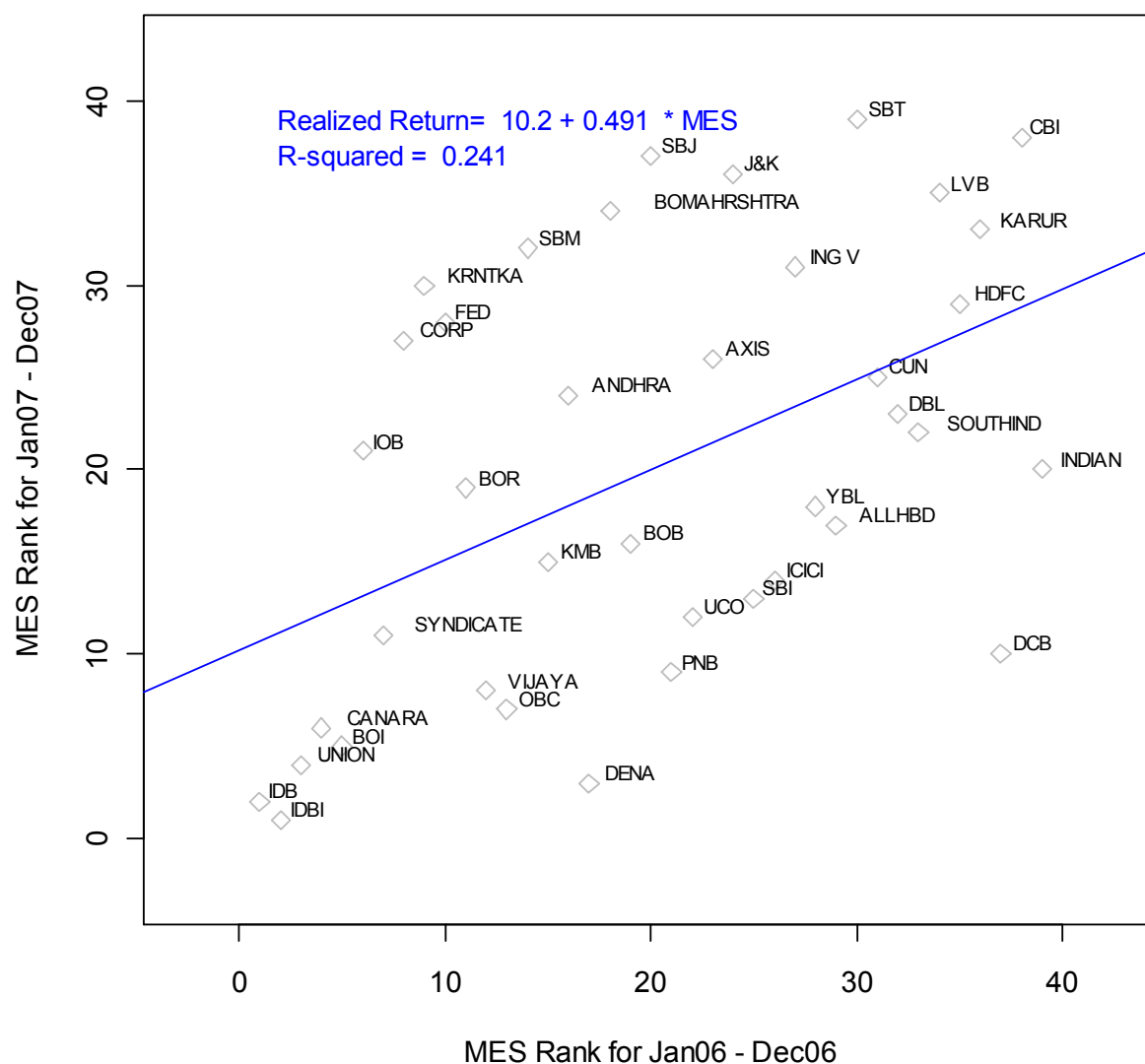
	2005 versus 2004	2006 versus 2005	2007 versus 2006	2008 versus 2007
PSB	0.174 (1.28)	-0.0279 (-0.20)	0.695* (5.63)	-2.145** (-2.71)
Pvt	0.378 (1.48)	0.464** (2.70)	0.531* (4.28)	-0.354 (-0.99)
MES*PSB	-2.276 (-1.10)	3.595 (0.63)	-3.468 (-1.38)	23.57 (1.46)
MES*Pvt	-6.349 (-1.40)	-7.560 (-1.11)	5.050 (1.51)	-22.24** (-2.27)
Adj. R-Square	0.0295	0.369	0.837	0.862
Observation	37	37	37	37

