

# Anatomy of a Banking Panic\*

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## Abstract

We develop micro-level evidence on the real effects of a large-scale flight to safety by bank *depositors*. Private banks in India, which had little exposure to US experienced sudden withdrawals of deposits after the 2008 financial crisis in the US, reflecting pure panic of depositors. We quantify, characterize, and examine the lending consequences of the deposit flight using granular branch-level data on deposits. Deposit flights are local as they transfer resources from private to public sector banks in the same district. Though deposit flights are concentrated in a few districts, geographically distant districts witness significant credit reallocation as the panic flows are propagated through the banks' internal capital networks. These loans eventually underperform. Firms with pre-existing relationships to affected public sector banks increase investment, but to potentially unproductive technologies possibly explaining the loan underperformance. Flights to safety which reallocate deposits within local markets can transform the structure of bank assets and liabilities across geographically distant markets.

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\*First version: November 2016 This version: May 23, 2019. We thanks conference participants and discussants at EFA 2016, NEUDC 2018, WFA 2018 and IFC 2018. We thank Martin Rama and Robert Carl Michael Beyer of the World Bank for sharing the night lights data.

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The global financial crisis has spawned a vast literature on the causes and consequences of the financial crisis. The sub-prime crisis and risk-taking by banks, especially banks deemed too big to fail, have been implicated as causes of the crisis and the connectedness between banks has led to its propagation. [Glasserman and Young \(2016\)](#) is a recent review. The crisis has led to a number of spillover effects. For instance, [Cetorelli and Goldberg \(2012\)](#) and [Puri, Rocholl and Steffen \(2011\)](#) discuss the spillover effects through the lending channel, as international banks adjust their portfolios in response to their US shocks. [Ivashina and Scharfstein \(2010\)](#) discuss the runs on banks due to withdrawal by borrowers of their lines of credit to increase their precautionary saving.

Our work identifies a new effect of the financial crisis, specifically a pure panic channel in which depositors run on local branches of banks although the banks that hold the deposits have no exposure to the fundamental crisis. We study the transmission of asset and liability transformations that occur as a result of this run including the branches that experience runs and the branches that receive the surpluses from the panic withdrawals. We study the propagation of these panic flows through the banks' internal capital networks as credit is reallocated to geographically distant districts. Finally, to pin down the reallocation of debt across firms we use bank-firm linkages to examine the impact on investment, wages and productivity of firms with pre-existing relationship with affected banks. We conclude by examining allocative efficiency at the industry-level to see whether productivity differences are driven by within-firm changes or are driven by reallocation of resources across firms.

If the funding structures at the flight bank and the receiving bank are different, there is a transformation of the nature of the bank deposit funding in the aggregate economy, and a transformation in the liability side of the two banks. If the funding changes trigger credit reallocations between the run and recipient banks and across branches through the banks' internal capital markets, there is reallocation of credit across geographies. In sum, pure panic by depositors is capable of initiating an aggregate rebalance in both the liabil-

ity and the asset side of an economy, and propagating this shock across geographies. We find that panic-induced funding shocks have long-lasting effects. Our evidence suggests that besides the frictions between firms and external capital markets, internal frictions between bank branches and headquarters also matter, even in a branch banking setup where all branches operate as part of the same legal entity. Additionally, it matters whether the reallocation of credit from private to public sector firms results in reallocation of credit to efficient or inefficient firms. The reallocation of credit from private to public sector banks as a result of the panic flows has significant implications for aggregate productivity in the economy.

India has an interesting mix of state-owned (public) and private sector banks. At the time of the 2008 financial crisis, state owned banks dominate in India and account for over 70% of total bank assets. Private banks are not as large but still significant with a 28% market share in terms of total assets in India. Both the state-owned and private banks are owned and operated domestically, and have little known economic exposure to the US banks. The bankruptcy of Lehman Brothers in the US in September 2008 was a source of exogenous shock in depositors' perception of bank fragility. India was relatively insulated from the market turmoil in the US. Indian institutions did not have large exposures to the US subprime market securities or institutions. Nor did they have large footprints abroad that might have led to funding constraints locally. Thus, the Lehman bankruptcy in September 2008 affected depositors' *perception* of bank fragility rather than having an actual impact on bank health.

The domestic focus of the private and state owned banks in India is accompanied by a rather small presence of foreign banks in India, with little to no interlinkages between the foreign and domestic banks. Thus, depositor runs in the Indian banking system are pure panic effects arising out of suspicions of investors about a crisis whose genesis or consequences they have little prior understanding of. In addition, the state-owned banks or public sector banks (PSBs) are majority owned and thus implicitly presumed to be

backed by the full faith and credit of the Indian government. Private sector banks are not owned by the government and bear no government imprimatur. The debt owed by the Indian government and the banking system is largely local currency denominated. The power of seigniorage thus implies that the deposits of state owned banks enjoy more protection than private bank deposits.

The variation between state owned banks and private banks provides an ideal setting to explore differences in depositor *perception* of bank fragility. When depositors understand the shock in the US market but do not understand its consequences for India's banks, the state owned banks become an automatic safe harbor. India's Bank Nationalization Act explicitly places all liability for public sector banks on the government. This is unlike the US, where ex-post state intervention through expanded deposit insurance or government stakes in banks require assurance of state ownership ([Acharya and Kulka-rni \(2016\)](#)). Finally, unlike the US, India has a very limited deposit insurance program. Insurance coverage is provided by the Deposit Insurance and Credit Guarantee Corpora-tion (DICGC) in India for bank deposits. However, coverage is limited to only Rs.100,000 (approximately \$2000) per depositor per bank ([Iyer and Puri \(2012\)](#)). So, shifts to state owned banks is really the only feasible path for flight-to-safety deposits.

We exploit rich branch-level data of the entire banking network in India, and show that there is heterogeneity in private sector bank branches that experienced runs. We identify a branch as having had a run if it satisfies all three of the following measures. In each of these measures a private sector branch is classified as having had a run (an indicator equal to 1) if it satisfies certain conditions. For the first bank run flag, a private sector bank branch is classified as having had a run if the actual deposit growth of private sector bank branches is less than predicted on an out-of-sample basis using a regression model estimated on prior year data. For the second bank run flag, we first identify private sector bank branches which had growth between FY 09 to FY 08 below a cutoff defined as the 5<sup>th</sup> percentile of growth rates in the prior year, that is between FY 07 and FY 08. To

account for the fact that some branches may have persistently declining deposit growth rates, we include only those private sector branches for which the difference in growth rate between FY 08–09 and FY 07–08 is negative. For the third run flag, we look at private sector bank branches that transitioned from being above the cutoff — as before, 5<sup>th</sup> percentile of growth rates in the prior year, that is between FY 07 and FY 08 — to being below the cutoff. That is a private sector bank branch is classified as having had a run if the growth in FY 08–09 is below the cutoff, but the growth rate in FY 07–08 is above the cutoff. For our baseline analysis, we classify a branch as having had a run if it is classified as having had a run using any of the three above measures.

