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JEL Classification: F34, G23, G28, G33, K42, O53

Keywords: Bank run, State-owned banks, Credit misallocation, Allocative efficiency

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Deposit and Credit Reallocation in a Banking Panic: The Role of State-Owned Banks*

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Abstract

We study a bank run in India in which private bank branches experience sudden and considerable loss of deposits that seek safety in state-owned public sector banks (PSBs). We trace the consequences of this reallocation using granular data on bank-firm relationships and branch balance sheets. The flight to safety is *not* a flight to quality. Lending shrinks and credit quality improves at the run banks but worsens at the recipient PSBs. The effects are pronounced in weaker PSBs, the ones more likely to exploit the shelter of state ownership. The resource reallocation is inefficient in the aggregate.

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A bank run occurs when many depositors suddenly withdraw their deposits within a short period of time. Because banks facing runs can fail, and the failure of one bank can result in contagion that takes down other banks as well, avoiding runs has been a key focus of bank regulators and supervisors (Calomiris and Mason, 1997; Saunders and Wilson, 1996). Runs are also economically disruptive as they trigger resource reallocations from banks facing runs to destinations seen as safe havens by depositors. This movement of resources can have negative real-side effects depending on the quality of reintermediation offered by the beneficiaries of the run surpluses.

We study a significant bank run episode in India that occurs in the aftermath of the 2008 global financial crisis. In the run, some branches of private banks in India experience a sudden and rather extreme loss of deposits. India's state-owned "public sector" banks (PSBs), the safe-haven destination for the run outflows, see a surge in stable deposit funding. A unique feature of our data is that we observe both sides of the ledger, the private banks losing run resources and the PSBs that gain the flight-to-safety flows. We analyze the real-side consequences of this reallocation and show that there are negative effects. In other words, the flight to *safety* is far from a flight to *quality*.

To trace the effects of the deposit reallocation of funds triggered by the run, we use two datasets. One is proprietary lending data at the level of a bank branch, which India's central bank shared with us. We also obtain from statutory filings data on bank-firm relationships. We use the datasets to analyze run consequences. Lending becomes more disciplined at the private banks subject to runs but credit quality worsens at the PSBs receiving the windfall surpluses. The reconfiguration of resources is more pronounced in the more vulnerable state-owned PSBs. We find that in the aggregate, allocative efficiency worsens, leading to impaired productivity growth. In other words, the run does not just *reallocate* but *misallocates* resources.

Two key features help frame our analysis. One, the formal protection for Indian bank depositors is very limited. The Indian deposit insurance programs cover only about $2,000 per depositor per bank (Iyer and Puri, 2012). They provide little comfort to a panicked depositor. The 2008 global financial crisis (GFC) has roots in the U.S. mortgage securities market (Acharya and Richardson, 2008), to which Indian banks had little direct exposure. While the exact reason for the run is not critical for our analysis, depositor panic seems to be a major driver of the run.

A second feature is the presence of state-owned public sector banks (PSBs) in India. The Indian government holds large direct stakes in PSBs, 70% on average. The state exercises significant control over all aspects of PSBs including director appointment, strategic and operational planning, as well as hiring, pay, retention, rotation, and promotion of employees at all levels. India's Banking Regulation Act obliges the Indian government to fulfill the obligations of PSBs in the event of bank failure. How this support plays out in practice is untested but the clause adds comfort to the safety of PSBs as perceived by depositors. The bottom line is that the imprimatur of state ownership confers implicit or "soft" protection to PSB depositors. Thus, depositors fleeing private banks could reasonably regard PSBs as safe repositories for their funds.

We proceed as follows. We use a proprietary dataset called the "Basic Statistical Returns" or BSR, which is compiled at the level of an individual bank branch. This level of granularity is important as runs occur at some branches of a bank, which we can identify using branch-level data. Indian banks report annual data ending on March 31, so a year from this point onwards refers to the 12-month period ending in March 31 of the year.

We define a bank branch as having a run if it experiences extreme deposit flight in the year 2009, the 12-month period ending March 2009 that brackets the 2008 GFC. We use three criteria to identify extreme deposit losses, viz., the 2009 deposit growth should be less than predicted growth on an out-of-sample basis, should be below the 5th percentile of growth rates in 2007 and 2008, and should transition from being above the 5% left tail cutoff in 2008 to below this cutoff in 2009. These filters identify an unusual and appreciable left tail in deposit losses in 2009, as we show with formal fixed-effects regressions. Simple descriptive statistics are informative. The median growth in deposits for run branches flips from +25% to -25% in one year while the 99th and 1st percentiles of deposit losses are -14% and -89%, respectively. It is perhaps worth emphasizing here the advantage of using branch-level data, which lets us identify *intra-bank* runs, a unique and hard-to-observe variety of "silent runs" (Baron, Verner and Xiong, 2020) that, as we will see, has consequential real effects.

We find that private banks facing runs lose deposits across current, savings, and term deposits. PSB branches within the run geography gain deposits, in particular, the more stable term deposits. Interestingly, private bank branches that are not run do *not* see deposit gains from the run. This finding indicates that it is the state ownership of the destination banks – and the extra layer of protection from state ownership – that matters to panicked depositors. We find that runs impact credit. Run branches contract credit, consistent with frictions in raising external finance (Kashyap and Stein, 1995, 2000).

Because the banks in our sample operate nationally, runs in select geographies can have bank-wide repercussions outside the run regions. To help assess these aggregate effects, we construct a "run exposure" variable at the bank level. A private bank's exposure variable is the fraction of deposits across its branches subject to runs. For PSBs, it is the weighted average of the deposits in the districts subject to runs.

We find that credit decreases at run private banks within and outside run geographies. Non-agricultural credit – subject to less oversight and regulation (Cole, 2009) and thus the credit flows over which lenders enjoy more discretion – witnesses significant decreases both in the run regions and outside. Conversely, credit increases at the state-owned PSBs receiving run inflows. Credit quality also changes. Non-performing assets decrease at the banks facing runs, consistent with the disciplining effects of runs (Calomiris and Kahn, 1991; Diamond and Rajan, 2001). In contrast, non-performing assets increase at PSBs, by about 10% for a one standard deviation increase in run exposure. Thus, credit quality worsens at the PSBs gaining the run flows.

The results are consistent with the view that the umbrella of state ownership lets PSBs attract safety-seeking flows. However, the umbrella that provides shelter for wary depositors in times of stress also provides shelter to PSBs from deposit market discipline, which in turn leads to poor lending choices without punitive market consequences. This indiscipline effect is reminiscent of the free cash flow hypothesis in corporate finance (Jensen, 1986) in which entrenched managers abuse excess cash because entrenchment shelters them from market discipline. Interestingly, while the free cash flow issue in corporate finance is the agency problem due to insufficient managerial ownership, here it reflects indiscipline created by *excessive* (state) ownership leading to access to cheap financing.

We turn to firm level tests next. Here, we exploit data on the banking relationships of firms. The data come from a special database maintained by the Ministry of Corporate Affairs on bank-firm relationships based on security interest filings (Chopra, Subramanian and Tantri, 2021) matched with firm-level identifiers in the CMIE Prowess database.

We examine how bank relationships are related to run exposure. We find that at the firm-bank level, firms exposed to runs (through their relationship) are more likely to exit bank relationships. The credit to borrowers decreases if their private bankers are more exposed to runs and conversely increases for firms whose state-owned bankers are more exposed to runs. Firms in the latter group get more credit but of weaker quality. They are more likely to have future interest coverage ratios below 1.0 – indicating impaired credit quality – and witness lower sales and capital growth.

We turn to the aggregate consequences of the credit reallocation between private and state-owned banks, which requires assumptions about the productive technologies. We show that industries more exposed to run public sector banks see an increase in the dispersion of marginal productivity of capital, which is an indicator of a deterioration in allocative efficiency (Hsieh and Klenow, 2009). We use the approach suggested by Sraer and Thesmar (2020) to assess outcomes relative to a no-run counterfactual. The estimates show that aggregate productivity declines by about 5%. Interestingly, the effect is predominantly *within*-sector, or continued lending to weak firms within a sector rather than the movement of funds across sectors.

We consider supplemental evidence from additional tests. In one test, we employ a regression discontinuity design to exploit exogenous variation in the presence of PSBs in a private bank's geography. We exploit a 2005 policy in which India's central bank, the Reserve Bank of India, liberalized licensing rules for underbanked areas using cutoffs based on the population served per branch (Young, 2017; Cramer, 2020). Private sector banks entered more in underbanked areas that were just above the cutoff but there was no abnormal entry below the cutoff. Using this rule, we generate a district-level instrument for the exposure of private branches to state-owned bank branches. We find that private sector banks in districts with greater exposure to state-owned PSBs see greater deposit withdrawals. Anecdotal evidence suggests that private banks are aware that the presence of state-owned banks makes their own deposits flighty (Business Line, 2009).

A question of particular interest concerns the variation *within* the state-owned PSBs that receive the run flows. We ask whether the weaker state-owned banks are more likely to draw the run flows. The economics of this test are straightforward. The "put" protection of depositors conferred by state ownership is more valuable for weak PSBs. When opportunities arise, the weaker PSBs should be more likely to use it to attract flows. A measure of a bank's weakness is the Marginal Expected Shortfall (MES), which reflects the tail dependence of a bank on aggregate downturns (Acharya et al., 2017). The greater the MES, the more vulnerable is a bank to aggregate downturns or crises.

We find that PSB weakness matters. The weak PSBs with greater MES increase lending more but the loans have poorer ex-post performance. Other evidence is consistent with the weak PSB effect. We obtain the deposit-weighted rates for deposits offered by banks. We find that the rates for the vulnerable PSBs are higher, consistent with these banks using the government ownership shelter to attract deposits. There is also anecdotal evidence that weak state-owned banks chased private bank outflows by increasing deposit rates, an aggressive practice that became so rampant that the central government had to step in to curb it (Business Line, 2008).[1] To conclude, state ownership of banks — more generally, differential government support within entities taking deposits — can alter the disciplining effect of runs and even result in negative real effects through suboptimal resource allocation.

We proceed as follows. Section I discusses the related literature. Section II describes the institutional details and the data. Section III examines deposit and credit growth at

[1] India experienced a long and deep non-performing assets (NPA) crisis for more than a decade in the 2010's (Chopra, Subramanian and Tantri, 2021; Chari, Jain and Kulkarni, 2020; Kulkarni et al., 2020). By no means do we claim that the run reallocation is its sole driver. Rather, our results highlight one channel for the NPAs, the absence of depositor discipline due to state ownership.

branches with runs. Section IV analyzes the local spillovers on deposit and credit growth and analyzes the propagation through the bank branch network and the performance of assets as a result of credit reallocation. Section V traces the impact on firm level outcomes and allocative efficiency. Section VI provides regression discontinuity evidence. Section VII examines evidence on heterogeneity within banks, particularly the state-owned ones. Section VIII concludes.

I Related Literature

Given the economic importance of (avoiding) bank runs, the literature on runs is vast. Theoretical models of runs include Diamond and Dybvig (1983); Chari and Jagannathan (1988); Calomiris and Kahn (1991); Diamond and Rajan (2001). For empirical evidence characterizing runs, see e.g., Bernanke (1983); Saunders and Wilson (1996); Calomiris and Mason (1997); Iyer and Puri (2012); Blickle, Brunnermeier and Luck (2022); Schumacher (1998). We add to this literature by examining the consequences of runs, for both the banks facing the runs and those receiving the run flows, and relatedly, the two-sided nature of the safety net provided by state-owned banks.

The nature and consequences of the state ownership of banks has been debated in the economics literature. Early work (Lewis, 1949; Meade, 1948; Allais, 1947) discusses how state ownership of *firms* can correct for market imperfections. Gerschenkron (1962) and Stiglitz (1989) argue that state ownership of banks can help mitigate underdevelopment of private institutions. However, Shleifer and Vishny (1994) point out that state owned banks are subject to political capture, and may thus misallocate credit and impair growth. Related work includes Banerjee (1997); Banerjee, Cole and Duflo (2005); Qian and Yeung (2015); Barth, Caprio and Levine (2001); Dinç (2005) and Shleifer (1998). We develop a related point. In our setting, state-owned banks coexist alongside large private banks. Our results indicate that because state ownership confers implicit protection to state-owned banks, it can distort resource flows to private banks and impair credit allocation.

The broader issue of resource misallocation is the subject of a thriving literature in economics. Hsieh and Klenow (2009) show that underperfoming firms exist. Reallocating resources from them to more productive firms enhances economic growth. A natural question is why resource misallocation exists in the first place. Implicated are poor property rights, financial frictions, trade and competition, and government regulations. See Restuccia and Rogerson (2017) for an overview and related references on the channels.[2]

Research shows that the state ownership of productive assets can contribute to resource misallocation.[3] Policies to subsidize and protect state-owned firms, possibly due to political considerations, impact the better ones in similar businesses.[4] We join this literature by highlighting an alternate channel, a distortion because the deposits at state-owned banks enjoy the implicit protection of the state not available to private banks. In developed economies, such protection is associated with size, as especially large banks are "too big to fail" (Penas and Unal, 2004; Iyer et al., 2019). We do not rely on size to identify implicit protection, which is instead identified through state ownership and control of banks and the related banking law.

Our evidence on resource reallocation after shocks contributes to two strands of banking research. One is about banking systems without a safety net, e.g., Argentina in the

[2]See, among others, Adamopoulos and Restuccia (2014); Midrigan and Xu (2014); Buera, Kaboski and Shin (2011); Bau and Matray (Forthcoming); Pavcnik (2002); Trefler (2004); Hopenhayn and Rogerson (1993); Guner, Ventura and Xu (2008).

[3]See Dollar and Wei (2007); Song, Storesletten and Zilibotti (2011); Brandt, Tombe and Zhu (2013) and Hsieh and Klenow (2009).

[4]See, e.g., Banerjee and Duflo (2005); Hsieh and Klenow (2009); Geng and Pan (2022); Sapienza (2004) and Dinç (2005).

1990s (Schumacher, 1998). Here, runs move funds to better private banks and improve credit discipline. In contrast, we show that runs can worsen outcomes when state-owned banks serve as a safety net. We also add to recent work on "silent" banking panics without accompanying bank failure (Baron, Verner and Xiong, 2020). Our setting features exactly this type of run without realized bank failure. We trace out the resulting resource reallocation and show the effects for both the banks experiencing runs and the banks receiving run flows, the state-owned banks enjoying the safety imprimatur conferred by government ownership. We find that silent runs do have negative effects. Thus, the conservative view towards runs taken by central banks and regulators seems appropriate.

II Institutional Details and Data

India has two major types of banks, private banks and state-owned or public sector banks (PSBs). Among the PSBs, State Bank of India, formed in 1806, is the oldest. The others are also old, with age of 80 years on average. They were private until they were nationalized in two waves in 1969 and 1980. PSBs have a combined 70% market share while private banks account for about 28% of banking assets. See Mishra, Prabhala and Rajan (2022).[5] Both types of banks have licenses to operate across the country.

The run episode we analyze occurs in the wake of the 2008 global financial crisis (GFC). Indian banks had virtually no exposure to the U.S. mortgage markets or entities such as Lehman Brothers involved in mortgage securitization. Nevertheless, deposits moved from private to public sector banks. Figure I, obtained from aggregate data, shows the total quarterly deposits (normalized to 1 in December 2007) for private and public sec-

[5] Amongst private banks, the ones formed after India's 1991 liberalization enjoy the dominant share. A small 2% share is held by foreign banks with operations in a few urban areas, cooperative banks, small finance banks, local area banks with small regional presence, and old private banks that were deemed too small to nationalize in 1969 and 1980.

tor banks for the fiscal years 2007 to 2011, where fiscal year is from April 1st to March 31st. The solid line dates the Bear Stearns rescue in March 2008 and the dashed line dates the bankruptcy of Lehman Brothers in September, 2008. While the pre-crisis deposit growth rates are similar for both types of banks, stark differences quickly emerge when the GFC took root in March 2008 with the collapse of the investment bank Bear Stearns. Aggregate data depict the overall growth by bank type, but cannot identify branches that had extreme resource flights and for which we will turn to the branch-level BSR dataset. In particular, we will see that some branches of private banks lose deposits while others continue to gain relative to the pre-crisis trend. This will imply that banks facing runs should exhibit a loss relative to the pre-trend and relative to that of other banks.

II.A Sovereign Support of Indian PSBs

We note that both public and private sector banks are insured by the Deposit Insurance and Credit Guarantee Corporation (DICGC). However, the coverage, INR 0.1 million (about $2000) per depositor per bank in 2007, is quite limited. Moreover, there are delays in processing deposit insurance claims. Thus, India's deposit insurance has not mitigated the propensity to run (Iyer and Puri, 2012). Soft support of PSBs by the state matters for depositors concerned with safety. India's 1949 Banking Regulation Act states that all obligations of PSBs will be fulfilled by the Indian government in case of failure. Moreover, the state injects capital into PSBs. For example, PSBs were recapitalized in 2009 through an equity infusion of nearly Rs. 31 billion (approximately $0.5 billion) (World Bank, 2009).

