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# GOVERNMENT GUARANTEES AND BANK VULNERABILITY DURING A CRISIS: EVIDENCE FROM AN EMERGING MARKET

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**ABSTRACT**

We analyze the performance of Indian banks during 2007–09 relative to their vulnerability to a crisis measured using pre-crisis data, in order to study the impact of government guarantees on bank performance during a crisis. Using bank branch-level regulatory data, we exploit geographic variation in the exposure to state-owned banks to show that vulnerable private sector bank branches in districts with greater exposure to state-owned banks experienced deposit withdrawals and shortening of deposit maturity. In contrast, nearby vulnerable state-owned bank branches grew their deposit base and increased loan advances but with poorer ex-post performance of loans. Our evidence suggests that access to stronger government guarantees during aggregate crises allows even vulnerable state-owned banks to access and extend credit cheaply despite their under-performance, and this renders private sector banks especially vulnerable to crises.

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# 1 Introduction

While government guarantees can keep markets well-functioning during periods of stress, they can also induce excessive ex-ante risk-taking by banks [Cordella and Yeyati (2003), Gorton and Huang (2004) and Gropp et al. (2006)]. Prior literature has mainly studied the ex-ante impact of such guarantees on bank risk-taking, leverage and cost of capital [Acharya et al. (2016) and references therein]. In this paper, we study how government guarantees distort bank behavior and outcomes *during* crisis periods. Specifically, we study whether government guarantees can have a destabilizing effect on unguaranteed banks during crisis periods due to flight-to-safety of depositors from unguaranteed to guaranteed banks.

India, which has a mix of state-owned banks (also called public sector banks) and private sector banks, provides an ideal setting to explore the impact of government guarantees during crises periods. While state-owned banks in India are explicitly and implicitly guaranteed by the government, private sector banks are not (or arguably, are guaranteed to a much weaker extent). In this paper, we highlight how the presence of implicit government guarantees for state-owned banks affected financial stability by destabilizing the private banking sector during the global financial crisis of 2007–09. Specifically, we look at ex-ante heterogeneity in bank vulnerability to a market-wide shock for the period preceding the crisis (January 2007 to December 2007). Then, separately for private sector banks and state-owned banks, we analyze around the financial crisis in 2008–09 the relationship between ex-ante bank vulnerability and (i) realized stock returns; (ii) deposit flows and corresponding deposit rates; (iii) loan advances and corresponding loans rates; (iv) loan performance; and finally, (v) economic activity.

We present five main findings. First, we analyze stock market returns during the crisis period and find that vulnerable private sector banks under-performed less vulnerable private sector banks. In contrast, vulnerable state-owned banks outperformed less vulnerable state-owned banks. Second, this preceding pattern is explained by deposit flows from vulnerable private sector banks to vulnerable state-owned banks. Such deposit flows occur because (i) more vulnerable private sector banks are not government guaranteed and hence see deposit outflows, and (ii) more vulnerable state-owned banks increase their deposit rates and hence are able to attract a larger proportion of the deposit outflows from private sector banks. Third, since banks heavily rely on deposits for their funding, these deposit flows affect lending outcomes. Deposit outflows from vulnerable private sector banks induce a contraction in their lending. However, vulnerable state-owned banks, which witness deposit inflows, increase lending during the crisis. Fourth, vulnerable state-owned banks — which increased lending — also saw a subsequent deterioration in loan performance. Fifth, these effects are persistent and do not revert following the crisis. Economic activity, as measured by night-lights, also declines in districts which witnessed deposit outflows from private sector banks.

These results suggest that access to stronger government guarantees during an aggregate crisis allows state-owned banks to access deposits and extend credit cheaply despite their underperformance. This in turn induces negative spillovers on the private banking sector, thus increasing the financial fragility of the banking sector as a whole.

As a first step to determine the role played by government guarantees, we relate an ex-ante measures of bank vulnerability to the bank's ex-post stock performance during the crisis. Our bank vulnerability measure, Marginal Expected Shortfall ($MES$) — proposed by Acharya et al. (2017b) — captures the tail dependence of the stock return of a financial firm on the downside of the market as a whole. It estimates the negative of the average stock return for a given financial firm in the worst 5 percent days of the market index for a particular past period (one year preceding a crisis in our case). Intuitively, the greater the MES, the more vulnerable is the firm to aggregate downturns or crises. We find that a 1 percentage point (pp) higher MES is associated with a 7.05 pp increase in realized stock market returns for state-owned banks whereas a 1 pp higher MES is associated with a 6.85 pp decline in stock market return of private sector banks.

As a second step, we explain the cross-sectional differences in stock market returns of banks by relating deposit flows to bank vulnerability. We find that at the bank-level, deposits flew from more vulnerable private sector banks to more vulnerable state-owned banks. Anecdotal evidence is consistent with a flight-to-safety of depositors from private and foreign banks to state-owned banks during this period. For example, Infosys (a large Indian multinational corporation) transferred nearly Rs.10 billion of deposits from ICICI to SBI just after the collapse of Lehman in September 2008 [*Economic Times* (2009)]. Private sector banks attributed this flight of funds from private to state-owned banks to the sovereign guarantees of the state-owned banks [*Business Line* (2009)]. The Bank Nationalization Act of India explicitly places all liability for state-owned banks on the government. State-owned banks enjoy implicit government guarantees, as well. For example, as the crisis of 2007–09 progressed, the Indian government announced a number of wide-ranging stimulus plans to jump-start the banking system and state-owned banks were promised capital injections to help them maintain adequate capital. Although deposits for all banks are insured upto a size threshold, government guarantees of state-owned banks still matter since deposit insurance coverage is limited and only partially effective [Iyer and Puri (2012)].

The main identification challenge to using bank-level data to study deposit flows during the crisis period is that deposit supply may be responding to contemporaneous changes in a bank's lending opportunities and our results may thus be confounded. Hence, we use regulatory branch-level data in a *within-bank* analysis and exploit geographic variation in "exposure" to state-owned bank branches to address this identification issue. The identifying assumption for the within-bank estimation is that banks can raise deposits at one branch and lend them at another branch so that local market (district) deposit flows are not affected by differences in lending opportunities of banks. Our exposure measure is the deposit share of state-owned banks in a district in the year prior to the crisis (2007). High branch-exposure refers to branches with above median values of this exposure measure. Districts with few state-owned bank branches serve as a control group because the crisis does not induce depositors to run to state-owned banks in these districts. Since we are interested in the effects for vulnerable state-owned versus vulnerable private sector banks, we set up a difference-in-difference-in-differences (DDD) design with the interaction between branch-exposure, bank vulnerability (MES) and whether a branch belongs to a state-owned bank. Using our preferred DDD specification, we show that branches of more vulnerable private sector banks (1 pp higher $MES$) in districts with high branch-exposure, saw a fall of 40.4 percent in deposit growth relative to other branches of the same private sector bank in areas with low branch-exposure. In contrast, branches of more vulnerable public sector banks in high branch-exposure districts witnessed a relative *increase* in deposits of 12.4 percent.

Why do depositors flee to the more vulnerable state-owned banks and not to the less vulnerable state-owned banks? We find that during this period, more vulnerable state-owned banks were increasing their deposit rates which allowed them to attract the deposit outflows from private sector banks. Plausibly, less vulnerable state-owned banks did not increase their deposit rates so as not to signal distress to the market. This practice of vulnerable state-owned banks increasing their deposits to chase deposit outflows from private sector banks became so rampant that the finance ministry had to step in and stop state-owned banks from excessively increasing their deposit rates [*Business Line* (2008)].

The key threat to the DDD design is the possibility that time-varying, district-specific shocks are correlated with our exposure measure. We address this concern in five ways: (1) presenting graphical evidence of parallel trends prior to the crisis and showing clear differences in deposit growth after the crisis period for state-owned and private sector banks; (2) conducting placebo tests to document the lack of time-varying effects on deposit flows from private to state-owned banks in the years prior to the crisis and showing that the effects are only present during and after the crisis period; (3) showing that deposit growth of private and state-owned banks is not driven by differences in asset quality, size and pre-crisis stock returns of banks; (4) showing robustness to alternate branch-exposure measures using more granular local market definitions, to sub-samples of urban and rural areas, to varying weighting schemes, to controlling explicitly for exposure to varying demographics, and to examining effects in levels as opposed to differences; and (5) finally, showing that alternate explanations such as pre-crisis leverage, liquidity, or too-big-to-fail guarantees do not explain our results.

We also supplement the DDD estimates using an alternate regression discontinuity approach. We build on the findings in Young (2017), who examines a 2005 banking reform in branch licensing in India which encouraged opening of branches in under-banked districts. Young (2017) uses a population per branch cut-off, above which districts are assigned an "under-banked" status. Using a regression discontinuity design, he finds that districts just above the cut-off (under-banked districts) saw a significant increase in private sector branches compared to districts just below the cut-off. There was no corresponding increase in the branches of state-owned banks, possibly because state-owned banks are covered under other implicit government mandates and hence lend to under-banked districts anyway. Building on this, we show that deposit share of state-owned banks — corresponding to our branch-exposure measure — also saw a discontinuous jump at the cut-off. We confirm that these districts do not differ along other demographic and economic dimensions at the cut-off. Consistent with the DDD estimates, the regression discontinuity estimates document that the branches of vulnerable state-owned banks in districts with high exposure to state-owned banks' branches — that is, districts just below the cut-off — saw a 5.7 percent increase in deposit growth whereas branches of vulnerable private sector banks saw a 28.7 percent decrease in deposit growth.

Having established that deposits flew from vulnerable private sector banks to vulnerable public sector banks, we now turn to the impact on lending. We cannot use the same DDD identification that we used for deposits to examine lending because banks can use their internal capital markets to transfer resources from one branch to another. We average across all of a banks' branches, the share of state-owned deposits in each district that the branch operates in. High bank-exposure refers to above median values of this measure. We set up a DDD design with the interaction of bank-exposure, bank vulnerability (MES) and whether a bank is state-owned. By looking at branches of different banks within a district, we ensure that bank branches face similar lending opportunities. The lending growth of high *MES* and high bank-exposure state-owned branches grew by 82 percent. In stark contrast, lending fell nearly 8-fold for vulnerable private sector branches with high bank-exposure.

One counterpoint could be that the increase in the deposit base of state-owned banks is not harmful for the economy as a whole if these banks are more willing to advance loans to the real economy resulting in much needed credit in times of a crisis, consistent with the socially maximizing view of state-owned banks. Our results on lending rates and loan performance suggest otherwise. Lending rates at the branches of more vulnerable high-exposure state-owned banks was higher by 6.9 bps relative to the less exposed branches, possibly reflecting a deterioration in the quality of borrowers. In comparison, lending rates of more vulnerable high-exposure private sector banks was lower by 173 bps, potentially reflecting a cut back in lending to less creditworthy borrowers. Subsequent deterioration in loan performance of more vulnerable state-owned bank branches supports this hypothesis. Sub-standard assets of more vulnerable high-exposure state-owned banks increased by 29.6 percent compared to a drastic fall of 365 percent at the branches of more vulnerable, high bank-exposure private sector banks.

Finally, we examine deposits, lending, and economic activity at the district level. Districts with high branch-exposure see an overall decline in deposit growth, indicating that not all the deposit outflows from private sector banks eventually make their way into state-owned banks. Additionally, districts served by banks that raise deposits in high branch-exposure markets experience a decline in lending, as well as lower subsequent economic activity as measured by night lights data.

To summarize, this paper documents a flight-to-safety from more vulnerable private sector banks to more vulnerable state-owned banks. While vulnerable private sector banks cut back on lending, vulnerable state-owned banks increase lending but with poorer ex-post performance of loans. Our results suggest that stronger government guarantees of state-owned banks can increase overall financial fragility by inducing negative spillovers on private sector banks during crises periods.

Our paper is related to the law and finance literature on state-ownership. For banks in particular, Gerschenkron (1962) and Stiglitz (1989) argue that state ownership is necessary and even socially optimal since the lack of economic infrastructure makes it difficult for private banks to succeed. An opposing strand of literature argues that the political influence of state-owned banks [Shleifer and Vishny (1994)] and their misaligned incentives can result in corruption and lazy banking [ Banerjee et al. (2005)], leading to a misallocation of resources [Qian and Yeung (2015)] and lower overall growth [Dinç (2005)]. Our work highlights how the presence of state-owned banks can have negative spillover effects on private sector banks. Our work also relates to the literature on deposit insurance [Demirgüç-Kunt and Detragiache (2002), Demirgüç-Kunt et al. (2008), and Calomiris and Chen (2018)]. In a vein similar to our findings, Calomiris and Jaremski (2016) find that the creation of the Federal Deposit Insurance Corporation (FDIC) in the US in 1933 led to hitherto uninsured banks increasing their risk-taking due to reduced market discipline post the introduction of deposit insurance.

The next section provides the institutional details and the time-line of the crisis. Section 3 describes the data. Section 4 studies the impact of government guarantees of state-owned banks on stock performance. Section 5 examines deposit flows. Section 6 examines lending. Section 7 provides evidence for the implicit sovereign guarantee of state-owned banks and section 8 concludes.

## 2 The Indian Banking Sector and the Crisis of 2008

Historically, India has had a large presence of state-owned banks. After the most recent wave of nationalization in the 1980s, nearly 90 percent of India's branches were nationalized. This changed after economic liberalization in the 1990s and private sector and foreign banks were allowed to enter the market. Despite this, given the historical legacy of state-ownership in the banking system, the Indian financial system continues to have substantive state ownership and as of March 2009 state-owned banks accounted for nearly 71.9 percent of aggregate assets.

### 2.1 The crisis of 2008 and the impact on India

The first signs of the global financial crisis of 2008–09 began in June 2007 when a subsidiary hedge fund of the investment bank Bear Stearns, which had heavily invested in subprime mortgages had to be rescued. Subsequently BNP Paribas announced a freeze on three of the bank's investment funds. Bear Stearns continued to write-down its subprime portfolios and as investor losses mounted, the Federal Reserve Bank of New York provided an emergency loan to try to avert a sudden collapse. However, the bank could not be rescued and eventually was sold to JP Morgan Chase on 17$^{th}$ March 2008 at fire sale prices. Financial conditions further deteriorated with Lehman Brothers reporting a loss of $3.9 billion in the third quarter of 2008 on September 10$^{th}$. Finally, on September 15$^{th}$ 2008, Lehman declared bankruptcy since it was unable to obtain short-term financing or a buyer.

The global financial crisis hit India in 2008 with the Indian stock market losing more than 60 percent of its peak valuation. 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 percent. The BSE index, another market index, similarly fell nearly 59 percent 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. In 2008–09, FIIs withdrew nearly Rs.433 billion (approximately $7 billion). This eventually resulted in a money market and credit squeeze which 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 Indian GDP fell from 9 percent in 2007 to nearly 6.1 percent in 2008. Eventually, the government of India, fearing a rapid deterioration of the economy, announced wide-ranging stimulus packages towards the end of 2008 that appeared to temporarily restore the economy back to its pre-2008 growth.

Before 2008, private sector banks such as ICICI Bank, Karnataka Bank, Lakshmi Vilas Bank and Kotak Mahindra topped the list of banks with the highest delinquent assets. This changed after the crisis and post 2008, delinquent assets of state-owned banks grew nearly six times to Rs.3,416 billion as of March 2016 with State Bank of India (SBI) and Indian Overseas Bank topping the list.

### 2.2 Government guarantees of state-owned banks

State-owned banks in India are both explicitly and implicity guaranteed by the government. The Banking Regulations Act explicitly guarantees that all obligations of state-owned banks will be fulfilled by the Indian government in case of failure. These guarantees can also be implicit. For example, as the crisis of 2007–09 progressed the Indian government announced a number of wide-ranging stimulus plans to jumpstart the banking system. PSBs were promised capital injections to help them maintain a risk-adjusted capital ratio of 12 percent. The government also launched three fiscal stimulus packages during December 2008–February 2009. Importantly, in the second stimulus package the government recapitalized state-run banks and infused nearly Rs. 31 billion (approximately $0.5 billion) in 2008-09 as tier-I capital [World Bank (2009)]

Although both public and private sector banks are insured by the Deposit Insurance and Credit Guarantee Corporation (DICGC), government guarantees of state-owned banks still matter since deposit insurance coverage is limited and only partially effective. In 2007, only Rs.100,000 (approximately $2000) per depositor per bank was covered by the DICGC. Further, uncertainty and delay in processing deposit insurance claims renders deposit insurance only partially effective. For example, Iyer and Puri (2012) analyze a bank run at an Indian co-operative bank and find that deposit insurance is only partially effective in preventing runs. Even depositors within the insurance limit but with larger deposit balances are likely to run. In the absence of full deposit insurance, government guarantees matter. In 2007–09, private sector banks too blamed the flight of funds from private to state-owned banks on the sovereign guarantees of state-owned banks, and lobbied for an increase in deposit insurance [*Live Mint* (2011)]. An RBI panel recommended raising the deposit insurance, but as of November 2019, the deposit insurance still remains unchanged.

### 2.3 Branch licensing and the 2005 banking reform

In Section 5.6 we follow Young (2017) and use the bank branch licensing policy reform implemented by the RBI on 8$^{th}$ of September, 2005 in one of our empirical strategies. This subsection provides some details on this policy. Prior to the 2005 banking reform, branch licensing was heavily regulated by the RBI and banks were required to seek permission on a case-by-case basis to open, close and shift branches. The banking reform in 2005, substantially overhauled and streamlined this process. The two important changes were, first, banks were required to submit on an annual basis the proposed branch openings, closings and re-locations that it wanted to implement in a given year. The RBI would then approve these proposals on a consolidated basis. Second, this policy specifically targeted financial inclusion and encouraged banks to increase their number of branches in under-banked districts. A district was designated as under-banked if the average population per branch of the district was above the national average population per branch. We exploit this criteria used to classify districts as under-banked in our empirical design in Section 5.6. Under-banked status remained constant nearly throughout our main analysis period from 2005 to 2009. Under-banked status was introduced in 2005, with minor revisions in 2006 and remained constant up until 2010.

## 3 Data

Stock market data is from the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE). We use the Marginal Expected Shortfall (MES) to measure the ex-ante bank vulnerability of banks to an aggregate crisis. 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 worst affected when a financial crisis materializes, as demonstrated by Acharya et al. (2017b) 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 for 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 percent market outcomes at daily frequency over the pre-crisis period. In our analysis, we take the 5 percent worst days for the market returns as measured by the S&P CNX NIFTY index during the period of 1$^{st}$ January 2007 to 31$^{st}$ December 2007, and then compute the negative of the average stock return for any given bank for these 5 percent worst days. Table A1 in the appendix shows the MES measures for public and private sector banks using January 2007 to December 2007 as the measurement period. As such, MES is a statistical measure but Acharya et al. (2017b) provide a theoretical justification for it in a model where the financial sector's risk-taking has externalities on the economy whenever the sector as a whole is under-capitalized Acharya et al. (2017b) show that the MES and leverage together determine the contribution of each financial firm to systemic risk in the event of a crisis. Our baseline analysis uses MES to measure bank vulnerability. Alternate MES measures include modified MES which uses market return based on all banks excluding own bank return, and W-MES which uses exponentially declining weights on past observations.

The remaining branch and bank level data are from the Reserve Bank of India (RBI). While bank-level data is publicly available, branch-level data is only collected for regulatory purposes and is proprietary. We only use publicly listed state-owned and private sector banks in India in our analysis since our bank vulnerability measure is based on stock returns. Of the 50 public and private sector banks, 38 banks (excluding Industrial Development Bank of India (IDBI)) are publicly listed, of which 21 are state-owned and 17 are private sector banks. The main exposure variable used in the analysis is the share of deposits of state-owned banks in a district. Districts are economically integrated areas, comparable to counties within the US. Since we are interested in the spillover effects of state-owned banks on private sector banks, only districts where the deposit share of private sector banks is greater than one percent are retained. Thus, 287 of 630 districts were retained in our analysis. The regulatory branch-level data, also called Basic Statistical Returns (BSR) has previously been used by Das et al. (2016) and Cole (2009). This data is collected as of March 31$^{st}$ of every year and covers a wide range of variables, such as amounts of deposits by type (demand, savings and term), amount of credit by sector, branch characteristics and personnel characteristics (skilled/unskilled). Our baseline analysis focuses on the 33,972 branches. We also use deposit amounts by deposit rate brackets, though this data is available only for 11,171 branches. Data on NPAs is also from the RBI, though is not collected as part of BSR and hence only 77 percent of the branches have data on NPA.