### Panel B: Regressions of realized returns versus MES for the Dotcom crash

PSB	-0.105 (-0.33)
Pvt	0.854* (3.08)
MES_PSB	3.716 (0.53)
MES_Pvt	-23.15* (-3.23)
Adj. R-Square	0.303
Observation	27

## Appendix A.2: MES Rank for Jan '07-Dec '07 versus MES Rank for Jan '06 - Dec '06

The graph below shows the scatterplot of the MES Rank computed during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007 versus the MES Rank computed during the period from 1<sup>st</sup> January, 2006 to 31<sup>st</sup> December, 2006. MES for a period is the marginal expected shortfall of a stock given that the market return is below its 5<sup>th</sup> - percentile during the same period. Market return is based on the S&P CNX NIFTY. “MES Rank” ranks firms in descending order of MES values (assigns rank 1 to the firm with the largest MES). The firms for which data was available for both periods were used in the analysis.





### Appendix A.3: Event return versus MES, beta, volatility, capitalization ratio and pre-crisis returns.

The table below shows the regression results for event return using alternative measures of risk and for capitalization ratio and pre-crisis returns. MES is the marginal expected shortfall of a stock given that the market return is below its 5<sup>th</sup> - percentile during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Realized return or event return is the actual stock return during the crisis period for the period January 2008 to February 2009. Beta is based on the S&P CNX NIFTY index as the market return. Global beta is based in the MSCI World Index returns. Volatility is the annualized daily volatility in the pre-crisis period from January 2007 to December 2007. Pre-crisis return is the stock return for the period January 2007 to December 2007. Leverage (LVG) measured as of March 31, 2008 is the ratio of the quasi-market value of assets measured as (book value of assets – book value of equity + market value of equity) to the market equity. Capitalization ratio is the inverse of leverage.

t-statistics in parentheses. \*\*\*, \*\* and \* indicate significance at 1, 5 and 10% levels, respectively.

PSB	-0.883* (-10.75)	-0.922* (-12.47)	-0.943* (-12.42)	-0.792* (-7.65)	-0.586* (-11.84)	-0.593* (-15.18)
Pvt	-0.434* (-4.24)	-0.572* (-7.69)	-0.629* (-6.55)	-0.434* (-4.24)	-0.660* (-11.72)	-0.624* (-14.55)
MES*PSB	6.128* (3.21)					
MES*Pvt	-6.617** (-2.61)					
beta*PSB		0.327* (4.45)	0.451* (3.15)			
beta*Pvt		-0.143 (-1.61)	0.147 (0.55)			
globalbeta*PSB			-0.124 (-1.00)			
globalbeta*Pvt			-0.265 (-1.34)			
vol*PSB				0.826 (1.59)		
vol*Pvt				-6.617** (-2.61)		
lv2008*PSB					-0.00211 (-1.19)	
lv2008*Pvt					-0.00180 (-0.60)	
precrisisreturns*PSB						-0.513 (-1.07)
precrisisreturns*Pvt						-0.547** (-2.24)
Adj. R-Square	0.979	0.980	0.980	0.973	0.965	0.967
Observation	38	38	38	38	38	38