Using the above measures of runs at a branch, we show that there are significant flights of deposits from private sector bank branches in the aftermath of the Lehman Brothers crisis. The decline in deposits also translates into a fall in credit across the services, agriculture and manufacturing sector at these branches.

Next, we characterize the spillovers of runs on the branches of the private sector banks to public sector bank branches in the same spatial location. To do this, we build a measure of propensity of runs at the district level to indicate districts that had higher private sector branch deposit outflows. We first identify districts which had branches with runs. We then calculate the negative of the deposit growth of all private sector branches which had runs in a given district. These variables are a continuous measure of propensity of private sector branch runs.

We use this district level propensity of runs to test whether there was a greater outflow from the private sector banks to the branches of public sector banks. We see that public sector bank branches in districts which had large deposit outflows on private sector branches had higher deposit growth. The growth in deposits was on both the intensive as well as the extensive margin. Credit falls in these districts, but we only see a muted relative increase in credit by the public sector bank branches which witnessed the deposit inflows. We see no effect in credit to the politically important agriculture sector. Private

sector banks in affected districts cut lending to the services sector, whereas public sector banks increased their lending to the sector. In contrast, we see only a muted effect on lending to the manufacturing sector. Lending to the manufacturing sector tends to be relationship-based and these results plausibly reflect private sector banks unwillingness to cut lending to their relationship firms. Lending to the services sector tends to be non-relationship based, and hence private sector banks are willing to pare back lending to these firms. Public sector firms fill in this gap and increase lending to the services sector.

If the deposit flows are not funneled back into the same district which experienced runs, where are they redirected? We hypothesize that banks use their internal capital networks and hence we only see muted local effects at the districts with runs. To trace out the reallocation of credit through the bank branch networks, we construct a bank level measure of exposure to districts which had runs. We use this definition instead of calculating whether a bank had a run because we are interested in tracing the effects on credit at the mostly private sector banks which had runs and lost deposits and the *nearby* public sector banks that gained these panic outflow of deposits. We find that credit at the branches of exposed banks fell for private sector bank branches but grew for public sector bank branches. Effects are strong for the services and manufacturing sector. Interpreting these results in combination with the muted effect on local credit in manufacturing, we hypothesize that public sector banks possibly redirected local inflow of deposits to geographically distant areas to their relationship firms in the manufacturing sector. The strong effects in the services sector is likely driven by the local spillover effects that we saw before. We find only muted effects for the agriculture sector which is politically important and hence likely both public and private sector lenders are unwilling to cut credit to this sector.

What are the consequences of such a credit reallocation due to panic flows from private to public sector banks? We start by looking at the performance of loans at the branches of the exposed banks. We find that the growth in distressed assets (non-performing

assets/ NPAs) fell at the branches of the exposed private sector banks. In sharp contrast, the NPAs at the public sector banks grew almost 431 percent.

To explain what could be driving this deterioration in asset quality, we use bank-firm linkages to determine where the credit was directed. We show that firms with pre-existing relationship to exposed private sector banks witnessed a decline in debt. Consistent with the above results, this effect is mostly driven by the manufacturing sector through the internal capital networks of banks. Further, firms linked to private sector banks cut investment, but also witness an increase in productivity. In contrast, firms with pre-existing relationship to public sector banks increased investment, but also witnessed a *fall* in productivity. These effects are also evident at the industry-level. Investment was higher in industries which predominantly borrow from the affected public sector banks, but this is accompanied by a decline in aggregate productivity of firms in the industry. To examine allocative efficiency, we use the Olley-Pakes decomposition and show that the decline in productivity is mostly driven by within-firm decline in productivity as opposed to greater allocation to unproductive firms.

Our findings emphasize the role of state-owned banks in providing stability during banking panics. An older literature on state owned banks has emphasized how state owned banks provide financial intermediation in less financially developed countries ([Gerschenkron \(1962\)](#), [Shleifer \(1998\)](#), [Hawtrey \(1926\)](#), [Lewis \(1950\)](#) and [Myrdal \(1968\)](#)). Private sector banks would not be willing to participate without the presence of these state-owned banks. Other papers have highlighted the political motives of government ownership which may result in inefficient investments. Political motives of bank managers may result in politically motivated but inefficient allocation of resources to supporters in return for political support ([Shleifer and Vishny \(1998\)](#), [Kornai \(1979\)](#), [Sapienza \(2004\)](#) and [Calomiris and Haber \(2009\)](#)). Government ownership of banks may also be associated with lower financial development and productivity growth ([La Porta, López-de Silanes and Shleifer \(2002\)](#)). Our results are also consistent with prior findings that lend-

ing of state-owned banks tends to be less responsive to macroeconomic shock (Myrdal (1968), Bonin, Hasan and Wachtel (2013)). We show, however, that this macro-level analysis can mask significant heterogeneity across banks as well as heterogeneity across regions. Additionally, we look at a pure panic induced shift in deposits from public sector banks which were perceived to be more stable to private sector banks. Importantly, our paper highlights how a reallocation of credit from private to public sector banks can have important implications for aggregate productivity in the economy.

The paper is organized as follows. Section 1 describes the institutional details and Section 2 describes the data used in our analysis. Section 3 analyzes the impact on deposit and credit of branches that had runs. Section 4 analyzes the local spillovers on deposit and credit growth of nearby branches, particularly the public sector bank branches. Section 5 analyzes the propagation through the bank branch network and the performance of assets as a result of this reallocation. Section 6 traces the impact on firm level outcomes. Section 7 analyze the industry level distortion arising from the increase in lending by public sector. Section 8 examines the impact on overall economic activity. Section 9 concludes.

## 1 Institutional details

The Indian banking sector has a mix of government owned state-banks (public sector banks) and private sector banks. The Indian banking sector has been dominated by public sector banks since 1969 when the larger banks were nationalized. In the 1990s, after economic liberalization, the government reduced its stake and allowed private sector banks and foreign players to enter the market. As of June 2016, nearly 70 percent of market share still belongs to public sector banks. Today's private sector banks can be further classified into two groups: old and new private sector banks. Old private sector banks refer to banks that existed prior to the nationalisation of banks in 1969 and since they were at the time deemed to be either too small or too specialized, were not nationalized. The new

private sector banks refer to the banks that came into existence post-liberalisation in the 1990s.