The limitations of deposit insurance make PSBs important destinations of funds for panicked depositors. PSBs matter as safety nets for depositors also because of their limited access to Indian sovereign paper, which is only available for banks and large financial institutions. Press reports indicate the broad awareness of the additional shelter provided by the government to PSB depositors. Private sector banks held this support responsible for the 2008 deposit flight and have been lobbying for an increase in deposit insurance to level the playing field (LiveMint, 2011).[6]

II.B Data

Branch-level data on deposits and credit come from the "Basic Statistical Returns" (BSR) dataset maintained by India's central bank, the Reserve Bank of India (RBI). The BSR data are annual as of March 31, the financial year-end for banks. The data identify agricultural and non-agricultural loans. Banks have more discretion over the latter compared to the politically sensitive agricultural lending (Cole, 2009). The geographical marker for a branch is a district, which is roughly comparable to a US county. The PSBs in a district can be reasonably viewed as safe-haven destinations for depositors fleeing private banks.

Aggregate bank-level variables are either the sum of individual branch-level data or from annual audited financial statements in the Prowess DX database compiled by the Center for Monitoring the Indian Economy (CMIE). The Prowess DX data also provide financial data for corporations that we use in the firm-level analyses. Variables used and data construction are detailed in Appendix C.1. A third database is the loan-level dataset that we obtain from the Ministry of Corporate Affairs. These loans identify bank relationships and are based on security interest filings akin to those in the U.S. analyzed by Gopal and Schnabl (Forthcoming). See also Chopra, Subramanian and Tantri (2021).

[6]The deposit insurance has been increased fivefold to INR 500,000 but only in February 4, 2020, more than a decade after the run episode we analyze.

II.C Identifying branch runs

A bank branch has a run if it satisfies three criteria:

Criterion 1: We require that the branch deposit growth rate is less than its out of sample predicted value, which we estimate using a regression. The data are pre-2006, one year prior to the run. The explanatory variables are the lagged log branch assets, the branch age, a dummy variable for whether the branch is in a rural district, the lagged credit to deposit ratio and a dummy variable for whether the bank is state-owned. Table I shows that 2.8% of branches meet the first criterion.

Criterion 2: This criterion attempts to identify an extreme left tail in deposit growth. We require that the fiscal 2009 branch deposit growth rate is below the 5^{th} percentile of the distribution of branch growth rates in the pre-run year (fiscal 2008). 4.8% of branches meet this criterion. Figure B.1 shows that the left tail events are more pronounced for private banks.

Criterion 3: Define p_5 as the 5^{th} percentile of deposit growth rates for private banks in fiscal 2008, the year preceding the run year. We require that a branch is not in the left tail of deposit growth rates g in 2008 but has a left tail event in 2009, i.e., $g_{2008} > p_5$ but $g_{2009} < p_5$. We find that 0.8% of branches fall into this category. See Table I.

We display the runs in our sample in a heat map in Figure II. Lighter shades (white) correspond to lower deposit growth. We see more regions with low deposit growth (lighter shaded areas, Panel (b)) for private banks and more areas of high deposit growth for public sector banks (darker shaded areas, Panel (c)).

III The Deposit Run

III.A Pre-Trends and The Run

We begin with an event-study style regression of deposit growth rates at the branch level in event time relative to the run year. We estimate the following specification:

$$gd_{jbdt} = \alpha_j + \theta_t + \sum_{\tau} \eta_\tau \times (\mathbb{1}_\tau \times \mathbb{1}_{(Run_j)}) + \epsilon_{jt} \tag{1}$$

where the dependent variable, gd_{jbdt} is the annual growth in deposit for branch j belonging to bank b in district d for time period t (where t ranges from 2002 to 2011), α_j and θ_t are branch and time period fixed effects respectively, and $\mathbb{1}_\tau = 1$ if the year is τ.

In equation (1), the coefficients of interest are the η_τ's. Coefficients close to zero in the pre-period would indicate that the run and non-run branches have similar trends prior to the run year. We present the estimates of equation (1) in the form of an event study plot in Figure III. The horizontal bars in the figure show 95% confidence intervals around the parameter estimates. None of the η_τ coefficients in the pre-crisis period is significant, indicating that the run and non-run branches have similar pre-event trends in deposit growth rates and the parallel trends assumption cannot be rejected.

The event study plot in Figure III is also useful in understanding the run. We see a sharp decline in deposits for the run branches in fiscal 2009. While this is not surprising given that we define runs based on left-tail outflows, the results validate our measure. We find a significant but less sharp decline in deposits in the year after the run. The coefficients stabilize thereafter but the growth still remains muted and below zero. Thus, runs seem to leave long-term scars on the funding bases of the run branches.

III.B The Run Aftermath: Branch Deposits

We assess the deposit growth rates in the post-run period between 2009 and 2011 using the specification:

$$Y_{jbdt} = \alpha_{bt} + \gamma_{dt} + \beta \times \text{Branch run}_j + \eta \times X_{jbdt} + \epsilon_{jbdt} \quad (2)$$

where Y_{jbdt} is the deposit growth rate for a given branch j of a bank b in district d for time t ranging between 2009 to 2011.

The variable Branch run$_j$ is an indicator for whether a branch j has a bank run. α_{bt} and γ_{dt} are bank-year and district-year fixed-effects respectively. X_{jbdt} are the control variables, which include branch characteristics and their interaction with a time trend ranging from 2009 to 2011 . The branch characteristics include an indicator for whether a branch is deposit poor (below median deposits in 2008) and the following two variables derived from the BSR dataset made available to us. We include the 2008 credit to deposit ratio. A high value of this ratio signals that the branch is resource constrained and may have inherently low expected deposit growth. We also include the percentage of skilled officers in a branch. The greater placement of skilled officers may indicate a branch with better growth prospects. The full sample specifications also include fixed effects for private bank-district-year. Robust standard errors are clustered at the branch level. The results are similar if clustered at the district level.

The estimates are in Table II. The coefficient of interest in Equation (2) is β, which measures the deposit growth for run branches relative to the remaining branches of the *same* bank. Column (1) shows that branches with runs have a 15.9 percentage points (pp) decrease in deposit growth after the run. The results again suggest that our run definition in Section II.C is able to identify run branches even after we include a rich suite of fixed effects in specification (2). There is one other noteworthy point. This specification includes state-owned banks, unlike the definitions in Section II.C. Column (2) in Table II reports similar estimates but for a sample comprising private sector banks alone. The point estimate are similar in magnitude and show a 14.6 pp decline in deposits for run banks. Placebo tests reveal that the run results are not typical of non-run years.[7]

Figure IV provides more color on the nature of the deposit losses at the run banks by plotting the β coefficients estimated in Equation 2. The left Panel (a) shows that losses in deposits are concentrated in demandable current deposits, typically held by firms. Savings deposits, which represent funds set aside by small retail customers for savings purposes, see less losses. In theory, these savings are also demandable with relatively short notice but do not seem to be as flighty as current accounts. Term deposits, akin to certificates of deposits in the U.S., witness greater flights than savings accounts. The maturity transformation due to the run is seen in Panel (b), where we see that public sector banks (PSBs) do not gain significantly – and in fact exhibit mild losses in – current accounts. However, PSBs appear to gain less flighty forms of capital, viz., term and savings deposits. The result is consistent with proactive deposit-seeking by PSBs, a point that we will explore later in Section IV.

III.C The Run Aftermath: Branch Credit

We turn to the credit consequences for the branches facing runs. Runs at a branch deplete local resources. If headquarters have seamless access to funds, any local gaps are easily made up through funding from headquarters. However, if banks are resource con-

[7] See Table C.2, in which we reestimate the specification in column 1, Table II with deposit growth in different years, viz., 2004–05, 2005–06, and 2006–07. The point estimates are not significantly different between run and non-run branches.

strained, e.g., because external capital raising is costly (Kashyap, Stein and Wilcox, 1993; Kashyap and Stein, 2000), local deposit losses may translate into credit losses at the branch level. Which effect matters is then an empirical question.

The question about branch-level funding constraints is also of interest from the viewpoint of the literature on internal capital markets. There is evidence that resource flows in one division of a conglomerate impact those in unrelated divisions. An early study is Lamont (1997), who shows that non-oil businesses of oil firms are sensitive to oil prices. Relatedly, Campello (2002) finds that resource flows are not seamless when banks operate through a subsidiary structure. The evidence here is noteworthy as it comes from the organizational form of a branch structure. The different branches of a bank are functionally similar subunits that carry out similar operations within a single umbrella. Thus, some part of a funding shock to a branch could be ameliorated by the funding from the remaining branches. If the mitigation is not complete, the fund-losing branches would need to cut credit. We examine whether this is the case.

Column (3) of Table II displays the credit results. We find that a branch experiencing a run sees a local credit impact with a 13.7 pp decline in credit growth after the run period. The estimates for private banks alone are similar, and show an 11.4 pp decline in credit at run branches. The specification includes bank-year fixed effects that control for bank-specific lending opportunities, and district-year fixed effects and branch covariates (including their interaction with time trends) to filter out secular aggregate movements.[8]

[8]In unreported results, we confirm that the results are more pronounced in the non-agricultural sector, in which lenders have more discretion.

IV Run Spillovers Within And Beyond Local Geography

We turn to the spillover effects of runs. We first look at local geographic spillover effects within the same district as the run branches. We then look beyond the local geography. We do so because the banks in our sample are national entities with broad footprints. Thus, besides local effects, runs could also result in incremental effects beyond local geographies for both the private banks facing a run and the PSBs who gain surpluses. Private banks could face the need to contract lending while the PSBs receiving windfall funds have the opportunity to grow. Besides the direct quantitative effect of the actual flows, there could also be the "scarring" impacts in which extreme experiences leave longer-term imprints (Malmendier and Shen, 2019).

IV.A Local Geographic Effects

A district is our unit of choice for assessing local spillovers. A district is an economically integrated region akin to a US county. Its collector, a bureaucrat appointed by the government, is responsible for collecting revenue from a district and managing the law and order in the district. We use the districts demarcated by the Indian Census in 2001, which apply in our sample period.

Our empirical construct for assessing spillovers is the variable District Exposure$_d$, the negative of the deposit growth of the run branches in district d. The greater its value, the greater the deposit flight in district d. We estimate the following specification:

$$Y_{jbdt} = \alpha_{bt} + \kappa_{dt} + \eta \times \text{District Exposure}_d \times \text{Public} + \gamma \times X_{jbdt} + \epsilon_{jbdt} \quad (3)$$

where the outcome variable is for period t, for a given branch j of a bank b in district

d. The outcome variables (Y_{jbdt}) are deposit growth and credit growth from $t-1$ to t. α_{bt} and κ_{dt} are bank-year and district-year fixed-effects, respectively. X_{jbdt} are the control variables and include branch characteristics and their interaction with time trends.

The coefficient of interest in Equation (3) is η, which measures the incremental effect of run exposure on state-owned bank branches relative to branches of the same bank in districts with lower exposure to runs and relative to private sector bank branches. We report $\eta * 100$, the impact on the outcome variable, say deposit growth, due to a 1 percent decline in the deposit growth of private sector branches with runs in the district. The branch characteristics (X_{jbdt}) included are an indicator for whether a branch is deposit poor (below-median deposits in 2008), the percentage of skilled officers, and the credit to deposit ratio in 2008. Robust standard errors are clustered at the district level. In variants of specification (3) we also focus on the sub-sample of public sector banks branches, and separately the sub-sample of private sector bank branches with no runs.

Table III reports the estimates of equation (3). In column 1, which includes all branches, we find that a one-percentage point (pp) increase in run exposure is associated with a 0.07 pp increase in deposit growth for the public sector banks. That is, for the same bank, a PSB branch sees 1.3 pp higher deposit growth if it is in a district with 1 SD greater deposit decline across the run branches in the district. Column 2 restricts the sample to public sector banks alone. The positive coefficient again indicates that branches of state-owned banks in districts subject to runs see an increase in deposits. Panel (b) of Figure IV, which plots the coefficient η from Equation 3 across deposit types, shows that the deposit inflows into public sector banks are driven by the longer-term savings and term accounts but not the shorter and more flighty current account deposits. This is in contrast to the results for private sector banks, which saw deposit outflows across all types of deposits.

The net effect is that the panic flows result in the growth of *more stable* deposits that now reside at the public sector banks.

It is possible that private sector bank branches were the beneficiaries of outflows from run branches. What do the data say? Column (3) restricts the sample to private sector branches that did not face runs. The effects on deposit growth are neither statistically nor economically significant, reinforcing the idea that the safety shelter provided by state ownership matters. PSBs enjoying the imprimatur from state ownership were the destinations for the run flows, not private branches (without runs) in the same district.

Columns (4) to (6) in Table III report the estimates for credit growth. Column (4) indicates that greater run exposure is associated with greater credit growth at the recipient PSBs. The estimates in column (5) are for a sample that is restricted to PSBs. Thus, they produce a *within*-PSB estimate. Here too, we see that a greater exposure to a private bank runs, which results in the PSB receiving more run flows, results in more expansion of credit relative to PSBs with less run exposure. The point estimates in column (5) are lower than those in column (4), since they are based on samples that exclude the private banks in which credit declines are greater. Thus, the difference estimates in column (5) should be muted, which exactly what we find. Column (6) restricts the sample to private sector bank branches with no runs. We find a negative effect on credit. This is initial evidence that runs have effects beyond the local geographies in which they occur, so private bank branches in districts without a run could still be impacted by the runs in the banks outside the district. We explore these national effects next.[9]

[9] In Table C.3 in the Appendix, we report estimates at the district rather than the branch level. As in Figure IV, deposit losses are concentrated in current and savings deposits but not term deposits. There is some but limited evidence on district-level night-time luminosity as a proxy for district-level economic activity, indicating that transmission across district borders matters – unsurprisingly given that our sample banks operate nationwide.

IV.B Beyond Local Geographies

To assess the run effects outside the local geographies, we need a metric for a bank's overall exposure to resource changes in the run geographies. We propose the metric *Bank Exposure* for private and public sector banks.

$$\text{Private bank exposure}_b = \sum_{j \in b} \frac{\text{Deposit}_j}{\text{Deposit}_b} \times \text{Branch Run}_j \tag{4}$$

where branch j belongs to bank b. Branch Run_j is an indicator for whether a private sector bank branch has a run on its branch. Deposit weights are based on 2007. The measure is standardized (z-scored) for easy interpretation. The measure captures whether a private sector bank raises a larger share of its deposits (as of 2007) from branches that eventually witnessed more runs in the crisis period.

The exposure measure for public sector banks is the deposit weighted exposure to district-level runs and calculated as:

$$\text{Public bank exposure}_b = \sum_{j \in b} \frac{\text{Deposit}_j}{\text{Deposit}_b} \times \text{District Exposure}_d \tag{5}$$

where branch j belongs to bank b. District Exposure_d as defined before is the negative of the deposit flows at the private sector banks that had runs and standardized (z-scored). Deposit weights are based on 2007. The measure captures whether the branches of a public sector bank operate in districts where private sector banks experienced more runs. We note that the exposure variable has a natural symmetry that facilitates interpretation. To wit, because one type of entity faces outflows while the other finds itself with surpluses, the private bank exposure variable captures the effects of outflows whereas the public bank exposure captures the effect of inflows.

IV.C Credit Volume

Bank-Level Evidence We estimate the following bank-level specification:

$$Y_{bt} = \theta_t + \beta \times \text{Bank Exposure}_b + \gamma \times X_{bt} + \epsilon_{bt} \tag{6}$$

for bank b in time t. θ_t is year fixed effect. The outcome variables, Y_{bt}, are deposit growth and credit growth from period $t-1$ to t. The specification is estimated separately for private and public sector banks.The coefficient of interest, β, measures the average growth in the outcome variable (deposit and credit growth) at banks for a one standard deviation (SD) increase in run exposure. The variable bank exposure is defined separately for public and private sector banks. The sample is (as before) from fiscal 2009 ending in March 2009 to the fiscal year ending in March 2011. Bank-level controls X_{bt} include banking density as reflected in ATMs per capita, the FY 2008 gross NPA by gross advances, the capital to risk-weighted assets ratio, and the interaction of the last two controls with a time trend. These are bank-level aggregates related to bank growth.

Table IV presents the estimates of equation (6). The columns represent different outcome variables, for private (columns 1 and 3) and state-owned banks (columns 2 and 4) separately. A one-SD increase in private bank exposure is associated with a 8.1 pp lower deposit growth (column 1). In comparison, a one-SD increase in PSB exposure is associated with a 1.5 pp greater deposit growth.

Do high-exposure private sector banks make up this shortfall in deposit funding during the crisis years? We assess this issue by examining the impact of exposure on the credit growth of private sector banks. The results in Column 3 suggests that private sector banks are constrained, in the sense that greater exposure results in more cutback of credit. The results are reminiscent – and in the spirit – of Kashyap and Stein (1995, 2000) that banks face funding constraints. A one-SD increase in private sector bank exposure results in about an 8.4 pp decline in private bank credit growth. Column (4) suggests that PSBs gaining deposit inflows have no overall credit effects. This could reflect the lack of power when working with broad bank aggregates rather than the more granular branch-level data, which matched firm-bank data will help address, as we will show shortly. In any event, the results do not speak to the *quality* of the credit subsequent to the run-induced reallocation. We turn to these points next.

Branch Level Evidence As discussed above, one question is whether in going from local runs to overall bank aggregates, we could lose some statistical power. While this does not seem to be an issue for private banks in Table IV, the results for state-owned banks (PSBs) warrants further analysis. Branch-level results can help sort out this issue. Of course, these results are also of interest in their own.

We first estimate the following model for the credit effects on (non-run) branches of private sector banks, controlling for the run branch effects:

$$Y_{jbdt} = \alpha_{dt} + \gamma \times \text{Branch Run}_j + \beta \times \text{Private bank exposure}_b + \eta \times X_{jbdt} + \epsilon_{jbdt} \qquad (7)$$

for period t, for a given branch j of a bank b in district d. α_{dt} includes district-year fixed effects. It is worth noting that the included interactive district-time fixed effects in the specification are strong controls for the possible heterogeneity at the local level in, e.g., credit demand. We include the controls at the branch and bank level used in prior specifications as well as their interaction with time variables. Robust standard errors are clustered at the district level.