To measure economic activity, we use satellite data on human-generated nightlight activity. The data is from VIIRS DNB data and collected by NOAA using the Suomi National Polar Partnership satellite that was launched in 2011. We use the nightlight intensity which measures low-light imaging data collected by the satellite. The data is filtered to measure the quantity of human-generated light in an area, but some stray light remains which adds noise to the estimates. To remove this noise, we remove cells for which the annual average of the data differ substantially from the annual composites before aggregating to the district level. To assess differences at the branch and district level, we use covariates from the 64$^{th}$ round of the NSS Employment and Unemployment survey conducted in 2007–08. Other variables in our analysis include beta, global beta, volatility, expected shortfall (ES) measured for the pre-crisis period 1$^{st}$ January 2007 to 31$^{st}$ December 2007; and leverage, log assets and liquidity measured as of March 31$^{st}$, 2008. Beta is based on the S&P CNX NIFTY index as the market return. Global beta is based on the MSCI World Index returns. Volatility is the annualized daily volatility. Expected shortfall (ES) is the expected return of the bank when the bank's return is below its 5$^{th}$ percentile in the pre-crisis period. Leverage ratio 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). Log assets is the natural logarithm of the book value of total assets. Liquidity is the ratio of the sum of cash in hand, balances with RBI, money at call and short notice, government securities and deposits to total liabilities.

For the regression discontinuity analysis, we exploit the branch licensing policy (see Section 2), which came into effect in September 2005. The policy encouraged lending to under-banked districts. A district was designated as under-banked if the average population per branch of the district was above the national average population per branch. The population data to construct the running variable is from the 2001 Census. The number of branches is from BSR as of March 2005. Using this data, we are able to correctly match all except 12 districts to their official under-banked status. Following Young (2017), we drop the unmatched districts from our analysis. Data for the covariates (weekly wages, median age, percentage rural population, fraction female population, fraction with high school education, and unemployment rate) are from the 61$^{st}$ round of the NSS Employment and Umeployment survey, which was conducted from July 2004 to June 2005.

# 4 Stock performance and bank-level analysis

We start by analyzing stock market performance and then relate it to bank-level deposits and credit.

### 4.1 Stock-performance and event Study Analysis

Panels A and B of Figure 1 examine stock market returns of private sector (solid red line) and state-owned (dashed blue line) banks from January 2008 to February 2009. Panel A examines aggregate stock market returns and Panel B examines heterogeneity across bank vulnerability. Returns are value-weighted by their market capitalization. The vertical solid line at $17^{th}$ March 2008 marks the Bear Stearns' fire sale to J. P. Morgan and the vertical dashed line at $15^{th}$ September 2008 marks the Lehman bankruptcy. Over the entire period, stocks of private sector banks fell by nearly 60 percent, compared to a 45 percent drop for state-owned banks (panel A). Panel B plots the difference in stock index performance between high and low MES banks. The top 7 banks with the highest MES within private sector and state-owned banks are classified as high MES and low MES otherwise. Prior to the Bear Stearns fire sale, the relative difference in returns between high and low MES banks of the private sector were similar to the state-owned banks, but started to diverge after. The difference between high and low MES state-owned banks (dashed blue line) increased, whereas the difference declined drastically for private sector banks (solid red line). This pattern is similar following the Lehman Brothers bankruptcy (panel d) and the relative difference between high and low MES state-owned and private sector banks increased by 27.7 percent.

More formal event study analysis in panels C and D of Figure 1 is consistent with this finding. We calculate abnormal returns for the two event dates. Expected return is calculated as $R_{i,t} = \alpha_i + \beta_i R_{M,t} + \epsilon_{i,t}$, where, $R_{i,t}$ is the individual stock returns over the estimation window and $R_{M,t}$ is the market return based on the S&P CNX NIFTY. We use an estimation window from 250 days prior to the event window and ending 10 days before the event date. The daily abnormal return is then calculated as the difference between the actual return and the expected return using $\alpha_i$ and $\beta_i$. Cumulative abnormal return (CAR) is calculated by cumulating the abnormal returns across time for the event window. Panels C and D show the difference in CAR for high MES minus low MES banks. Consistent with the raw data in panels A and B, the difference between high and low MES state-owned banks increased post the Bear Stearns collapse. In comparison, this difference in abnormal returns for private sector banks saw a relative decline of 10 percent compared to state-owned banks. Patterns are similar following the Lehman bankruptcy with a spread of 7 percent between the relative (high MES minus low MES) CAR of state-owned banks versus private sector banks (panel D).

## 4.2 Bank-level analysis

Our bank-level analysis relates bank vulnerability to stock market returns. We then relate this to bank-level deposits and lending. The empirical specification is:

$$y_j = \alpha + \beta * MES_j + \phi * Private_j + \gamma * MES_j * Private_j + \epsilon_j \quad (1)$$

where $y_j$ is the relevant dependent variable: stock market return, deposit growth and lending growth. Stock market return is from January 2008 to February 2009. Deposit growth is measured as the log of change in total deposits (deposit flow) of bank $j$ for the period starting from $31^{st}$ March 2008 to $31^{st}$ March, 2009. Log of change in credit is analogously defined. $MES_j$ is the marginal expected shortfall measure for a bank $j$ and $Private_j$ is 1 for private sector banks and zero otherwise. All regressions are weighted by the deposits in 2007.

Figure 2 Panel A, graphically relates stock returns during the crisis to ex-ante bank vulnerability as measured by MES. Private sector banks with higher vulnerability were worse hit during the market-wide downturn and a 1 pp higher MES is associated with a 6.61 pp decline in stock returns during the crisis. More vulnerable state-owned banks, however, had higher stock returns during the crisis and a 1 pp higher MES is associated with a 6.12 pp *increase* in stock returns.

Results in columns 1–2 in Table 3 confirm the above results using formal regressions with stock returns as the dependent variable in Equation 1. On average, the returns of private sector banks were 10 percent lower than state-owned banks (column 1). But, this masks significant heterogeneity within private and state-owned banks across bank vulnerability (column 2). Stock returns of safer private sector banks were actually 49 percent higher than safer state-owned banks as indicated by the coefficient on Pvt. State-owned banks with 1 pp higher MES, however, saw a 7.05 pp increase in stock returns. Relative to the state-owned banks, the higher MES private sector banks saw a 13.9 pp relative *decline* in stock returns. Adding up the coefficients, this is a 6.85 pp overall decline in stock returns of the vulnerable private sector banks. Stock returns of more vulnerable state-owned banks increased whereas stock returns of more vulnerable private sector banks declined.

To explain the above results, we next relate bank vulnerability to deposit flows. Figure 2, panel B relates deposit growth to ex-ante bank vulnerability. Consistent with the pattern observed in stock returns, more vulnerable private sector banks had lower deposit growth, whereas more vulnerable state-owned banks had higher deposit growth during the crisis. Table 3, analyzes this more formally.

On average, deposit flows were 7.86 percent (column 3) lower for private sector banks, possibly indicating a flight to safety from private to state-owned banks. On adding the interaction with MES, we see that the state-owned banks with higher vulnerability, saw an increase of 33 percent in deposit flows. In contrast, private sector banks with 1 pp higher MES saw a relative outflow in deposits of 641 percent. Overall, vulnerable private sector banks saw a 6-fold decline in deposit flows. Column 5 links bank stock performance to deposit growth. Indeed, banks with higher stock returns had higher deposit growth. The stock market returns observed in column 2 is explained by the deposit flows in column 4.

Columns 6–7 look at lending. Lending growth was, on average, not significantly lower for private sector banks (column 6). On adding the interaction term with MES, we see that the state-owned banks with 1 pp higher MES saw an increase in lending of 1.67 percent. In contrast, vulnerable private sector banks see a 12.8 percent relative decline in lending. Overall, this translates to an 11.13 percent decline in lending at vulnerable private sector banks.

The regressions in columns 4 and 7 allow us to directly calculate the implied impact on lending for each rupee value of deposit flow, that is the elasticity of new lending to deposit flows. For vulnerable state-owned banks, a percentage increase in deposits led to a 0.05 percent increase in lending. This is obtained by dividing the coefficient on MES in column 7 by the corresponding coefficient in column 4 (0.0167/0.330). For vulnerable private sector banks, a percentage increase in deposits led to a 0.0183 percent increase in lending. Summing up the coefficient on MES and MES*Pvt in columns 4 and 7 gives the total implied deposit and lending flows for private sector banks. Dividing these sums gives the implied elasticity of lending to deposit flows [(-0.128+0.0167)/(-6.408+0.330)].

To sum, the aggregate evidence in this section suggests that more vulnerable private sector banks had lower stock returns. This is driven by the deposit outflows from less vulnerable private sector banks which also impacts lending. The above estimates are merely correlational. We now turn to the more challenging aspect of showing that the observed patterns are a direct causal effect of deposit flows due to the exposure to state-owned banks and not merely driven by differences in lending opportunities of banks.

## 5 Results on deposits

We now turn to causally estimating the impact of government guarantees on the deposit flows of state-owned and private sector banks.

### 5.1 Identification Strategy

We use branch-level data to examine how the government guarantees of state-owned banks affect deposit flows of private sector banks during crisis periods. We exploit geographic variation in exposure to state-owned banks across the branches of a bank. This also helps address several identification issues that arise in the bank-level analysis, as explained below.

The main identification challenge with an across-bank empirical strategy (as seen in Section 4.1) to show the causal effect of government guarantees is the potential for omitted variables. For example, if crisis periods result in a decline in lending opportunities of vulnerable private sector banks, then they could contract deposit supply thus explaining our results. We address this identification challenge by exploiting the geographic variation in the exposure to state-owned banks in local deposit markets, namely districts. However, we cannot simply compare deposits across banks because different banks may have different lending opportunities. To control for bank-specific lending opportunities, we compare deposits across branches of the same bank located in districts with different exposures to state-owned banks. The identifying assumption for this within-bank estimation is that banks can raise deposits at one branch and lend them at another. A large literature shows that banks use their internal capital markets to move deposits raised in one area to another depending on loan demand (Gilje et al. (2016) and Drechsler et al. (2017)). Later in Section 6, we empirically test this identifying assumption and show that a bank's lending in a given district is unrelated to the presence of state-owned banks in the local deposit-market within a district.

The exposure measure in our analysis is the average share of deposits of state-owned branches in a district, in a time period (2007) prior to the crisis. Figure 3, panel A shows the geographic variation of the continuous exposure variable. Panel B restricts to districts with at least 1 percent deposit share of private sector banks. As the map shows, there is a wide geographic variation in exposure which allays concerns that results may be purely driven by geographic differences in exposure. Panel C shows the binary exposure measure we use in our baseline analysis. This is called branch-exposure since it captures the exposure to state-owned banks at the branch-level as opposed to exposure at the bank-level which we will define in Section 6. Branch-exposure is 1 for districts with above median exposure to state-owned banks. Our baseline analysis uses this binary measure for ease of interpretation. We look at alternate measures in a number of robustness tests. Table 2 shows that around 40 percent of the bank branches were in high exposure districts with 20 (10) percent of low (high) MES private sector bank branches in the high exposure districts. In comparison, 40 percent of the state-owned banks were in the high exposure districts.

Table 4 explores the correlates of the branch-exposure variable. Districts with high branch-exposure have lower average wages, are younger, are more rural, and have fewer people with high-school education (panel A ). Bank branches in high-exposure districts have fewer skilled workers, are less likely to serve the urban populations, have higher non-performing assets, have lower credit to deposit ratios and are smaller (panel B). In other words, the branches in high branch-exposure areas are the worse performing branches of a bank. High branch-exposure districts are serviced mostly by state-owned banks due to the implicit and explicit government mandates on financial inclusion for state-owned banks.[1] Our empirical strategy compares the impact on state-owned banks relative to private sector banks. What matters for identification is whether there are differences between state-owned and private sector banks in districts with high branch-exposure. Panel C shows that the branches of private sector banks in high branch-exposure districts banks were 15 percent more likely to cater to the urban population, but were not significantly different from state-owned banks in the proportion of skilled workers, in loan performance, in credit to deposit ratios and in size.

### 5.2 Within-bank estimation

The empirical specification uses branch-level data and exploits within-bank variation in exposure to state-owned banks to control for differences in banks' lending opportunities. For a branch $i$ located in district $d$ belonging to a bank $j$, we run the following specification:

$$\Delta Y_{i,j,d(08-09)} = \alpha_j + \delta_d + \phi * Branch\text{-}Exposure_d * Private_j + \beta * MES_j * Branch\text{-}Exposure_d + \gamma * MES_j * Branch\text{-}Exposure_d * Private_j + \kappa X_i + \epsilon_{i,j,d} \quad (2)$$

where $\alpha_j$ and $\delta_d$ are the bank and district fixed effect respectively. The dependent variable is the log of the change in deposits (deposit flows) for the period starting from $31^{st}$ March 2008 to $31^{st}$ March, 2009. $Branch\text{-}Exposure_d$ is at the district level $d$ and is 1 if the average share of deposits of state-owned banks, as of $31^{st}$ March 2007, within a district is above median. $Private_j$ is 1 for private sector banks and 0 otherwise. All other lower order interaction terms are absorbed by the fixed effects. The key set of controls are the bank fixed effects $\alpha_j$, which absorbs all differences between banks. Intuitively, we

[1] One such government mandate is the Lead Bank Scheme introduced in 1969 wherein a state-owned bank with adequate presence in the district was assigned "Lead Bank" status. These banks used to oversee and coordinate branch expansion in the districts and monitor credit disbursement. While branch licensing changed significantly post 2005, the historical legacy of these banks implies that rural areas still have high presence of state-owned banks.

are comparing branches of the same bank and asking whether for a bank with higher vulnerability, as measured by MES, the bank's branches in districts more exposed to state-owned branches experience larger outflows, relative to branches with lower exposure to state-owned branches. By including bank fixed effects we are controlling for any changes in the bank's lending opportunities under our identifying assumption that banks are able to allocate funds internally. District fixed effects ($\delta_d$) control for district-specific factors such as local economic conditions. $X_i$ are the remaining control variables. As the previous subsection showed, private sector bank branches were more likely to cater to the urban population. Hence we add a control for whether a branch serves the rural, semi-urban, urban or metropolitan population. In addition we add the interaction of these indicators with MES to control for geographic variation with MES. To control for other bank characteristics that can vary with the exposure measure, we also interact the Branch-Exposure measure with bank leverage. Similarly, we add Branch-Exposure measure interacted with total bank assets. Standard errors are clustered at the district level since our exposure measure is also at the district level. Regressions are weighted by deposits in 2007.

The coefficients of interest are $\beta$ and $\gamma$. $\beta$ measures deposit flows of vulnerable state-owned banks at branches in districts with more state-owned banks (high branch-exposure) relative to branches in districts with fewer state-owned banks (low branch-exposure). $\gamma$ measures the deposits flows of vulnerable private sector banks at branches in districts with more state-owned banks relative to branches with low exposure to state-owned banks *and* relative to similar state-owned banks. $\beta + \gamma$ measures the deposits flows of the high branch-exposure branches of the more vulnerable private sector banks.

### 5.3 Growth in Deposits

Table 5 shows the results using the specification in Equation 2. We include bank-fixed effects in all columns since we want to compare branches in high branch-exposure districts to the branches of the same private sector bank in low branch-exposure districts. All specifications also control for bank specific factors and geographic factors as described in the previous section. Regressions are weighted by deposits in 2007 (except in column 7). We include district fixed effects in some specifications to control for local economic conditions. We include only state fixed effects (and exclude district fixed effects) in columns 1, 3, and 5 since we are interested in the coefficient on branch-exposure which is collinear with district fixed effects .

Before turning to the full sample, we first separately examine private and state-owned banks.

Columns 1-2 looks at the sub-sample of private sector bank branches. On average, deposit growth of private sector bank branches did not vary significantly with branch-exposure (column 1). This, however, masks heterogeneity within private sector banks. The branches of more vulnerable private sector banks (those with 1 pp higher MES) saw a 38 percent decline in deposit growth (column 2) in high branch-exposure districts relative to low branch-exposure districts. Columns 3-4 restrict to state-owned bank branches. On average, the deposit growth of state-owned bank branches did not vary with branch-exposure (column 3). More vulnerable state-owned bank branches in high branch-exposure districts had a 10.2 percent higher deposit growth relative to less vulnerable banks and relative to branches in low branch-exposure districts (Column 4).

Using the full-sample of branches, Column 5 shows that branches of more vulnerable state-owned banks in high branch-exposure districts saw an 11.4 percent increase in deposit growth. In comparison, branches of more vulnerable private sector branches in high-exposure districts saw a relative 52.5 percent decline in deposit growth. Effects are similar on adding district level fixed effects in column 6. Branches of more vulnerable state-owned bank branches in high-exposure areas saw a 12.4 percent increase in deposit flows, whereas branches of more vulnerable private sector banks in high-exposure areas saw a relative decline of 52.8 percent. Adding up the coefficients, private sector branches of more vulnerable banks in high branch-exposure districts saw a 40.4 percent decline in deposit growth.

Our results are robust to a number of alternate specifications. Results are similar when we do not weight by deposits in 2007 (column 7). One concern is that private sector banks in high-exposure districts cater to urban areas. We already address this, by including an extensive set of controls for urban areas in all regressions. In addition, we show that results are similar in the sub-sample of urban (column 8) and rural (column 9) areas. Column 10 shows that results are similar with the continuous measure of branch-exposure. Results are also similar when we use the level of deposits as opposed to growth (column 11). In our baseline analysis, the dependent variable is the log of deposit flows as it allows us to trace deposit flows and more closely tied to our estimate of interest. Table A2 shows that results are similar with the dependent variable deposit growth defined as change in log deposits.

Why do depositors move to the more vulnerable state-owned banks and not to the safer state-owned banks? To answer this question, Table 6 examines deposit growth in different deposit rate buckets. Columns 1–3 repeats the specification in Equation 2 with the dependent variable as the growth rate of deposits with deposit rates less than 9 percent and columns 4–6 with the dependent variable as growth rate of deposits with deposit rates greater than or equal to 9 percent.[2] The repo rate during this period ranged from 5 to 9 percent, so we take 9 percent as the cut-off for the low deposit rate category. Deposits are further split into retail and wholesale deposits. Columns 1-3 show that there was no differential impact on deposit growth in the low deposit rate category for state-owned banks. Private sector banks see a decline in wholesale deposits in this category, but not in retail deposits. In stark contrast, columns 4–6 show that deposit growth of state-owned bank branches in this high deposit rate bracket increased by 13.6 percent for more vulnerable state-owned branches in high branch-exposure districts. Deposit growth was relatively 44.4 percent lower for private sector bank branches of more vulnerable banks in high exposure districts. This effect seems to be driven entirely by retail deposits with a 15 percent higher growth for vulnerable state-owned bank branches and a relative 45.6 percent lower growth for vulnerable private sector banks in high branch-exposure districts. The coefficients on $MES * Branch\text{-}Exposure$ and $Private * MES * Branch\text{-}Exposure$ for the retail deposits in the high interest rate bracket are also statistically different from the coefficients for retail deposits in the low interest rate bracket. These results suggest that state-owned banks were increasing deposit rates to attract the deposits flowing out of the private sector banks and hence we see an increase in retail deposit flows to the *more* vulnerable state-owned banks.

Table A3 examines the heterogeneity by deposit type and by deposit maturity. An important distinction between the different deposit types in India — namely, demand, savings, and term deposits — is that while banks were able to set deposit rates for demand deposits and term deposits, rates of savings deposits were heavily regulated by the government during this period.[3] Columns 1–3 show that the deposit flows from vulnerable private sector banks to vulnerable state-owned banks were mostly concentrated in the demand and term deposits. The impact on savings deposits is insignificant and noisy (column 2). Plausibly, state-owned banks had the liberty of changing deposit rates of demand and term deposits and were thus able to attract the deposit outflows from private sector banks. Composition of deposits also changed for the vulnerable private sector banks which witnessed a fall in the longer maturity term deposits (columns 3–6). Maturity of term deposits also shrunk by 18 percent at the branches of more vulnerable private sector banks in high branch-exposure areas. To sum, affected private sector bank branches saw a maturity shortening, as well as a shift in the composition of their deposits.

[2] Number of observations in this Table 6 differ from Table 5 since deposit rate data is not available for all branches.
[3] Savings deposit rates were deregulated post October 2011 [see RBI (2009)].