The Indian banking sector was reasonably robust during the financial crisis of 2007–09 when fragility of the financial sector, especially in US and Europe, exacerbated economic shocks into severe recessions. The relative outperformance of the Indian banking sector at the time was attributed to heavy government regulation that prevented banks and financial firms from taking excessive risks. However, as we show there was significant heterogeneity in the way private and public sector bank fragility was perceived during this period.

Distress in the global financial markets can be traced to June 2007 when the investment bank Bear Stearns in the US had to rescue its subsidiary hedge fund which had heavy exposure to subprime mortgages. This eventually led to significant write-downs by Bear Stearns in March 2008 which set off a mass panic. Firms began withdrawing short-term financing to Bear Stearns and the ensuing panic resulted in a forced sale of Bear Stearns to J.P. Morgan ([Chodorow-Reich \(2014\)](#)). Markets stabilized in the period following the Bear Stearns debacle, but deteriorated sharply in September 2008. Lehman Brothers reported a \$3.9 billion loss on September 10, 2008. Short-term financing dried up. Unable to find a buyer, Lehman Brothers filed for bankruptcy on September 15, 2008 and global markets plummeted.

Indian banks, despite limited exposure to the US real estate markets were also affected. Panel A in Figure 1 shows the value weighted (with the outstanding market value of each stock) stock index of private and public sector banks. The index has been normalized to 100 as of December 2007. The dashed line is shown as of the day of the bankruptcy of Lehman Brothers on September 15, 2008. We see that stock prices for public and private sector banks showed similar patterns in the period leading up to the Lehman crisis. However, once Lehman declared bankruptcy, the stock price of private sector banks fell more drastically compared to public sector banks.

Panel B, Figure 1 shows this is due to a flight-to-safety of deposits from private sector banks to public sector banks. The figure in panel B shows the quarterly deposit growth for private sector and public sector banks respectively for the period December 2007 to March 2009. Underlying data on deposits is reported by the RBI at quarterly frequency as of March 31<sup>st</sup>, June 30<sup>th</sup>, September 30<sup>th</sup> and December 31<sup>st</sup>. The dashed line is shown as of the day of the bankruptcy of Lehman Brothers on September 15, 2008. As we can see, deposit growth rates were similar for both public and private sector banks. But as the crisis progressed, particularly post the Lehman crisis, deposit growth rates for public and private sector banks differed starkly. Particularly, deposit growth for public sector banks was almost five times that of private sector banks in the quarter immediately following Lehman bankruptcy. Note, the deposit growth rates diverged even in the quarter preceding the Lehman bankruptcy. This can be attributed to the sale of Bear Stearns in March 2008. For our main analysis, we use annual data — calculated from March 2008 to March 2009 — which encompasses both the Lehman bankruptcy and Bear Stearns sale and hence the exact timing of deposit outflows does not alter our analysis. Anecdotal evidence, too, suggests that depositors in India did panic following the Lehman bankruptcy. Infosys, a large Indian multinational corporation, transferred nearly Rs. 10 billion in deposits from ICICI (a private sector bank) to SBI (a public sector bank) after Lehman collapsed (see “Deposits with SBI zoom past Lehman collapse”, April 7, 2009).<sup>1</sup>

## 2 Data

We now describe the data used in our analysis. We use data from the Basic Statistical Returns which is collected by the Reserve bank of India (RBI). This data has previously been used by [Das, Mishra and Prabhala \(2016\)](#), [Cole \(2009\)](#) and [Kumar \(2016\)](#). This dataset provides deposits and credit at the branch level. We use data for the period 2006 to 2012. Data is reported as of March 31st of every year. Deposit data is available at the branch

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<sup>1</sup>[http://articles.economictimes.indiatimes.com/2009-04-07/news/27639025\\_1\\_private-banks-bank-deposits-deposit-base](http://articles.economictimes.indiatimes.com/2009-04-07/news/27639025_1_private-banks-bank-deposits-deposit-base)

level for every bank in India. We have both the volume of deposits in rupees as well as number of accounts. Branches classified as rural correspond to census city centers covering a population of up to 10,000, semi-urban branches to population between 10,000 and 100,000, urban branches to population between 100,000 and 1 million and metropolitan branches to areas with population above 1 million. For our analysis, we retain districts (and corresponding branches) where at least 10 percent of the lending is from private sector banks.

Lending data is also at the branch level. We use the lending growth rate for our baseline analysis. Sector-wise lending is also provided. For our analysis on heterogeneity in lending, we look at the following sectors: personal loans, trade loans, financial loans, agricultural loans, industrial loans and professional services.

Our main analysis focuses on regional variation in the deposit flows. India is divided into states or union territories, and each state/union territory is further subdivided into districts. There are currently 36 states or union territories and 630 administrative districts. Each district resides within a state and this unit is comparable to counties within the US. For our baseline analysis we use data at the branch-level. We also use district-level variation to motivate the analysis and to identify nearby banks in our analysis of spillover effects. Districts can be thought of as regions which are economically integrated.

To measure real activity, we link the bank measures to firm-level data. The primary database used for this analysis is the ProwessDx database, maintained by Centre for Monitoring Indian Economy (CMIE). This database provides financial data for all Indian firms, both listed as well as unlisted, and has been used in several other research studies ([Bhue, Prabhala and Tantri \(2015\)](#), [Gopalan, Mukherjee and Singh \(2016\)](#)) for firm-level analysis. While the coverage for listed firms is comprehensive (due to reporting requirements), the coverage for unlisted firms is limited. We collect information under three broad categories from Prowess: identity, standalone annual financial statements, and bankers. An identity dataset maintained by CMIE contains identifiers for firms covered by Prowess.

We use the Prowess Company code, a numerical code assigned to every company in the CMIE database, to identify unique entities.

We download stand-alone annual financial statements for all companies. The vast majority of Indian corporate firms have fiscal year ending in March. All variables are as of March 31 of a given calendar year. If year end occurs in a month other than March, all firms with year end before September 30 are assigned to the prior fiscal year, and remaining such firms are assigned to the next fiscal year. For the baseline analysis we restrict to the period 2006 to 2012. Our main variables of interest using the CMIE data are: wages, capital expenditure and marginal productivity of capital. We use wages instead of number of employees because this data is better populated in ProwessDx. Capital expenditure is the change in gross fixed assets. Marginal productivity of capital is calculated as gross fixed assets divided by sales.

We then link the bank exposure data from the BSR data to Prowess as follows. The CMIE data does not provide the amount of loan provided by each bank or lender. However it does indicate the primary lender for a given firm. The data on bankers is extracted from CMIE as a separate dataset that gives the name of the bank which is the banker to the firm in that particular year. A firm may have more than one banker in a year. The data field "Order" stores a number that determines the order in which the banks appear in the source document i.e. the annual report of the company. In case of multiple bankers, we retain the top banker based on "Order no." as it is assumed that firms display the name of its most important banker or the bank which has the highest exposure to the company at the top of the list. The top bank is assigned to a firm. This assignment makes the assumption that all increase in debt of a firm is from the primary banker.