Column (1) in Table V shows that branches with run exposure see an 11.2 pp decline in credit growth. The real interest here is on what we can say about the coefficient on the variable reflecting overall private bank exposure (beyond the run districts). We find that even after controlling for the effects on run branches themselves, a one-SD increase in run exposure results in a 2.41 pp lower credit growth. The findings show that runs at private sector banks spread beyond local geographies, consistent with Table IV results on an overall bank-level growth decline.

A similar specification lets us examine the transmission of run shocks through the bank-branch network of state-owned banks. We estimate

$$Y_{jbdt} = \tau_t + \gamma \times \text{District Exposure}_d + \beta \times \text{Public bank exposure}_b + \eta \times X_{jbdt} + \epsilon_{jbdt} \quad (8)$$

for period t, for a given branch j of a bank b in district d. We include a slew of control variables as before including the bank-level aggregates and district characteristics. We also experiment with the rather strong local controls with district-year interactive fixed effects, which filter out heterogeneity (e.g., local credit demand or economic conditions in a given year). Of course, with these interactive district-year controls, district-level invariants will drop out, so there will be no coefficients estimated for District Exposure$_d$. Robust standard errors are clustered at the district level.

While credit effects in private banks are both local and national, the effects for state-owned banks appear to be more local. See, e.g., columns (2) and (3) of Table V. Column (2) in the table indicates that most of the credit growth for state-owned banks is concentrated in the district in which the runs occur. The coefficient for the variable District Exposure$_j$ is positive. The effect on the credit growth in the remaining branches of the high exposure PSBs is far more limited. Although the coefficient for public sector bank exposure is negative and statistically significant at the 10% level in column (2), this effect disappears when we include district-year fixed effects in column (3). Thus, the branch networks appear to be more local for the state-owned PSBs and more integrated for the private sector banks in our sample.

IV.D Credit Quality

India's central bank, RBI, provided us data on markers for non-performing assets (NPAs) at the branch level. These indicators mark impaired loans as substandard, doubtful, or loss.[10] We use these indicators to assess the quality of the the new lending triggered by run inflows into PSB branches. Table VI reports the results, versions of equations (7) and (8) applied to NPAs.

Column (1) in Panel A of Table VI shows that NPAs shrink at the private sector banks experiencing runs. We see a similar disciplining effect at state-owned banks receiving surpluses but the results hide very interesting differences between agricultural and non-agricultural credit. Column (6) shows that the run-related NPA coefficients are more significant for the *non-agricultural* sector. This result is seen both locally as well as the remaining branches of the exposed banks. These results suggest that unexpected surpluses in runs flow to unproductive non-agricultural lending by the state-owned banks.[11]

We consider one additional issue. The RBI allowed banks to classify some restruc-

[10] In our sample period, substandard loans are delinquent for between 90 days and 2 years. Doubtful loans have no repayments for more than 2 years. Loss loans are loans that are written off.

[11] It is reasonable to ask why agricultural NPAs don't expand. This is a political economy question. In India, farmers including those behind in repayments enjoy frequent support from the state, e.g., through interest "subvention" or loan waivers in which repayments are made by the central or state governments. See, e.g., https://www.pradhanmantriyojana.co.in/agriculture-farmers-welfare-schemes/

tured loans as standard assets although borrowers in these cases may have been distressed (Chari, Jain and Kulkarni, 2020). We use bank-level disclosures on restructured assets to assess changes in this class of non-performing assets. Using the bank-level specification in Equation (6) and the dependent variable as the growth in stressed assets (i.e., sum of non-performing assets and restructured assets), we see in Panel B that private banks with high exposure had lower growth in stressed assets. High exposure PSBs, on the other hand, show no similar effect (column (2)).[12]

In sum, the run appears to have resulted in credit quantity and credit quality effects. The run contracted credit and improved loan quality at run-exposed private banks. The public sector banks that served as destinations for the run inflows witness deterioration in credit quality in non-agricultural lending. We next attempt to assess aggregate effects of this resource reallocation by exploiting the data we have on bank-firm linkages.

V Firm-Level Outcomes and Allocative Efficiency

V.A Impact on firm-level credit and real outcomes

We consider three empirical questions. One, does debt increase for corporates whose principal lenders are public sector banks that are more exposed to runs? On the flip side, does debt decrease for corporates that bank with private banks exposed to runs? And finally, what is the overall effect on aggregate productivity? We use the loan-level data from the Ministry of Corporate Affairs combined with firm-level annual financial statements from the CMIE Prowess database to analyze these issues.[13]

[12] As the disclosures are at the bank level, we cannot parse out the portion due to non-agricultural lending.

[13] We retain firms in sectors for which the source filings that are based on security interests better cover the universe of bank relationships rather than what is selectively reported. We retain non-financial companies and public limited and private limited companies. We exclude industries with the 2-digit National

The MCA Bank Relationships Data We estimate a loan-level specification with data then aggregated to the firm-bank level:

$$\Delta Y_{fb} = \omega_f + \beta \times \text{Private bank exposure}_b + \gamma \times \text{Public bank exposure}_b$$
$$+ \eta \times X_{fb} + \epsilon_{fb} \qquad (9)$$

for firm f borrowing from bank b. The terms ω_f capture firm fixed effects. The dependent variables are the intensive margin of credit measured as the log change in (1+credit) for a firm-bank pair calculated between the years before the crisis (2006–2008) and the crisis years (2009–2011). For the extensive margin of credit, we measure exit and entry into bank-firm relationships for the same period. For a given bank-firm relationship, "exit" occurs if no loan is renewed between 2009–2011 and a firm-bank relationship exists in the 3-year interval between 2006 and 2008. Likewise, "entry" occurs if at least one loan is made between 2009–2011 and no firm-bank relationship exists between 2006 and 2008. The bank run exposure variables, Private bank exposure$_b$ and Public bank exposure$_b$, are as defined in Section IV.B. We include the consistent set of bank-level controls used before in Equations (4) and (5) and cluster standard errors at the bank-level.

In specification (9), β measures the effect of run exposure on the credit provision by bank b to firm f from a private sector bank over the period. The coefficient γ measures the impact on credit from bank b to firm f for public sector banks that operate in markets where private sector bank branches faced runs. In Panel A in Table VII, columns (1) and (2) show the intensive margin results, that is the log change in credit to firms. In column

Industrial Classification code (NIC) codes between 01-03 corresponding to agricultural firms and firms with 2-digit NIC codes 45 or 47 (corresponding to wholesale and retail trade/repair of motor vehicles and motorcycles) and 69-75 (corresponding to firms in professional, scientific and technical activities).

(1), we find that a one-SD increase in private bank run exposure results in a 17.7% contraction in credit. As before, there is not a detectable effect on PSB credit to run exposure.

In column (2), we include firm fixed effects. This allows us to use the design suggested in Khwaja and Mian (2008), which compares the same firm borrowing from different banks. For a firm borrowing from two private sector banks, there is greater decline from the more exposed private sector bank relative to the a private sector bank with lower exposure. Strikingly, the point estimates are very similar in columns (1) and (2). The demand-side factors that the Khwaja and Mian (2008) approach mitigates, do not seem to be the main driver of the private bank contraction in credit. In columns (3) to (6), we examine the extensive margin, that is, the formation of or exits from banking relationships. Columns (3) and (4) indicate that firms linked to exposed private sector banks are slightly more likely to exit banking relationships. However, there is no effect on the formation of new ones. The result is consistent with the view that credit relationships are sticky, which is a plausible phenomenon in a credit-hungry emerging economy such as India.

Firm-Level Exposure To Runs We next consider a firm-level exposure measure based on firms' preexisting banking relationships using the specification:

$$\begin{aligned}\Delta Y_f &= \alpha + \beta \times \text{Private bank exposure}_f \\ &+ \gamma \times \text{Public bank exposure}_f + \eta \times X_f + \epsilon_f \end{aligned} \tag{10}$$

for a firm f. The first dependent variable of interest at the firm-level is the log change in (1+credit) from 2006-2008 to 2009-2011. We also examine an indicator for low quality firms, an indicator for whether a firm has earnings to cover interest payments, viz., an indicator for whether the interest coverage ratio is less than 1.0. Other accounting metrics include sales growth, change in return on assets, and capital growth for the period. Public bank exposure$_f$ (Private bank exposure$_f$) is the loan-weighted Public bank exposure$_b$ (Private bank exposure$_b$) measure, which we aggregate to the firm-level using prior total lending as weights. Standard errors are clustered at the industry-level. All regressions include 3-digit NIC industry fixed effects.

Table VII, Panel B presents the results. In column (1), the estimate of β is negative, indicating that credit contracts for private banks. At the firm level, we see a positive coefficient γ for public sector banks, indicating that the banks receiving run flows increase credit. Column (2) shows that the PSB exposure is associated with worse credit, as the bank is more likely to have future interest coverage ratio below one. We note that this result controls for pre-period distress as the control variables include whether a firm cannot cover interest expense coming in to the run period. The results are remarkably consistent with the branch-level analysis in Table VI on the deterioration in asset quality of exposed public banks. While interest coverage is our main focus as a marker of credit quality, we make brief remarks on the other accounting results. Firms linked to exposed public banks also see a decline in sales growth (column (3)). Firms linked to exposed private sector banks, however, see no such decline. There is little detectable impact on profitability but the results in column (5) show a decline in capital growth.[14]

V.B Aggregate Effects of Reallocation

The results displayed thus far show firm-level effects of runs. We turn to the aggregate effects next. To motivate the exercise, view a run as a (positive or negative) resource shock to a bank and the firms it lends to. Each firm borrowing from a bank experiences a treat-

[14] While results are similar for even longer periods, we do not stress these results as there are other significant regulatory interventions into the banking system focused on asset quality. See Chari, Jain and Kulkarni (2020) and Kulkarni et al. (2020).

ment effect. Sraer and Thesmar (2020) show that the aggregate effect across all firms can be computed based on the distribution of the marginal productivity of capital (MRPK). Three moments of log-MRPK: the variance of log-MRPK, the mean of log-MRPK, and the covariance of log-MRPK and sales lead to an estimate of the aggregate effect of the shock.

- $\Delta\Delta\sigma^2(s)$, the difference-in-differences estimate of the effect of the natural experiment on the variance of log-MRPK in a given industry s. This estimate corresponds to the change in the variance of log-MRPK for firms in industry s, relative to a set of industries that are not affected (or less affected) by the event.

- $\Delta\Delta\mu(s)$ is the difference-in-differences estimate of the effect of the event on the mean log-MRPK in industry s.

- $\Delta\Delta\sigma_{MRPK,py}(s)$ is the difference-in-differences estimate of the effect of the event on the covariance between log output and log sales in industry s.

We obtain the above estimates in our setting. As in Sraer and Thesmar (2020), the output-to-capital ratio, log-MRPK, at the firm-level is the log of the ratio of sales to the gross book value of total assets, averaged over the pre-period (2006–2008) and the post period (2009-2011). We compute the moments of the log-MRPK distribution at the 3-digit NIC industry level for the two periods. We have 100 unique industries with 200 before-after observations, for which we compute the moments for estimating aggregate effects.

We estimate a difference-in-differences specification with heterogeneous treatment exposure at the industry level:

$$M_{ind,t} = \alpha_s + \beta_M \times \text{Private bank exposure}_s \times Post_t$$
$$+\gamma \times \text{Public bank exposure}_s \times Post_t + \eta \times Post_t + \epsilon_{ind,t} \qquad (11)$$

where s is the industry in period t. Our empirical implementation focuses on two periods, 2006–2008 and 2009–2011, which are before and after the run. The dependent variables, $M_{ind,t}$ are each of the three moments, (i) variance of log-MRPK, (ii) mean of log-MRPK, and (iii) the cross-sectional covariance between log-MRPK and log sales in industry-time. Public bank exposure$_s$ (Private bank exposure$_s$) is the industry-level loan-weighted bank exposure, that is, Public bank exposure$_b$ (Private bank exposure$_b$) aggregated to the industry-level using the total lending between 2002 and 2008 as weights. Post$_t$ is an indicator for the post period (2009–2011). All specifications include industry fixed effects and standard errors are clustered at the industry-level.

Table VII, Panel C presents the estimates. Column (2) shows that industries with high exposure to run public sector banks, saw an increase in the variance of log-MRPK. We find no discernible effect of private sector bank exposure (coefficient=0.182, SD=0.229). The specification in column (1) excludes industry-level fixed effects, which lets us examine pre-period differences between exposed and unexposed industries (as indicated by the coeffcient on the uninteracted exposure terms). In the pre-period, industries with differing private (public) exposure were not significantly different from each other. Column 4 shows the effect of the run episode on average log-MRPK. The relationship is significant at 10%. Column (6) shows that there is no effect on the covariance term. Columns (3) and (5) show that there are no pre-period differences in the other moments either.

Our results show that: $\Delta\Delta\sigma^2(s) = 0.782 \times \text{Public bank exposure}_s - 0.182\times$ Private bank exposure$_s$, $\Delta\Delta\mu(s) = 0.047 \times \text{Public bank exposure}_s - 0.098 \times \text{Private bank exposure}_s$, and $\Delta\Delta\sigma_{MRPK,py}(s) = -0.071 \times \text{Public bank exposure}_s + 0.070 \times \text{Private bank exposure}_s$. With these estimates, we can compute the aggregate effects. Before we do so, we examine the distribution of log-MRPKs, which should be normally distributed for the methods we use to be well-specified. Figure B.2 reports normal probability plots for manufacturing firms (Panel (a)) and non-manufacturing firms (Panel (b)). The empirical cumulative distribution plots, which represent the z-scored log output to capital ratio, indicates that a normal distribution is a reasonable assumption.

Based on standard calibration parameters in David and Venkateswaran (2019) and Sraer and Thesmar (2020), we set the capital share in production to 0.33, the price elasticity of demand to 6.0 corresponding to $\theta = 0.83$. ϕ_s is the pre-period share of sales of industry s and κ_s is its pre-run period share of capital. The aggregation to obtain the overall change in total factor productivity (TFP) is:

$$\begin{aligned}\Delta \log(TFP) \approx & \underbrace{-\frac{\alpha}{2}\left(1+\frac{\alpha\theta}{1-\theta}\right)\sum_{s=1}^{S}\kappa_S \widehat{\Delta\Delta\sigma^2}(s)}_{\text{-4.91\%}} \\ & \underbrace{-\frac{\alpha}{2}\left(1+\frac{\alpha\theta}{1-\theta}\right)\sum_{s=1}^{S}(\phi_S-\kappa_S)\left(\widehat{\Delta\Delta\mu(s)}+\Delta\Delta\sigma_{\widehat{MRPK,py}}(s)+\frac{1}{2}\frac{\alpha\theta}{1-\theta}\widehat{\Delta\Delta\sigma^2}(s)\right)}_{\text{-0.08\%}} \\ & \approx -4.99\%\end{aligned} \tag{12}$$

The effect on aggregate output can be calculated using the following equation:

$$\Delta\log(Y) \approx -\frac{\alpha(1+\epsilon)}{1-\alpha}\sum_{s=1}^{S}\phi_S\left(\widehat{\Delta\Delta\mu(s)}+\frac{1}{2}\frac{\alpha\theta}{1-\theta}\widehat{\Delta\Delta\sigma^2}(s)+\Delta\Delta\sigma_{\widehat{MRPK,py}(s)}\right) \approx -5.23\% \tag{13}$$

where ϵ is the Frisch elasticity. Using $\epsilon = 0.2$, we estimate that aggregate output declined by 5.23% due to bank runs and credit reallocation from private to public banks.[15]

[15] In unreported results we also consider a second approach. If capital is efficiently allocated, its productivity MRPK across enterprises should be equal. Thus, reallocations that increase the variation in capital

An interesting and related question is whether the reallocation efficiency gains reflect the *ex-ante* differences in the quality of the firms that the two types of banks lend to. This is easily examined by analyzing the ex-ante productivity and quality of the average firm in the portfolio of each bank type. See columns (1) and (2) in Appendix Table C.4. Briefly, we do not find significant differences between the two in the period prior to the run. Thus, the worse performance of PSBs gaining run resources does not reflect passive lending to the same (worse) pool of clients they inherited. Rather, the ex-ante similarity of clients and the ex-post worse performance suggests that the marginal lending decisions were worse at the PSBs gaining run resources. We explore this idea further in Section VII.

VI Exogeneity in Exposure to PSBs

Does the presence of PSBs in a district make private banks more vulnerable to panic runs? We present evidence from a regression discontinuity design (RD).

In India, the branch licensing policies are set by RBI, India's central bank. On September 8, 2005, the central bank moved to quantitative formulas for branch licensing. Entry was allowed in underbanked districts, which were defined as ones in which the population per branch exceeded the national average. Following the reform, private sector banks were incentivized to enter – and did enter – underbanked areas while state-owned public sector banks did not, perhaps because the PSBs were already present in areas with underserved populations (Young, 2017). Thus, the 2005 branching rules generate exoge-

productivity increase inefficiencies. We examine heterogeneity by ex-ante MRPK (a proxy for financial constraints) and determine the effect on MRPK growth for firms with high public and private bank exposure. Combining these estimates of MRPK growth and the aggregation method in Blattner, Farinha and Rebelo (2019) and Osotimehin (2019), we estimate an 11.2% decline in aggregate productivity due to the run. While the assumptions underlying the aggregation are plausible, we interpret it as an upper bound and as a robustness check of the estimates based on Sraer and Thesmar (2020). These results are available on request.

nous variation in private branch exposure to state-owned banks in ways that vary across districts. See Young (2017) and recently, Cramer (2020) and Khanna and Mukherjee (2020).