### 5.4 Pre-existing trends and long-term effects

To now examine pre-existing trends and long-term effects we look at a longer time period between 2005 to 2013. We run the following specification separately for state-owned and private sector banks at the branch-level:

$$\Delta Y_{i,j,d,t} = \alpha_j + \delta_d + \eta_t + \beta * MES_j * Branch\text{-}exposure_d + \sum_{\tau} \phi_\tau * \mathbb{1}_\tau * Branch\text{-}exposure_d + \sum_{\tau} \eta_\tau * MES_j * \mathbb{1}_\tau + \sum_{\tau} \gamma_\tau * MES_j * Branch\text{-}exposure_d * \mathbb{1}_\tau + \epsilon_{i,j,d,t} \quad (3)$$

where $\alpha_j$ is the bank fixed effect, $\delta_d$ is the district fixed effect and $\eta_t$ is the time fixed effect. The dependent variable is the log of the change in deposits (deposit flows) for the period starting from $31^{st}$ March in year $t-1$ to $31^{st}$ March in year $t$. *Branch-Exposure*$_d$ is at the district level $d$ and is 1 if the share of deposits as of $31^{st}$ March 2007 of state-owned bank banks within a district is above median. $\mathbb{1}_\tau$ is 1 for each year. We plot $\gamma_\tau$ which allows us to examine the pre-trend and longer term effects on deposit flows separately for state-owned and private sector branches. The coefficients are normalized relative to the year 2007 since the annual deposit flow between March 2007–08 captures the effect of the Bear Stearns fire sale also.

Figure 4, panel A plots the coefficients from the event study plot for private sector banks. The dashed grey lines represent the confidence interval at the 5 percent level. Prior to 2008, branches of more vulnerable private sector banks in high-exposure areas were similar to those in low-exposure areas. However, post the crisis, there was a steep fall in the deposit growth of the branches of more vulnerable private sector banks in high-exposure areas and the effect persisted even 5 years post the crisis. Panel B repeats the same for state-owned banks, and shows that prior to the crisis deposit growth at the branches of more vulnerable state-owned banks in high-exposure areas was not significantly different from zero. However, post the crisis the deposit growth in high exposure areas of more vulnerable state-owned banks was higher than those of less vulnerable banks and relative to branches of the same bank in low branch-exposure areas. Further, this effect was persistent. These tests validate our interpretation that our estimates of the flow of deposits is due to a flight to safety of deposits rather than to pre-existing trends in districts that had a higher exposure to runs.

Figure 4, panel C repeats the specification in Equation 2 for each year between 2005 to 2013 and plots the coefficient on the triple interaction term, *Private* $*$ *Branch-Exposure***MES*. Private and state-owned banks were on similar time trends prior to the crisis and the parallel trends assumption cannot be rejected. As before, effects are persistent and there is no reversal of deposit flows post the crisis.

## 5.5 Robustness tests

This section (i) shows robustness to alternate measures of branch-exposure, (ii) compares MES to alternate risk measures, and (iii) shows robustness to alternate explanations.

### 5.5.1 Alternate exposure measures

In our baseline, branch-exposure is the average deposit share of state-owned branches in a local market, namely a district, in 2007. Since we want to capture how exposed a branch is to state-owned banks, defining the measure at the district level is reasonable because districts represent economically integrated units. Table A4, column 1 shows that results are robust to defining branch-exposure as the deposit share of state-owned banks in more local markets, namely pincodes.[4] Deposit flows may also be affected by state-owned banks in nearby pincodes and not just those in the pincode a branch is located in. In columns 2–5, we define an alternate distance-weighted measure of exposure: $Branch\text{-}Exposure_i^{\lambda} = \frac{\sum_i^j Branch\text{-}Exposure_j^{Pincode} \times e^{-\lambda d_{ij}}}{\sum_i^j e^{-\lambda d_{ij}}}$, where $Branch\text{-}Exposure_j^{Pincode}$ is the share of state-owned banks in a pincode $j$. Pincodes farther away from a branch are given decreasing weights and pincodes outside a district are given zero weight. $\lambda$ ranges from 0.01 to 0.2. Values outside this range lead to implausible weights. For $\lambda$=0.01 (0.02), pincodes at 10 and 20 km receive weights of 0.91 (0.16) and 0.82 (0.02) relative to the weight at 1 km. Results are robust to using this alternate distance-weighted measure.

### 5.5.2 Alternate risk measures

Table A5 compares MES to alternate measures of bank vulnerability. First, we focus on two measures of firm level risk, namely the annualized standard deviation of returns based on daily stock returns (volatility), and expected shortfall (ES) defined as the negative of the firm's average stock return in its own 5 percent left tail. Second, we look at the standard measure of systemic risk, beta, which is the covariance of a firm's stock returns with the market returns divided by the variance of market returns. In contrast to MES, the baseline effects using firm-level risk measures are in the right direction but noisy (columns 1 and 2). With the traditional systemic risk measure beta (column 3), we see our familiar result with branches of vulnerable state-owned banks in high exposure districts witnessing

[4] Table A4 has fewer observations since pincode data is available for only 44 percent of branches.

deposit inflows and branches of vulnerable private sector banks in these areas witnessing deposit outflows. Acharya et al. (2017b) too find that the systemic risk measures perform better compared to the firm measures, though MES better captures bank vulnerability. The difference between the MES and beta is that the MES is based on tail dependence whereas beta is based on *average* covariance with the market. MES captures the propensity of each bank to be under-capitalized when the financial sector as a whole is under-capitalized, and is a better measure of the systemic risk externality arising when the financial sector as a whole is under-capitalized.

What is important for our analysis is whether a ranking of banks based on the normal-time MES works well during crisis periods. Figure A1 plots MES rankings in January 2006-December 2006 against MES rankings from January 2007-December 2007. MES rankings in 2006 were reflective of which banks would be systemically important in 2007 and MES values are stable over time.

We now examine alternate definitions of MES. Modified MES is similar to MES except market return is calculated using all banks in the economy, excluding own bank return. Weighted MES (W-MES) uses exponentially declining weights ($\lambda$=0.94) on past observations to estimate the average equity returns on the 5 percent worst days of the market. Table A5, columns 4–5 show that results are robust to alternate definitions of MES.

#### 5.5.3 Robustness to alternate explanations

Our results are robust to several alternate explanations. Effects are not explained by higher exposure of private sector banks to the global markets. Table A6, column 1 looks at deposit growth against global beta (measured as the sensitivity to the MSCI World market index). The coefficients on the interaction terms with beta go in the expected direction (though the triple interaction term is noisy and insignificant) and the interaction terms with the global beta are negative and insignificant. These results assure us that exposure to the global markets are not driving our results. Pre-crisis leverage does explain our results (column 2). The pattern of deposit flows cannot be explained by bank asset size either (column 3), assuring us that it is the sovereign guarantees and not a too-big-to-fail guarantee that is driving deposit flows.

Columns 4–5 examines whether our results are simply capturing a reversal in pre-crisis effects. Though column 4 seems to suggest that deposit flows could be driven by pre-crisis returns, on adding the interaction with MES in column 5 we see our familiar result. Deposit flows in state-owned and private sector banks are not related to pre-crisis stock returns, assuring us that we are not merely capturing a reversal in deposit flows.

Pre-crisis liquidity differences do not explain deposit flows either. Column 5 seems to suggest that the branches of more illiquid private sector banks in exposed districts had lower deposit flows. However, *more* illiquid state-owned banks saw deposit inflows contrary to a pure flight to safety of depositors from illiquid private sector banks to liquid state-owned banks. On adding the interaction with MES in column 6, we see our familiar result. Deposit flows across bank vulnerability persist even after controlling for bank liquidity.

## 5.6 Regression discontinuity using the 2005 banking reform

To supplement our earlier findings on the effect of exposure to government guaranteed state-owned banks on desposit flows, we provide evidence from a regression discontinuity (RD) design. This approach allows us to more precisely estimate the impact of higher exposure to state-owned banks on deposit flows of private and state-owned banks. To implement the RD, we use branch-level data and exploit a 2005 banking reform that differentially affected exposure of districts to state-owned banks.

### 5.6.1 Empirical strategy

The 2005 banking reform substantially revised branch licensing in India and explicitly encouraged opening of branches in under-banked districts. A district is designated as under-banked if the district average population per branch is above the national average population per branch. Young (2017) compares districts just above the threshold for under-banked status to districts just below the threshold in an RD design and shows that the number of private sector branches in under-banked districts increased significantly. However, there was no corresponding increase in the branches of state-owned banks. Young (2017) postulates that the reform had minimal effect on state-owned banks because they are not driven by market incentives. Alternatively, state-owned banks are implicitly encouraged to operate in under-banked districts under alternate financial inclusion schemes (such as the Lead Bank Scheme discussed above) and hence, on the margin, are not affected by the reform.

We build on the above result from Young (2017) and first estimate whether the deposit share of state-owned banks — which also corresponds to our branch-exposure measure — changed discontinuously at the RD threshold. We estimate the following regression model within a narrow window around the under-banked threshold:

$$Exposure_d = \delta_s + \beta * Banked_d + \gamma * Banked_d * f(run_d) + \phi * (1 - Banked_d) * f(run_d) + \kappa X_d + \eta_d \quad (4)$$

where, $Exposure_d$ is the deposit share of state-owned banks for each district $d$ in 2006–08. $run_d$ is the running variable, calculated by subtracting the national average population per branch from the district's average population per branch. $Banked_d$ takes a value 1 for all districts with negative values of $run_d$. That is, $Banked_d$ is one for all banked districts and 0 for the under-banked districts. $\delta_s$ is the state fixed-effect. $X_d$ are the controls variables: number of persons and number of persons squared in a district. Following Gelman and Imbens (2014), we use second degree polynomials. We use a triangular kernel for the baseline which uses decaying weights for observations with higher distances from the threshold. Regressions are weighted by population in 2001. We use a bandwidth of 4.5 thousand persons per branch around the threshold so as to compare districts that are fairly close to the cut-off point. This is within the Imbens and Kalyanaraman (2011) bandwidth. In robustness tests, we use alternate specifications with the Imbens and Kalyanaraman (2011) and Calonico et al. (2014) bandwidths and the bandwidth used in and is the same bandwidth used in Young (2017).

$\beta$ is the RD coefficient of interest and estimates the discontinuous jump in exposure to state-owned banks at the threshold. The RD design provides the causal estimate of the impact of the reform on branch openings (and consequently on deposit share of state-owned banks) because districts just above the threshold are good counterfactuals for districts just below the threshold. Under-banked districts where the population per branch ratio is very small (far away from the RD threshold) are likely to be different from districts with a very high population per branch. However, when we narrow our focus to the set of districts close to the threshold, it becomes more plausible that districts just above the threshold are reasonable counterfactuals for districts just below the threshold. Equation 4 allows us to estimate the causal impact of the reform on deposit share of state-owned banks.

Next, using branch-level data we examine the heterogeneity in the impact on deposit growth of public and private sector bank branches across the RD threshold. The specification is:

$$\begin{aligned} \Delta Y_{i,j,d(08-09)} &= \alpha_j + \delta_d + \phi * Banked_d * f(run_d) + \theta * (1 - Banked_d) * f(run_d) + \kappa X_i \\ &+ \beta * Banked_d * MES_j + \theta * Banked_d * Private_j + \gamma * Banked_d * MES_j * Private_j + \eta_{i,j,d} \quad (5) \end{aligned}$$

where as before, $\Delta Y_{i,j,d}$ is log of the change in deposits (deposit flow) in 2008–09 for a branch $i$ belonging to bank $j$ in district $d$. $run_d$ is the running variable described in Equation 5. $Banked_d$ takes a value 1 for all districts with negative values of $run_d$. $\delta_d$ is the district fixed-effect. $X_d$ includes the controls number of persons and number of persons squared in a district. Standard errors are clustered at the district level. As before, we use second degree polynomials with triangular kernels and a bandwidth of 4.5 thousand persons per branch. Regressions are weighted by population in 2001. The coefficients of interest are $\beta$ and $\gamma$. $\beta$ measures the impact on deposit flows of the branches of vulnerable state-owned banks in districts just below the threshold (banked) to those just above the threshold (under-banked). $\beta$+$\gamma$ measures the analogous effect for the branches of vulnerable private sector banks.

The intuition for the RD is as follows. First, Equation 4 establishes whether the banking reform of 2005 caused a discontinuous change in deposit share of state-owned banks (analogous to our branch-exposure measure) in 2006–08 at the RD threshold. This is the period prior to our analysis. Equation 5 then compares the effect on the branches of state-owned banks relative to private sector banks across bank vulnerability in 2008–09, analogous to the DDD specification in Equation 2. While the RD estimate is a local average treatment effect and measures the heterogeneity in the discontinuous jump in deposit growth at the RD threshold, the DDD estimates measures average treatment effect. The RD specification helps address the concern in the previous section that districts with very high branch-exposure are also more rural districts since government mandates require state-owned banks to operate in these areas. The RD specification restricts to districts within a narrow band around the RD threshold and thus plausibly subsets to districts which are similar along all other dimensions besides exposure to state-owned banks. We test the plausibility of this assumption below.

Identification for the RD specification requires that all relevant factors besides treatment vary smoothly at the threshold between banked and under-banked districts. Formally, letting $y_1$ and $y_0$ denote potential outcomes under banked and under-banked districts, identification requires that$E[y_1|run]$ and $E[y_0|run]$ are continuous at the RD threshold. This assumption is needed for districts which fall just under the RD threshold (and were thus designated as banked districts) to be appropriate counterfactuals for districts that are just above the RD threshold (and were thus designated as under-banked districts). To assess the plausibility of the identifying assumptions, Table 7 Panel A examines at the district- level whether weekly wages(column 1), median age (column 2), percentage of rural households (column 3), percentage of females (column 4), percentage of those who have finished high school (column 5) and unemployment rate (column 6) are balanced across the RD threshold. Results suggest that these demographic and economic covariates vary smoothly across the RD threshold. This is in contrast to Table 4, panel A where high and low exposure districts differed along every dimension. The RD design allows us to subset to districts that are similar along almost every dimension besides exposure to state-owned banks. Column 7 also shows that the deposit share of state-owned banks between 2001–2003, prior to the banking reform, did not change discontinuously across the RD threshold. We exclude 2004 and 2005 since the reform was anticipated and may have had spillover effects before the implementation date in September 2005.

Figure 5 analyzes this covariate balance graphically. Covariates are plotted against the running variable. Points to the right of the cut-off represent districts that had a higher average population per branch than the national average population per branch, and are thus designated as under-banked. Each point represents the average of the relevant covariate value in 0.2 percentage points of the run bins. We use second degree polynomials to plot covariates against the running variable on either side of the RD threshold which is shown by the solid line. Dashed lines show the 95 percent intervals. State fixed effects are partialed out here, and other controls are excluded in order to transparently display raw data. Consistent with the results in Table 7 panel A, covariates did not change discontinuously at the RD threshold.

Identification also requires the absence of selective sorting around the RD threshold. Figure A3 shows the McCrary plot and tests for selective sorting. Panel A includes the full sample and Panel B removes the outliers, that is, observations greater than 50. Given that the assignment to under-banked status was based on the 2001 population census which was four years prior to banking reform in 2005, it would have been difficult for banks to manipulate around the threshold. It is, however, possible that banks manipulate the number of branches in a district prior to the reform to game the classification into under-banked status. This seems unlikely given the difficulties of such coordinated manipulation. Indeed, Figure A3 shows that there is no discontinuity in the density of observations around the RD threshold.

#### 5.6.2 Results

First, we graphically examine the deposit share of public sector banks around the RD threshold in Figure 6. Panel A shows that the reform led to a discontinuous increase in the number of private sector bank branches at the RD threshold in under-banked districts. Panel B shows, however, that the reform had no impact on state-owned branches. This could either be due to the lack of market incentives for state-owned banks ([Young (2017)] or because state-owned banks have other financial inclusion mandates and thus the reform does not bind for them. The above findings are consistent with Young (2017).

Panel C shows that the deposit share of state-owned banks in 2006–08 was discontinuously lower at the RD threshold in under-banked districts. That is, districts just above the RD threshold (corresponding to banked districts) had a discontinuously higher share of state-owned banks compared to the districts just above the RD threshold (corresponding to under-banked districts). Panel D shows that there was no discontinuity in deposit share of state-owned banks in 2001–03, prior to the reform.

Table 7, panel B shows these results more formally. All columns use state fixed effects and also control for number of persons and number of persons squared. Number of private sector bank branches was discontinuously lower (higher) by 25 branches in the banked (under-banked) districts (column 1). There was no discontinuous impact on the number of state-owned banks (column 2). Fraction of state-owned banks was discontinuously higher in banked districts at the RD threshold (column 3). Deposit share of state-owned banks, was 9.22 percent higher in districts just below the RD cut-off (banked districts) compared to districts just above the RD cut-off (under-banked districts) as shown in column 4. This is our main estimate of interest and corresponds to branch-exposure measure previously defined. These results confirm that the banking reform led to discontinuously higher exposure to state-owned banks in districts just below the RD threshold (banked districts). Table A7 shows that our results are robust to alternate bandwidths: Imbens and Kalyanaraman (2011) (column 1), Calonico et al. (2014) (column 2), bandwidth of 4 (column 3), and bandwidth of 4.5 (column 4). Results are also robust to using the Young (2017) bandwidth and to using local linear polynomials (column 5). Figure A2 shows the RD plots with a bandwidth of 3.5 and a local linear regression. Results are similar to the baseline plots in Figure 6.

Having established that the banking reform led to a discontinuously higher exposure to state-owned banks in banked districts just below the RD threshold, we now examine deposit flows at vulnerable private sector and state-owned banks in these otherwise similar districts. Table 8, panel A examines deposit flows at the branch-level in 2008–09. Consistent with Table 5, we use a within-bank estimation strategy and include bank fixed effects. Columns 1, 2, and 4 also include district fixed effects to control for local economic conditions. For robustness column 3 only includes state fixed effect. Control variables included are population and population squared. Regressions are weighted by population in 2001. Column 1 restricts to private sector banks. Branches of vulnerable private sector banks in districts just below the RD threshold (banked districts) saw a discontinuous decline in deposit flows of 34 percent. In other words, branches of private sector banks in districts with a discontinuously higher share of state-owned bank branches also had a discontinuous decline in deposit growth compared to branches in less-exposed districts (those districts above the RD threshold and were thus designated as under-banked) and relative to less vulnerable private sector banks. When we restrict to public sector bank branches, we see that the branches of more vulnerable state-owned banks in exposed districts (those below the RD threshold, that is, banked districts) saw a discontinuous increase in deposit growth. Columns 3 and 4 with the full sample of public and private sector banks shows similar results. Column 4, also includes district fixed effects and the coefficient on Banked*MES in column 4 indicates that branches of more vulnerable public sector banks just below the RD cut-off saw a 4.6 percent increase in deposit growth compared to those in districts just above the RD cut-off. In contrast, branches of vulnerable private sector banks saw a relative discontinuous decline of 36.2 percent in districts just below the RD threshold. As a robustness test, column 3 only includes state-fixed effects instead of the district fixed effects to be consistent with the specifications in Table 7. Results are similar.

Table 8, Panel B, examines deposit flows in the pre-crisis years, 2004–05 (column 1), 2005–06 (column 2), 2006–07 (column 3) and 2007–08 (column 4). There was no discontinuous change in deposit flows at the RD threshold, assuring us that private and public sector bank branches in districts just above and below the RD threshold were on similar trends prior to the crisis.

## 6 Impact on bank lending

This section examines the impact on lending. Since deposits account for nearly 79 percent of banks' liabilities and are the main source of banks' funding, we would expect to see an impact on credit. This section concludes by looking at district-level impact on credit availability and the resulting impact on real economic activity.

### 6.1 Identification strategy

Since banks can use their internal capital markets to allocate deposits across branches, the impact on lending may not be affected by local exposure to state-owned banks and hence, we cannot use the same empirical strategy as in Section 5. Instead, we calculate a bank-level measure by averaging at the bank level, the exposure of the bank's branches to state-owned banks. To control for differences in lending opportunities we compare the lending of different banks in the same district. This empirical strategy to examine lending is consistent with the identification strategy used to examine deposits in Section 5. Previously, our identification strategy relied on the assumption that banks are able to allocate funds across branches and thus local deposit flows are not driven by local lending opportunities. We will also explicitly test this assumption in our empirical analysis below.

### 6.2 Within-district estimation

We now implement our bank-level estimation strategy by first calculating a bank level exposure to state-owned branches. Bank exposure is calculated as the weighted average of all branches of a bank in a district, $Exposure_j = \sum_{i \in j} W_{i,j,d} Branch\text{-}share_d$, for a bank $j$ with branches $i$ in district $d$. $Branch\text{-}share_d$ is the district level measure of the share of deposits of state-owned banks. The weight, $W_{i,j,d} = Deposits_{i,d} / \sum_{i \in j} Deposits$, where weight of each branch $i$, of a bank $j$, in a district $d$ is the deposit of a branch $i$ in district $d$ divided by the sum of deposits of all branches of that bank. We use $Bank\text{-}Exposure_j$ in our analysis, which is 1 for above median value of $Exposure_j$.