## Appendix A.4: Deposit growth versus MES, beta, volatility, capitalization ratio and pre-crisis returns.

The table below shows the regression results for deposit growth against alternative measures of risk and against measures of leverage measures. Measures of risk are MES, Beta and volatility. MES is the marginal expected shortfall of a stock given that the market return is below its 5<sup>th</sup> - percentile during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Deposit growth (reported annually) for the crisis period is measured from 31<sup>st</sup> March, 2008 to 31<sup>st</sup> March, 2009. Beta is based on the S&P CNX NIFTY index as the market return. Global beta is based in the MSCI World Index returns. Volatility is the annualized daily volatility in the pre-crisis period from January 2007 to December 2007. Measures of leverage include capitalization ratio and pre-crisis returns. Leverage (LVG) measured as of March 31, 2008 is the ratio of the quasi-market value of assets measured as (book value of assets – book value of equity + market value of equity) to the market equity. Capitalization ratio is the inverse of leverage. Pre-crisis return is the stock return for the period January 2007 to December 2007.

t-statistics in parentheses. \*\*\*, \*\* and \* indicate significance at 1, 5 and 10% levels, respectively.

PSB	0.150* (8.16)	0.138* (8.18)	0.132* (6.46)	0.181* (6.20)	0.206* (7.34)	0.207* (12.08)
Pvt	0.499* (2.82)	0.317* (3.53)	0.282** (2.37)	0.499* (2.82)	0.178** (2.58)	0.207* (3.41)
MES*PSB	1.439* (2.94)					
MES*Pvt	-9.069*** (-1.79)					
beta*PSB		0.0802* (3.58)	0.119** (2.16)			
beta*Pvt		-0.205 (-1.54)	-0.0276 (-0.08)			
globalbeta*PSB			-0.0385 (-0.76)			
globalbeta*Pvt			-0.162 (-0.58)			
vol*PSB				0.149 (1.06)		
vol*Pvt				-9.069*** (-1.79)		
lv2008*PSB					0.000196 (0.21)	
lv2008*Pvt					-0.00171 (-0.37)	
precrisisreturns*PSB						0.0458 (0.24)
precrisisreturns*Pvt						-0.479 (-1.31)
Adj. R-Square	0.785	0.747	0.735	0.781	0.714	0.726
Observation	38	38	38	38	38	38

## Appendix B: Systemic Risk Ranking of Indian Financial Firms during January 2007 to December 2007

This table contains the list of Indian financial firms used in our analyses. Pre-crisis period measurements are market capitalization, Beta, Global Beta, Volatility, and leverage MES is the marginal expected shortfall of a stock given that the market return is below its 5<sup>th</sup> - percentile during the period 1<sup>st</sup> January, 2007 to 31<sup>st</sup> December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. Realized return or event return is the actual stock return during the crisis period for the period January 2008 to February 2009. Beta is based on the S&P CNX NIFTY index as the market return. Global beta is based in the MSCI World Index returns. Volatility is the annualized daily volatility in the pre-crisis period from January 2007 to December 2007.

Crisis period measurements included in this analysis are event return and deposit growth. Event return is the stock return for the individual firms during the crisis period from January 2008 to February 24, 2009. Deposit growth for the crisis period is calculated from data provided by RBI for the period from 31<sup>st</sup> March, 2008 to 31<sup>st</sup> March, 2009. The 38 firms for which both MES data and RBI deposit growth estimates are available were used in this analysis.