To examine whether deposits are impacted by the threshold, we estimate

$$\begin{aligned} \text{PSB share}_b &= \delta_s + \beta * \text{Banked}_d + \gamma * \text{Banked}_d * f(T_d) \\ &+ \phi * (1 - \text{Banked}_d) * f(T_d) + \kappa X_d + \eta_d \end{aligned} \quad (14)$$

where PSB share$_b$ denotes the deposit share of state-owned banks, T_d denotes the running treatment variable, the population per branch minus its national average, Banked is an indicator for whether $T_d < 0$, i.e., the district is not underbanked. δ_s denotes state fixed effects while X_d denotes linear and squared terms (Gelman and Imbens, 2019). We include the population and its square. We estimate the regression for fiscal 2006-2008, prior to the 2009 run and with a window after the 2005 policy change to allow for realized entry by private banks. The RD estimation uses a triangular kernel with a 4.5 persons per thousand bandwidth in line with the suggestion in Imbens and Kalyanaraman (2012) but is robust to other choices suggested in the literature (e.g., Calonico, Cattaneo and Titiunik (2014); Young (2017)). The regressions are weighted by the 2001 population estimates used to define underbanked thresholds. The fitted value of the dependent variable estimates the exposure of private sector banks to the state-owned banks in a district accounting for the threshold discontinuity generated by the 2005 policy change.

Analyzing runs is then straightforward using an IV specification.

$$\text{Deposit Growth}_{jdst} = \alpha_{bt} + \delta_{st} + \beta \times \widehat{\text{PSB share}}_d + \eta \times X_{jdst} + \nu_{jdst} \quad (15)$$

The specification includes state-year and bank-year fixed effects and also covariates X_{jdst}, viz., an indicator for whether a branch is deposit poor (below median deposits in 2008), the percentage of skilled officers, and the credit to deposit ratio in 2008 and their interactions with time trends. We weight the regressions with 2007 deposits and cluster standard errors at the district level.

For evidence on covariate balance, see Panel A of Table C.5. There is relatively smooth variation in several district level indicators available to us, including weekly wages, age, percentage of rural households, percentage of women and high-school educated, and unemployment rates. Column (7) shows no pronounced discontinuities in PSB deposit shares in 2001-2003, well before the 2005 rule change. The balance is also indicated by Figure B.3, which presents second degree polynomial plots of covariates against the running variable after partialing out state-year fixed effects. Points to the right represent underbanked districts and dotted lines represent confidence intervals. We find no evidence of covariate discontinuity around the threshold. Nor do the McCrary plots in Figure B.4 show any evidence of selective sorting.

We turn to the main results. In Figure V, Panel (a), we find that there is a discontinuous increase in the number of private sector bank branches at the RD threshold in under-banked districts. Panel (b) confirms that this does not occur at state-owned banks, as discussed above. Panel (c) depicts the results for deposit shares around the RD threshold: state-owned banks see a discontinuous decrease in deposit shares. That is, private banks expand shares around the threshold after the 2005 rule change. Panel (b) in the Appendix Table C.5 shows the results more formally. The discontinuity is economically equivalent to about 28 private sector branches and 9.71 pp in terms of deposit share. In the Internet Appendix in Table C.6 we show that the results are not sensitive to the empirical choices for implementing the RD.

The run period results are in Table VIII. In column (1), we display the estimates of the first-stage equation (14). The F-statistic is 161, indicating that the instrument is strong. Estimates of the second stage regression specification (15) are in Column 2. We see that private banks in districts with greater exposure to state-owned banks are more likely to witness runs. Placebo (pre-trend) results for the pre-crisis periods in the Appendix Table C.7 show no such effects. Thus, run period flights are special.

VII Heterogeneity Within PSBs

Following Acharya et al. (2017), we classify banks based on "MES," or marginal expected shortfall. More vulnerable banks have greater MES. One advantage of the Indian market setting is that we can compute MES for PSBs, which are majority state-owned but have minority outside holdings traded in the stock market. Appendix Table C.8 reports a list of banks for which we can compute MES. We cover all major banks in India.

We test whether the more vulnerable banks, the high MES banks, attract panic flows. These banks benefit more from the protection conferred by state ownership and thus have greater marginal benefit from taking in the panic flows. An interesting test is whether we see similar results for *private* banks. This should not be the case if safety-seeking depositors value the state's implicit protection for the banks it owns.

Figure VI depicts the evidence on deposit flows. The more vulnerable – weaker – private banks show lower deposit growth. In contrast, weaker state-owned banks had *greater* deposit growth. Table IX provides estimates of Equation (6) in which we replace exposure with bank vulnerability. Columns (1) and (3) show that for private banks, MES is negatively related to deposit and credit growth. In contrast, columns (2) and (4) show that for PSBs, the relation reverses, with greater growth for the more vulnerable PSBs.

Non-performing assets in non-agricultural loans, over which banks have more discretion, increase in MES at PSBs but decrease at private banks.[16]

We obtain additional data to speak to the deposit-acquisitive behavior of the more vulnerable PSBs. See Panel B of Table IX. The branch-level BSR data give average deposit rates in different categories, viz., deposits paying less than 5%, and in 1% increments for 5 to 15%, and finally, a bucket for deposits above 15%. The weighted average is based on the two end-points and the multiple mid-points. Retail deposit rates in columns (1) and (2) are negatively related to the MES but the rates for non-retail deposits increase in bank MES. Non-retail, i.e., business depositors are likely to be more sophisticated. Thus, they exhibit more sensitivity to interest rates offered on deposits and are more likely to incorporate and understand the implicit protection conferred by state ownership. The more vulnerable banks appear to understand and leverage this feature.

While we cannot say much more formally given what data are available, we also collected anecdotal evidence on the deposit-acquisition strategies of the vulnerable state-owned banks. The increase in deposit rates by these banks during the crisis to chase deposit outflows from private sector banks became so rampant that the Indian Finance Ministry had to step in to curb the behavior (Business Line, 2008). In sum, the more vulnerable PSBs exploit the safety net provided by the government guarantee in crises when the government ownership umbrella becomes more valuable for both the banks and more salient for depositors. These results add texture to our baseline point that the access to government support eases funding access for state-owned PSBs, especially in crises, making stabilization more difficult.[17] Ex-post events reveal that the safety-net perceptions

[16] At the bank level, Table C.9 shows qualitatively similar results for the growth in NPAs and restructured assets. These results are less precise as the bank-level data are less granular than what we have in the branch BSR data.

[17] Preliminary results from the Covid-19 period are supportive of this channel. Private sector banks,

of depositors concerning the state's implicit guarantee were not irrational.[18]

VIII Conclusion

We study a significant bank run episode in India in which private banks face sudden and large losses in deposits that migrate to safe public sector banks (PSBs) owned by the state. A key feature of our analysis is that we observe outcomes for both the banks that face runs and the banks that gain from the flight-to-safety flows. Using data on bank-firm relationships, we also assess the onward impact on bank borrowers and estimate the aggregate impact of the run.

We find that runs propagate beyond the local geographies in which they occur. Banks facing runs cut lending and their credit discipline improves, but it worsens at the state-owned PSBs receiving the windfall deposits from the run. At the firm level, we find that credit contracts for borrowers whose relationships are domiciled at run banks. While it expands for firms borrowing from PSBs gaining run surpluses, these firms tend to perform worse ex-post. The aggregate effects of the reallocation are negative, with growth impaired by about 5%.

An important thread in our study is that while the banks facing runs and their clientele have been the principal focus of research and policy on bank runs, what also matters is how the flight-to-safety flows are re-intermediated back to the real economy. In our study, reintermediation occurs through state-owned banks, the weaker ones. They seem

which received 55% of incremental deposits in the pre-Covid periods, saw their share shrink to 30% in the Covid period. We are developing and pursuing this analysis in future work.

[18] In February 2009, the government announced capital injections in 3 state-owned banks: UCO Bank, Central Bank of India and Vijaya Bank. 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. These injections were based on capital needs, so effectively recapitalized the worse performing banks. These banks are among the highest MES banks in our sample.

to bear greater responsibility for the negative aggregate effects of the run. A policy implication is that while government support is (correctly) seen as a source of financial stability during a crisis, its provision is not free of costs. In the instance we study, the support that lends stability also shelters banks from discipline in the funding market, leading to lax credit allocation.

In our specific setting, the variation in the ownership structure between state-owned and private banks results in a clear marker of differential government support. It seems interesting for further empirical inquiry to test the plausible hypothesis that our conclusions carry over to other settings with differential access to government support such as for too-big-to-fail or too-systemic-to-fail banks vis-a-vis other banks, and for government-sponsored enterprises vis-a-vis private financial institutions.

References

Acharya, Viral V, and Matthew P Richardson. 2008. *Restoring Financial Stability: How to Repair a Failed System.* John Wiley & Sons.

Acharya, Viral V, Lasse H Pedersen, Thomas Philippon, and Matthew Richardson. 2017. "Measuring systemic risk." *The Review of Financial Studies*, 30(1): 2–47.

Adamopoulos, Tasso, and Diego Restuccia. 2014. "The size distribution of farms and international productivity differences." *American Economic Review*, 104(6): 1667–97.

Allais, Maurice. 1947. "Le Probleme de la Planification Economique dans une Economie Collectiviste." *Kyklos*, 1: 254–280.

Banerjee, Abhijit, Shawn Cole, and Esther Duflo. 2005. *Bank Financing in India.* London:Palgrave Macmillan UK.

Banerjee, Abhijit V. 1997. "A Theory of Misgovernance." *The Quarterly Journal of Economics*, 112(4): 1289–1332.

Banerjee, Abhijit V, and Esther Duflo. 2005. "Growth theory through the lens of development economics." *Handbook of economic growth*, 1: 473–552.

Baron, Matthew, Emil Verner, and Wei Xiong. 2020. "Banking Crises Without Panics." *Quarterly Journal of Economics*, 131(1): 51–113.

Barth, James R., Gerard Jr. Caprio, and Ross Levine. 2001. "Banking Systems around the Globe: Do Regulation and Ownership affect Performance and Stability?" *Prudential Supervision: What Works and What Doesn't*, 31–96.

Bau, Natalie, and Adrien Matray. Forthcoming. "Misallocation and capital market integration: Evidence from India." *Econometrica*.

Bernanke, Ben. 1983. "Nonmonetary effects of the financial crisis in Propagation of the Great Depression." *American Economic Review*, 73(3): 257–276.

Blattner, Laura, Luisa Farinha, and Francisca Rebelo. 2019. "When losses turn into loans: The cost of undercapitalized banks." *ECB Working paper*.

Blickle, Kristian, Markus Brunnermeier, and Stephan Luck. 2022. "Who Can Tell Which Banks Will Fail?" *Princeton Working Paper*.

Brandt, Loren, Trevor Tombe, and Xiaodong Zhu. 2013. "Factor market distortions across time, space and sectors in China." *Review of Economic Dynamics*, 16(1): 39–58.

Buera, Francisco J, Joseph P Kaboski, and Yongseok Shin. 2011. "Finance and development: A tale of two sectors." *American Economic Review*, 101(5): 1964–2002.

Business Line. 2008. "India and the global financial crisis."

Business Line. 2009. "Private banks want deposit insurance cap hiked."

Calomiris, Charles, and Charles Kahn. 1991. "The role of demandable debt in structuring optimal debt arrangements." *American Economic Review*, 81(3): 497–513.

Calomiris, Charles W., and Joseph R. Mason. 1997. "Contagion and Bank Failures During the Great Depression: The June 1932 Chicago Banking Panic." *American Economic Review*, 87(5): 863–883.

Calonico, Sebastian, Matias D Cattaneo, and Rocio Titiunik. 2014. "Robust nonparametric confidence intervals for regression-discontinuity designs." *Econometrica*, 82(6): 2295–2326.

Campello, Murillo. 2002. "Internal capital markets in financial conglomerates: Evidence from small bank responses to monetary policy." *The Journal of Finance*, 57(6): 2773–2805.

Chari, Anusha, Lakshita Jain, and Nirupama Kulkarni. 2020. "The Unholy Trinity: Regulatory Forbearance, Stressed Banks and Zombie Firms." *CAFRAL Working Paper*.

Chari, V, and Ravi Jagannathan. 1988. "Banking Panics, Information, and Rational Expectations Equilibrium." *Journal of Finance*, 43(3): 749–761.

Chopra, Yakshup, Krishnamurthy Subramanian, and Prasanna L. Tantri. 2021. "Bank Cleanups, Capitalization, and Lending: Evidence from India." *The Review of Financial Studies*, 34: 4132–4176.

Cole, Shawn. 2009. "Fixing market failures or fixing elections? Agricultural credit in India." *American Economic Journal: Applied Economics*, 1(1): 219–50.

Cramer, Kim Fe. 2020. "Bank Presence and Health." *Available at SSRN 3917526*.

David, Joel M., and Venky Venkateswaran. 2019. "The Sources of Capital Misallocation." *American Economic Review*, 109(7): 2531–2567.

Diamond, Douglas, and Phil Dybvig. 1983. "Bank runs, deposit insurance, and liquidity." *Journal of Political Economy*, 91(3): 401–419.

Diamond, Douglas, and Raghuram Rajan. 2001. "Liquidity Risk, Liquidity Creation, and Financial Fragility: A Theory of Banking." *Journal of Political Economy*, 109: 287–327.

Dinç, I Serdar. 2005. "Politicians and Banks: Political Influences on Government-Owned Banks in Emerging Markets." *Journal of Financial Economics*, 77(2): 453–479.

Dollar, David, and Shang-Jin Wei. 2007. "Das (wasted) kapital: firm ownership and investment efficiency in China." *IMF Working Papers*, 07(9).

Gelman, Andrew, and Guido Imbens. 2019. "Why high-order polynomials should not be used in regression discontinuity designs." *Journal of Business & Economic Statistics*, 37(3): 447–456.

Geng, Zhe, and Jun Pan. 2022. "The SOE Premium and Government Support in China's Credit Market." *Shanghai Advanced Institute of Finance Working Paper*.

Gerschenkron, Alexander. 1962. "Economic Backwardness in Historical Perspective." *Harvard University Press.*

Gopal, Manasa, and Philipp Schnabl. Forthcoming. "The Rise of Finance Companies and FinTech Lenders in Small Business Lending." *Review of Financial Studies*.

Guner, Nezih, Gustavo Ventura, and Yi Xu. 2008. "Macroeconomic implications of size-dependent policies." *Review of Economic Dynamics*, 11(4): 721–744.

Hopenhayn, Hugo, and Richard Rogerson. 1993. "Job turnover and policy evaluation: A general equilibrium analysis." *Journal of Political Economy*, 101(5): 915–938.

Hsieh, Chang-Tai, and Peter J Klenow. 2009. "Misallocation and manufacturing TFP in China and India." *The Quarterly Journal of Economics*, 124(4): 1403–1448.

Imbens, Guido, and Karthik Kalyanaraman. 2012. "Optimal bandwidth choice for the regression discontinuity estimator." *The Review of Economic Studies*, 79(3): 933–959.

Iyer, Rajkamal, and Manju Puri. 2012. "Understanding Bank Runs : The Importance of Depositor-bank Relationships and Networks." *American Economic Review*, 102(4): 1414–1445.

Iyer, R, T Jensen, N Johannesen, and A Sheridan. 2019. "The distortive effects of too-big-to-fail: evidence from the Danish market for retail deposits." *Review of Financial Studies*, 32: 4653–4695.

Jensen, Michael C. 1986. "Agency costs of free cash flow, corporate finance, and takeovers." *American Economic Review*, 76(2): 323–329.

Kashyap, Anil K, and Jeremy C Stein. 1995. "The impact of monetary policy on bank balance sheets." *Carnegie-Rochester Conference Series on Public Policy*, 42: 151–195.

Kashyap, Anil K, and Jeremy C Stein. 2000. "What do a million observations on banks say about the transmission of monetary policy?" *American Economic Review*, 90(3): 407–428.

Kashyap, Anil K., Jeremy C. Stein, and David W. Wilcox. 1993. "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance." *American Economic Review*, 83(1): 78–98.

Khanna, Gaurav, and Priya Mukherjee. 2020. "Political Punishment and Financial Safety Nets: Evidence from India's Demonetization." *Available at SSRN 3514947*.

Khwaja, Asim Ijaz, and Atif Mian. 2008. "Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market." *American Economic Review*, 98(4): 1413–42.

Kulkarni, N., S. K. Ritadhi, S. Vij, and K. Waldock. 2020. "Unearthing Zombies." *CAFRAL Working Paper*.

Lamont, Owen. 1997. "Cash flow and investment: Evidence from internal capital markets." *The Journal of Finance*, 52(1): 83–109.

Lewis, Arthur W. 1949. *The Principles of Economic Planning.* G. Allen and Unwin, London.

LiveMint. 2011. "RBI panel for raising deposit insurance cover to Rs 500000."

Malmendier, Ulrike, and Leslie Shen. 2019. "Scarred Consumption." *University of California, Berkeley Working Paper*.

Meade, James Edward. 1948. *Planning and the Price Mechanism: The Liberal Socialist Solution.* G. Allen and Unwin Ltd.

Midrigan, Virgiliu, and Daniel Yi Xu. 2014. "Finance and misallocation: Evidence from plant-level data." *American Economic Review*, 104(2): 422–58.