The empirical specification to examine lending is:

$$\Delta Y_{i,j,d(08-09)} = \delta_d + \alpha MES + \eta Private_j + \beta * MES_j * Bank\text{-}Exposure_j + \kappa * MES_j * Private_j + \phi * Private_j * Bank\text{-}Exposure_j + \gamma * MES_j * Bank\text{-}Exposure_j * Private_j + \epsilon_{i,j,d} \quad (6)$$

where $\delta_d$ is the district fixed effect. The dependent variable is the log of the change in loans (flow of credit) for the period starting from $31^{st}$ March 2008 to $31^{st}$ March, 2009. All other lower order interaction terms are absorbed by fixed effects. Intuitively, we are comparing branches of banks which had high exposure to state-owned banks to branches of banks in the same district which had low exposure to state-owned banks. The previous section showed that private sector bank branches were more likely to cater to urban borrowers, we thus add a control for whether a branch serves a rural population, a semi-urban population, an urban population or a metropolitan population. In addition we add the interaction of these indicators with MES. To control for other bank-level factors that can vary with the exposure measure, we also interact the branch-exposure measure with bank leverage and bank assets. The above equation is our baseline regression to examine lending and lending performance. Standard errors are clustered at the district level and the regression is weighted by deposits in 2007.

In supplemental regression we repeat the specification in Equation 2 with lending growth as the dependent variable to test the identifying assumption that lending is not affected by local deposit flows. If capital markets work well, we should see no impact or minimal impact on lending for branches with high exposure to state-owned banks.

### 6.3 Lending

Table 9 shows the lending results. Column 1 restricts to private sector banks. Lending growth at branches of more vulnerable, high exposure private sector banks saw a decline in lending growth, relative to branches of less vulnerable, low exposure banks, in the same district. On the other hand, lending growth of vulnerable state-owned banks with high bank-exposure increased (column 2). Our preferred specification in column 3 shows that lending increased by 82 percent at more vulnerable state-owned banks with high bank-exposure. Lending at more vulnerable private sector branches with high bank-exposure was nearly 9 times lower as shown by the coefficient for $MES * Bank\text{-}Exposure_j * Private$. By comparing branches within a district, we are controlling for differences in lending opportunities. These large magnitudes for the impact on lending of vulnerable private sector banks possibly indicate that though deposit outflows were spread across districts, the lending effects were actually concentrated in a few districts. Unweighted regressions in column 4 yields similar results. Column 5 tests our identifying assumption using the specification in Equation 2. Lending at the branch-level does not depend on branch exposure to state-owned banks, supporting our identifying assumption that branch deposit flows are not affected by local lending opportunities since banks use their internal capital markets to reallocate deposits across branches.

Results are also robust to using the continuous measure of bank-exposure (column 6). Columns 7–9 examine sector-wise lending, where we split loans into (i) services, (ii) agriculture, and (iii) industry. Branches of more vulnerable, private sector banks with high bank-exposure saw a decline in deposit growth across all sectors. Also, the increase in credit growth of more vulnerable state-owned banks was concentrated in the industry sector. Industry lending tends to be long term in nature and thus relies on relationship lending. Lending flows by state-owned banks to predominantly to the industry sector could point to a "lazy banking" theory which postulates that managers of state-owned banks are more prone to lending to existing customers since they are heavily penalized for making bad loans, but do not face harsh consequences for passing on good opportunities [Banerjee et al. (2005)]. Agricultural lending by state-owned banks does not increase, even though it is considered to be a politically important sector [Cole (2009) and Kumar (2019)]. Column 9 confirms that the bank-exposure measure also captures effects on deposit growth. Branches of vulnerable private sector banks more exposed to state-owned banks saw a decline in deposit growth, whereas branches of state-owned banks saw an increase in deposit growth, thus tying the result on deposit flows as documented in Section 5 with the lending patterns documented above.

Table A8 examines loan rates. Lending rates at the branches of more vulnerable private sector banks with high bank-exposure was significantly lower compared to the branches of more vulnerable state-owned banks in these areas (column 1). These effects are driven by the industry and services sector (columns 3–5).

These differences in lending rates plausibly reflect a deterioration in credit-worthiness of borrowers of vulnerable state-owned banks relative to private sector banks. Plausibly, more vulnerable private sector banks reduce lending to the least profitable borrowers, and thus have lower lending rates. To test this hypothesis, we examine loan performance in the next section.

### 6.4 Loan Performance

There could be several explanations as to why state-owned banks do not cut back on lending during crises. One argument is that vulnerable state-owned banks are socially maximizing and therefore increase lending during crises and are thus helpful in maintaining credit flow in the economy when it is most needed. In contrast, a political economy view suggests that this increased lending by state-owned banks may be due to political pressures, and could thus lead to inefficient investments [Sapienza (2004) and Dinç (2005)]. Both the social and the political motive result in greater lending and greater investment. However, in the former, state-owned banks invest in projects which are welfare maximizing whereas in the latter, they investments may be inefficient. To see which of the above motives dominate, this section examines loan performance between March 2008 to March 2013.

We focus on a longer time period, since it takes some time for the loans to become delinquent. A loans is classified as an a non-performing asset (NPA) if a borrower misses payments for 90 days (or 180 days in some cases). Banks are further required to further classify NPAs into three categories, each with different provisioning requirements: (i) sub-standard assets for assets that have remained NPAs for less than or equal to 18 months and with a provisioning requirement of 10 percent; (ii) doubtful assets for NPAs exceeding 18 months an with a provisioning requirement of 20-50 percent; and finally, (iii) loss assets if the assets are considered uncollectible, and thus have to be written off. Given these differences in provisioning requirements, banks are not inclined to recognize loss assets on their balance sheets. Because banks have an incentive to delay the classification of delinquent loans, we also look at sub-standard and doubtful assets.

Using the specification in Equation 6, column 1 in Table 10 suggests that NPAs of private sector banks declined, whereas the NPAs of state-owned banks increased. Effects, however, are noisy and not statistically significant. On further splitting into the components of NPAs, we see that there was a 30 percent increase in sub-standard assets of vulnerable state-owned banks with high bank-exposure. Relative to the state-owned bank branches, private sector branches of vulnerable banks with high bank-exposure saw a sharp decline in sub-standard assets. There was no impact on doubtful assets which require higher provisioning. Strikingly, loss assets declined for state-owned banks but increased for private sector banks. We interpret these as reflecting state-owned banks' reluctance to write down even delinquent loans. However, the (true) deterioration in asset quality is reflected in sub-standard assets (column 2) is also has much lower provisioning requirements.

### 6.5 District-level lending and economic activity

We now aggregate to the district level and examine how the deposit flows affect lending and subsequent economic activity (as measured by night lights). To examine the district-level impact, we first construct a district-level exposure measure. District-exposure is defined as the weighted average of bank-exposure across all banks lending in a given district, using deposit shares in 2007 as weights. This measure captures the extent to which a district is served by banks that raise deposits in districts with high exposure to state-owned banks (high branch-exposure).

The specification to examine lending and economic activity is:

$$Y_d = \delta_s + \beta * \textit{District-Exposure}_d + \kappa X_d + \epsilon_d \tag{7}$$

where $\delta_s$ is the state fixed effect. To look at the impact on lending, the dependent variable is the log of the change in loans (flow of credit) for the relevant period. To look at the impact on economic activity, we take the logarithm of night light intensity. We look at short term growth from $31^{st}$ March 2008 to $31^{st}$ March, 2009. To measure long term impact we also look at the years 2009–13. The control variables included are unemployment rate and percentage rural population in 2007–08. Standard errors are clustered at the state level and the regression is weighted by total deposits in 2007.

Table 11 presents the results of the district-level analysis. As a first step, we first examine the district-level impact on deposits using branch-exposure (columns 1–2). Districts with high share of state-owned banks (high branch-exposure) saw a 93 percent decline in deposit flows in 2008–09 and a decline of 90 percent over the five year period. The overall negative growth at the district-level in exposed districts, suggests that not all the deposits that flew out of private sector banks made their way to state-owned banks. Since banks can use their internal capital markets, these deposit flows may not directly impact the districts which witnessed deposit flows and hence we use the district-exposure defined above to examine the impact on lending and real economic activity. Districts whose banks raise deposits in markets more exposed to state-owned banks saw a decline in lending (column 3) and this effect persisted up until 2013 (column 4). A one standard deviation increase in district-exposure (0.22) was associated with a 1.6 times relative decline in lending in 2008–09. Columns 6–7 examine the impact on real economic activity. A one standard deviation increase in district-exposure was associated with a 33 percent decline in economic activity, as measured using night light intensity.

## 7 Evidence of implicit government guarantee of state-owned banks

This section examines the extent of capital support provided by the Indian government to the state-owned banks in the aftermath of the crisis. The sample of banks that received capital injections is small and hence we only provide a descriptive analysis. Beginning December 2008, the government announced a number of capital injections for state-owned banks. Importantly, weaker state-owned banks received greater capital injections. In February 2009, the government announced capital injections in 3 state-owned banks: UCO Bank, Central Bank of India and Vijaya Bank. Further, as part of the 2010-2011 budget, the government announced additional capital infusion in five state-owned banks: IDBI Bank, Central Bank, Bank of Maharashtra, UCO Bank and Union Bank. The amount of capital injections was determined based on funding requirements of state-owned banks and their need for a capital buffer. Effectively, the state-owned banks which performed the worst during the crisis, that is, those that had higher capital depletion received greater support from the government. As of March 2009, all the banks mentioned above (except Union Bank) had less than 8 percent of Tier 1 capital. Based on the MES measure, these were also among the more vulnerable banks in our analysis. For example, Union Bank had an MES of 5.74 percent and Vijaya Bank had an MES of 5.27 percent. UCO Bank had a relatively lower MES of 4.80 percent. More vulnerable state-owned banks, thus, received greater ex-post government support. Such direct capital support was not provided to more vulnerable private sector banks, consistent with our starting assumption that state-owned banks have greater government support as compared to the private sector banks.

# 8 Conclusion

In this paper, we examine the relatively strong performance of state-owned banks in India compared to their private-sector counterparts during the global financial crisis of 2007–09. While more vulnerable private sector banks performed worse than less vulnerable private sector banks, vulnerable state-owned banks performed better. We attribute this to the presence of government guarantees which enabled more vulnerable state-owned banks to grow their deposit base by increasing their deposit rates. They also increased loan advances. However, ex-post, these loans have been associated with greater non-performance and restructuring of assets. Our results suggest that the presence of state-owned banks can decrease financial fragility during crisis periods by destabilizing the private banking sector. Such distorted lending by under-performing state-owned banks may further sow the seeds of an eventual slowdown in economic investments [as documented by Acharya et al. (2017a) in India].

Our findings are, in fact, consistent with the experience 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 deleveraged and sold these securities [He et al. (2010)]. Eventually, Fannie Mae and Freddie Mac effectively failed and were put under the United States government conservatorship in September 2008. In contrast, private-label mortgage securitizers lost a significant market share during the crisis and have not recovered since then. Thus, even though access to government guarantees might be considered a source of financial stability during a crisis, our results suggest that greater presence of government institutions in the financial sector (or greater extent of government intervention in a crisis) is likely to be associated with the misfortune of crowding out the private financial sector in the long run.

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**Table 1:** Summary Statistics: Bank level data

| Variables | All | | Public Sector Banks | | | | Private Sector Banks | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Low MES | | High MES | | Low MES | | High MES | |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| | Risk Measures | | | | | | | | | |
| MES (in%) | 4.00 | 1.23 | 3.47 | 1.32 | 5.47 | 0.32 | 3.23 | 0.44 | 4.69 | 0.67 |
| Volatility (in%) | 20.02 | 7.48 | 18.08 | 7.54 | 23.07 | 4.43 | 16.37 | 5.18 | 26.04 | 8.82 |
| Expected Shortfall (in%) | 5.54 | 0.80 | 5.40 | 0.52 | 6.23 | 0.43 | 4.91 | 0.80 | 5.94 | 0.76 |
| Beta | 0.86 | 0.29 | 0.77 | 0.30 | 1.14 | 0.13 | 0.68 | 0.20 | 0.99 | 0.23 |
| Global Beta | 0.70 | 0.32 | 0.63 | 0.38 | 0.92 | 0.07 | 0.50 | 0.16 | 0.91 | 0.30 |
| Modified MES (in%) | 4.22 | 1.04 | 4.20 | 0.59 | 5.27 | 0.59 | 3.13 | 0.57 | 4.76 | 1.07 |
| W-MES (in%) | 4.57 | 0.95 | 4.43 | 0.50 | 5.71 | 0.52 | 3.55 | 0.54 | 5.09 | 0.63 |
| | Other Variables | | | | | | | | | |
| Log Assets (in%) | 10.82 | 1.16 | 11.35 | 0.77 | 11.67 | 0.57 | 10.33 | 1.28 | 9.59 | 0.72 |
| Leverage (in%) | 17.97 | 9.63 | 21.48 | 10.13 | 17.99 | 8.51 | 14.55 | 9.85 | 15.79 | 8.85 |
| Liquidity (in%) | 37.70 | 5.19 | 37.59 | 3.17 | 36.02 | 2.69 | 36.77 | 3.52 | 40.95 | 10.06 |
| Pre-crisis Stock Returns (in%) | 9.05 | 6.45 | 7.43 | 4.32 | 6.08 | 3.96 | 8.22 | 3.31 | 16.43 | 10.14 |
| Stock Returns (in%) | -65.52 | 12.38 | -66.81 | 11.89 | -55.11 | 12.41 | -61.95 | 8.55 | -78.46 | 5.28 |
| Deposit Growth (in%) | 18.40 | 11.52 | 20.44 | 5.06 | 22.12 | 4.95 | 23.96 | 6.71 | 2.67 | 17.47 |
| Credit Growth (in%) | 19.20 | 11.60 | 21.15 | 4.62 | 22.45 | 5.16 | 22.91 | 13.37 | 6.72 | 16.21 |
| Bank-Exposure | 0.50 | 0.51 | 0.79 | 0.43 | 0.86 | 0.38 | 0.10 | 0.32 | 0.14 | 0.38 |
| **Obs. (Banks)** | 38 | | 21 | | | | 17 | | | |

This table shows the summary statistics for all bank-level variables used in our analysis. This data is for 38 banks for the period March 31st 2008 to March 31st 2009. Ex-ante bank vulnerability, measured by 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. *High MES* refers to the top 7 banks within the state-owned or private sector banks. Remaining are classified as *Low MES* banks. For the definitions of volatility, expected shortfall, beta, global beta, modified MES, $W-MES$, log asset, leverage and liquidity refer to Table A5 and Table A6 in the appendix. *Pre-crisis stock returns* (*stock returns*) is based on the S&P CNX NIFTY for the pre-crisis period from 1st January, 2007 (1st January, 2008) to 31st December, 2007 (24th February, 2009). *Deposit* and *credit growth* is for the period March 31st 2008 to March 31st 2009. Only districts where private sector bank deposit share is greater than one percent are retained. Bank-exposure is calculated for every bank in our sample. It is the weighted average of the district-level share of deposits of state-owned banks, where the weight of each branch of that bank is the total deposits of that branch in a district, divided by the sum of deposits of all branches of the bank. It is 1 for banks which have above median exposure. Branch-level data is from the Reserve Bank of India. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

## **Table 2:** Summary Statistics: Branch level data

| Variables | All | | Public Sector Banks | | | | Private Sector Banks | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Low MES | | High MES | | Low MES | | High MES | |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Branch-Exposure | 0.40 | 0.50 | 0.40 | 0.50 | 0.40 | 0.50 | 0.20 | 0.40 | 0.10 | 0.40 |
| | | | | | Deposit Variables | | | | | |
| Deposit growth (in %) | 29.00 | 23.70 | 29.30 | 23.50 | 26.40 | 22.50 | 35.20 | 26.60 | 29.50 | 25.50 |
| I) Demand deposit growth | 53.80 | 133.40 | 61.40 | 140.30 | 42.60 | 123.70 | 35.60 | 100.10 | 63.00 | 152.10 |
| II) Savings deposit growth | 21.90 | 26.20 | 22.80 | 25.40 | 20.20 | 26.20 | 22.50 | 28.50 | 20.40 | 30.90 |
| III) Term deposit growth | 36.90 | 39.00 | 36.10 | 38.10 | 34.10 | 36.80 | 51.90 | 47.30 | 37.00 | 41.70 |
| a)Deposit Growth: Rate $<$ 9% | -24.60 | 47.80 | -25.30 | 47.90 | -25.90 | 44.50 | -17.00 | 50.70 | -27.50 | 59.30 |
| i) Retail Deposit Growth: Rate $<$ 9% | -19.90 | 62.70 | -19.70 | 65.70 | -23.50 | 51.90 | -13.90 | 58.40 | -26.70 | 64.60 |
| ii) Wholesale Deposit Growth: Rate $<$ 9% | 23.50 | 255.50 | 29.30 | 275.70 | 3.90 | 213.20 | 16.90 | 185.50 | 34.30 | 223.20 |
| b)Deposit Growth: Rate $\geq$ 9% | 50.40 | 131.40 | 52.60 | 139.30 | 37.10 | 118.80 | 61.70 | 93.20 | 20.70 | 102.70 |
| i) Retail Deposit Growth: Rate $\geq$ 9% | 66.00 | 171.60 | 71.40 | 187.10 | 43.80 | 134.30 | 73.10 | 113.80 | 18.10 | 98.90 |
| ii) Wholesale Deposit Growth: Rate $\geq$ 9% | 134.00 | 515.70 | 166.00 | 576.50 | 53.80 | 405.40 | 89.40 | 295.50 | 128.30 | 425.70 |
| | | | | | Lending Variables | | | | | |
| Credit growth (in %) | 18.30 | 32.70 | 18.40 | 29.80 | 16.10 | 31.70 | 24.30 | 44.50 | 21.00 | 46.60 |
| I) Services credit growth | 12.70 | 36.90 | 14.60 | 34.80 | 6.700 | 36.10 | 21.10 | 48.90 | 8.900 | 34.50 |
| II) Agriculture credit growth | 44.40 | 191.00 | 35.70 | 172.50 | 56.40 | 208.00 | 52.20 | 213.90 | 74.70 | 263.10 |
| III) Industry credit growth | 93.80 | 379.90 | 74.90 | 336.10 | 117.00 | 422.30 | 154.20 | 485.30 | 71.00 | 383.00 |
| Lending Rate | 11.90 | 1.10 | 11.60 | 0.90 | 11.70 | 0.90 | 13.40 | 1.00 | 14.20 | 1.10 |
| I) Lending Rate: Services | 11.70 | 1.60 | 11.50 | 1.50 | 11.50 | 1.40 | 12.70 | 1.70 | 14.00 | 1.90 |
| II) Lending Rate: Agriculture | 12.60 | 1.50 | 12.30 | 1.40 | 12.30 | 1.50 | 14.10 | 1.50 | 14.60 | 1.50 |
| III) Lending Rate: Industry | 11.60 | 1.60 | 11.20 | 1.30 | 11.50 | 1.40 | 13.20 | 1.60 | 14.30 | 1.80 |
| | | | | | Non-performing Assets (NPA) Variables | | | | | |
| NPA growth (in %) | 6.20 | 1.70 | 6.00 | 1.70 | 6.20 | 1.60 | 7.00 | 1.90 | 7.00 | 2.10 |
| I) Sub-standard assets | 6.10 | 1.60 | 6.00 | 1.50 | 6.00 | 1.50 | 6.90 | 1.80 | 6.80 | 1.80 |
| II) Doubtful assets | 5.70 | 1.60 | 5.70 | 1.50 | 5.70 | 1.60 | 6.20 | 1.60 | 6.40 | 1.70 |
| III) Loss assets | 5.20 | 1.60 | 5.20 | 1.60 | 5.00 | 1.60 | 5.30 | 1.70 | 5.60 | 2.10 |
| **Obs. (Branches)** | 33,972 | | 29,861 | | | | 4,111 | | | |

Summary statistics at the branch level are shown above. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its $5^{th}$- percentile during the period $1^{st}$ January, 2007 to $31^{st}$ December, 2007. Branch-exposure is at the district level and takes a value 1 if the share of deposits of state-owned banks in a district is greater than the median, as measured in 2007. Deposits are classified into demand, savings and term. Term deposits are further broken into deposits with rates less than 9 percent and those with rates greater than or equal to 9 percent. Credit and lending rates are classified into credit to the services, agriculture, and lending sector. A loan is an NPA if a borrower misses payments for 90 days (or 180 days in some cases). Sub-standard assets are assets that have remained NPAs for less than 18 months. Doubtful assets are assets that have remained NPAs for a period exceeding 18 months. Loss assets are uncollectible NPAs. All growth rates are from March $31^{st}$ 2008 to March $31^{st}$ 2009. Branch-level data is from the Reserve Bank of India (RBI) as part of the Basic Statistical Returns data. Data on NPA and deposit rates is also collected by the RBI but only available for a subset of the branches. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