To measure overall economic activity, we use satellite data on human-generated night-light activity. The data is from VIIRS DNB data collected by NOAA using the Suomi National Polar Partnership satellite that was launched in 2011. We use the nightlight intensity which measures low-light imaging data collected by the satellite. The data is filtered

to measure the quantity of human-generated light in an area, but some stray light may remain which may add noise to the estimates. To remove this noise we do the following. NOAA provides annual composites which contain additional processing to remove such stray light. Following [WorldBank \(2017\)](#), we remove cells for which the annual average of the data differ substantially from the annual composites before aggregating to the district level.

Table 1 shows the summary statistics of the data used in our analysis. Branch-level deposits grew by an average of 29.34 percent between March 2008 to March 2009. Lending grew by 29.45 percent on average at the branch-level. We also report the summary statistics for Deposit and Credit Growth by year in Table A1 and Table A2 respectively. It can be directly inferred from Table A1 that during the period 2008-09, the growth in deposits for private sector banks decreased dramatically by 9.2 percentage points. On the contrary, for Public sector banks in the same time period, we notice a sudden increase in deposit growth to 1.1 percent. This can be attributed to the fact that during the crisis period, many people move away from the private sector banks and move towards public sector banks. We notice a similar pattern when we study the year wise credit growth rates of Private and Public sector banks. Table A2 summarizes the year - wise credit growth for the period 1997- 2013. In the year 2009, for the 10th percentile, we observe a sharp decline in the credit growth for private sector banks and it drops to -28.2 percent. The credit growth for both public and private sector banks is negative for the period but the decline is much more substantial for private sector banks.

These averages computed at the national level mask significant heterogeneity across regions. Figure 2, Panel A shows the geographical variation in overall deposit growth. The plots present the heat maps of deposit growth with lighter shades (white) corresponding to lower deposit growth and darker shades (red) corresponding to higher deposit growth. Within private sector banks (panel b), we see that many regions had low deposit growth (lighter shaded areas) compared to public sector banks (darker shaded

areas, panel c). However, since private sector banks also had a higher range in deposit growth, it is unclear from the heat map whether private sector banks on average performed worse than public sector banks in terms of deposit growth. In Figure 3 we explicitly restrict to regions which had low growth (less than 10 percent). Figure 3, panel a shows that there were a number of districts which had deposit growth below 10 percent. The greyed out areas represent areas which had deposit growth rates above 10 percent. However, from panel b we see that there were *no* districts with deposit growth below 10 percent for branches of public sector banks.

## 2.1 Identifying branch runs

For our analysis, we need to classify branches which had runs (significant deposit outflows) as a result of the global financial crisis. Motivated by the analysis in the previous subsection, particularly, the impact on stock prices and deposit growth in Figure 1 we classify branches as having had runs only if they belong to private sector banks. Next, within the private sector bank branches we classify a given branch as having had a run based on four different measures of bank runs. These methods exploit the time-series variation and cross-sectional variation in deposit growth.

Measure 1: The first bankrun flag is 1 if the predicted deposit growth of private sector bank branches is more than the actual growth rate. The prediction equation is the deposit growth rate on size (lagged credit), age, whether rural, lagged credit to deposit ratio and also whether it belongs to a public sector bank (allows for PSBs to have on average lower growth rates). We use out-of-sample regression and restrict to before 2006 and predict for remaining years. Figure A3 provides justification for this using this measure. Plot (a) shows that controlling for bank characteristics, private sector bank branches had lower deposit growth as noticed by the mass in the lower tail compared to the public sector banks. 3 percent of the branches are classified as having had runs using this measure. See Table 1.

Measure 2: Figure [A1](#) gives justification for the second classification of private sector branches that had runs. From Panel(a) we see that difference in growth rates between during March 2006–March 2007 and March 2007–March 2008 ( $\Delta$  of growth rates) was very similar in for public and private sector banks. That is, unconditionally controlling for prior years growth rates the growth in the pre-panic period was very similar for public and private sector banks. In contrast, in panel(b) shows the difference in growth rates during March 2007–March 2008 and March 2008–March 2009 ( $\Delta$  of growth rates). We see that, in contrast to the previous year, growth rates of private sector bank branches was below the growth rates of public sector banks. Motivated by this analysis, we calculate the first bankrun flag as follows. We first identify private sector bank branches which had growth (in 2009) below the 5<sup>th</sup> percentile of growth rates in 2008. However, to account for prior year’s growth rate we look at the change ( $\Delta$  Growth Rate) in growth rates between 2009 (March 2008 to March 2009) and 2008 (March 2007 to March 2008). A private sector branch is classified as having had a run in 2009 if the above ( $\Delta$  Growth Rate) is less than zero. 6 percent of the branches are classified as having had runs using this measure. See Table 1.

Measure 3: Figure [A2](#) gives justification for the third classification of private sector branches with runs. Panel(A) plots the raw deposit growth rates for public and private sector bank branches in 2008 (March 2007–March 2008) and 2009 (March 2008–March 2009). In Panel (A) we see that there we see that difference in growth rates for public sector bank branches is very similar, though there seems to be a slight increase in growth rates for public sector banks. In the plot on the right in panel(A) we see that growth rates of private sector bank branches were lower in 2009 compared to the previous year. The graphs in Panel (B) restrict to the lower tail and show the deposit growths below zero. Motivated by these figures we classify a private sector bank branch as having had a run as follows. We identify private sector banks in the bottom 5 percentile of their deposit growth between March 2007 to March 2008. Then using this cutoff, we look at private

sector bank branches which had lower deposit growth between March 2008 to March 2009. The branches which were not previously below this cut-off but now appear below the cutoff are classified as having had runs. 1 percent of the branches are classified as having had runs using this measure. See Table 1.

Our baseline measure combines all the above measures. A bank run flag is the intersection of the first three measures, i.e. it takes the value 1 in case the bank classifies as run in all the three measures above. We use this most stringent definition of branch runs, though the results are qualitatively similar using each of the above measures.

### 3 Effect on branches with bank runs

We first start by documenting the effect on deposit and credit growth at the branches which had runs.