Mishra, Prachi, Nagpurnanand Prabhala, and Raghuram Rajan. 2022. "Why banks differ in the pace of adoption of new technology." *The Review of Financial Studies*.

Osotimehin, Sophie. 2019. "Aggregate productivity and the allocation of resources over the business cycle." *Review of Economic Dynamics*, 32: 180–205.

Pavcnik, Nina. 2002. "Trade liberalization, exit, and productivity improvements: Evidence from Chilean plants." *The Review of Economic Studies*, 69(1): 245–276.

Penas, Maria, and Haluk Unal. 2004. "Gains in mergers: Evidence from the bond markets." *Journal of Financial Economics*, 74: 149–179.

Qian, M., and B.Y. Yeung. 2015. "Bank Financing and Corporate Governance." *Journal of Corporate Finance*, 32: 258–270.

Restuccia, Diego, and Richard Rogerson. 2017. "The causes and costs of misallocation." *Journal of Economic Perspectives*, 31(3): 151–74.

Sapienza, Paola. 2004. "The effects of government ownership on bank lending." *Journal of Financial Economics*, 72(2): 357–384.

Saunders, Anthony, and Berry Wilson. 1996. "Contagious bank runs: evidence from the 1929–1933 period." *Journal of Financial Intermediation*, 5(4): 409–423.

Schumacher, Liliana B. 1998. "Information and Currency Run in a System Without a Safety Net: Argentina and the 'Tequila' Shock." *IMF Working Paper*.

Shleifer, Andrei. 1998. "State Versus Private Ownership." *Journal of Economic Perspectives*, 12(4): 133–150.

Shleifer, Andrei, and Robert W Vishny. 1994. "Politicians and Firms." *The Quarterly Journal of Economics*, 109(4): 995–1025.

Song, Zheng, Kjetil Storesletten, and Fabrizio Zilibotti. 2011. "Growing like china." *American Economic Review*, 101(1): 196–233.

Sraer, David., and David Thesmar. 2020. "How to Use Natural Experiments to Estimate Misallocation." *UC Berkeley Working Paper*.

Stiglitz, Joseph E. 1989. "Markets, Market Failures, and Development." *The American Economic Review*, 79(2): 197–203.

Trefler, Daniel. 2004. "The long and short of the Canada-US free trade agreement." *American Economic Review*, 94(4): 870–895.

World Bank. 2009. "India - First Banking Sector Support Loan Project (English)." *Washington, DC: World Bank*.

Young, Nathaniel. 2017. "Banking and growth: Evidence from a regression discontinuity analysis." *EBRD Working Paper*.

Figure I: Time trends in deposits of public and private sector banks

This figure shows the quarterly deposits for private sector and public sector banks respectively for the period 2007 to 2012, where year is the fiscal year from April 1st to March 31st. Deposits have been normalized to 1 as of December 2007 (i.e., Q3 2008). The solid vertical line is shown as of the date of the Bear Stearns rescue on March, 2008. The dashed vertical line is shown as of date of the bankruptcy of Lehman Brothers on September, 2008. Data for quarterly deposits is from the publicly available "Database on Indian Economy" provided by the Reserve Bank of India.

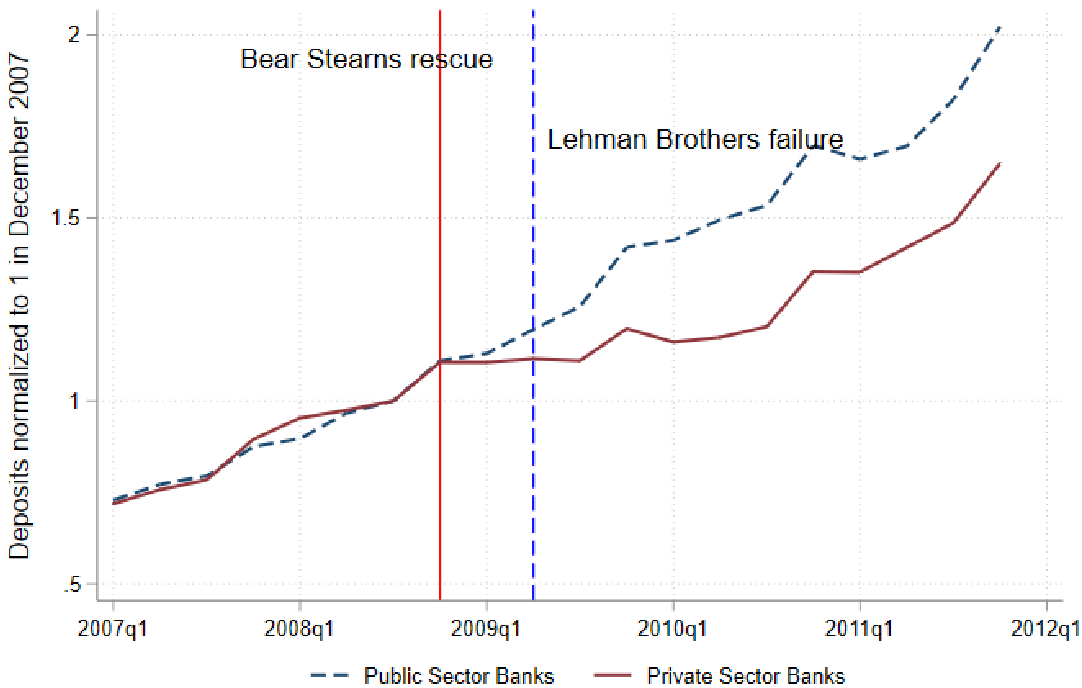


Figure II: Deposit growth and bank runs

The figures below show the heatmap at the district-level the deposit growth for private and public sector banks. Deposit growth is from year 2008 to 2009. Year refers to fiscal year from April 01st to March 31st. Panel (a) shows the overall deposit growth. Panel (b) shows the deposit growth for private sector banks and panel (c) shows the deposit growth for the public sector banks. Districts with no available data are shaded in grey.Data is provided by the Reserve Bank of India.

(a) All Deposits | (b) Private Sector Banks | (c) Public Sector Banks

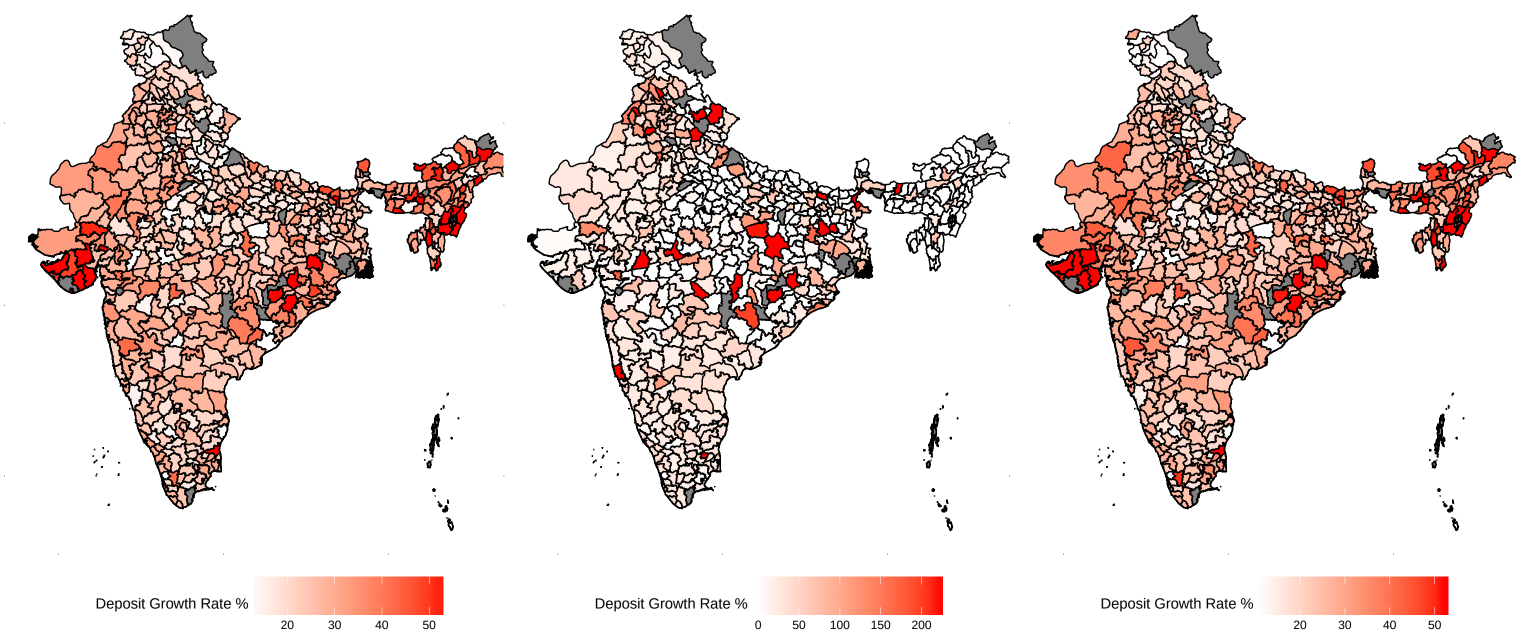


Figure III: Parallel trends assumption

The figure below shows the event study plot for deposit growth in run branches. The coefficients (η_τ) in the the event study plot are obtained from the specification:

$$gd_{jbdt} = \alpha_j + \theta_t + \sum_{\tau} \eta_\tau \times (\mathbb{1}_\tau \times \mathbb{1}_{(Run_j)}) + \epsilon_{jt}$$

where the dependent variable, gd_{jbdt} is the annual growth in deposit for branch j belonging to bank b in district d for time period t (where t ranges from 2002 to 2011), α_j and θ_t are branch and time period fixed effects respectively, and $\mathbb{1}_\tau = 1$ if the year is τ. Branch run variable is 1 (and otherwise) if: (i) the predicted deposit growth of private sector bank branches is more than the actual growth rate, where prediction is on an out-of-sample basis using a regression of deposit growth on size (lagged credit), age, whether rural, lagged credit to deposit ratio and whether public for the years between 2002 and 2006; (ii) the difference in growth rate between 2009 and 2008 is less than zero; (iii) the branch does not appear in the bottom 5 percentiles of deposit growth in the year 2008 but does in 2009. Year refers to fiscal year from April 1st to March 31st. Standard errors are clustered at the branch level. The η_τ coefficients are shown in the figure. Dashed grey lines depict the 5% confidence intervals.

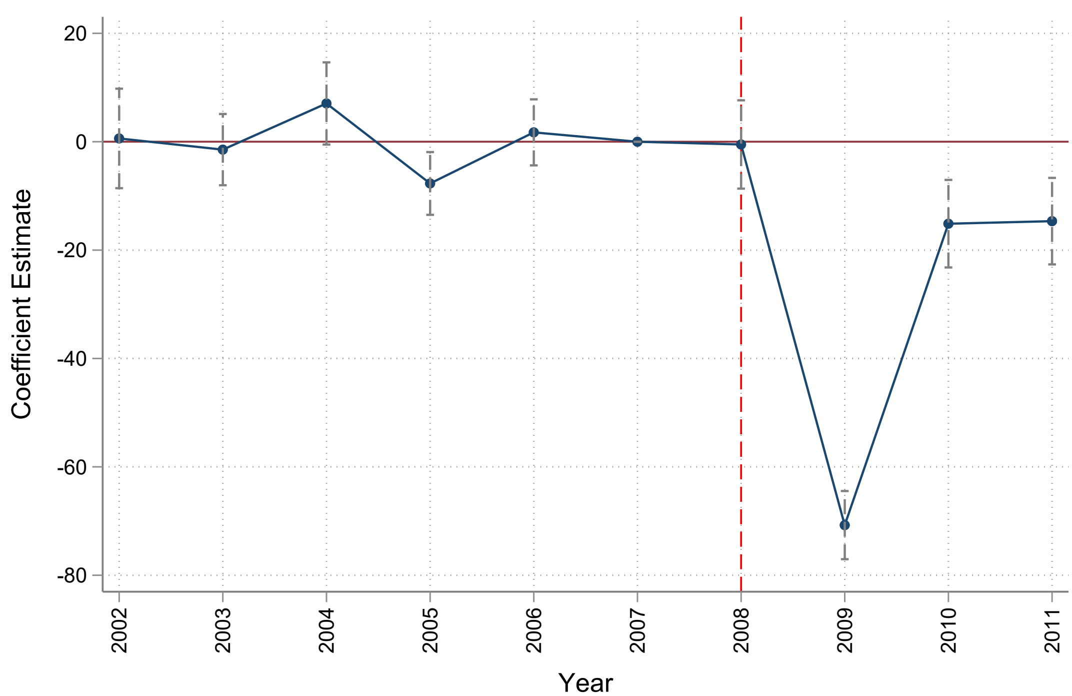
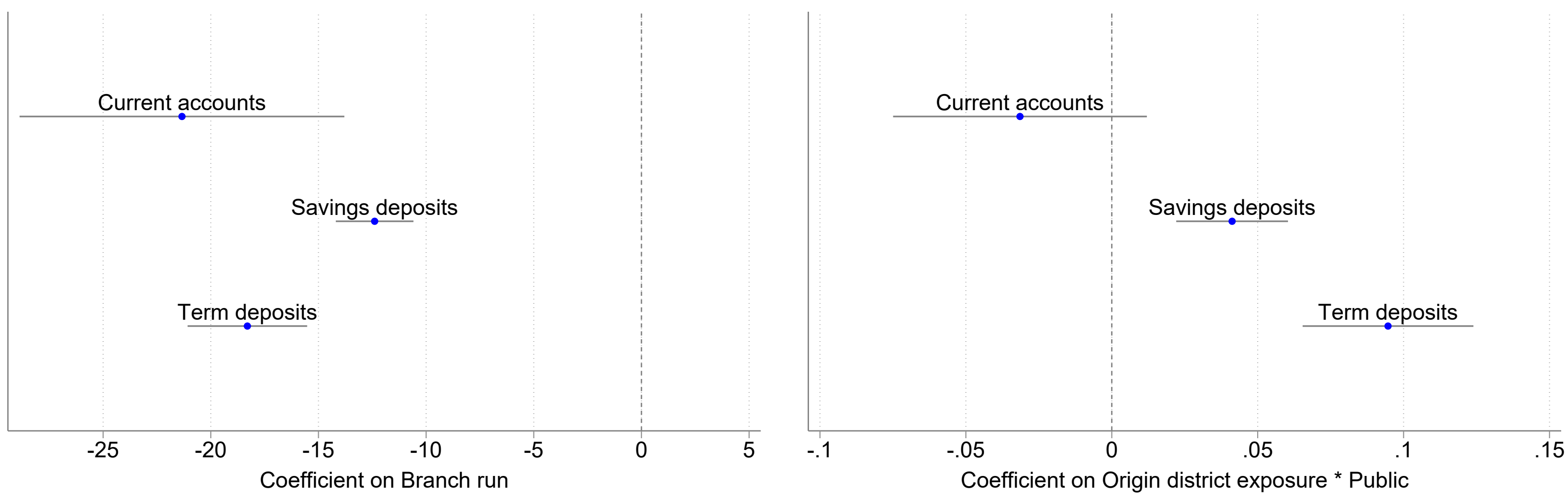


Figure IV: Deposit transformation

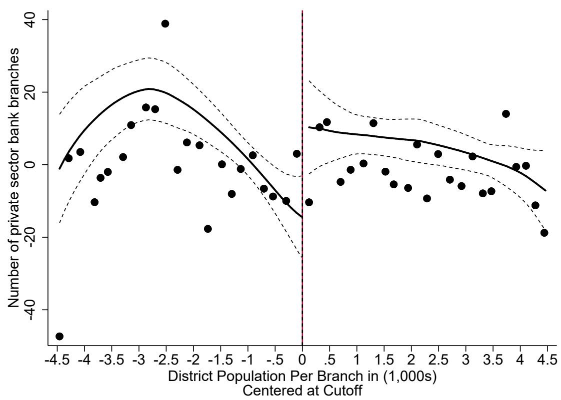
The figures below show the impact on the types of deposit growth: current accounts, savings deposits, and term accounts. Panel (a) shows the impact on the private sector branches with runs. The coefficients (β) from the regression specification in (2) with the dependent variable, deposit growth for current accounts, savings deposits and term deposits are shown. Panel (b) shows the impact on the public sector branches in districts with high exposure to runs. The coefficients (η) from the regression specification in (3) with the dependent variable, deposit growth for current accounts, savings deposits and term deposits are shown. Remaining variables are as defined in Table C.1. The point estimates are represented by dots and the 5% confidence intervals are represented by the lines passing through the point estimates.