**Table 3:** Bank-level regressions

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Stock market returns | | Ln(Δ Deposits) | | | Ln(Δ Lending) | |
| Pvt | -0.102** | 0.496*** | -7.860** | 18.43* | 24.30** | -0.109 | 0.421* |
| | (0.0409) | (0.153) | (3.666) | (9.409) | (9.205) | (0.0749) | (0.248) |
| MES | | 0.0705*** | | 0.330** | | | 0.0167*** |
| | | (0.0143) | | (0.126) | | | (0.00327) |
| MES*Pvt | | -0.139*** | | -6.408** | | | -0.128** |
| | | (0.0333) | | (2.581) | | | (0.0605) |
| Crisis Returns | | | | | 5.260*** | | |
| | | | | | (1.649) | | |
| Crisis Returns*Pvt | | | | | 46.58*** | | |
| | | | | | (16.30) | | |
| No. of Obs. | 38 | 38 | 38 | 38 | 38 | 38 | 38 |
| R squared | 0.145 | 0.580 | 0.477 | 0.725 | 0.693 | 0.254 | 0.513 |

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table estimates the effect of government guarantees on bank-level outcomes. The dependent variable in columns 1–2 is the bank's stock market returns from January 2008 to February 2009. The dependent variable in columns 3–5 is the log of the change in deposits (deposit flow) and the dependent variable in columns 6–7 is log of the change in lending for the period 31st March, 2008 to 31st March, 2009. Private is 1 if the bank is a private sector bank and 0 otherwise. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its 5th- percentile during the period 1st January, 2007 to 31st December, 2007. All observations are weighted by deposits in 2007. Robust standard errors are shown in parenthesis. Bank data is publicly available and from the Reserve Bank of India. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

**Table 4:** Correlates of exposure

Panel A: Characteristics of districts

| | (1) Ln (Wages) | (2) Age | (3) Fraction rural population (in %) | (4) Fraction female (in %) | (5) Fraction high-school (in %) | (6) Unemp. rate (in %) |
|---|---|---|---|---|---|---|
| High Branch-Exposure | -0.127** | -2.076*** | 0.0942*** | -0.00412 | -0.0172*** | 0.00914 |
| | (0.0591) | (0.367) | (0.0215) | (0.00291) | (0.00409) | (0.00937) |
| No. of Obs. | 285 | 285 | 285 | 285 | 285 | 285 |
| R squared | 0.0160 | 0.102 | 0.0649 | 0.00709 | 0.0597 | 0.00338 |

Panel B: Characteristics of branches

| | (1) Skilled workers (in %) | (2) Urban | (3) NPA ratio (in %) | (4) $\frac{Credit}{Deposit}$ | (5) Large |
|---|---|---|---|---|---|
| Branch-Exposure | -1.154*** | -0.189*** | 0.489*** | -27.01** | -0.162*** |
| | (0.192) | (0.00506) | (0.105) | (13.44) | (0.00511) |
| No. of Obs. | 39876 | 39876 | 39863 | 39876 | 39876 |
| R squared | 0.000878 | 0.0335 | 0.000550 | 0.0000594 | 0.0245 |

Panel C: Heterogeneity across state-owned and private sector bank branches

| | (1) Skilled workers (in %) | (2) Urban | (3) NPA ratio (in %) | (4) $\frac{Credit}{Deposit}$ | (5) Large |
|---|---|---|---|---|---|
| Private * Branch-Exposure | 0.255 | 0.145*** | -0.368 | 30.38 | -0.0171 |
| | (1.319) | (0.0237) | (0.733) | (19.94) | (0.0250) |
| No. of Obs. | 39876 | 39876 | 39863 | 39876 | 39876 |
| R squared | 0.625 | 0.385 | 0.119 | 0.00427 | 0.163 |
| Bank-FE | Y | Y | Y | Y | Y |
| District-FE | Y | Y | Y | Y | Y |

Standard errors in parentheses
$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

This table examines district and branch level characteristics. Panel A examines district-level characteristics. The dependent variables in panel A are district-level weekly wages (column 1), median age (column 2), percentage of rural population (column 3), percentage of female population (column 4), percentage of population with high school (column 5), and unemployment rate (column 6). Panel B examines branch-level characteristics. The dependent variables are percentage of skilled workers (column 1), whether a branch caters to an urban population (classified as urban or metropolitan in the data) (column 2), ratio of non-performing assets (NPA) to total deposits plus credit (column 3), credit to deposit ratio column (4), and whether a branch is large, defined as branches with total loans above the median in 2007 (column 5). Panel C examines the heterogeneity across branches of private and state-owned banks. Branch-exposure takes a value 1 if the share of deposits of state-owned banks in a district is greater than the median, as measured in 2007. Private is 1 if the bank is a private sector bank and 0 if it is a state owned bank. All columns include bank and district fixed effects and are weighted using deposits in 2007. Only districts where deposit share of private sector banks is greater than 1 percent are retained. All observations are weighted by deposits in 2007. Standard errors are clustered at the district level. All variables have been winsorized at the 2 percent level. Branch-level data is from the Reserve Bank of India. District-level data is from the 61 $^{st}$ NSS Employment and Unemployment Survey for 2004–05.

## **Table 5:** Deposit Growth

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Private | | Public | | Within State | Within district | Unwtd. | Urban | Rural | Cont. measure | Levels |
| Branch-Exposure | -1.119 | | -0.846 | | -1.075 | | | | | | |
| | (0.913) | | (0.670) | | (0.654) | | | | | | |
| Branch-Exposure * MES | | -0.384*** | | 0.102*** | 0.114*** | 0.124*** | 0.0701*** | 0.137*** | 0.0730** | | 0.0642*** |
| | | (0.143) | | (0.0327) | (0.0366) | (0.0325) | (0.0140) | (0.0436) | (0.0353) | | (0.0237) |
| Private * Branch-Exposure * MES | | | | | -0.525*** | -0.528*** | -0.135* | -0.450*** | -0.490*** | | -0.116** |
| | | | | | (0.142) | (0.132) | (0.0797) | (0.143) | (0.181) | | (0.0581) |
| Branch-Exposure (cont.) * MES | | | | | | | | | | 0.440*** | |
| | | | | | | | | | | (0.0921) | |
| Private * Branch-Exposure (cont.)* MES | | | | | | | | | | -0.793** | |
| | | | | | | | | | | (0.382) | |
| No. of Obs. | 4111 | 4111 | 29861 | 29861 | 33972 | 33972 | 33972 | 15487 | 18485 | 33972 | 33972 |
| R squared | 0.533 | 0.609 | 0.416 | 0.481 | 0.437 | 0.497 | 0.450 | 0.381 | 0.366 | 0.497 | 0.583 |
| Bank-FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| State-FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| District-FE | N | Y | N | Y | N | Y | Y | Y | Y | Y | Y |
| Controls | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table examines deposit growth against an ex-ante measure of bank vulnerability using branch-level data. Columns 1–2 restrict to private sector banks. Columns 3–4 restrict to state-owned banks. Columns 5, 6, 7, 10, and 11 include the full sample. Column 8 restricts to branches that cater to the urban and metropolitan population and column 9 restricts to branches that cater to the rural and semi-urban population. Private is 1 if the bank is a private sector bank and 0 otherwise. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its $5^{th}$- percentile during the period $1^{st}$ January, 2007 to $31^{st}$ December, 2007. Branch-exposure takes a value 1 if the share of deposits of state-owned banks in a district is greater than the median, as measured in 2007. Column 10 uses the continuous measure of branch-exposure, namely the deposit share of state-owned banks in a district. The dependent variable is the log of the change in deposits (deposit flow) for the period $31^{st}$ March, 2008 to $31^{st}$ March, 2009 in columns 1–10 and the log of the level of deposits as of $31^{st}$ March, 2009 in column 11. All columns include bank and state fixed effects. All columns except columns 1, 3, and 5 also include district fixed effects. All specifications include an indicator for the population a branch caters to (rural, semi-urban, urban or metropolitan), and their interaction with MES. All specifications also include bank-exposure separately interacted with bank leverage, and with bank assets. All columns except column 7 are weighted by deposits in 2007. Only districts where deposit share of private sector banks is greater than 1 percent are retained. Standard errors are clustered at the district level. Variables have been winsorized at the 2 percent level. Branch-level data is from the Reserve Bank of India. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

**Table 6:** Deposit Rates and MES

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Deposit rates $< 9\%$ | | | Deposit rates $\geq 9\%$ | | |
| | All | Retail | Other | All | Retail | Other |
| Branch-Exposure * MES | -0.0352 | -0.0200 | 0.144 | $0.136^{***}$ | $0.150^{***}$ | -0.00701 |
| | (0.115) | (0.0950) | (0.0960) | (0.0324) | (0.0361) | (0.0479) |
| Private * Branch-Exposure * MES | 0.313 | 0.198 | $-0.902^{***}$ | $-0.444^{***}$ | $-0.456^{***}$ | -0.274 |
| | (0.253) | (0.172) | (0.198) | (0.116) | (0.123) | (0.167) |
| No. of Obs. | 11711 | 11711 | 11711 | 11711 | 11711 | 11711 |
| R squared | 0.470 | 0.531 | 0.451 | 0.474 | 0.436 | 0.511 |
| Bank-FE | Y | Y | Y | Y | Y | Y |
| State-FE | Y | Y | Y | Y | Y | Y |
| District-FE | Y | Y | Y | Y | Y | Y |
| Controls | Y | Y | Y | Y | Y | Y |

Standard errors in parentheses
$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

This table examines deposit growth across deposit rate buckets for retail and wholesale deposits. Columns 1–3 restricts to deposits with deposit rates lower than 9 percent. Columns 4–6, restricts to deposits with deposit rates greater than 9 percent. Columns 2 and 5 restrict to retail deposits, columns 3 and 6 restrict to wholesale deposits. The dependent variable is the log of the change in deposits (deposit flow) for the period $31^{st}$ March, 2008 to $31^{st}$ March, 2009. Private is 1 if the bank is a private sector bank and 0 if it is a state owned bank. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its $5^{th}$- percentile during the period $1^{st}$ January, 2007 to $31^{st}$ December, 2007. Branch-exposure is at the district level and takes a value 1 if the share of deposits of state-owned banks in a district is greater than the median, as measured in 2007. All columns include bank, state and district fixed effects. All specifications control for the kind of population a branch serves (rural, semi-urban, urban or metropolitan), their interaction with MES, and bank-exposure separately interacted with bank leverage and with bank assets. Standard errors are clustered at the district level. All observations are weighted using deposits in 2007. Branch-level data is from the Reserve Bank of India. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

**Table 7:** Regression discontinuity: Under-banked status and state-owned banks' deposit share

Panel A: Covariate balance

| | (1) Ln (Wages) | (2) Age | (3) Fraction rural population (in %) | (4) Fraction female (in %) | (5) Fraction high-school (in %) | (6) Unemp. rate (in %) | (7) Deposit share of public sector branches in 2001–03 |
|---|---|---|---|---|---|---|---|
| Banked | 0.0915 | 0.0481 | -5.335 | 0.00834 | 0.0242 | 0.0531 | 0.0844 |
| | (0.174) | (0.0509) | (8.009) | (0.0106) | (0.0159) | (0.0327) | (0.0505) |
| State-FE | Y | Y | Y | Y | Y | Y | Y |
| No. of Obs. | 247 | 247 | 247 | 247 | 247 | 247 | 247 |
| R squared | 0.580 | 0.705 | 0.551 | 0.264 | 0.466 | 0.214 | 0.579 |

Panel B: Deposit share of state-owned banks in 2006–08

| | (1) Number of private sector bank branches | (2) Number of state-owned bank branches | (3) Fraction of state-owned bank branches | (4) Deposit share of state-owned bank branches |
|---|---|---|---|---|
| Banked | -25.52** | 17.43 | 0.110* | 0.0922** |
| | (11.34) | (14.05) | (0.0620) | (0.0446) |
| State-FE | Y | Y | Y | Y |
| No. of Obs. | 255 | 255 | 255 | 255 |
| R squared | 0.622 | 0.926 | 0.455 | 0.546 |

This table examines the impact of the 2005 banking reform on public and private sector bank branches and deposits using district-level data. Panel A examines covariate balance with a standard RD specification. The dependent variables in panel A are district-level weekly wages (column 1), median age (column 2), percentage of rural population (column 3), percentage of female population (column 4), percentage of population with high school (column 5), unemployment rate (column 6) and deposit share of state-owned banks in 2001–03 (column 5). Panel B presents the RD estimates with the dependent variable number of private sector branches in a district (column 1), number of state-owned branches in a district (column 2), fraction of state-owned bank branches in a district (column 3), and deposit share of state-owned banks in a district in 2006–08. The running variable is the the national average population per branch subtracted from the district level average population per branch. Banked takes a value 1 if the running variable is negative. All regressions use second degree polynomials and triangular kernel with a bandwidth of 4.5 around the cut-off. All regressions include state fixed effects and are weighted by population in 2001. Controls included are population and population squared. Standard errors are clustered at the district level. Data for covariates is from the 61$^{st}$ round of the NSS Employment and Unemployment Survey conducted in 2004–05. Bank data is from the Reserve Bank of India. Population data to construct the running variable is from Census 2001.

**Table 8:** Regression discontinuity: Under-banked status and impact on deposit growth during the crisis

Panel A: Deposit growth

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Private | Public | All | |
| Banked * MES | -0.345** | 0.0446* | 0.0491** | 0.0464** |
| | (0.152) | (0.0229) | (0.0238) | (0.0229) |
| Banked * MES * Private | | | -0.287* | -0.362** |
| | | | (0.154) | (0.156) |
| State-FE | Y | Y | Y | Y |
| District-FE | Y | Y | N | Y |
| Bank-FE | Y | Y | Y | Y |
| No. of Obs. | 2074 | 18383 | 20457 | 20457 |
| Adj.$R^2$ | 0.565 | 0.483 | 0.455 | 0.488 |

Panel B: Placebo Years

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | 2004–05 | 2005–06 | 2006–07 | 2007–08 |
| Banked * MES | 0.0104 | -0.0227 | 0.0264 | -0.00456 |
| | (0.0329) | (0.0274) | (0.0345) | (0.0327) |
| Banked * MES * Private | -0.166 | 0.0765 | 0.272 | 0.0470 |
| | (0.184) | (0.178) | (0.192) | (0.0807) |
| District-FE | Y | Y | Y | Y |
| Bank-FE | Y | Y | Y | Y |
| No. of Obs. | 16834 | 18311 | 19096 | 18871 |
| Adj.$R^2$ | 0.399 | 0.410 | 0.372 | 0.355 |

This table presents the regression discontinuity (RD) estimates for deposit growth using branch-level data. The dependent variable in both panels is log of the change in deposits (deposit flow) from the previous fiscal year to the current fiscal year (as of March 31$^{st}$). Panel A shows the RD estimates for the year 2008–09. Panel B shows the RD estimates for the year 2004–05 (column 1), 2005–06 (column 2), 2006–07 (column 3), and 2007–08 (column 4). Column 1 in panel A restricts to private sector banks and column 2 in panel A restricts to state-owned banks. Remaining columns include the full sample. The running variable for the RD design is the the national average population per branch subtracted from the district level average population per branch. Banked takes a value 1 if the running variable is negative. Private is 1 if the bank is a private sector bank and 0 otherwise. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its 5$^{th}$- percentile during the period 1$^{st}$ January, 2007 to 31$^{st}$ December, 2007. Branch-exposure is at the district level and takes a value 1 if the share of deposits of state-owned banks in a district is greater than the median, as measured in 2007. All regressions use second degree polynomials and triangular kernel with a bandwidth of 4.5 around the cut-off. All regressions include bank and state fixed effect and are weighted by population in 2001. All columns (except column 3 in panel A) also include district fixed effect. Controls included are population and population squared. Standard errors are clustered at the district level. Branch data is from the Reserve Bank of India. Population data to construct the running variable is from Census 2001. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

**Table 9:** Lending during the Crisis

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | All Lending | | | | | | | |
| | Private | Public | Wtd. | Un-Wtd. | Branch-exposure | Cont. | Services Lending | Agri. Lending | Industry Lending | Deposit growth |
| Bank-Exposure * MES | -15.89*** | 0.934*** | 0.815*** | 0.369*** | | | 0.410 | -0.227 | 1.139*** | 0.0628* |
| | (3.839) | (0.161) | (0.180) | (0.0905) | | | (0.340) | (0.258) | (0.116) | (0.0377) |
| Private * Bank-Exposure * MES | | | -8.756*** | -7.380*** | | | -9.767*** | -5.849*** | -4.510*** | -2.086*** |
| | | | (1.658) | (0.943) | | | (1.605) | (1.103) | (1.497) | (0.404) |
| Branch-Exposure * MES | | | | | 0.0715 | | | | | |
| | | | | | (0.0736) | | | | | |
| Private * Branch-Exposure * MES | | | | | 0.103 | | | | | |
| | | | | | (0.288) | | | | | |
| Bank-Exposure (cont.)* MES | | | | | | 6.123*** | | | | |
| | | | | | | (2.342) | | | | |
| Private * Bank-Exposure (cont.) * MES | | | | | | -34.76*** | | | | |
| | | | | | | (7.598) | | | | |
| No. of Obs. | 4111 | 29861 | 33972 | 36176 | 36176 | 33972 | 33972 | 33972 | 33972 | 33972 |
| R squared | 0.275 | 0.0639 | 0.0754 | 0.0693 | 0.0966 | 0.0768 | 0.0867 | 0.123 | 0.0831 | 0.444 |
| District-FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Controls | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

This table examines lending growth against an ex-ante measure of bank vulnerability using branch-level data. Column 1 restricts to private sector banks. Column 2 restricts to public sector lending. Remaining columns include both private and public sector banks. Columns 7–9 examines lending to the following sectors: services (column 7), agriculture (column 8), and industry (column 9). The dependent variable in columns 1–9 is the log of the change in lending for the period $31^{st}$ March, 2008 to $31^{st}$ March, 2009 and the dependent variable in column 10 is the log of the change in deposits for the same period. Private is 1 if the bank is a private sector bank and 0 if it is a state owned bank. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its $5^{th}$- percentile during the period $1^{st}$ January, 2007 to $31^{st}$ December, 2007. Branch-exposure is at the district level and takes a value 1 if the share of deposits of state-owned banks in a district is greater than the median, as measured in 2007. Bank-exposure (continuous) is the bank-level weighted average of the continuous measure of branch-exposure across a bank's branches using deposit shares in 2007 as weights. Bank-exposure takes a value 1 if the exposure is greater than the median. All columns include district fixed effects.All specifications control for the kind of population a branch serves (rural, semi-urban, urban or metropolitan), their interaction with MES, and bank-exposure separately interacted with bank leverage and with bank assets. Standard errors are clustered at the district level and all observations are weighted by deposits in 2007. Branch-level data is from the Reserve Bank of India. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

**Table 10:** Non-performing Assets and Restructured Loans

| | (1) NPA | (2) Sub-standard assets | (3) Doubtful | (4) Loss |
|---|---|---|---|---|
| Bank-Exposure * MES | 0.113 | 0.296*** | 0.0612 | -0.460*** |
| | (0.120) | (0.0820) | (0.0791) | (0.146) |
| Private * Bank-Exposure * MES | -1.453 | -3.952** | 1.755 | 1.884** |
| | (1.248) | (1.605) | (1.798) | (0.947) |
| No. of Obs. | 130651 | 130651 | 130651 | 130651 |
| R squared | 0.0466 | 0.0262 | 0.0310 | 0.0840 |
| District-FE | Y | Y | Y | Y |
| Controls | Y | Y | Y | Y |

Standard errors in parentheses
$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

This table examines non-performing assets (NPA) growth against ex-ante bank vulnerability using branch-level data. A loans is an NPA if a borrower misses payments for 90 days (or 180 days in some cases). Sub-standard assets are assets that have remained NPAs for less than 18 months. Doubtful assets are assets that have remained NPAs for a period exceeding 18 months. Loss assets are uncollectible NPAs. The dependent variable is the log of the change in NPA (column 1), sub-standard assets (column 2), doubtful assets (column 3), and loss assets (column 4) respectively for the period 31$^{st}$ March, 2008 to 31$^{st}$ March, 2013. Private is 1 if the bank is a private sector bank and 0 if it is a state owned bank. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its 5$^{th}$- percentile during the period 1$^{st}$ January, 2007 to 31$^{st}$ December, 2007. Branch-exposure is at the district level and takes a value 1 if the share of deposits of state-owned banks in a district is greater than the median, as measured in 2007. Bank-exposure (continuous) is the bank-level weighted average of the continuous measure of branch-exposure across a bank's branches using deposit shares in 2007 as weights. Bank-exposure takes a value 1 if the exposure is greater than the median. All columns include district fixed effects. All specifications control for the kind of population a branch serves (rural, semi-urban, urban or metropolitan), their interaction with MES, and bank-exposure separately interacted with bank leverage and with bank assets. Standard errors are clustered at the district level and all observations are weighted by deposits in 2007. Branch-level data is from the Reserve Bank of India. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

**Table 11:** District-level effects on deposits, lending and economic activity

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Ln(Δ Deposits) | | Ln(Δ Lending) | | Ln(Night lights) | |
| | 2008–09 | 2008–2013 | 2008–09 | 2008–2013 | 2008–09 | 2008–2013 |
| Branch-exposure | -0.927*** | -0.896*** | | | | |
| | (0.125) | (0.134) | | | | |
| District-exposure | | | -7.139*** | -4.528*** | -1.490*** | -1.449*** |
| | | | (2.426) | (1.445) | (0.497) | (0.465) |
| No. of Obs. | 279 | 1368 | 279 | 1368 | 279 | 1368 |
| R squared | 0.495 | 0.481 | 0.487 | 0.210 | 0.568 | 0.556 |
| State-FE | Y | Y | Y | Y | Y | Y |
| Controls | Y | Y | Y | Y | Y | Y |

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table examines the district-level effect on deposits, lending and economic activity. In columns 1–2, the dependent variable is log of the change in deposits (deposit flow) from the previous fiscal year to the current fiscal year (as of March 31$^{st}$). In columns 3–4, the dependent variable is log of the change in lending from the previous fiscal year to the current fiscal year (as of March 31$^{st}$). In columns 5–6, the dependent variable is log of night lights intensity. Columns 1, 3, and 5 are for the annual period 2008–09. Columns 2, 4, and 6 are for the period 2008–13. Branch-exposure is at the district level and takes a value 1 if the share of deposits of state-owned banks in a district is greater than the median, as measured in 2007. Bank-exposure (continuous) is the bank-level weighted average of the continuous measure of branch-exposure across a bank's branches using deposit shares in 2007 as weights. District-exposure is the district-level weighted average of bank-exposure (continuous) across the branches in a district using deposit share in 2007 as the weights. All columns include state and year fixed effects. Controls included are unemployment rate and share rural population. Standard errors are clustered at the state level and all observations are weighted by deposits in 2007. Branch-level data is from the Reserve Bank of India. Night lights data is provided by the World Bank. Data for controls is from the 64$^{th}$ round of the NSS Employment and Unemployment Survey conducted in 2007-08.