#### 3.1 Empirical strategy

First, we examine the local effects on deposit and credit growth at the branches which had runs. The specification is as follows:

$$Y_{jbd t} = \alpha_j + \theta_t + \beta * \mathbb{1}_{Run_j} * Post + \epsilon_{jbd t} \quad (1)$$

where  $Y_{jbd t}$  is the outcome variable in period  $t$  for a given branch  $j$  of a bank  $b$  in district  $d$ . Our analysis focuses on the period 2006 to 2012.  $Post$  is an indicator for post the run, so for any year greater than or equal to 2009.  $\mathbb{1}_{Run_j}$  is an indicator equal to 1 for a branch  $j$  which has had a bank run.  $\alpha_j$ ,  $\theta_t$  and  $\gamma_d$  are branch and year fixed-effects.  $\beta$  measures the outcome variables (deposits and credit) of the bank branches which experienced runs relative to other branches.  $\beta$  can be thought of as capturing the difference-in-difference estimate. The fixed effect controls for time-invariant differences in branch characteristics. The remaining uninteracted terms are subsumed by the fixed effects. Robust standard errors are clustered at the branch level.

One concern in using the difference-in-difference specification above is that the branches which had runs may have been on very different time trends compared to the branches which had no runs. To facilitate a transparent examination of the parallel trends assumption implicit in the difference-in-difference above, we also estimate a year-by-year specification and present the results as event study plots. To examine the parallel trends assumption we plot the event study graphs below.

$$Deposit\ Gwt_{jbd t} = \alpha_j + \gamma_t + \sum_{\tau} \eta_{\tau} \times (\mathbb{1}_{\tau} \times \mathbb{1}_{(Run_j)}) + \epsilon_{jt} \quad (2)$$

where  $\tau$  ranges from 2002 to 2012,  $\mathbb{1}_{\tau} = 1$  if year is  $\tau$  and  $\eta_{\tau}$  is coefficient of interest. Bars show the 95% confidence intervals,  $\tau = 0$  is the year 2007–2008 before the crisis, and all coefficients are normalized relative to  $\tau = 1$ . Though our period of analysis starts in 2006 for the remaining analysis in the paper, we extend the estimates further back to 2002 to more transparently examine the parallel trends assumption over a larger period. Robust standard errors are clustered at the branch level. The dependent variable,  $Deposit\ Gwt_{jbd t}$  is deposit growth rate over  $t - 1$  to  $t$ . The coefficient of interest is  $\eta_{\tau}$ , which measures the difference, in the outcome deposit growth, between branches with runs and remaining branches  $\tau$  years after the passage of the crisis.

## 3.2 Results

In this section, we document the impact on deposit and credit growth of branches with the bank run in a difference-in-difference setting for the period of 2006-2012. We run the specification in Equation 1. In Table 2 column 1, our dependent variable is the year to year growth in the number of depositor accounts. We see the bank branches classified as having a bank run had a 17.2 percent lower growth of deposits account compared to other bank branches in the post-crisis period. In table 2 column 2, we use the volume of deposit growth as the dependent variable. We observe that the branches that had the runs show a 28.5 percent decline in growth in volume of deposits post the crisis.

One concern might be that since we defined branch runs based on their ex-post growth rates in 2009 at private sector branches, the results might be mechanical. The above results show that this is not so, since we are comparing the (private sector bank) branches which had runs to all remaining branches. Note, our measure did not explicitly condition on growth rates at other branches. The above results show that we are in fact correctly capturing the branches which may indeed have experienced runs relative to other branches. Since we do not condition on the deposit growth at public sector branches and hence the above specification provides a test of the run measure.

Another concern may be that these branches may have been on different time trends prior to the crisis and we are simply seeing a reversion post crisis. Figure 4 shows that this is not so and that the parallel trends assumption cannot be rejected. This graph also allows us to transparently examine the time trend in deposit growth. Two things stand out. First, there was a sharp fall in deposits immediately following the crisis. Second, this trend was persistent. Not only did the growth rate of at these branches not revert back following the crisis, the growth was persistently lower even four years after the panic. Our formal empirical specification captures the overall average effect from 2009 to 2012 relative to the pre-period. However, the sharp effect in the year immediately following the crisis and a lower *but* persistent effect over the entire period is observed across specifications.<sup>2</sup>

Next, we test the impact of deposit runs on the asset-side, that is lending at these branch. In Table 2 column 3, we see that the bank branches that had runs witnessed a 26.8 percent decline in bank credit growth post-crisis period in comparison to the remaining bank branches. In columns 4–7, we analyze the impact on sectoral credit growth for branches with a bank run using our difference-in-difference setting. The effects are mainly driven by the services sector (in column 4) and the manufacturing sector (in column 6) with a 24.5 percent and a 110.5 percent decline respectively in credit growth, while the credit growth in the politically sensitive agriculture sector remain unaffected.

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<sup>2</sup>Results available upon request

## 4 Local spillover effects of bank runs on nearby branches

Next, we turn to the effect on deposit and credit growth at nearby branches. The goal is to trace the impact on deposit flows at nearby branches and the impact this has on lending.

### 4.1 Empirical strategy

This section examines the spillovers of the panic flows away from the private sector bank branches on the nearby branches. To estimate this, we first identify districts which had branches with runs. Propensity of private sector branch runs at the district level is calculated as the negative of the deposit growth of the private sector bank branches which were classified as having had "runs" using the baseline bankrun measure. This tells us which districts had a higher degree of bank runs, which we term as propensity or intensity of runs throughout.

For the spillover analysis we compare the outcome variable for the private and public sector branches in the districts affected by the branch runs. The specification is:

$$\begin{aligned} Y_{jbd t} = & \alpha_j + \theta_t + \phi * District Run_d + \eta * District Run_d * Public \\ & + \gamma * Post * Public + \delta * Post * District Run_d + \beta * Post * District Run_d * \mathbb{1}_{Public} + \epsilon_{jbd t} \end{aligned} \quad (3)$$

where outcome variable is for period  $t$ , for a given branch  $j$  of a bank  $b$  in district  $d$ . The outcome variables ( $Y_{jbd t}$ ) we analyze are deposit growth and credit growth from period  $t - 1$  to  $t$ .  $District Run_d$  is the negative deposit growth rate of all branches in a district which has had runs.  $Post$  is an indicator for post the run, so for any year after 2009.  $\alpha_j$  and  $\theta_t$  are branch and year fixed-effects. The fixed effects control for time-invariant differences in branch characteristics. The remaining interaction terms are subsumed by the fixed effects.

A flight-to-safety story would indicate that  $\beta > 0$ .  $\beta$  can be interpreted as the average

relative growth in outcome variable (e.g. deposits) at public sector bank branches that were in districts which has a 1 percent decline in deposit growth at the branches with runs.  $\delta$  captures the overall effect in affected districts in the post-crisis period.

To understand the economic magnitudes of outcomes in affected districts, we aggregate outcomes to the district level and analyze using the following specification.

$$Y_{dt} = \alpha_t + \theta_d + \beta * Post * District Run_d + \epsilon_{dt} \quad (4)$$

where deposit growth is the annual growth from 2008 to 2009 in a given district  $d$  in year  $t$ . *Propensity Run* is the negative deposit growth rate of all branches in a district which has had runs.  $\theta_d$  is the district level fixed-effects.  $\beta$  can be interpreted as the average growth in deposits in districts which had a 1 percent decline in deposit growth at the (private sector bank) branches with runs.