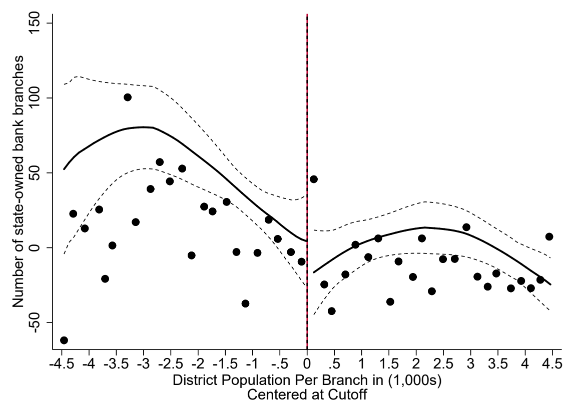
(a) Private sector banks (b) Public sector banks

Figure V: Regression discontinuity: Share of state-owned bank branches

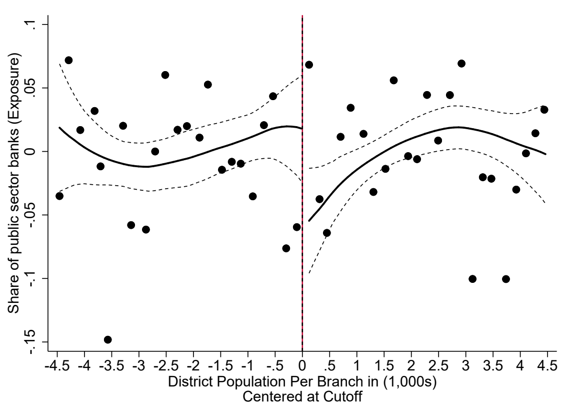
Below are the regression discontinuity plots for the number of private sector bank branches in 2006–08 (panel (a)), number of state-owned bank branches in 2006–08 (panel (b)), deposit share of state-owned banks in 2006–08 (panel (c)), and deposit share of state-owned banks in 2001–03 (panel (d)) at the district-level. Year refers to fiscal year from April 01st to March 31st. 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.



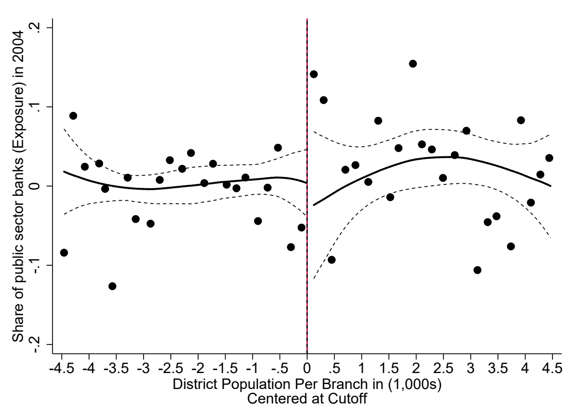
(a) Private sector bank branches in 2006–08



(b) State-owned bank branches in 2006–08



(c)
Deposit share of state-owned banks in 2006–08



(d) Deposit share of state-owned banks in 2001–03

Figure VI: Deposit growth and bank vulnerability

This figure plots the deposit growth during the crisis period against MES for private and state-owned banks. Deposit growth is from March 2008 to March 2009. MES Stock market data is from the National Stock Exchange and the Bombay Stock Exchange and as defined in Table C.1. Deposit data is from the Reserve Bank of India.

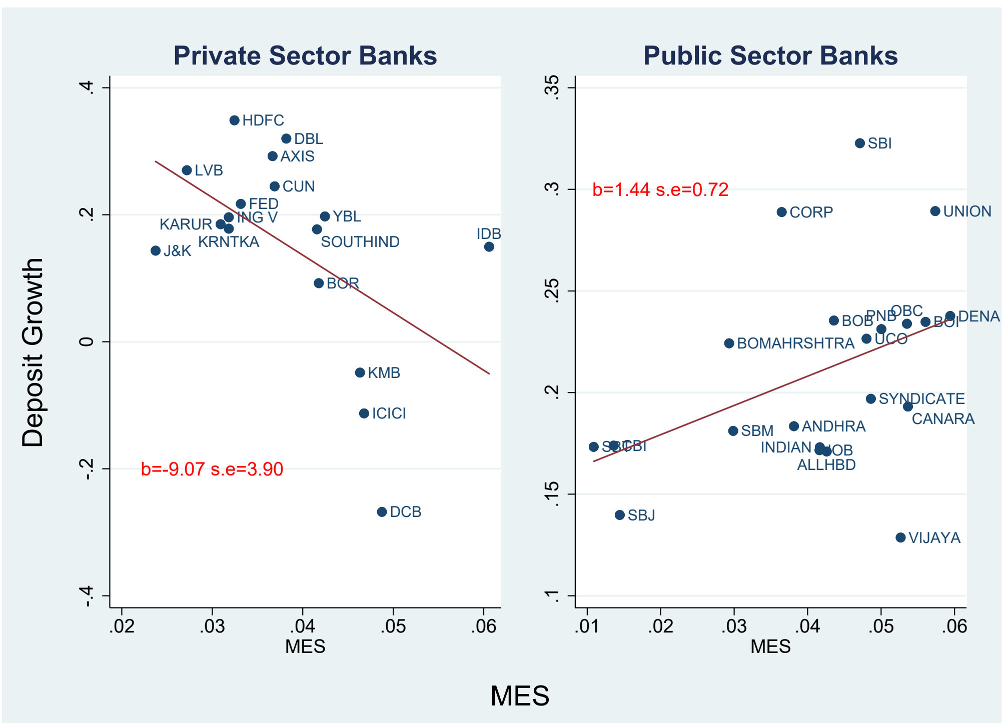


Table I: Descriptive Statistics

This table presents the summary statistics for all branches in our analysis. Panel A shows the summary statistics for the measures of exposure to runs. Panel B, C, D, and E show the summary statistics for variables at the branch-level, bank-level, firm-level, and industry-level respectively. Branch run variable is 1 (and otherwise) if: (i) the predicted deposit growth of private sector bank branches is more than the actual growth rate, where prediction is on an out-of-sample basis using a regression of deposit growth on size (lagged credit), age, whether rural, lagged credit to deposit ratio and whether public for the years between 2002 and 2006; (ii) the difference in growth rate between 2009 and 2008 is less than zero; (iii) the branch does not appear in the bottom 5 percentiles of deposit growth in the year 2008 but does in 2009. District exposure is the negative deposit growth rate of all branches in a district that with Branch run equal to 1. Private bank exposure is the deposit weighted average of the branch run measure for every branch of a bank with the 2007 deposits as weights. Public bank exposure is the average of the district exposure measure with the 2007 deposits as weights. Firm-level public bank exposure (private bank exposure) is the loan-weighted public bank exposure (private bank exposure) measure, aggregated to the firm level using prior total borrowing between 2002 to 2008 as weights. Industry-level public bank exposure (private bank exposure) is the loan-weighted bank exposure, that is, bank-level public bank exposure (private bank exposure) aggregated to the industry level using the total borrowing between 2002 and 2008 as weights. Data is for the post-period between 2009–2011 in all panels. Pre-period data in Panel E is for the period 2006–2008. Year refers to the fiscal year from April 1st to March 31st. Deposit, credit, non-performing assets (NPA), and deposit rate growth are for the annual period from t to t-1. Remaining variables are as defined in Table C.1.

Panel A: Measures of exposure to runs

	Obs.	Mean	SD	p10	p50	p90
Branch run (indicator)	62161	0.0070				
(i) Measure 1	62161	0.0279				
(ii) Measure 2	62161	0.0483				
(iii) Measure 3	62161	0.0080				
District exposure	560	8.40	18.76	0.00	0.00	36.94
Private bank exposure	22	.104	.096	.012	.0805	.234
Public bank exposure	26	41.19	7.341	30.736	40.699	52.705

Panel B: Branch-level variables

Branch-level	All		Public Sector Banks		Private Sector Banks	
	Mean	SD	Mean	SD	Mean	SD
Deposit growth (in %)	21.50	27.30	20.70	26.10	26.60	33.90
(i) Demand deposit growth	50.10	138.10	50.50	140.30	47.30	122.60
(ii) Savings deposit growth	23.10	32.00	22.10	30.80	29.60	38.40
(iii) Term deposit growth	23.40	39.30	22.20	37.30	31.20	50.40
Credit growth (in %)	28.00	55.30	24.30	46.70	52.40	90.50
(i) Services credit growth	20.40	47.80	19.10	45.70	32.60	63.20
(ii) Agriculture credit growth	73.70	237.50	68.70	226.30	118.60	316.50
(iii) Industry credit growth	108.90	388.70	103.00	375.30	154.20	477.80
Obs. (Branch × Year)	168525		148580		19945	
NPA growth (in %)	56.10	166.90	56.70	165.80	46.90	184.10
(i) Agricultural NPA growth	107.10	336.40	108.40	335.90	85.60	345.20
(ii) Non-agricultural NPA growth	113.10	374.80	111.20	368.00	131.00	433.50
Obs. (Branch × Year)	64041		58203		5838	

Table I: Descriptive Statistics (contd)

Panel C: Bank-level variables

Bank-level	All		Public Sector Banks		Private Sector Banks	
	Mean	SD	Mean	SD	Mean	SD
Deposit growth (in %)	17.30	10.50	16.70	9.30	18.00	11.90
Credit growth (in %)	19.30	12.10	18.30	8.90	20.40	15.10
Deposit rate growth (in %)	1.10	0.50	1.10	0.60	1.10	0.50
Obs. (Bank × Year)	232		127		105	

Panel D: Firm-level variables

	Mean	SD	p10	p50	p90
Δ log(Credit) growth	0.01	7.65	-1.88	0.00	1.89
$\mathbb{1}_{Low-quality}$	0.24	0.43	0.00	0.00	1.00
Δ Log Sales	0.24	0.98	-0.29	0.02	0.98
Δ ROA	0.00	1.87	-0.13	0.00	0.11
Post-period MRPK	32.85	2080.00	0.22	1.22	3.26
Post-period MRPK	14.69	350.54	0.17	1.22	3.32
Pre-period Log Sales	5.25	2.41	1.89	5.36	8.21
Pre-period Tangibility	0.44	2.10	0.00	0.32	1.00
Pre-period $\mathbb{1}_{Low-quality}$	0.20	0.40	0.00	0.00	1.00
Obs. (Firm)	12668				

Panel E: Industry-level moments of log-MRPK distribution

	Mean	SD	p10	p50	p90
Pre-period Var(log-MRPK)	2.58	1.41	1.59	2.28	3.20
Pre-period Mean(log-MRPK)	0.45	0.84	-0.04	0.44	0.96
Pre-period Cov(log-MRPK, log VA)	0.50	0.24	0.33	0.54	0.65
Post-period Var(log-MRPK)	2.66	1.64	1.47	2.34	3.32
Post-period Mean(log-MRPK)	0.51	0.80	0.05	0.44	0.95
Post-period Cov(log-MRPK, log VA)	0.44	0.22	0.30	0.47	0.57
Obs. (Industry)	100				

Table II: Deposit and credit growth at branches with runs

This table looks at the deposit and credit growth for branches. The dependent variable in columns 1–2 (columns 3–4) is the annual growth rate of deposits (credit) from t to t-1 for the period 2009 to 2011. Columns 1 and 3 (2 and 4) include all branches (private sector branches). Branch run variable is 1 (and otherwise) if: (i) the predicted deposit growth of private sector bank branches is more than the actual growth rate, where prediction is on an out-of-sample basis using a regression of deposit growth on size (lagged credit), age, whether rural, lagged credit to deposit ratio and whether public for the years between 2002 and 2006; (ii) the difference in growth rate between 2009 and 2008 is less than zero; (iii) the branch does not appear in the bottom 5 percentiles of deposit growth in the year 2008 but does in 2009. Year refers to the fiscal year from April 1st to March 31st. Bank-year, private bank-district-year, district-year fixed effects are as indicated. All columns include the branch covariates and their interaction with a time trend. The branch characteristics included are an indicator for whether a branch is deposit poor (below median deposits in 2008), the percentage of skilled officers, and the credit to deposit ratio in 2008. Standard errors are clustered at the branch-level.

	(1)	(2)	(3)	(4)
Dep. variable:	Deposit growth		Credit growth	
Sample:	All branches	Private sector branches	All branches	Private sector branches
Branch run	-15.893***	-14.617***	-13.671***	-11.450***
	(0.976)	(0.976)	(1.972)	(1.997)
R-squared	0.145	0.291	0.121	0.197
No. of Obs.	168525	19945	168525	19945
Bank × Year-FE	Y	Y	Y	Y
Private bank × District × Year FE	Y	N	Y	N
District × Year FE	Y	Y	Y	Y
Branch characteristics	Y	Y	Y	Y
Branch characteristics × t	Y	Y	Y	Y

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

Table III: Local spillover effects of bank runs on nearby branches

The table shows the impact of runs on branches in the same district for deposit and credit growth. The dependent variable in columns 1–3 (columns 4–6) is the annual growth rate of deposits (credit) from t to t-1 for the period 2009 to 2011. District exposure is the negative deposit growth rate of all branches in a district that with Branch run equal to 1, where branch run is as defined in Table C.1. Public is the indicator variable for a public sector bank. Columns 1 and 4 include all branches, columns 2 and 5 include only public sector bank branches, and columns 3 and 6 include only private sector bank branches with no runs (branches with branch run as 0 where branch run is as defined in Table C.1). Year refers to the fiscal year from April 1st to March 31st. Bank-year and district-year fixed effects are as indicated. All columns also include branch characteristics and district covariates, and their interaction with a time trend. Branch characteristics included are an indicator for whether a branch is deposit poor (below median deposits in 2008), the percentage of skilled officers, and the credit to deposit ratio in 2008. The district covariates from the 64th NSS Employment and Unemployment Survey for 2006–07 are the percentage of urban population, unemployment rate, average age, and average weekly wages of households in a given district; each of the control variables are also interacted with a time trend component. Standard errors are clustered at the district level.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable:		Deposit growth			Credit growth	
Sample:	All branches	Public sector branches	Private sector branches with no runs	All branches	Public sector branches	Private sector branches with no runs
District exposure		0.043***	0.010		0.055***	-0.166***
		(0.010)	(0.020)		(0.020)	(0.053)
Public * District exposure	0.071***			0.290***		
	(0.014)			(0.047)		
R-squared	0.109	0.054	0.154	0.113	0.052	0.133
No. of Obs.	179442	156256	21954	179442	156256	21954
Bank × Year-FE	Y	Y	Y	Y	Y	Y
District × Year FE	Y	N	N	Y	N	N
District covariates	Y	Y	Y	Y	Y	Y
District covariates × t	Y	Y	Y	Y	Y	Y
Branch characteristics	Y	Y	Y	Y	Y	Y
Branch characteristics × t	Y	Y	Y	Y	Y	Y

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

Table IV: Bank-level impact

This table looks at the impact of exposure to bank runs on deposit growth and credit growth at the bank-level. The dependent variable in columns 1–2 (columns 3–4) is the annual growth rate of deposits (credit) from t to t-1 for the period 2009 to 2011. Columns 1 and 3 include only private sector banks and columns 2 and 4 include only public sector banks. Private bank exposure is the deposit weighted average of the branch run measure for every branch of a bank with the 2007 deposits as weights. Public bank exposure is the average of the district exposure measure with the 2007 deposits as weights. Year refers to the fiscal year from April 1st to March 31st. Bank level controls included are gross NPA by gross advances in percentage, tier-1 capital adequacy ratio, and ATMs per capita in 2008 their interaction with a time trend component and whether a bank is an old private bank. Standard errors are clustered at the bank-level.

	(1)	(2)	(3)	(4)
Dep. variable:	Deposit growth		Credit growth	
Sample:	Private	Public	Private	Public
Private bank exposure	-8.098***		-8.484***	
	(2.104)		(2.694)	
Public bank exposure		1.542**		0.863
		(0.626)		(0.553)
R-squared	0.389	0.289	0.313	0.312
No. of Obs.	53	74	53	74
Year-FE	Y	Y	Y	Y
Bank controls	Y	Y	Y	Y
Bank controls × t	Y	Y	Y	Y

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

Table V: Transmission of credit shock through the bank-branch network

This table examines the impact on credit growth of branches with different exposure to runs. The dependent variable is the annual growth rate of total credit from t to t-1 for the period 2009 to 2011. Branch run variable is 1 (and otherwise) if: (i) the predicted deposit growth of private sector bank branches is more than the actual growth rate, where prediction is on an out-of-sample basis using a regression of deposit growth on size (lagged credit), age, whether rural, lagged credit to deposit ratio and whether public for the years between 2002 and 2006; (ii) the difference in growth rate between 2009 and 2008 is less than zero; (iii) the branch does not appear in the bottom 5 percentiles of deposit growth in the year 2008 but does in 2009. District exposure is the negative deposit growth rate of all branches in a district that with Branch run equal to 1. Private bank exposure is the deposit weighted average of the branch run measure for every branch of a bank with the 2007 deposits as weights. Public bank exposure is the average of the district exposure measure with the 2007 deposits as weights. Year refers to the fiscal year from April 1st to March 31st. Bank level controls included are gross NPA by gross advances in percentage, tier-1 capital adequacy ratio, and ATMs per capita in 2008 their interaction with a time trend component and whether a bank is an old private bank. Fixed effects and samples are as indicated. Branch characteristics included are an indicator for whether a branch is deposit poor (below median deposits in 2008), the percentage of skilled officers, and the credit to deposit ratio in 2008. The district covariates from the 64th NSS Employment and Unemployment Survey for 2006–07 are the 2006–2007 percentage of urban population, unemployment rate, average age, and average weekly wages of households in a given district; each of the control variables are also interacted with a time trend component. Standard errors are clustered at the district-level.