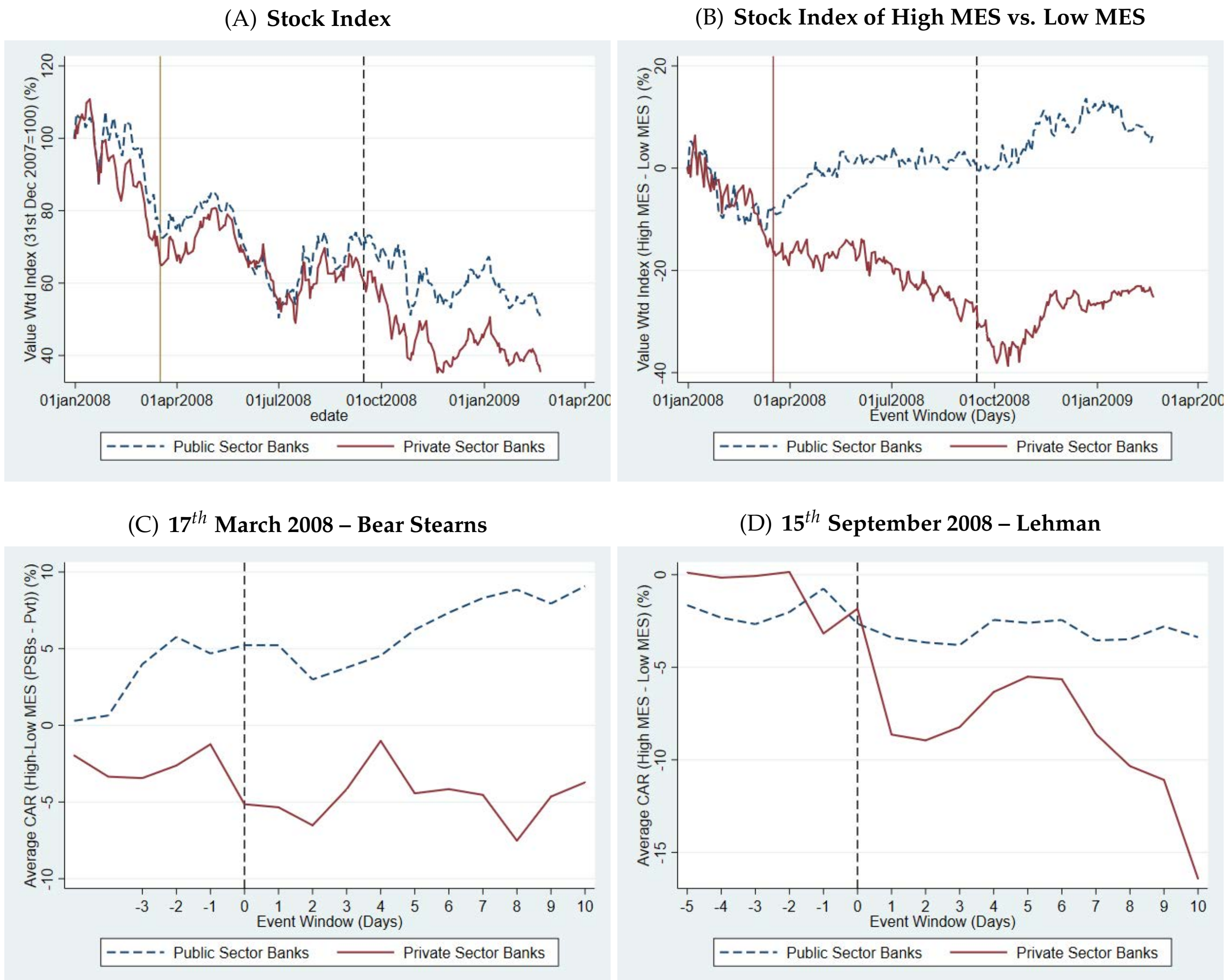
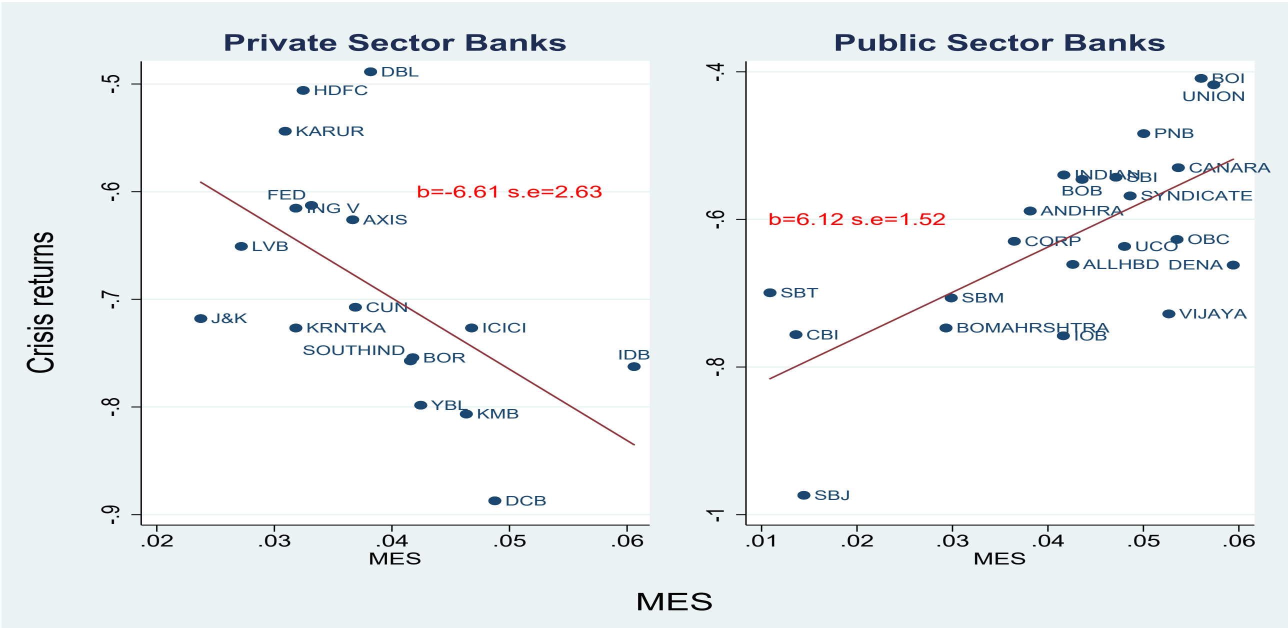



**Figure 1:** Stock Index Performance of Private and State-Owned banks

Panel A shows the indexed value weighted returns for all private and state-owned banks used in our analysis. It is weighted by their market capitalization for the period starting January 2008 to February 2009. The solid line is the indexed value weighted returns for private sector banks, and the dashed line is the same for state-owned banks. Returns are indexed to 31$^{st}$ December, 2007. In Panel B, the solid line depicts the *difference* between high and low MES private sector banks, and the dashed line represents the same for state-owned banks. In all panels, the solid vertical line depicts the date of the Bear Stearns collapse (17$^{th}$ March 2008) and the solid dashed line depicts the date of the Lehman bankruptcy (15$^{th}$ September 2008). MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its 5$^{th}$- percentile during the period 1$^{st}$ January, 2007 to 31$^{st}$ December, 2007. High MES refers to the top 7 banks within state-owned and private sector banks. Remaining banks are classified as low MES banks. Panels C and D show the Cumulative Average Returns (CAR) of private and state-owned banks against ex-ante bank vulnerability. The market model is used to estimate the expected return wherein for each bank, its stock returns are regressed on market returns separately over the estimation window starting 250 days prior to the event window and ending 10 days before the event date. CAR is computed as the cumulated abnormal returns across time over the event window. The event window is five days before and ten days after the event date. Market return is based on the S&P CNX NIFTY. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

(A) **Panel A: Stock Returns vs. MES**




(B) **Panel B: Deposit Growth vs. MES**

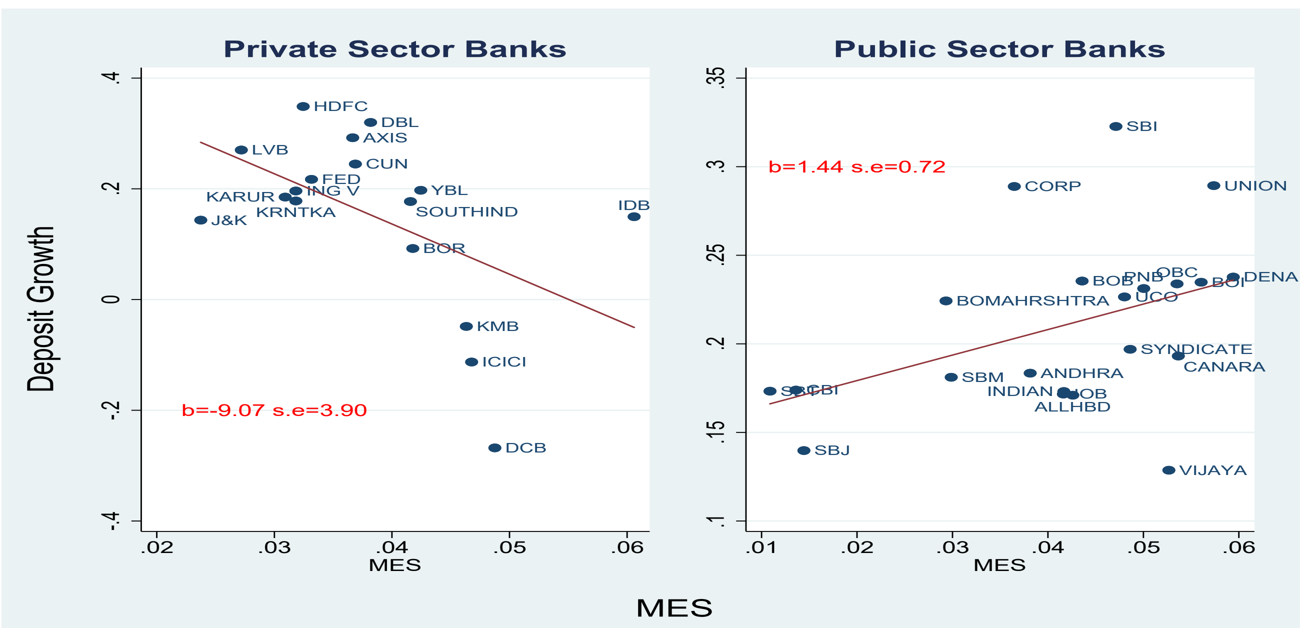



**Figure 2:** Stock Performance and Deposit Growth Versus *MES*

Panel A plots stock market returns during the crisis period against MES for private and state-owned banks. Panel B plots deposit growth against MES for private and state-owned banks. Stock return is calculated from January 2008 to February 2009, that is the period of the crisis. Deposit growth is from March 2008 to March 2009. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its $5^{th}$- percentile during the period $1^{st}$ January, 2007 to $31^{st}$ December, 2007. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange. Deposit data is from the Reserve Bank of India.

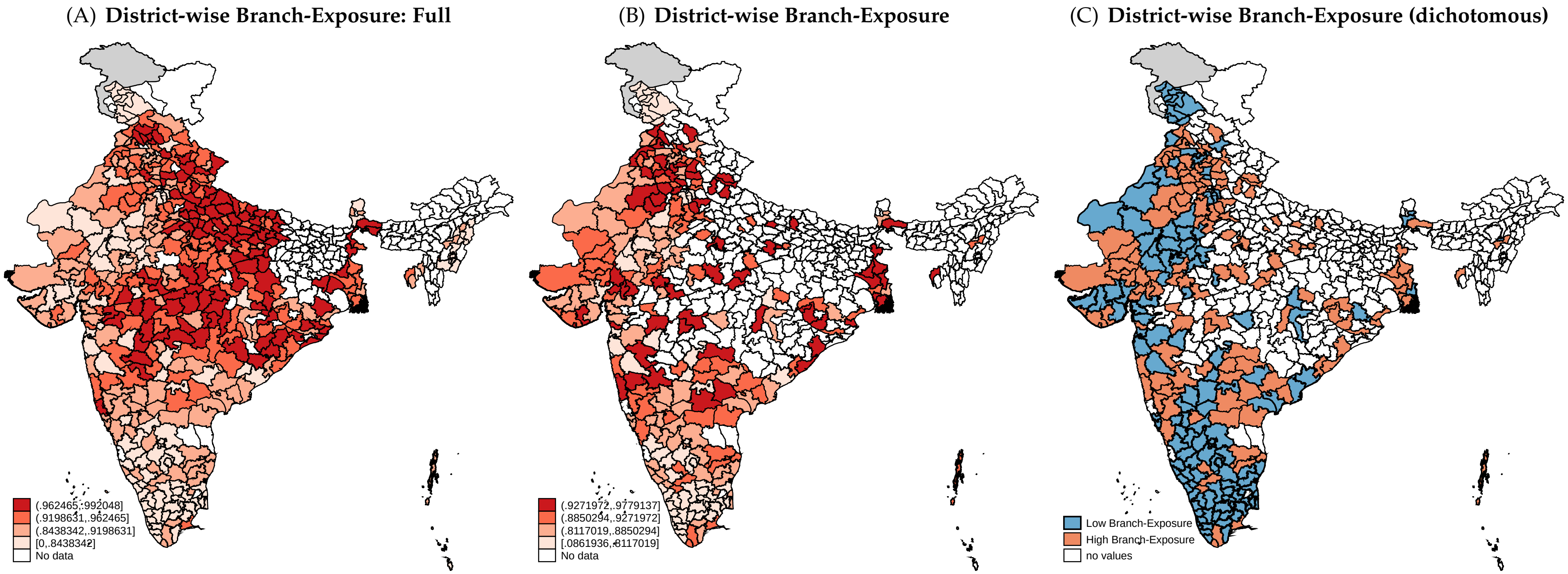
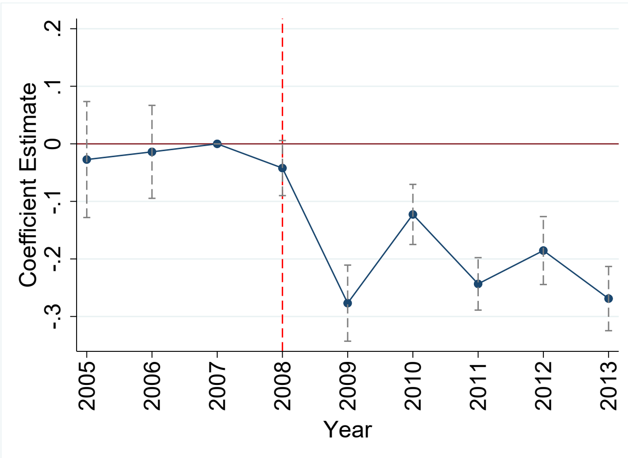


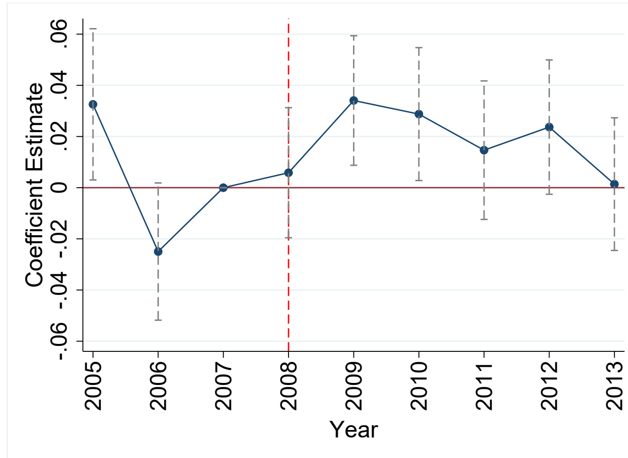

**Figure 3:** Geographic variation of deposit share of state-owned Banks

These figures show the geographic variation of the district-level average share of deposits of state-owned banks in 2007, or the continuous value of the Branch-Exposure variable. Panel A shows the variation using all districts for which data is available. Panel B shows the variation for the districts specifically used in our analysis (districts with private sector bank deposit shares greater than 1 percent). Districts with darker shades are those with higher values of Branch-Exposure. Panel C shows the variation using the dichotomous exposure variable for these specific districts. The dichotomous Branch-Exposure variable is coded at the district level, and is 1 if the share of deposits of state-owned banks within a district is above the median in 2007. Districts where Branch-Exposure takes a value of 1 are shown in red, and are high exposure districts. All branch-level data is from the Reserve Bank of India.