Before turning to the results of the empirical analysis, a discussion of the district run measure is in order. The goal is to identify geographic regions which had higher intensity of runs. In the analysis we focus on district-level variation of number of branches which had runs. Districts capture regions which are economically integrated and thus are a natural way to define exposure to branches which had runs. To get a measure of regions (districts) which experienced high number of bank runs we do the following. Propensity of private sector branch runs at the district level is calculated as the negative of the deposit growth of the private sector bank branches which were classified as having had "runs" using the baseline bankrun measure. Using this procedure of the propensity of private sector branch runs using the first measure is on average 6.23 implying that relative to the previous year, on average private sector branches had a negative growth of 6.23 percent. As we move towards the 75<sup>th</sup> percentile we see that the number is 5.68 implying that deposit growth of private sector branches which had runs was negative. Similarly, using the second and third measure the propensity was on average 2.92 and 8.81 respectively.

What matters for us is the relative measure of these propensities. Additionally, these measures intuitively map to the deposit growth rates of the private sector branches and hence it is useful to estimate district-level run propensity this way. See Table 1.

## 4.2 Results

We now estimate the spillovers of the deposit flight documented in Section 3 on the nearby branches. Table 3 shows the results of running the specification in Equation 3. In column 1, we look at the extensive margin, namely the number of accounts. Districts with a 1 percent higher propensity of bank runs witnessed a 7.9 percent decline in the number of deposits at the private sector banks. In contrast, the branches of public sector banks in these districts experienced a relative 5.18 percent increase in number of deposit accounts. Deposit growth in volume shows similar trends. In column 2, we see that at the intensive margin, namely the volume of depositors growth declined by 10 percent relative. From column 2, we see that a 1 percent increase in bank run propensity in a district resulted in 6.04 percent higher relative growth in volume of depositors for public sector bank branch. Private sector branches lost deposits both on the extensive margin (number of accounts) as well as the intensive margin (volume of deposit accounts) and public sector banks witnessed a relative increase in both volume of deposits and the number of depositors suggesting a flight-to-safety away from private sector bank branches to public sector bank branches.

Next we turn to the impact of this spillover of deposit growth on the local credit supply within the districts. In Table 3, column 3–7 our dependent variable is credit growth at bank branches. In column 3, the dependent variable is the overall credit growth. We see that districts where private sector bank branches had higher propensity of bank runs show a decline in credit growth post crisis period compared to the remaining districts. This is, however, not made up by a subsequent increase in credit growth at public sector bank branches which is surprising considering that these branches also witnessed an

increase in deposit flows as we saw in columns 1–2.

There are differences in credit growth across sectors though. In column 4, when we subset to the services sector, we do see that the 12.6 percent decline in credit to the services sector is mitigated to some extent by an 9.1 percent increase in credit extended to the services sector by the public sector bank branches. We do not see similar effects for the remaining sectors, particularly agriculture and manufacturing. We saw in Table 2 that credit to the agriculture did not decline even for the private sector branches which had runs, potentially because this is a politically important sector. Results are consistent in column 5 of Table 3. In column 6, we see that private sector branches in these districts did not see a decline in manufacturing sector either. In contrast to Table 2 where there was a decline in manufacturing at the branches with runs, it seems that overall there was no decline in lending. We even see a lower growth in credit to manufacturing sector by the public sector branches in these districts. Lending relationships with manufacturing firms tend to be more relationship based. Hence, the results suggest that private sector banks are unwilling to cut lending to these firms. Potentially, the branches that witness runs cut credit to manufacturing firms, but nearby branches makeup for the shortfall. In contrast, the services sector is non-relationship based. Hence, one sees a greater cutback in credit by the private sector banks to this sector and potentially, the public sector branches are also able to attract these customers and increase lending to the services sector.

Overall, the point estimates in this table suggest that the decline in deposits and subsequent credit at the private sector branches was not made up by the public sector branches. Adding the two estimates, shows that overall the districts with runs did see a decline in deposits, as well as credit. To see this more clearly and examine the economic magnitude of the effect of these runs at the district level, we turn to aggregate deposit and credit growth at the district level. The goal is to quantify the aggregate effects of the banking panic at the district level. In Table 4, we see that the district level impact of deposit and credit growth for the period 2006 to 2012 with the propensity of district bank runs.

In Table 4, columns 1–2 report the aggregate effect of the intensive and extensive margin of deposit growth with propensity of bank runs in a district. In column 1, to we see no significant impact on the aggregate growth in number of bank accounts post the financial crisis. However, there is a 6 percent decline in aggregate deposit growth in districts with a 1 percent higher propensity of bank runs. The local aggregate effect on credit growth is, however, muted. Column 4 shows that there was no statistically significant decline in credit in the aggregate at the districts with runs. The services sector which tends to be non-relationship based shows a significant decline of 20.8 percent consistent with the results in Table 3. The remaining columns show no significant decline. If anything, column 5 shows an increase in lending to the politically important agricultural sector.

These results suggest that despite the decline in deposits observed at the district level due to bank runs, there seems to be only a muted effect on credit growth in these districts. We hypothesize that banks used their internal capital networks to redirect their funds either to or away from the bank run hit districts. We now turn to whether geographically distant, but areas linked to these markets through the bank internal capital networks and which were hence affected by the runs.

## 5 Propagation of bank runs through the bank branch-network

### 5.1 Empirical Strategy

To analyze propagation through the bank branch network, we first calculate an aggregate measure at the bank level of whether the bank was exposed to bank runs in the districts that it operates in. The measure is calculated as follows:

$$Bank\ Exposure_b = \sum_{j \in b} \frac{Deposit_j}{Deposit_b} District\ Run_d \quad (5)$$

We focus on this measure of bank runs instead of simply calculating whether the branches of a bank witnessed runs because we are also interested in capturing the effect on the

public sector banks that were exposed to the districts that had runs.

The specification to analyze propagation through the banks' internal capital networks is:

$$Y_{jbd t} = \alpha_j + \theta_t + \gamma * Post * Public + \delta * Post * Bank Exposure_b + \beta * Post * Bank Exposure_b * \mathbb{1}_{Public} + \epsilon_{jbd t} \quad (6)$$

where outcome variable is for period  $t$ , for a given branch  $j$  of a bank  $b$  in district  $d$ . The outcome variables ( $Y_{jbd t}$ ) we analyze are deposit growth and credit growth from period  $t - 1$  to  $t$ .  $Bank Exposure_b$  is the deposit weighted exposure at the bank level of the branches to districts in which there were runs.  $Post$  is an indicator for post 2008.  $\alpha_j$  and  $\theta_t$  are branch and year fixed effects. The fixed effects control for time-invariant differences in branch characteristics. The remaining interaction terms are subsumed by the fixed effects.  $\beta$  can be interpreted as the average growth in outcome variable (e.g. deposits) at public sector bank branches (relative to private sector bank branches) that belong to banks that had operate in districts which had bank runs.