	(1)	(2)	(3)
Dep. variable:	Credit growth		
Sample:	Private	Public	
Private bank exposure	-2.412***		
	(0.823)		
Public bank exposure		-0.433*	-0.043
		(0.236)	(0.237)
Branch run	-11.199***		
	(1.992)		
District exposure		0.034***	
		(0.012)	
R-squared	0.179	0.024	0.064
No. of Obs.	18938	146150	146150
District-Year FE	Y	N	Y
Year-FE	Y	Y	Y
Bank controls	Y	Y	Y
Bank controls $\times$t	Y	Y	Y
District covariates	Y	Y	Y
District covariates$\times$t	Y	Y	Y
Branch characteristics	Y	Y	Y
Branch characteristics$\times$t	Y	Y	Y

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

Table VI: Effect on loan performance

The table looks at the impact on loan performance. Observations in Panel A are at the branch-level. The dependent variable is the annual growth in non-performing assets (NPA) — for all, agricultural, and non-agricultural loans — from t to t-1 for the period 2009 to 2011. Branch run, district exposure, public bank exposure and private bank exposure is as defined in Table C.1. Standard errors are clustered at the district-level. Observations in Panel B are at the bank-level. The dependent variable is the annual growth in stressed assets — defined as the sum of non-performing and restructured assets — from t to t-1 for the period 2009 to 2011. Year refers to the fiscal year from April 1st to March 31st. Standard errors are clustered at the bank-level. In both panels, bank-level controls included are as in Table IV. District and branch covariates are as in Table V. Samples and fixed effects are as indicated.

Panel A: Branch-level Non-performing assets

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable:	NPA growth					
Sample:	Private sector banks			Public sector banks		
Type:	All	Agri.	Non-agri.	All	Agri.	Non-agri.
Bank run	1.578	3.044	28.11			
	(3.054)	(40.08)	(19.24)			
Private bank exposure	-3.591***	-1.612	-0.407			
	(0.981)	(9.503)	(6.504)			
Public bank exposure				1.770**	1.751	10.27***
				(0.782)	(5.628)	(2.561)
District Exposure				-0.143***	-0.356*	0.246**
				(0.0212)	(0.195)	(0.101)
R-squared	0.0139	0.0345	0.0113	0.0115	0.00630	0.0112
No. of Obs.	5838	1654	5412	58203	21340	51056
District-Year FE	Y	Y	Y	N	N	N
Bank controls	Y	Y	Y	Y	Y	Y
Bank controls × t	Y	Y	Y	Y	Y	Y
District covariates	Y	Y	Y	Y	Y	Y
District covariates × t	Y	Y	Y	Y	Y	Y
Branch characteristics	Y	Y	Y	Y	Y	Y
Branch characteristics × t	Y	Y	Y	Y	Y	Y

Panel B: Bank-level stressed assets

	(1)	(2)
Dep. variable:	Stressed assets growth	
Sample:	Private	Public
Private bank exposure	-10.944**	
	(5.077)	
Public bank exposure		-3.472
		(4.820)
R-squared	0.492	0.515
No. of Obs.	49	74
Year-FE	Y	Y
Bank controls	Y	Y
Bank controls × t	Y	Y

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

Table VII: Real outcomes

Panel A is loan-level data aggregated to the firm-bank level. The dependent variable in columns 1–2 is the log changes in credit calculated between the years before the crisis (2006–2008) and the crisis years (2009-2011). The dependent variable in columns 3–4 and 5–6 is an indicator for exit and entry for a bank-firm pair. Exit is an indicator equal to 1 if no new loan is made in crisis years and at least one loan was made in the pre-crisis period. Entry is an indicator equal to 1 if a new loan is made in the crisis years but no loan was made in the pre-crisis period for the bank-firm pair. Private and public bank exposure are as defined in Table C.1. Bank level controls included are gross non-performing assets to advances, tier-1 capital adequacy ratio, and ATMs per capita as of 2008. Firm fixed effects are included in columns 2, 4, and 6. Standard errors are clustered at the bank-level. Observations in Panel B are at the firm-level. The dependent variable in column 1 is the log changes in credit calculated between the years before the crisis (2006–2008) and the crisis years (2009-2011). In column 2, low-quality is an indicator for whether the interest coverage ratio in all years between 2009–2011 is less than 1. The remaining dependent variables in Panel B are sales growth in column 3, change in return on assets (EBIT/Assets) in column 4, and capital growth (log change in gross fixed assets) in column 5. Year refers to fiscal year from April 01^{st} to March 31^{st}. Firm-level controls included are an indicator for whether a firm has interest coverage ratio less than 1, log of total assets, and the tangibility ratio (defined as net fixed assets to total assets) during the period 2006–2008. Private and Public bank exposure$_{Firm}$ are as defined in Table C.1. All columns include fixed effects at the 3-digit industry level. Standard errors are clustered at the 3-digit industry level. Observations in Panel C are at the industry-level for the pre-period (2006–2008) and post-period (2009–2011). The dependent variable is one of the three moments of the log-MRPK distribution: the cross-sectional variance of log-MRPK in an industry year (columns 1–2), the cross-sectional mean of log-MRPK (columns 3–4), and in columns 5–6 the correlation of log-MRPK and log VA (log sales), with average MRPK calculated for the pre- and post-period as the total sales to capital (gross fixed assets). Post is a dummy variable for the crisis period (2009-2011). Private and Public bank exposure$_{industry}$ are as defined in Table C.1. Columns include time and 3-digit industry fixed effects as indicated. Standard errors are clustered at the industry level.

Panel A: Loan-level outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable:	Δ log(Credit)		Exit		Entry	
Private bank exposure	-0.177***	-0.177***	0.012**	0.012**	0.007	0.007
	(0.051)	(0.052)	(0.006)	(0.006)	(0.006)	(0.006)
Public bank exposure	0.005	0.005	-0.003	-0.003	-0.005	-0.005
	(0.052)	(0.053)	(0.003)	(0.003)	(0.004)	(0.004)
R-squared	0.001	0.047	0.005	0.046	0.006	0.061
No. of Obs.	97128	97128	137233	137233	137233	137233
Firm FE	N	Y	N	Y	N	Y
Firm controls	Y	Y	Y	Y	Y	Y
Bank controls	Y	Y	Y	Y	Y	Y

Panel B: Firm-level outcomes

	(1)	(2)	(3)	(4)	(5)
Dep. variable:	Δ log(Credit)	$\mathbb{1}_{Low-quality}$	Δ Log Sales	Δ ROA	Δ Log Capital
Private bank exposure$_{Firm}$	-1.384***	-0.013	-0.019	-0.008	-0.013
	(0.224)	(0.010)	(0.022)	(0.009)	(0.023)
Public bank exposure$_{Firm}$	0.573**	0.016**	-0.055**	-0.003	-0.105***
	(0.282)	(0.008)	(0.026)	(0.006)	(0.022)
R-squared	0.013	0.190	0.023	0.059	0.081
No. of Obs.	17461	12749	12749	12668	10850
Industry FE	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y

Panel C: Industry-level outcomes: Moments of log-MRPK distribution

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable:	Var(log-MRPK)		Mean(log-MRPK)		Cov(log-MRPK, log VA)	
Post * Public bank exposure$_{industry}$	0.955**	0.782**	-0.038	0.047	-0.067	-0.071
	(0.433)	(0.393)	(0.142)	(0.111)	(0.072)	(0.072)
Post * Private bank exposure$_{industry}$	-0.371	-0.182	-0.004	-0.098*	0.065	0.070
	(0.297)	(0.229)	(0.103)	(0.053)	(0.080)	(0.081)
Public bank exposure$_{industry}$	0.054		-0.173		0.013	
	(0.287)		(0.214)		(0.064)	
Private bank exposure$_{industry}$	0.527		0.023		-0.054	
	(0.336)		(0.187)		(0.073)	
R-squared	0.054	0.799	0.011	0.952	0.028	0.745
No. of Obs.	201	200	201	200	201	200
Industry FE	N	Y	N	Y	N	Y
Period FE	Y	Y	Y	Y	Y	Y

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

Table VIII: Regression discontinuity: Under-banked status, share of state-owned banks, and deposit growth of private sector banks

This table presents the estimates for deposit growth of private sector bank branches with high share of public sector bank (PSB) deposits using branch-level data. The dependent variable is the annual growth rate of deposits from t-1 to t for the period 2009 to 2011. Year refers to fiscal year from April 01st to March 31st. PSB share is instrumented with whether a district is banked, that is, whether the the population per branch minus its national average is less than zero. The first and second stage results are as presented. The specification includes state-year and bank-year fixed effects and also the following covariates: an indicator for whether a branch is deposit poor (below median deposits in 2008), the percentage of skilled officers, and the credit to deposit ratio in 2008 and their interactions with time trends. Observations are weighted with 2007 deposits and 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.

	(1)	(2)
Dep. variable:	Deposit growth	
Sample:	Private	
	First stage	Second stage
Banked	0.0387***	
	(0.00305)	
PSB share		-65.57**
		(27.27)
F-stat	161	
R-squared	0.816	0.187
No. of Obs.	12098	12093
State-Year FE	Y	Y
Bank-Year FE	Y	Y
Controls	Y	Y

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

Table IX: Heterogeneity within private and state-owned banks: Bank vulnerability

The dependent variable in Panel A is deposit growth (columns 1–2), credit growth (columns 3–4), and agricultural and non-agricultural non-performing assets (NPA) growth (columns 5–8) from t-1 to t at the branch-level for the period 2009–2011. Year refers to fiscal year from April 01st to March 31st. MES is defined as 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. The dependent variable in Panel B is the change in weighted average deposit rate in Basis Points (BPS) for retail (columns 1 and 3) and non-retail (columns 2 and 4) depositors. The sample of public and private sector banks is as indicated in both panels. All columns include district-year fixed effects. Standard errors are clustered at the branch-level.

Panel A: Deposit, credit, and non-performing assets growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. variable:	Deposit growth		Credit growth		NPA growth			
Sample:	Private	Public	Private	Public	Private		Public	
Type:					Agri.	Non-Agri.	Agri.	Non-Agri.
MES	-2.367***	0.182**	-2.112**	0.363***	8.064	-28.252***	7.702***	2.746**
	(0.487)	(0.077)	(0.826)	(0.134)	(15.042)	(7.405)	(2.581)	(1.348)
R-squared	0.099	0.049	0.078	0.037	0.235	0.116	0.108	0.028
No. of Obs.	18924	103966	18924	103966	2001	6900	17536	52589
District-Year FE	Y	Y	Y	Y	Y	Y	Y	Y

Panel B: Deposit rates

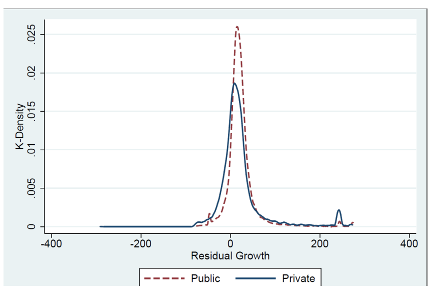
	(1)	(2)	(3)	(4)
Dep. variable:	Change in Deposit Rates (in BPS)			
Sample:	Private		Public	
Type:	Retail	Non-retail	Retail	Non-retail
MES	1.157	-0.713	-6.392***	2.483***
	(0.765)	(2.085)	(0.186)	(0.657)
R-squared	0.752	0.370	0.539	0.060
No. of Obs.	9929	9651	40857	36736
District-Year FE	Y	Y	Y	Y

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

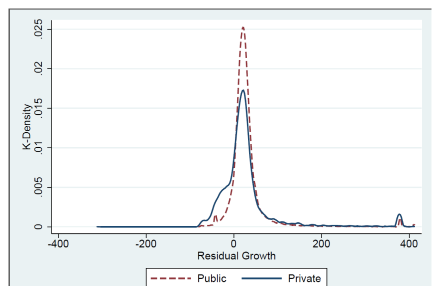
Online Appendix

Figure B.1: Distribution of ΔDeposit growth rates

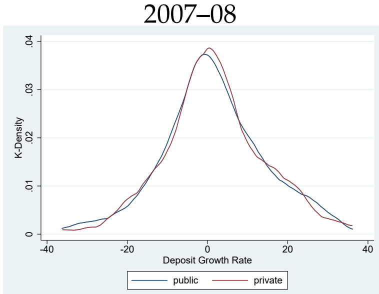
Panels (a) and (b) plots the excess deposit growth in the year 2008 and year 2009. Year refers to fiscal year from April 01st to March 31st. Excess deposit growth is the difference between the actual deposit growth rate and the predicted growth on an out-of-sample basis using a regression of deposit growth on size (lagged credit), age, whether rural, lagged credit to deposit ratio and whether public for the years between 2002 and 2006. Panels (c) and (d) show the distribution of the change in growth rates of deposits. Panel (c) shows the difference in growth rates for year 2007 and year 2008 (Δ of growth rates). Panel (d) shows the difference in growth rates for year 2008 and year 2009. Panel (e) and (f) show the distribution of deposit growth rate for year 2008 and year 2009 for public sector banks and private sector banks, and restrict to branches with deposit growth rates below zero.



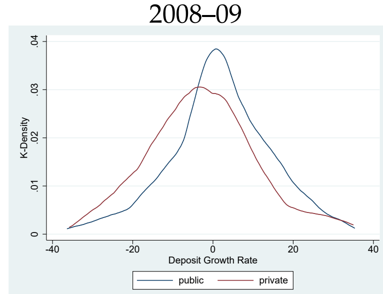
(a)
2007–08



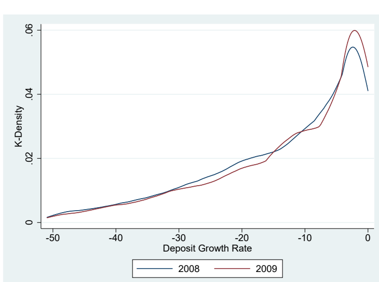
(b)
2008–09



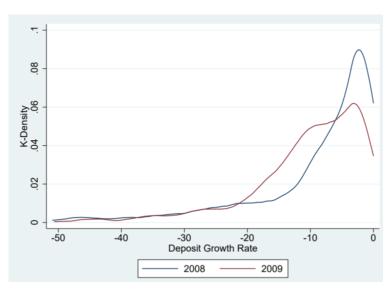
(c)
2007–08



(d)
2008–09



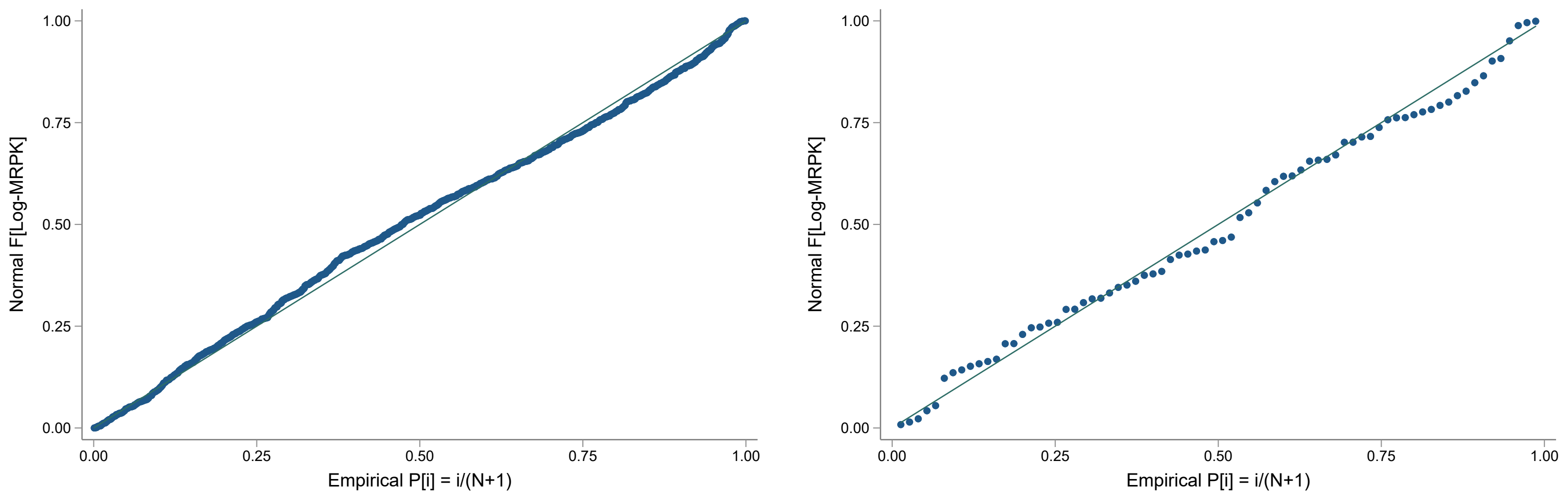
(e)
2007–08



(f)
2008–09

Figure B.2: Log-normality of MRPKs in the data

The figure shows the quantiles of log-MRPK against quantiles of normal distribution. MRPK is as of 2008 and computed as the ratio of sales to the gross book value of total assets and is then standardized (z-scored by subtracting the mean value and dividing by the standard deviation). Panel (a) shows the figure for the sample of manufacturing firms and panel (b) is for the remaining sample of non-manufacturing firms.