<b>Public Sector Banks</b>									
		<b>Pre-crisis</b>						<b>Post-Crisis</b>	
<b>Names</b>	<b>Type</b>	<b>MES</b>	<b>Beta</b>	<b>Global Beta</b>	<b>Vol</b>	<b>LVG-2008</b>	<b>Pre-Crisis Returns</b>	<b>Event Returns</b>	<b>Deposit Growth</b>
DENA BANK	Public	5.94%	1.00	0.86	26.79%	35.48	12.87%	-66.20%	23.77%
UNION BANK OF INDIA	Public	5.74%	1.16	0.96	23.71%	19.80	6.76%	-41.77%	28.93%
BANK OF INDIA	Public	5.60%	1.39	1.01	30.53%	17.58	7.57%	-40.89%	23.48%
CANARA BANK	Public	5.37%	1.11	0.80	21.10%	15.97	1.97%	-53.00%	19.31%
ORIENTAL BANK OF COMMERCE	Public	5.35%	1.14	0.99	21.32%	15.88	2.28%	-62.72%	23.39%
PUNJAB NATIONAL BANK	Public	5.00%	1.14	0.90	17.01%	12.57	2.99%	-48.38%	23.12%
SYNDICATE BANK	Public	4.86%	1.02	0.80	18.94%	27.36	5.42%	-56.82%	19.69%
UCO BANK	Public	4.80%	0.97	0.78	21.18%	51.66	17.55%	-63.66%	22.65%
STATE BANK OF INDIA	Public	4.71%	1.17	1.02	16.69%	11.19	8.92%	-54.29%	32.27%
BANK OF BARODA	Public	4.36%	1.12	0.94	19.81%	20.12	8.99%	-54.58%	23.55%
ALLAHABAD BANK	Public	4.26%	0.90	0.70	14.87%	20.52	3.33%	-66.10%	17.10%
INDIAN BANK	Public	4.17%	1.05	1.24	28.63%	16.46	9.75%	-53.98%	17.31%
INDIAN OVERSEAS BANK	Public	4.16%	0.91	0.81	17.36%	16.75	5.81%	-75.77%	17.16%
ANDHRA BANK	Public	3.81%	0.74	0.79	13.51%	13.68	2.23%	-58.87%	18.34%
CORPORATION BANK	Public	3.65%	0.90	0.86	21.26%	13.36	2.23%	-62.97%	28.88%
STATE BANK OF MYSORE	Public	2.99%	0.42	-0.05	36.29%	15.14	10.44%	-70.64%	18.11%
BANK OF MAHARASHTRA	Public	2.93%	0.57	0.35	15.54%	27.56	9.89%	-74.71%	22.42%
STATE BANK OF BIKANER & JAIPUR	Public	1.44%	0.36	0.23	10.10%	21.23	9.64%	-97.38%	13.98%
CENTRAL BANK OF INDIA	Public	1.36%	0.38	0.39	6.35%	26.33	1.78%	-75.61%	17.39%
STATE BANK OF TRAVANCORE	Public	1.09%	0.33	0.02	12.54%	19.41	8.09%	-69.94%	17.33%

<b>Private Sector Banks</b>									
		<b>Pre-crisis</b>						<b>Post-Crisis</b>	
<b>Names</b>	<b>Type</b>	<b>MES</b>	<b>Beta</b>	<b>Global Beta</b>	<b>Vol</b>	<b>LVG-2008</b>	<b>Pre-Crisis Returns</b>	<b>Post-Crisis Returns</b>	<b>Deposit Growth</b>
JAMMU & KASHMIR BANK LTD.	Private	2.37%	0.39	0.35	10.33%	27.28	3.57%	-71.79%	14.35%
VIJAYA BANK	Public	5.27%	1.03	0.93	21.02%	8.66	8.12%	-72.80%	12.86%
AXIS BANK LTD.	Private	3.67%	0.94	0.71	19.33%	35.63	10.74%	-62.61%	29.23%
BANK OF RAJASTHAN LTD.	Private	4.18%	0.78	0.82	31.05%	18.30	34.81%	-75.42%	9.22%
CITY UNIONBANK (NSE)	Private	3.69%	0.57	0.41	21.86%	8.76	14.54%	-70.74%	24.48%
DEVELOPMENT CREDIT BANK LTD.	Private	4.88%	0.89	0.77	34.83%	22.96	13.95%	-88.72%	-
DHANALAKSHMI BANK LTD.	Private	3.82%	0.59	0.49	23.88%	16.02	9.86%	-48.86%	31.99%
FEDERAL BANK LTD.	Private	3.32%	0.70	0.48	13.62%	4.61	9.77%	-61.27%	21.72%
H D F C BANK LTD.	Private	3.25%	1.05	0.81	15.08%	5.40	6.16%	-50.59%	34.87%
I C I C I BANK LTD.	Private	4.68%	1.12	0.93	15.52%	16.96	3.80%	-72.66%	-
INDUSIND BANK (NSE)	Private	6.06%	1.36	1.51	38.91%	17.49	16.93%	-76.25%	14.96%
I N G VYSYA BANK LTD.	Private	3.18%	0.66	0.36	17.63%	10.95	9.58%	-61.53%	19.61%
KARNATAKA BANK LTD.	Private	3.18%	0.71	0.50	12.31%	10.75	4.62%	-72.66%	17.81%
KARUR VYSYA BANK LTD.	Private	3.09%	0.50	0.30	8.60%	10.21	5.65%	-54.38%	18.51%
KOTAK MAHINDRA BANK LTD.	Private	4.63%	1.16	1.03	21.21%	2.89	22.38%	-80.66%	-4.86%
LAKSHMI VILAS BANK LTD.	Private	2.72%	0.67	0.54	21.10%	15.92	7.69%	-65.08%	27.01%
SOUTH INDIAN BANK LTD.	Private	4.16%	0.73	0.69	19.78%	26.96	15.46%	-75.71%	17.71%
YES BANK LTD.	Private	4.25%	0.89	0.62	21.02%	4.96	7.64%	-79.83%	19.74%