## 5.2 Results

The results up until now point to effects of the deposit runs being very localized. In contrast, the effect on credit at the local districts was more muted. We now look at this in an alternate specification. We test whether the internal capital markets resulted in banks redirecting both the outflow or inflow of funds through deposits to other branches of the bank. The bank exposure variable captures whether a bank predominantly operates in districts that witnessed runs. Our measure "Bank Exposure" is the measure of exposure of a bank to the propensity of runs of districts weighted by deposits of branches located of the bank located in that district.

In Table 5, we see the impact on deposit and credit growth of bank branches with bank exposure for the period 2006 to 2012. In column 1, we find that the bank exposure measure

does a good job of capturing whether its branches were exposed to districts with deposit runs. We see the familiar result, that while private sector branches experienced a decline in deposit account and volume, public sector branches experienced a relative increase in both deposit accounts as well as overall volume of deposits. Interestingly, in contrast to the localized effects, we see a strong effect on credit at branches of banks exposed to runs. A high bank exposure results in a 103.1 percent lower credit growth at the branch level. Relative to this, the branches of public sector banks exposed to runs experienced an increase in credit growth. The effects are evident across all the three sectors. Credit growth in the services sector declined by 71.4 percent whereas relatively, it increased by 66.2 percent for branches of exposed public sector banks. We saw in Section 4 that this is partly driven by local effects of lending. Consistent with the political nature of agricultural lending, we don't see a fall in loans to the agriculture sector of exposed private sector bank branches. Exposed public sector bank branches redirect some of their deposit inflows to agriculture. In sharp contrast to the findings in Section 3 and Section 4, we find a strong effect on the credit to the manufacturing sector. A higher bank exposure results in a 77.4 percent decline in lending by the exposed private sector branches to the manufacturing sector. The public sector bank branches on the other hand increase their lending to the manufacturing sector by 336 percent. This is consistent with the prior results where we conjectured that lending to the manufacturing sector seems to be predominantly relationship based. Hence, likely public sector banks are either unable or unwilling to redirect lending to the manufacturing sector locally. Instead, they redirect the sudden inflow of deposits to the manufacturing firms (plausibly with pre-existing relationships) through their internal capital networks.

How did these loans perform? In Table 6, we analyze the impact on NPA growth. For completeness, we also look at the branch level effects. We see that loan performance improved at branches with bank runs. At the aggregate level, the estimates are noisy for private sector branches but loan performance seems to have *deteriorated* for public sector

branches. This is evident in column 3, where we see these effects using our preferred specification using the bank exposure measures. A 1 percent higher exposure at the bank level results in a 349 percent lower growth in NPAs of private sector branches. Relative to this, the NPA growth at public sector branches of exposed banks had a 431 percent increase in NPA growth.

This result can be plausibly attributed to inefficient lending by public sector banks. Since public sector banks experienced increase in both extensive and intensive margin of deposits, they may have increased the credit supply to inefficient firms in the post period. We will explore this point in detail in the next sections by looking at bank-firm linkages.

## 6 Impact on firm outcomes

To explain the deterioration of loan quality, we analyze firms level outcomes. The goal is to trace the effect of the outflow from private sector banks to public sector banks on the firms that either witnessed a cut back or an increase in lending.

### 6.1 Empirical strategy

To analyze the impact on firm outcomes, we run the firm-level specification analogous to Equation 6 as follows:

$$\begin{aligned}
 Y_{ijbt} = & \alpha_b + \theta_t + \delta_{jt} + \gamma * Post * Public + \delta * Post * Bank Exposure_b \\
 & + \beta * Post * Bank Exposure_b * \mathbb{1}_{Public} + \epsilon_{jbt}
 \end{aligned} \tag{7}$$

where outcome variable is for period  $t$ , for a given firm  $i$  which borrows predominantly from bank  $b$  and operates in industry  $j$ . The outcome variables ( $Y_{ijbt}$ ) we analyze are log of employment wages, log of capital expenditure and log of the marginal productivity of capital.  $Bank Exposure_b$  is the deposit weighted exposure at the bank level of the branches to districts in which there were runs.  $Post$  is an indicator if year is greater than or equal to 2009.  $\alpha_b$ ,  $\theta_t$  and  $\delta_{jt}$  are bank, year and industry-year fixed effects. The remaining

interaction terms are subsumed by the fixed effects.

## 6.2 Results

Table 7 first looks at the impact on debt. Consistent with prior results, we see that debt declined by 2 percent for firms connected to the exposed private sector banks whereas it increased by 2.3 percent for firms connected to public sector banks. As before, results are particularly strong for manufacturing firms as before. Results are weaker for the services sector possibly driven by the small sample size. As before agriculture and the remaining sectors show weak results.

Table 8 looks at firm level outcomes. Column 1 shows that the decrease in lending resulted in a decline in wages, but firms which are able to borrow from public sector banks were able to mitigate this fall in wages to a certain extent. Column 2 shows that capital expenditure of firms borrowing predominantly from private sector banks that were exposed to bank runs witnessed a 7 percent decline in capital expenditure. Firms which were able to borrow from exposed public sector banks were able to mitigate this to some extent relatively increased their capital expenditure by 6 percent. Column 3 shows, however, that the marginal productivity of capital of firms borrowing from private sector banks increased by 5.6 percent whereas the productivity of firms borrowing from public sector banks *declined* by 1.2 percent. This possibly explains the higher NPAs of the branches of the exposed public sector banks. This provides evidence that while the firms which received funding from public sector banks increased investment, they possibly directed the investment to less productive technologies.

## 7 Industry-level distortions

This section analyzes industry-level distortions arising from an increase in lending by public sector banks to potentially inefficient firms.

## 7.1 Empirical strategy

First, we look at the impact on outcomes for those industries that predominantly borrow from the exposed public sector banks. The idea is to see whether this depresses employment (wages) and capital expenditure on remaining firms.

To analyze industry level exposure to affected public sector banks, we define *Industry Exposure<sub>b</sub>* as simply the asset-weighted percentage of firms in the industry that borrow from the exposed public sector banks. This measure is calculated as follows:

$$Industry\ Exposure_j = \sum_{i \in j} \frac{Asset_i}{Asset_j} Bank\ Exposure_{ib} * Public \quad (8)$$

*Industry Exposure<sub>j</sub>* is calculated for industry *j* and aggregates across firms *i* in the industry where each firm *i* borrows from bank *b*. *Public* is an indicator for whether the bank that the firm borrows from is a public sector bank.