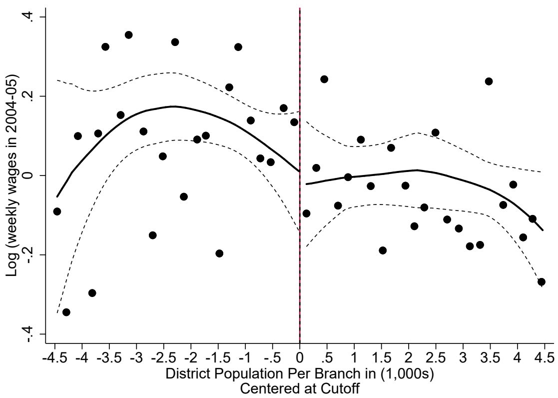


(a) Manufacturing firms

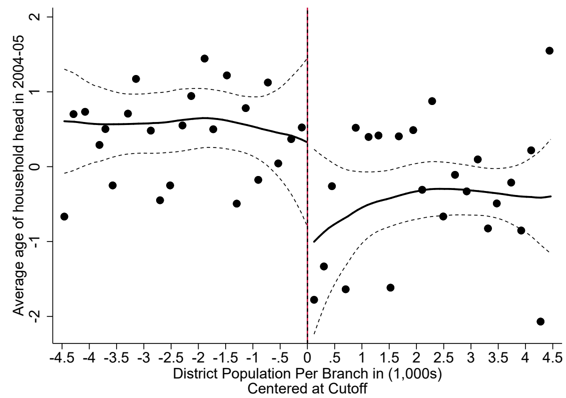
(b) Non-manufacturing firms

Figure B.3: Regression discontinuity: Covariate balance

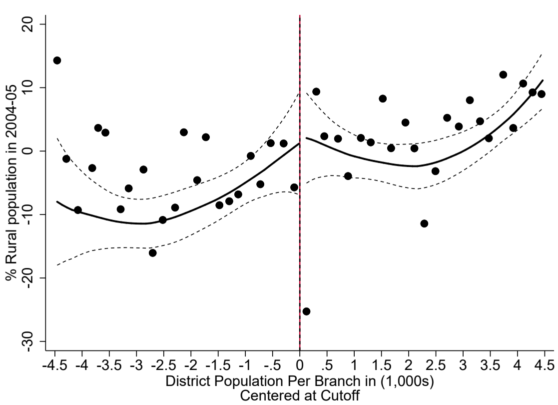
The figure below shows the regression discontinuity (RD) plots for the covariates weekly wages (panel (a)), median age (panel (b)), percentage rural population (panel (c)), percentage female population (panel (d)), percentage of population with high school education (panel (e)), and unemployment rate (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 64th NSS Employment and Unemployment Survey for 2006–07. Branch-level and population data to construct the running variable are from the Reserve Bank of India and the 2001 Census respectively.



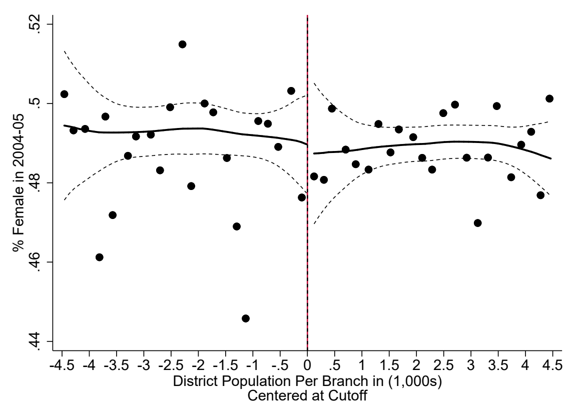
(a) Weekly Wages



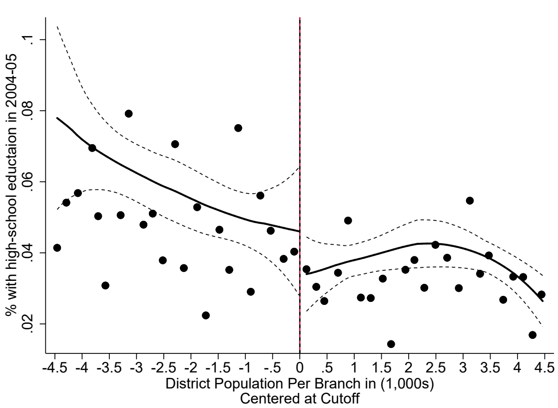
(b) Median Age



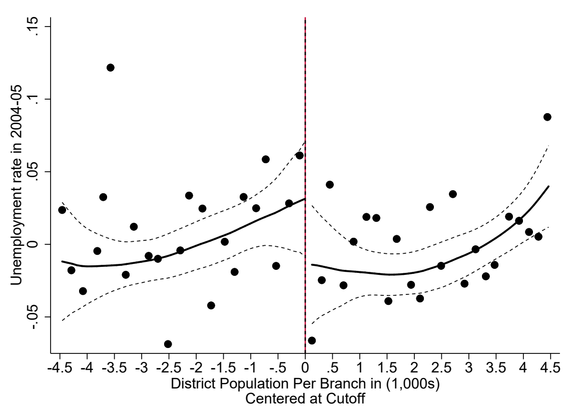
(c) Rural Population (in %)



(d) Fraction female (in %)



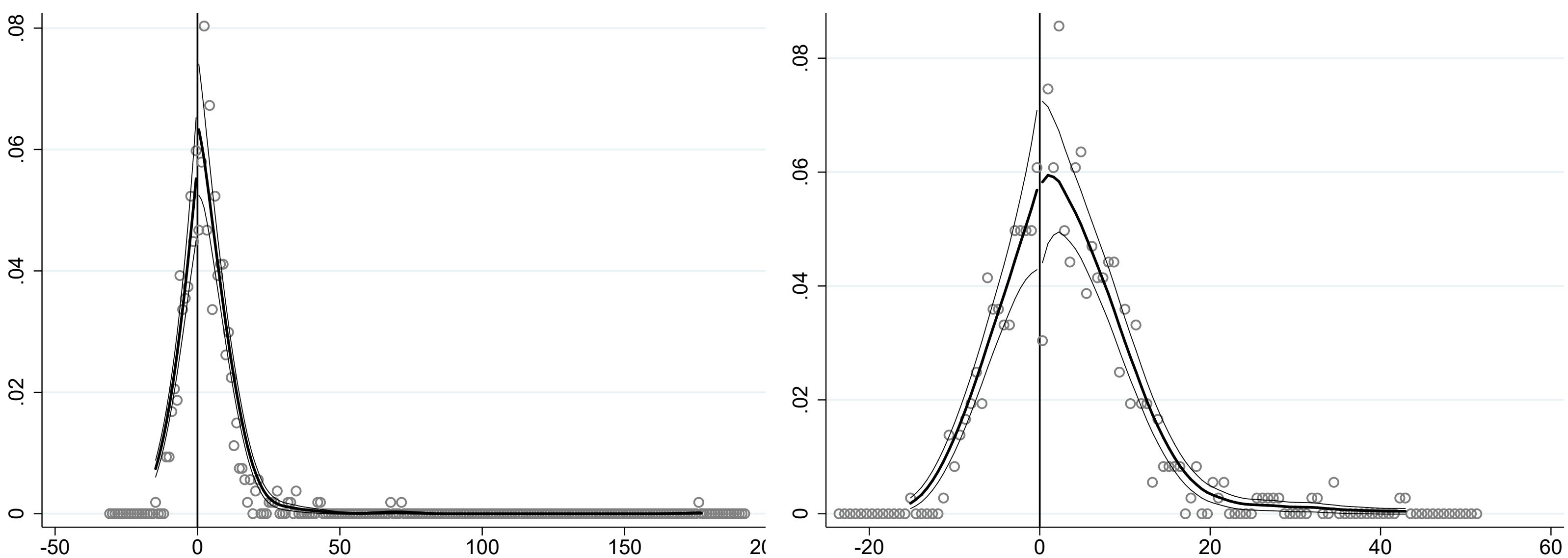
(e) Fraction with high school education (in %)



(f) Unemployment Rate

Figure B.4: 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. 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.



(a) Full sample

(b) Without outliers

Table C.1: Glossary of variables

Data Item	Variable	Definition & Source
1	Branch Run	Branch run variable is 1 (and otherwise) if all conditions below are satisfied. Year refers to the fiscal year from April 1^{st} to March 31^{st}. (i) The predicted deposit growth of private sector bank branches is more than the actual growth rate, where prediction is on an out-of-sample basis using a regression of deposit growth on size (lagged credit), age, whether rural, lagged credit to deposit ratio and whether public for the years between 2002 and 2006. (ii) The difference in growth rate between 2009 and 2008 is less than zero. (iii) The branch does not appear in the bottom 5 percentiles of deposit growth in the year 2008 but does in 2009.
2	District exposure	District exposure is the negative deposit growth rate of all branches in a district that with Branch run equal to 1.
3	Private bank exposure	Private bank exposure is the deposit weighted average of the branch run measure for every branch of a bank with the 2007 (measured as of March 31^{st}) deposits as weights.
4	Public bank exposure	Public bank exposure is the average of the district exposure measure with the 2007 (measured as of March 31^{st}) deposits as weights.
5	Public (Private) Firm exposure	Firm-level public bank exposure (private bank exposure) is the loan-weighted public bank exposure (private bank exposure) measure, aggregated to the firm level using prior total borrowing between 2002 to 2008 as weights. Year refers to fiscal year from April 1^{st} to March 31^{st}.
6	Public (Private) Industry Exposure	Industry-level public bank exposure (private bank exposure) is the loan-weighted bank exposure, that is, bank-level public bank exposure (private bank exposure) aggregated to the industry level using the total borrowing between 2002 and 2008 as weights. Year refers to the fiscal year from April 1^{st} to March 31^{st}.
7	MES (Marginal Expected Shortfall)	MES 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.
8	$\mathbb{1}_{Low-quality}$	Indicator for whether the interest coverage ratio in all years between 2009-2011 is less than 1.

Table C.1: Glossary of variables (contd.)

Data Item	Variable	Definition & Source
9	Δ Log Sales	Growth in average sales from the years before the crisis(2006-2008) to the crisis years(2009-2011), measured as of March 31st each year.
10	ΔROA	Change in average return on assets(EBIT/Assets) from 2006-2008 to 2009-2011, measured as of March 31st each year.
11	MRPK	Ratio of sales to the gross book value of total assets.
12	Tangibility	Net fixed assets of a firm to its total assets.

Table C.2: Placebo years

This table looks at the local impact on deposit for branches using placebo years. The dependent variable in all columns is the annual growth rate of deposits from t to t-1. Branch run variable is 1 (and otherwise) if: (i) the predicted deposit growth of private sector bank branches is more than the actual growth rate, where prediction is on an out-of-sample basis using a regression of deposit growth on size (lagged credit), age, whether rural, lagged credit to deposit ratio and whether public for the years between 2002 and 2006; (ii) the difference in growth rate between 2009 and 2008 is less than zero; (iii) the branch does not appear in the bottom 5 percentiles of deposit growth in the year 2008 but does in 2009. Year refers to fiscal year from April 1st to March 31st. District covariates from the 64th NSS Employment and Unemployment Survey for 2006–07 are the percentage of urban population, unemployment rate, average age, and average weekly wages of households. Branch level covariates include an indicator for whether a branch is deposit poor (below median deposits in 2008), percentage of skilled officers, and the credit to deposit ratio in 2008. Samples and fixed effects are as indicated. Standard errors are clustered at the branch-level.

	(1)	(2)	(3)
Dep. variable:	Deposit growth		
Sample:	2004–05	2005–06	2006–07
Branch run	-0.411	3.208	0.981
	(1.925)	(2.443)	(2.765)
R-squared	0.119	0.134	0.108
No. of Obs.	49930	51143	51955
Bank-FE	Y	Y	Y
Year-FE	Y	Y	Y
District-FE	Y	Y	Y
District covariates	Y	Y	Y
District covariates × t	Y	Y	Y
Branch characteristics	Y	Y	Y
Branch characteristics × t	Y	Y	Y

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

Table C.3: Aggregate district-level effect of bank runs

The table looks at the aggregate district-level impact of bank runs on deposit growth and credit growth. The dependent variable in columns 1–4 (column 5) is the annual growth rate of deposits (credit) from t to t-1 for the period 2009 to 2013. Year refers to fiscal year from April 01st to March 31st. District exposure is the negative deposit growth rate of all branches in a district that with Branch run equal to 1, where Branch run is as defined in Table C.1. Fixed effects are as indicated. The district covariates from the 64th NSS Employment and Unemployment Survey for 2006–07 are the percentage of urban population, unemployment rate, average age, and average weekly wages of households in a given district, each of the control variables are also interacted with a time trend component. Standard errors are clustered at the district level.

	(1)	(2)	(3)	(4)	(5)
Dep. variable:	Deposit growth				Credit growth
Type:	All	Current	Savings	Term	All
District exposure	-0.054**	-0.169***	-0.067**	-0.018	0.039
	(0.027)	(0.049)	(0.026)	(0.031)	(0.028)
R-squared	0.155	0.079	0.066	0.136	0.045
No. of Obs.	1626	1626	1626	1626	1626
Year-FE	Y	Y	Y	Y	Y
District covariates	Y	Y	Y	Y	Y
District covariates × t	Y	Y	Y	Y	Y

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

Table C.4: Determinants of Capital Wedge in 2008

This table relates the 2008 capital wedge to bank exposures. Public is an indicator equal to 1 if a firm borrow from any state-owned bank between 2002 to 2008. Firm-level public bank exposure (private bank exposure) is the loan-weighted public bank exposure (private bank exposure) measure, aggregated to the firm level using prior total borrowing between 2002 to 2008 as weights. Public bank exposure and private bank exposure is as defined in Table C.1. Capital wedge is as of 2008 and calculated as the ratio of total sales to capital. Year refers to fiscal year from April 01st to March 31st. Standard errors are clustered at the 3 digit industry-level. All columns include 3-digit industry fixed effects.

	(1)	(2)
Dep. variable:	Capital Wedge 2008	
Public	22.138	
	(17.488)	
Public bank exposure$_{Firm}$		7.506
		(9.252)
Private bank exposure$_{Firm}$		-8.633
		(7.600)
R-squared	0.010	0.010
No. of Obs.	3219	3219
Industry-FE	Y	Y

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

Table C.5: Regression discontinuity: Under-banked status and state-owned banks' deposit share

This table examines the impact of the 2005 banking reform on public and private sector bank branches and deposits using district-level data using a regression discontinuity design. Panel A examines covariate balance with a standard RD specification. Dependent variables are as indicated. Panel B presents the RD estimates with dependent variables as indicated. 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 kernels with a bandwidth of 4.5 around the cut-off. All regressions are weighted by the 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.

Panel A: Covariate balance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. variable:	Ln (Wages)	Age	Fraction rural population (in %)	Fraction female (in %)	Fraction high-school (in %)	Unemp. rate (in %)	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)
R squared	0.580	0.705	0.551	0.264	0.466	0.214	0.579
No. of Obs.	247	247	247	247	247	247	247
State-FE	Y	Y	Y	Y	Y	Y	Y

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

	(1)	(2)	(3)	(4)
Dep. variable:	Number of private sector bank branches	Number of state-owned bank branches	Fraction of state-owned bank branches	Deposit share of state-owned bank branches
Banked	-27.76**	20.84	0.118**	0.0971**
	(10.97)	(13.19)	(0.0578)	(0.0411)
R squared	0.630	0.926	0.456	0.547
No. of Obs.	265	265	265	265
State-FE	Y	Y	Y	Y

Table C.6: Robustness: Regression discontinuity: Under-banked status and state-owned banks' deposit growth

This table examines robustness of the regression discontinuity (RD) estimates examining the impact of the 2005 banking reform on deposits growth of state-owned banks in 2006–08. The dependent variable is deposit share of state-owned banks in 2006–08 at the district-level. Year refers to fiscal year from April 01[st] to March 31[st]. Column 1 uses the Imbens and Kalyanaraman (2012) bandwidth. Column 2 uses the Calonico, Cattaneo and Titiunik (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.

	(1)	(2)	(3)	(4)	(5)
Dep. variable:	Deposit growth				
Bandwidth Type:	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)
R squared	0.556	0.556	0.559	0.484	0.538
No. of Obs.	220	247	229	285	207
State-FE	Y	Y	Y	Y	Y

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

Table C.7: Regression discontinuity: Under-banked status and impact on deposit growth during the non-crisis years

This table presents the regression discontinuity (RD) estimates for deposit growth using branch-level data for placebo years, 2005–2006, 2006–2007, and 2007–2008. The dependent variable in all columns is the annual growth rate of deposits from t to t-1. Year refers to fiscal year from April 01st to March 31st. Exposure to state-owned banks is firm level share of Public Sector Banks' Advances. Samples and fixed effects are as indicated. 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.

	(1)	(2)	(3)
Dep. variable:		Deposit growth	
Sample:	2005–06	2006–07	2007–08
Exposure to state-owned banks	53.58	97.26	22.35
	(80.82)	(70.91)	(63.78)
F-stat	17	24	30
R-squared	0.265	0.176	0.295
No. of Obs.	1990	1973	1923
State-Year FE	Y	Y	Y
Bank-Year FE	Y	Y	Y
Controls	Y	Y	Y

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

Table C.8: Banks and MES during 2007–2009

This table shows the bank vulnerability measure used for all 21 state-owned banks and 17 private sector banks used in our analysis. Stock market data is from the National Stock Exchange and the Bombay Stock Exchange.

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		

Table C.9: Effect on loan performance: Heterogeneity by bank vulnerability

This table looks at the heterogeneity by bank-vulnerability in impact on stressed asset growth at the bank-level. The dependent variable is the annual growth in stressed assets — defined as the sum of non-performing and restructured assets — from t to t-1 for the period 2009 to 2011. Year refers to fiscal year from April 01st to March 31st. MES is as defined in Table C.1. Bank level controls included are gross NPA by gross advances in percentage, tier-1 capital adequacy ratio, and ATMs per capita in 2008 their interaction with a time trend component and whether a bank is an old private bank. Standard errors are clustered at the bank-level.

	(1)	(2)
Dep. variable:	Stressed assets growth	
Sample:	Public	Private
MES	2.976	-1.986
	(1.964)	(10.554)
R-squared	0.545	0.558
No. of Obs.	63	43
Year-FE	Y	Y
Bank controls	Y	Y
Bank controls $\times$ t	Y	Y

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$