## Appendix C: Model

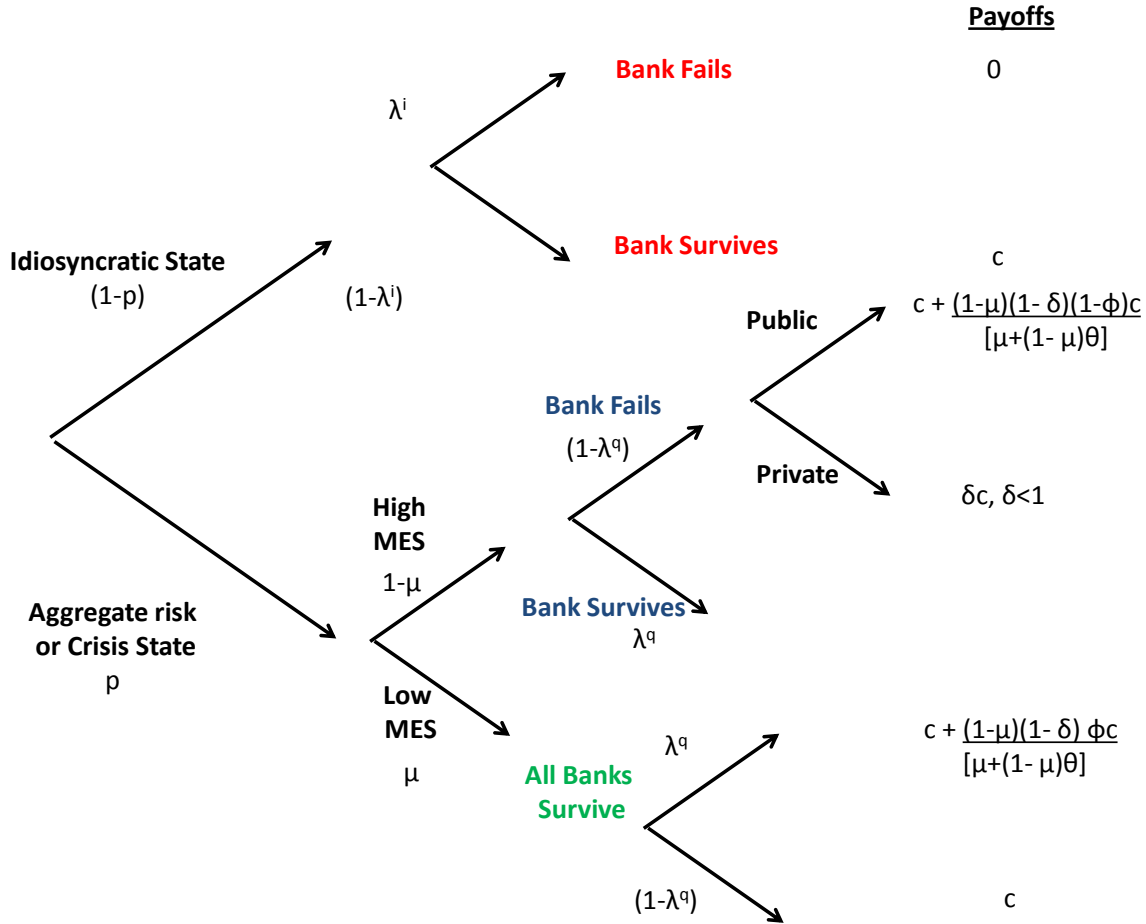
This appendix provides an intuitive explanation for the results in Section IV. The simple calculations below show why public sector banks with greater aggregate risk (MES) have higher stock returns during a crisis.