(A) **Private Sector Banks**




(B) **State-Owned Banks**




(C) **All banks**

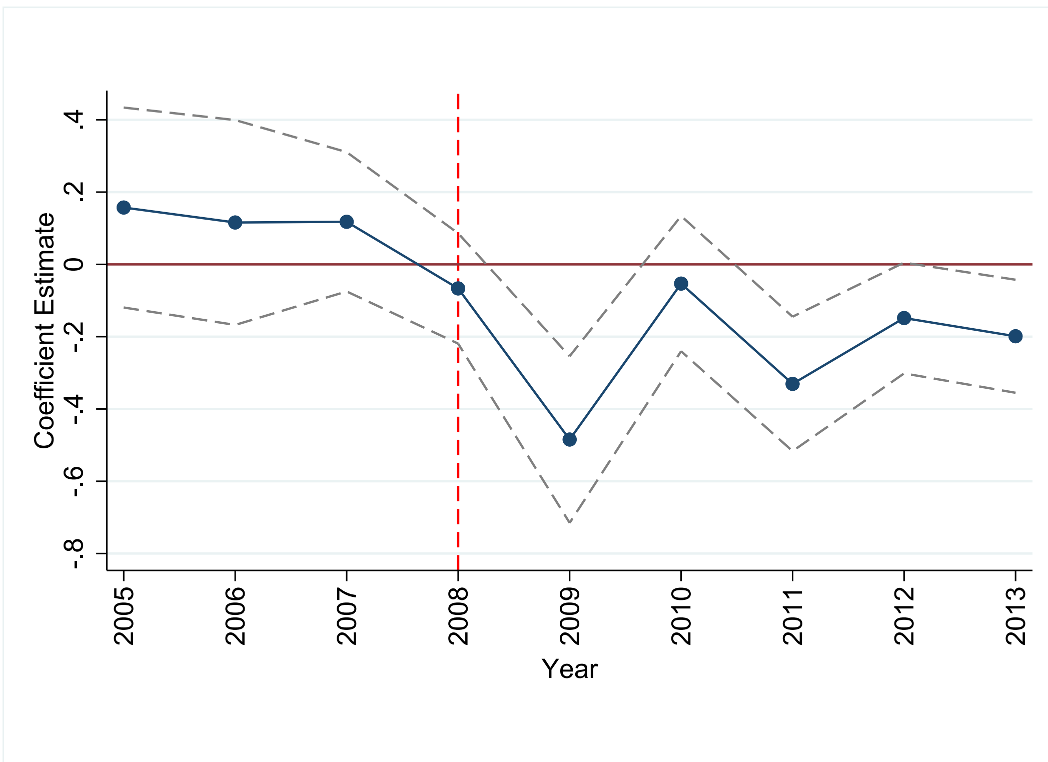



**Figure 4:** Event study plots and pre-trends

This figure plots the event study plots for the impact on deposit flows. The dependent variable in all panels is log of change in deposits (deposit flow) from March 31st of the previous year to March 31st of the current year. Panels A and B plot the coefficient $\gamma_\tau$ from equation (3). Panel C plots the coefficient $\gamma$ from equation (2). The red dashed vertical line at 2008 represents the year of the financial crisis. Coefficients are normalized with respect to 2007. Panel A is restricts to private sector banks. Panel B restricts to state-owned. Panel C is the full sample. The dashed grey lines represent the 5 percent confidence interval in all graphs. Branch-level data is from the Reserve Bank of India. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

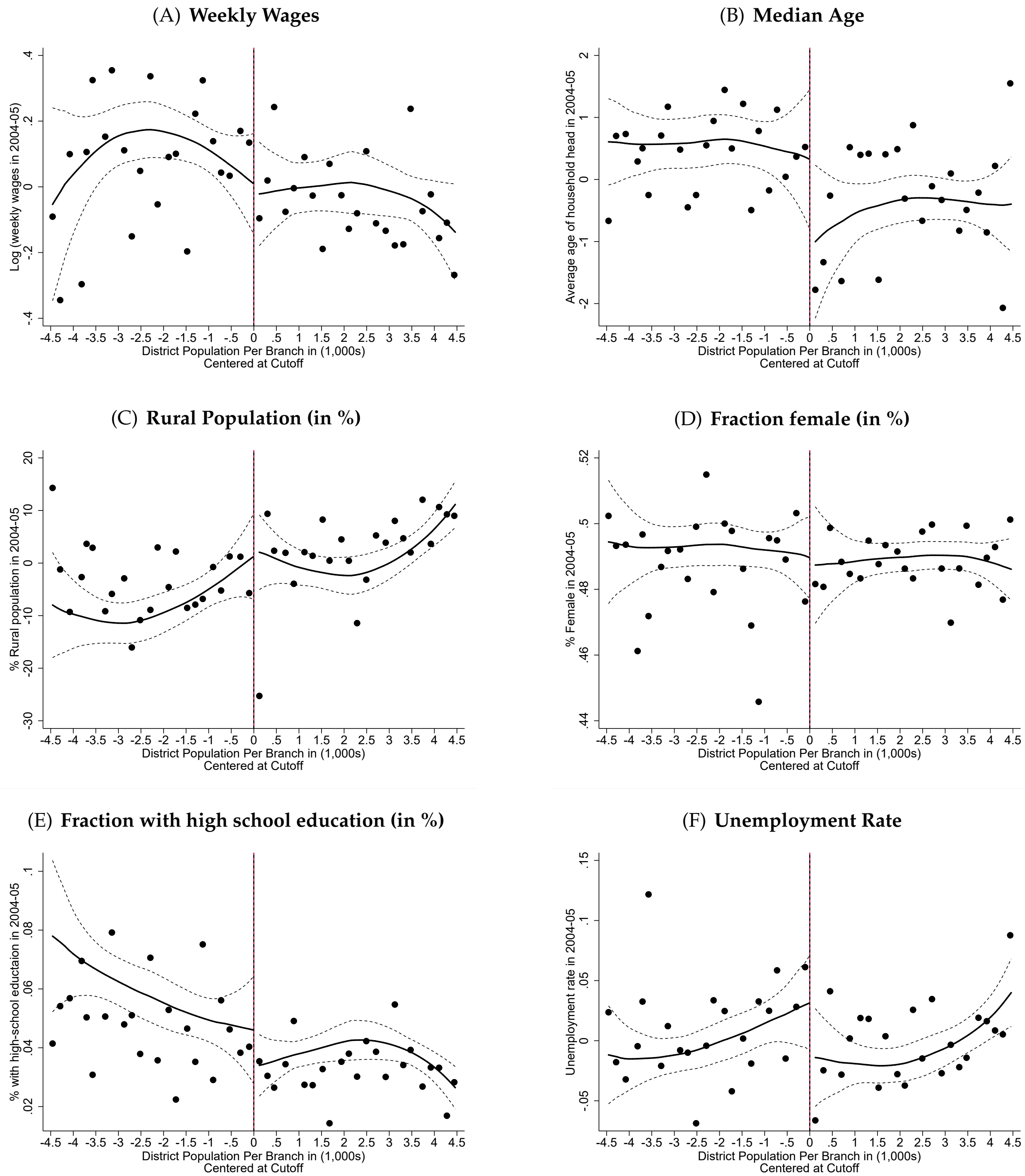



**Figure 5:** Regression discontinuity: Covariate balance

The figure above shows the regression discontinuity (RD) plots for the covariates weekly wages (panel A), median age (panel B), percentage rural population (panel C), percentage female population (panel D), percentage of population with high school education (panel E), and unemployment rate (panel F) at the district level. The running variable is the national average population per branch subtracted from the district average population per branch and is centered at zero and scaled by thousand. Points to the right (left) of 0 are under-banked (banked) districts. Each point represents the average value of the outcome in 0.2 percentage point run variable bins. The solid line plots predicted values, with separate quadratic trends with triangular kernels estimated on either of 0. Bandwidth of (-4.5,+4.5) is used. State fixed effects have been partialed out. The dashed lines show 95 percent confidence intervals. Covariates are from the $61^{st}$ NSS Employment and Unemployment Survey for 2004–05. Branch-level and population data to construct the running variable are from the Reserve Bank of India and the 2001 Census respectively.

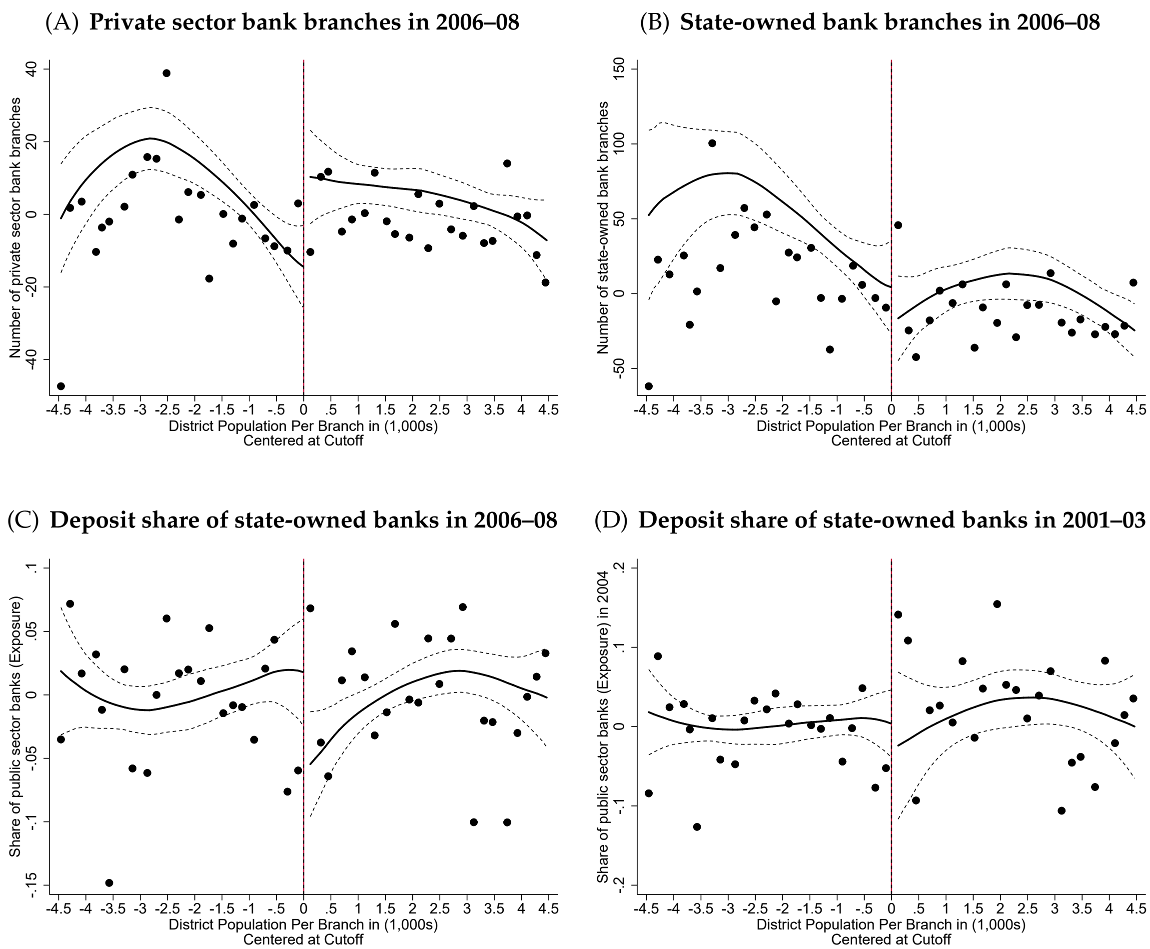



**Figure 6:** Regression discontinuity: Share of state-owned bank branches

The figure plots the regression discontinuity plots number of private sector bank branches in 2006–08 (panel A), number of state-owned bank branches in 2006–08 (panel B), deposit share of state-owned banks in 2006–08 (panel C), and deposit share of state-owned banks in 2001–03 (panel D) at the district-level. The running variable on the horizontal axis is the national average population per branch subtracted from the district average population per branch. It is centered at zero and scaled to thousands of persons per district. Points to the right (left) of 0 are under-banked (banked) districts. Each point represents the average value of the outcome in 0.2 percentage point run variable bins. The solid line plots predicted values, with separate quadratic trends with triangular kernels estimated on either of 0. Bandwidth of (-4.5,4.5) is used. State fixed effects have been partialed out. The dashed lines show 95 percent confidence intervals. Branch-level data is from the Reserve Bank of India. Population data used to construct the running variable is from the 2001 Census.

**Table A1:** Banks and MES during 2007–2009

| State-owned banks | | Private sector banks | |
|---|---|---|---|
| Bank Name | MES | Bank Name | MES |
| Allahabad Bank | 0.04 | Axis Bank | 0.04 |
| Andhra Bank | 0.04 | Bank of Rajasthan | 0.04 |
| Bank of Baroda | 0.04 | City Union Bank | 0.04 |
| Bank of India | 0.06 | Development Credit Bank | 0.05 |
| Bank of Maharashtra | 0.03 | Dhanalakshmi Bank | 0.04 |
| Canara Bank | 0.05 | Federal Bank | 0.03 |
| Central Bank of India | 0.01 | HDFC Bank | 0.03 |
| Corporation Bank | 0.04 | ICICI Bank | 0.05 |
| Dena Bank | 0.06 | IndusInd Bank | 0.06 |
| Indian Bank | 0.04 | ING Vysya Bank | 0.03 |
| Indian Overseas Bank | 0.04 | Jammu & Kashmir Bank | 0.02 |
| Oriental Bank of Commerce | 0.05 | Karnataka Bank | 0.03 |
| Punjab National Bank | 0.05 | Karur Vysya Bank | 0.03 |
| State Bank of Bikaner and Jaipur | 0.01 | Kotak Mahindra Bank | 0.05 |
| State Bank of India | 0.05 | Lakshmi Vilas Bank | 0.03 |
| State Bank of Mysore | 0.03 | South Indian Bank | 0.04 |
| State Bank of Travancore | 0.01 | Yes Bank | 0.04 |
| Syndicate Bank | 0.05 | | |
| UCO Bank | 0.05 | | |
| Union Bank of India | 0.06 | | |
| Vijaya Bank | 0.05 | | |

This table shows the bank vulnerability measure used for all 21 state-owned banks and 17 private sector banks used in our analysis. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its $5^{th}$- percentile during the period $1^{st}$ January, 2007 to $31^{st}$ December, 2007. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

**Table A2:** Deposit Growth

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Δ Ln (Deposits) | | | | |
| | Private | | Public | | All |
| Branch-Exposure | 0.591 | | 1.755*** | | |
| | (0.722) | | (0.524) | | |
| Branch-Exposure * MES | | -0.497*** | | 0.0557** | 0.0575* |
| | | (0.182) | | (0.0272) | (0.0305) |
| Private * Branch-Exposure * MES | | | | | -0.296** |
| | | | | | (0.146) |
| No. of Obs. | 4981 | 4981 | 33131 | 33131 | 38112 |
| R squared | 0.453 | 0.505 | 0.0819 | 0.0978 | 0.224 |
| Bank-FE | Y | Y | Y | Y | Y |
| State-FE | Y | Y | Y | Y | Y |
| District-FE | N | Y | N | Y | Y |
| Controls | Y | Y | Y | Y | Y |

Standard errors in parentheses
$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

This table examines deposit growth against an ex-ante measure of bank vulnerability. Columns 1–2 restrict to private sector banks. Columns 3–4 restrict to state-owned banks. Column 5 includes the full sample. Private is 1 if the bank is a private sector bank and 0 otherwise. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its $5^{th}$- percentile during the period $1^{st}$ January, 2007 to $31^{st}$ December, 2007. Branch-exposure is at the district level and takes a value 1 if the share of deposits of state-owned banks in a district is greater than the median, as measured in 2007. The dependent variable is the change in the log of deposits for the period $31^{st}$ March, 2008 to $31^{st}$ March, 2009. All columns include bank and state fixed effects. All columns except columns 1 and 3 also include district fixed effects. All specifications include an indicator for the population a branch caters to (rural, semi-urban, urban or metropolitan), and their interaction with MES. All specifications also include bank-exposure separately interacted with bank leverage, and with bank assets. All columns are weighted by deposits in 2007. All variables have been winsorized at the 2 percent level. Branch-level data is from the Reserve Bank of India. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

## **Table A3:** Heterogeneity by deposit type and maturity

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Ln(Δ deposits) | | | Share of deposits | | | |
| | Demand | Savings | Term | Demand | Savings | Term | Ln(Wtd. Maturity) |
| Branch-Exposure * MES | 0.408** | 0.115 | 0.124** | -0.000693 | 0.000874 | -0.000181 | 0.0353 |
| | (0.161) | (0.110) | (0.0600) | (0.00169) | (0.00473) | (0.00521) | (0.0303) |
| Private * Branch-Exposure * MES | -1.891*** | -1.246** | -0.574*** | 0.0193 | 0.0187 | -0.0380** | -0.178* |
| | (0.659) | (0.568) | (0.196) | (0.0148) | (0.0165) | (0.0157) | (0.0967) |
| No. of Obs. | 31940 | 31940 | 31940 | 31940 | 31940 | 31940 | 31940 |
| R squared | 0.198 | 0.170 | 0.576 | 0.241 | 0.460 | 0.423 | 0.0803 |
| Bank-FE | Y | Y | Y | Y | Y | Y | Y |
| State-FE | Y | Y | Y | Y | Y | Y | Y |
| District-FE | Y | Y | Y | Y | Y | Y | Y |
| Controls | Y | Y | Y | Y | Y | Y | Y |

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table examines deposit growth by deposit type and maturity. The dependent variable in columns 1–3 is the change in the log of deposits for the period 31$^{st}$ March, 2008 to 31$^{st}$ March, 2009 for demand deposits (column 1), savings (column 2), and term deposits (column 3). The dependent variable in columns 4–6 is the share of demand deposits (column 4), savings (column 5), and term deposits (column 6). The dependent variable in column 7 is the deposit weighetd maturity of all deposits. Private is 1 if the bank is a private sector bank and 0 otherwise. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its 5$^{th}$- percentile during the period 1$^{st}$ January, 2007 to 31$^{st}$ December, 2007. Branch-exposure is at the district level and takes a value 1 if the share of deposits of state-owned banks in a district is greater than the median, as measured in 2007. All columns include bank and state fixed effects. All columns except columns 1 and 3 also include district fixed effects. All specifications include an indicator for the population a branch caters to (rural, semi-urban, urban or metropolitan), and their interaction with MES. All specifications also include bank-exposure separately interacted with bank leverage, and with bank assets. All columns are weighted by deposits in 2007. All variables have been winsorized at the 2 percent level. Branch-level data is from the Reserve Bank of India. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

**Table A4:** Alternate measures of branch exposure

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | | Distance-weighted exposure measure | | | |
| | Pincode | $\lambda$=0.01 | $\lambda$=0.05 | $\lambda$=0.1 | $\lambda$=0.2 |
| Branch-Exposure * MES | 0.133** | 0.0678* | 0.0783*** | 0.0374 | 0.0368* |
| | (0.0525) | (0.0366) | (0.0236) | (0.0247) | (0.0193) |
| Private * Branch-Exposure * MES | -0.528*** | -0.497*** | -0.601*** | -0.624*** | -0.622*** |
| | (0.152) | (0.150) | (0.131) | (0.128) | (0.127) |
| No. of Obs. | 15028 | 15028 | 15028 | 15028 | 15028 |
| R squared | 0.490 | 0.489 | 0.490 | 0.490 | 0.490 |
| Bank-FE | Y | Y | Y | Y | Y |
| State-FE | Y | Y | Y | Y | Y |
| District-FE | Y | Y | Y | Y | Y |
| Controls | Y | Y | Y | Y | Y |

Standard errors in parentheses
$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

This table shows robustness to alternate measures of branch-exposure. The dependent variable is the log of the change in deposits for the period 31$^{st}$ March, 2008 to 31$^{st}$ March, 2009. In column 1, branch-exposure takes a value 1 if the deposit share of state-owned banks within a pincode is above the median in 2007. In columns 2–5, the branch-exposure of a branch is an exponentially weighted average of the deposit share of all pincodes in a district that a branch belongs to. Pincodes farther away from the branch receive exponentially declining weights of $\lambda$ ranging from 0.01 to 0.2 in columns 2–5. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its 5$^{th}$- percentile during the period 1$^{st}$ January, 2007 to 31$^{st}$ December, 2007. All columns include bank and district fixed effects. All specifications include an indicator for the population a branch caters to (rural, semi-urban, urban or metropolitan), and their interaction with MES. All specifications also include bank-exposure separately interacted with bank leverage, and with bank assets. All columns are weighted by deposits in 2007. Branch-level data is from the Reserve Bank of India. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

**Table A5:** Alternate measures of risk

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Branch-Exposure * Volatility | 0.714 | | | | |
| | (0.565) | | | | |
| Private * Branch-Exposure * Volatility | -0.313 | | | | |
| | (1.082) | | | | |
| Branch-Exposure * ES | | 2.787 | | | |
| | | (2.235) | | | |
| Private * Branch-Exposure * ES | | -16.07* | | | |
| | | (8.913) | | | |
| Branch-Exposure * Beta | | | 0.434*** | | |
| | | | (0.161) | | |
| Private * Branch-Exposure * Beta | | | -1.105*** | | |
| | | | (0.392) | | |
| Branch-Exposure * Modified MES | | | | 0.0368 | |
| | | | | (0.0251) | |
| Private * Branch-Exposure * Modified MES | | | | -0.240*** | |
| | | | | (0.0859) | |
| Branch-Exposure * W-MES | | | | | 0.0414* |
| | | | | | (0.0243) |
| Private * Branch-Exposure * W-MES | | | | | -0.325*** |
| | | | | | (0.112) |
| No. of Obs. | 33972 | 33972 | 33972 | 33972 | 33972 |
| R squared | 0.495 | 0.497 | 0.497 | 0.497 | 0.497 |
| Bank-FE | Y | Y | Y | Y | Y |
| District-FE | Y | Y | Y | Y | Y |
| Controls | Y | Y | Y | Y | Y |

Standard errors in parentheses
$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

This table shows the results of deposit flows against alternative measures of risk. The dependent variable is log of the change in deposits for the period 31$^{st}$ March, 2008 to 31$^{st}$ March, 2009. Volatility of returns based on the S&P CNX NIFTY index is for the period January 2007 to December 2007. Expected shortfall (ES) is the expected return of the bank when the bank's return is below its 5$^{th}$ percentile, during the period 1$^{st}$ January 2007 to 31$^{st}$ December 2007. Beta is based on the S&P CNX NIFTY index. Branch-exposure is at the district level and takes a value 1 if the share of deposits of state-owned banks in a district is greater than the median, as measured in 2007. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its 5$^{th}$- percentile during the period 1$^{st}$ January, 2007 to 31$^{st}$ December, 2007. Modified MES is similar to MES except market return is calculated using all banks in the economy excluding the bank for which MES is being calculated. W-MES is a weighted MES which uses exponentially declining weights ($\lambda$=0.94) on past observations to estimate the average equity returns on the 5 percent worst days of the market. Private is 1 if the bank is a private sector bank and 0 if it is not. All columns include bank and district fixed effects. All specifications include an indicator for the population a branch caters to (rural, semi-urban, urban or metropolitan), and their interaction with the respective risk measure. All specifications also include bank-exposure separately interacted with bank leverage, and with bank assets. All columns are weighted by deposits in 2007. Branch-level data is from the Reserve Bank of India. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

## Table A6: Alternate explanations

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Branch-Exposure * Beta | 0.550** | | | | | | |
| | (0.274) | | | | | | |
| Private * Branch-Exposure * Beta | -0.140 | | | | | | |
| | (0.831) | | | | | | |
| Branch-Exposure * Global Beta | -0.137 | | | | | | |
| | (0.277) | | | | | | |
| Private * Branch-Exposure * Global Beta | -0.867 | | | | | | |
| | (0.662) | | | | | | |
| Branch-Exposure * Lvg. | | -0.00669 | | | | | |
| | | (0.00417) | | | | | |
| Private * Branch-Exposure * Lvg. | | 0.000889 | | | | | |
| | | (0.00688) | | | | | |
| Branch-Exposure * Log Assets | | | 0.0879** | | | | |
| | | | (0.0420) | | | | |
| Private * Branch-Exposure * Log Assets | | | 0.0169 | | | | |
| | | | (0.0600) | | | | |
| Branch-Exposure * Pre-crisis returns | | | | 0.394 | 0.0903 | | |
| | | | | (0.938) | (1.139) | | |
| Private * Branch-Exposure * Pre-crisis returns | | | | -0.0831 | 2.365 | | |
| | | | | (1.345) | (1.889) | | |
| Branch-Exposure*MES | | | | | 0.0558* | | 0.0562* |
| | | | | | (0.0289) | | (0.0296) |
| Private * Branch-Exposure * MES | | | | | -0.662*** | | -0.521*** |
| | | | | | (0.168) | | (0.126) |
| Branch-Exposure * Liquidity | | | | | | -2.394* | -1.519 |
| | | | | | | (1.442) | (1.681) |
| Private * Branch-Exposure * Liquidity | | | | | | 12.15*** | 6.710 |
| | | | | | | (4.010) | (4.240) |
| No. of Obs. | 33972 | 33972 | 33972 | 33972 | 33972 | 33972 | 33972 |
| R squared | 0.497 | 0.495 | 0.497 | 0.496 | 0.497 | 0.497 | 0.498 |
| Bank-FE | Y | Y | Y | Y | Y | Y | Y |
| District-FE | Y | Y | Y | Y | Y | Y | Y |

Standard errors in parentheses
$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

This table explores alternate hypotheses. The dependent variable if log of the change in deposits for the period from 31st March, 2008 to 31st March, 2009. Branch-exposure is at the district level and takes a value 1 if the share of deposits of state-owned banks in a district is greater than the median, as measured in 2007. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its 5th- percentile during the period 1st January, 2007 to 31st December, 2007. Beta and Global Beta is based on the S&P CNX NIFTY index and MSCI World Index returns respectively. Private is one if the bank is private sector bank and 0 if it is not. Lvg is the ratio of the quasi-market value of assets(book value of assets - book value of equity + market value of equity) to the market equity. Log Assets is the logged value of total assets. Pre-Crisis stock return is based on the S&P CNX NIFTY for the pre-crisis period from 1st January, 2007 to 31st December, 2007. Liquidity is the sum of cash in hand, balances with the RBI, money at call and short notice, government securities and deposits to the total liabilities as on 31st March, 2008. All columns include bank and district fixed effects. All specifications include an indicator for the population a branch caters to (rural, semi-urban, urban or metropolitan), and their interaction with the respective bank-level measure in each column. All specifications also include bank-exposure separately interacted with bank leverage, and with bank assets. All columns are weighted by deposits in 2007. Branch-level data is from the Reserve Bank of India. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

**Table A7:** Regression discontinuity: Under-banked status and state-owned banks' deposit share

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Imbens-Kalyanaraman bandwidth | Calonico, Cattaneo, and Titiunik bandwidth | Bandwidth=4 | Bandwidth=5 | Bandwidth=3.5, Linear polynomial |
| Banked | 0.101* | 0.100* | 0.104** | 0.0782* | 0.0726** |
| | (0.0574) | (0.0497) | (0.0491) | (0.0434) | (0.0300) |
| State-FE | Y | Y | Y | Y | Y |
| No. of Obs. | 220 | 247 | 229 | 285 | 207 |
| R squared | 0.556 | 0.556 | 0.559 | 0.484 | 0.538 |

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table examines robustness of the regression discontinuity (RD) estimates examining the impact of the 2005 banking reform deposits share of state-owned banks in 2006–08. The dependent variable is deposit share of state-owned banks in 2006–08 at the district-level. Column 1 uses the Imbens and Kalyanaraman (2011) bandwidth. Column 2 uses the Calonico et al. (2014) bandwidth. Columns 3 and 4 use a bandwidth of (-4,+4) and (-5, +5) around the cut-off. Column 5 uses a bandwidth of (-3.5, +3.5). The running variable is the the national average population per branch subtracted from the district level average population per branch Banked takes a value 1 if the running variable is negative. All regressions (except column 5) use second degree polynomials and triangular kernel with a bandwidth of 4.5 around the cut-off. Column 5 uses a local linear polynomial. All regressions include state fixed effects and are weighted by population in 2001. Controls included are population and population squared. Standard errors are clustered at the district level. Bank data is from the Reserve Bank of India. Population data to construct the running variable is from Census 2001.

**Table A8:** Lending rates during the crisis

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | All Lending | | Services Lending | Agri. Lending | Industry Lending |
| Bank-Exposure * MES | 0.0692*** | | 0.0537*** | -0.0758** | 0.0599*** |
| | (0.0207) | | (0.0201) | (0.0323) | (0.0197) |
| Private * Bank-Exposure * MES | -1.727*** | | -0.506*** | -3.179*** | -3.018*** |
| | (0.186) | | (0.192) | (0.364) | (0.252) |
| Branch-Exposure * MES | | -0.0225 | | | |
| | | (0.0160) | | | |
| Private * Branch-Exposure * MES | | 0.0879 | | | |
| | | (0.0548) | | | |
| No. of Obs. | 190557 | 190557 | 162887 | 68953 | 108636 |
| R squared | 0.250 | 0.356 | 0.345 | 0.201 | 0.265 |
| District-FE | Y | Y | Y | Y | Y |
| Controls | Y | Y | Y | Y | Y |

Standard errors in parentheses
$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

This table examines lending rates against a measure of ex-ante bank vulnerability. Columns 1–2 examines lending across all sectors. Columns 3–5 examines lending to the following sectors: services (column 3), agriculture (column 4), and industry (column 5). The dependent variable in all columns is the weighted lending rate at the branch-level for the period 31$^{st}$ March, 2008 to 31$^{st}$ March, 2009. Private is 1 if the bank is a private sector bank and 0 if it is a state owned bank. MES (marginal expected shortfall ) is the negative of the average returns of a stock given that the market return is below its 5$^{th}$- percentile during the period 1$^{st}$ January, 2007 to 31$^{st}$ December, 2007. Branch-exposure is at the district level and takes a value 1 if the share of deposits of state-owned banks in a district is greater than the median, as measured in 2007. Bank-exposure (continuous) is the bank-level weighted average of the continuous measure of branch-exposure across a bank's branches using deposit shares in 2007 as weights. Bank-exposure takes a value 1 if the exposure is greater than the median. All columns include district fixed effects.All specifications control for the kind of population a branch serves (rural, semi-urban, urban or metropolitan), their interaction with MES, and bank-exposure separately interacted with bank leverage and with bank assets. Standard errors are clustered at the district level and all observations are weighted by deposits in 2007. Branch-level data is from the Reserve Bank of India. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

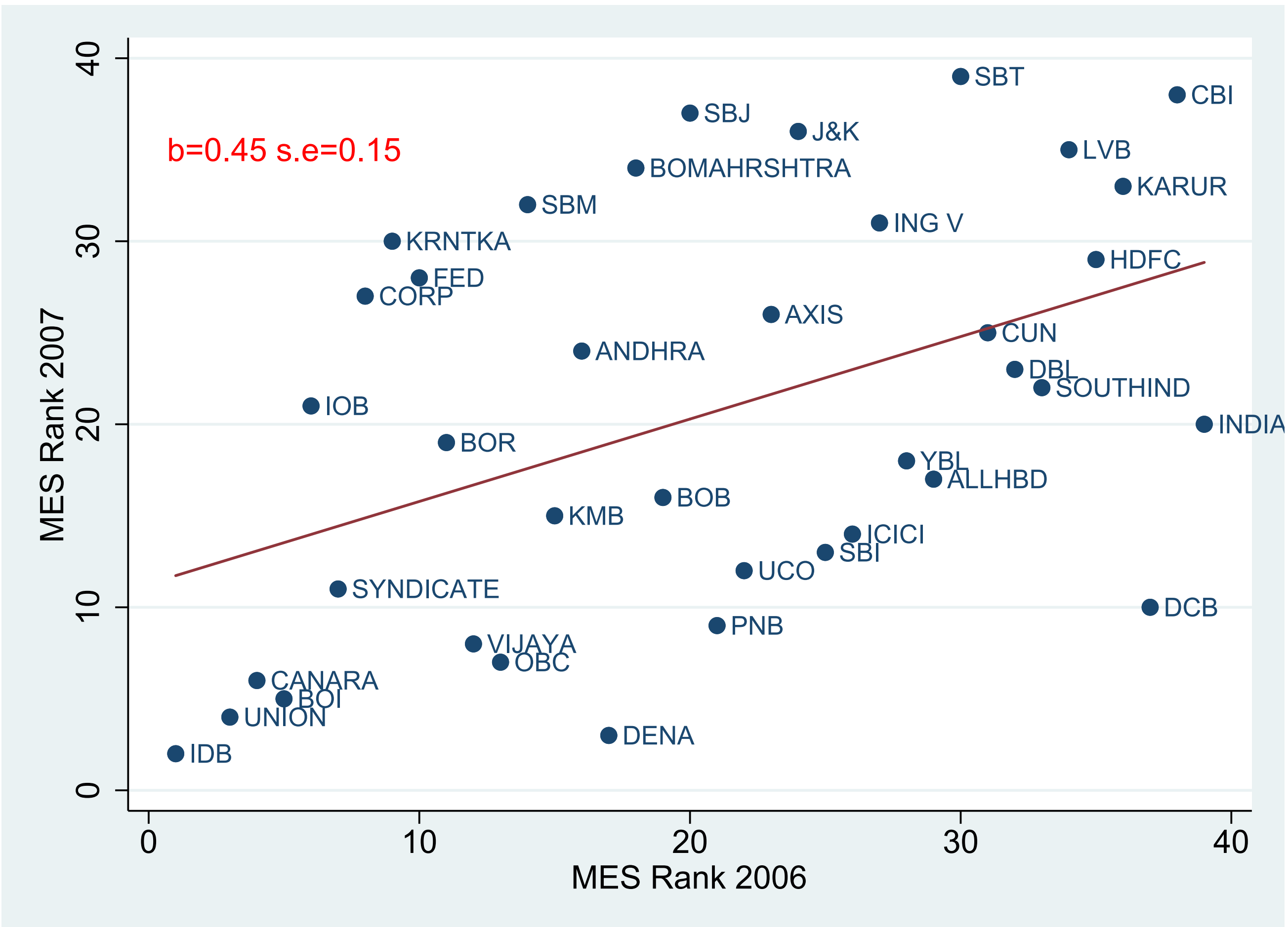
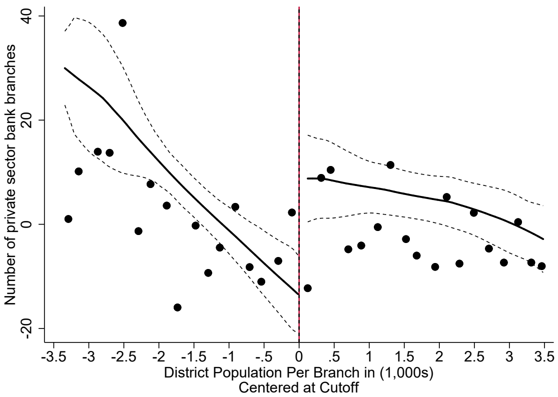


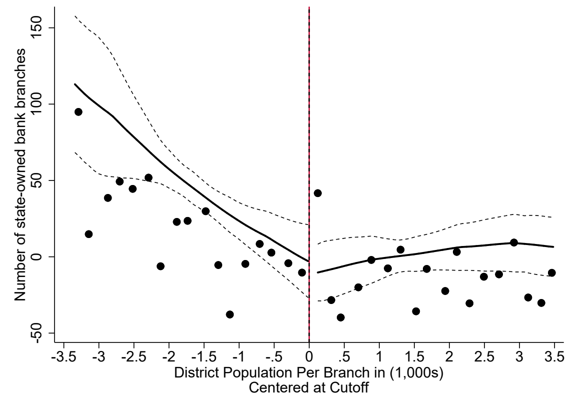

**Figure A1:** MES Rank for Jan '07–Dec '07 versus *MES* Rank for Jan '06–Dec '06

The graph above shows the scatter plot of the MES Rank computed during the period 1st January, 2007 to 31st December, 2007 versus the MES Rank computed during the period from 1st January, 2006 to 31st December, 2006. MES for a period is the marginal expected shortfall of a stock given that the market return is below its 5th - percentile during the same period. Market return is based on the S&P CNX NIFTY. MES Rank ranks banks in descending order of MES values (assigns rank 1 to the bank with the largest MES). The 38 banks for which data was available for both periods were used in the analysis. Data is from the Reserve Bank of India.

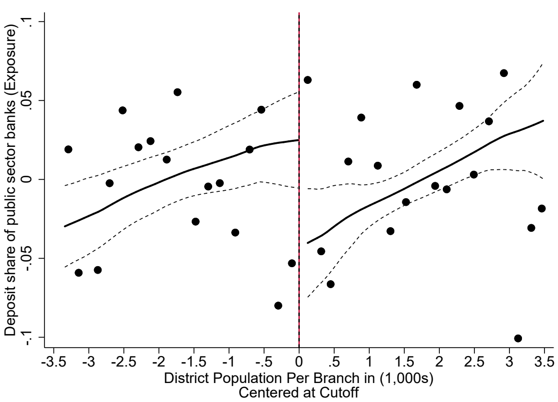
(A) **Private sector bank branches in 2006–08**




(B) **State-owned bank branches in 2006–08**




(C) **Deposit share of state-owned banks in 2006–08 (Exposure)**




(D) **Fraction of state-owned banks in 2006–08**

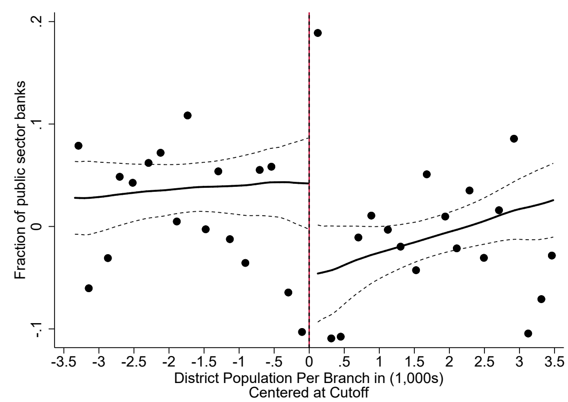



**Figure A2:** Regression discontinuity: Share of state-owned bank branches (Robustness)

The figure plots the regression discontinuity plots number of private sector bank branches in 2006–08 (panel A), number of state-owned bank branches in 2006–08 (panel B), deposit share of state-owned banks in 2006–08 (panel C), and deposit share of state-owned banks in 2001–03 (panel D) at the district-level. The running variable on the horizontal axis is the national average population per branch subtracted from the district average population per branch. It is centered at zero and scaled to thousands of persons per district. Points to the right (left) of 0 are under-banked (banked) districts. Each point represents the average value of the outcome in 0.2 percentage point run variable bins. The solid line plots predicted values, with separate local linear trends with triangular kernels estimated on either side of 0. Bandwidth of (-3.5,3.5) is used. State fixed effects have been partialed out. The dashed lines show 95 percent confidence intervals. Branch-level data is from the Reserve Bank of India. Population data used to construct the running variable is from the 2001 Census.

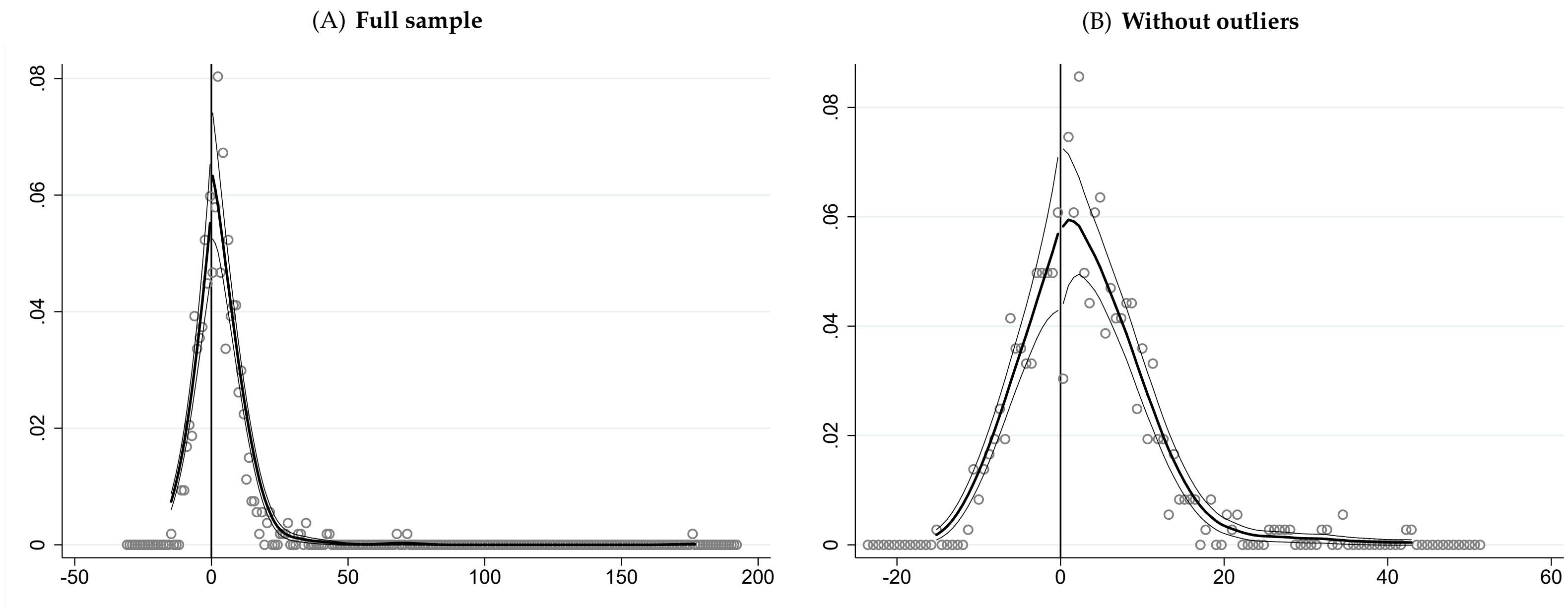



**Figure A3:** Regression discontinuity: McCrary test

This figure plots the McCrary graphs. It graphs the density of the running variable. The running variable on the horizontal axis is the national average population per branch subtracted from the district average population per branch. It is centered at zero and scaled to thousands of persons per district. It is centered at zero and scaled to thousands of persons per district. Points to the right (left) of 0 are under-banked (banked) districts. Panel A is the full sample and Panel B removes outliers above 60. Branch-level data is from the Reserve Bank of India. Population data used to construct the running variable is from the 2001 Census.