Nature selects either of two states: idiosyncratic state with probability  $(1-p)$  and a crisis state with probability  $p$ . When the idiosyncratic state occurs either of two things can happen: either the bank fails with a probability  $\lambda^i$  in which case it gets a payoff of 0 or it survives with a probability  $(1-\lambda^i)$  in which case it gets a payoff of  $c$ . Note, in case of an idiosyncratic shock and subsequent bank failure, there is no difference between a public sector or a private sector bank. Both get a value of zero in case of a failure.

Now consider the case when there is an aggregate shock. A mass  $(1-\mu)$  of banks have high MES and the remaining  $\mu$  banks have low MES. High MES banks fail with a high probability whereas low MES banks have a low probability of failing. For simplicity, let us assume that low MES banks do not fail. Let  $\lambda^q$  be the probability that a high MES bank fails when there is an aggregate shock and  $(1-\lambda^q)$  be the probability that it survives. If high MES bank survives then it gets the full amount  $c$ . If it fails however, private and public sector banks get different amounts.

Let  $\theta$  be the mass of public sector banks and  $(1-\theta)$  is the mass of private sector firms. When a high MES private sector bank fails, it gets only  $\delta c$ , where  $\delta$  is less than 1. The remaining  $(1-\delta)c$  is shared by the surviving banks, that is, between high PSBs and low MES banks. Intuitively,  $(1-\delta)c$  can be thought of the excess demand that is created for bank services (e.g. deposits and advances) when a high MES private sector bank fails. Let the parameter  $\phi$  control the distribution of this excess demand between high MES PSBs and low MES banks.

Note, low MES banks do not fail. Thus, with probability  $(1-\lambda^q)$  no high MES (private sector bank) fails and all low MES banks get  $c$ . But if a high MES private sector bank fails (which happens with probability  $\lambda^q$ ), then the  $(1-\delta)c$  is shared between the high MES PSBs and low MES banks. The estimated franchise values are shown in the figure below.



We want to calculate ex-ante, how the bank franchise value changes with the probability of aggregate crisis and relate it to bank exposure to aggregate risk as measured by MES. Let  $V^{Pvt}$  and  $V^{PSB}$  represent the franchise value of private sector bank and public sector banks respectively. Let  $\Delta V^{PSB}$  represent the difference in franchise value between high MES PSBs and low MES PSBs.

Thus it is easy to show that,  $\Delta V^{PSB} = p \lambda^q (1-\mu) (1-\delta) (1-2\phi) c$

Note,  $\Delta V^{PSB} > 0$  if and only if  $(1-2\phi) > 0$ , that is,  $\phi < 1/2$ .

Similarly, let  $\Delta V^{Pvt}$  represent the difference in franchise value between high MES private sector banks and low MES private sector banks.

$$\Delta V^{Pvt} = -p \lambda^q (1-\mu) (1-\delta) c - p \lambda^q (1-\mu) (1-\delta) c \phi$$

Now,  $\frac{d\Delta V^{Pvt}}{dp} < 0$ , for all values of  $\phi$ .

This simple model helps us understand the results that we saw in section IV.  $(1-\phi)$  parametrizes the amount that high MES PSBs are able to attract. We need  $\phi$  to be less than 0.5 for franchise value of high MES PSBs to be higher than low MES PSBs. That is, high MES PSBs need to attract the excess supply of deposits created by a failed high MES private sector bank. This can occur if say the PSB is too big to fail- such as in the case of SBI and its subsidiaries or if ex-ante they gamble and manage to attract deposits their way, say, by increasing deposit rates.

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