We then compare the outcome variables for firms that borrow from private sector banks but are predominantly in the industries funded by public sector banks. The specification is as follows:

$$Y_{ijbt} = \alpha_b + \delta_{jt} + \theta_t + \delta * Industry\ Exposure_j * \mathbb{1}_{Private} \\ + \phi * Post * \mathbb{1}_{Private} + \gamma * Post * Industry\ Exposure_j * \mathbb{1}_{Private} + \epsilon_{ibt} \quad (9)$$

where outcome variable is for period *t*, for a given firm *i* which borrows predominantly from bank *b* in industry *j*. We link each firm to the firm's lead bank in the pre-period. The outcome variables (*Y<sub>ibt</sub>*) we analyze are log of employment wages, log of capital expenditure and log of the marginal productivity of capital. *Post* is an indicator for post the run, so for any year after 2009.  $\alpha_b$ ,  $\delta_{jt}$ , and  $\theta_t$  are bank, industry-year and year fixed effects. The remaining interaction terms are subsumed by the fixed effects. *gamma* measures the average outcome variable of firms that borrow from private sector banks, but operate in

industries that are predominantly funded by the *exposed* public sector banks.

## 7.2 Results

Table 9 analyzes the spillover effects of credit reallocation from private to public sector banks. The idea is that keeping credit away from the most productive firms can depress wages and investment of firms that operate in the same industry, especially for those banks that cannot borrow from the public sector banks. We see that investment of firms that borrow from private sector banks declined (relative to those that borrow from public sector banks) by a stark 628 percent. Wages declined by 298 percent. Marginal productivity of capital of the firms that borrow from exposed private sector banks, especially in these decongested industries was higher (though not statistically significant) by 113 percent.

## 8 Allocative efficiency and overall economic activity

Finally, we analyze the impact on allocative efficiency in the industries that predominantly had pre-existing relationships with public sector banks. We conclude by analyzing real economic activity using the night lights data.

### 8.1 Empirical Strategy

To examine allocative efficiency, we can decompose productivity gains into the part attributable to declines in average productivity and the part attributable to reallocation following [Olley and Pakes \(1996\)](#).

Aggregate marginal productivity of capital can be written as:

$$\Phi_t = \sum_i s_{it} mpk_{it} = \overline{mpk}_t + \sum_i (s_{it} - \bar{s}_t)(mpk_{it} - \overline{mpk}_t) \quad (10)$$

$\Phi_t$  is aggregate marginal productivity of capital and  $mpk_{it} = \ln(MPK_{it})$  is the log

of the marginal product of capital calculated as log of the ratio of capital to sales.<sup>3</sup>  $s_{it}$  is the share of capital of firm  $i$  to the entire industry.  $\overline{MPK}_t = (1/n) \sum_i MPK_{it}$  and  $\overline{s}_t = (1/n) \sum_i s_{it}$ . In the [Olley and Pakes \(1996\)](#) decomposition the first term is the unweighted technical productivity measure which captures the within-firm productivity improvements. The second term is the total covariance between a firm's share of the market and its productivity and captures the reallocation across firms.

We then run the following specification to analyze the contribution due to each term. The specification is as follows:

$$Y_{ijbt} = \alpha_b + \theta_t + \delta_i + \beta * Post * Industry Exposure_j + \epsilon_{ijbt} \quad (11)$$

where outcome variable is for period  $t$ , for a given firm  $i$  which borrows predominantly from bank  $b$  in industry  $j$ . The outcome variables ( $Y_{ibt}$ ) we analyze are log of employment wages, log of capital expenditure and log of the marginal productivity of capital.  $Post$  is an indicator for post the run, so for any year after 2009.  $\alpha_b$ ,  $\delta_i$ , and  $\theta_t$  are bank, firm and time fixed-effects. The remaining interaction terms are subsumed by the fixed effects.  $\beta$  in the above specification measures the average outcome variable of firms that borrow industries dominated by public sector banks relative to the private sector banks.

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<sup>3</sup>Consistent with the literature, we use the logged MPK. While the level measures are more intuitive and useful for aggregate welfare implications, the logged measure avoids measurement bias while calculating the contributions of surviving firms in the decomposition analysis. For example, if we use the level values, an overall percentage improvement in productivity of all firms in the economy would be split into equal contributions of the average productivity improvement and reallocation improvement. However, if all firms improve productivity to the same extent we would ideally like the reallocation term to be zero, which is achieved when productivity is in logs. See [Melitz and Polanec \(2015\)](#) and [Petrin and Levinsohn \(2012\)](#) for a discussion.

## 8.2 Results

### 8.2.1 Allocative Efficiency

Table 10 then analyzes the spillover effects of this credit reallocation. The [Olley and Pakes \(1996\)](#) decomposition splits the effect on marginal productivity of capital into the component driven by changes in within firm productivity and the component due to reallocation across firms. Columns 1–3 tell us that most of the productivity deterioration was driven by a decline in within-firm productivity. While overall productivity declined by 51 percent, within firm productivity declined by 39 percent. There was almost no effect due to reallocation of capital across firms in industries, that is, from more productive to less productive firms.

### 8.2.2 Overall economic activity

Finally, we conclude by looking at the impact on real economic activity at the district level. Since high quality GDP data is not available at the district level, we use night lights data to proxy for GDP growth. One advantage of the night lights data is that it captures activity in both the formal and the informal economy.

In Table 11, column 1 shows that economic activity declined by 0.16 percent in districts where intensity of bank runs increased by 1 percent. In column 2, we see a similar decline in overall activity of 1.13 percent in districts where exposed banks operate. As column 3 shows, some of this decline is mitigated by the presence of public sector banks. In districts where the fraction of lending by public sector branches is higher, there is a relative increase of 2.8 percent in luminosity as opposed to a 2.9 percent decrease in luminosity otherwise. This is consistent with our analysis where we find that lending by public sector branches of exposed banks increased in the post-crisis period. However, column 2 indicates that despite the presence of public sector banks, there is an overall fall in economic activity. This is also consistent with the results in Table 4 where we found

that not all the panic outflow of deposits out of the private sector banks made their way to the public sector banks and hence there was an overall decline in deposit growth in districts with runs. This is reflected in the overall reduction in credit growth, as the funding shocks are transmitted through the banks' internal capital networks.

Further, the analysis in this paper has focused on just the flows from private to public sector lending. Bigger firms could borrow from foreign banks (though these banks account for only a small share of overall lending). Smaller firms could borrow from or cooperative banks or from the informal lending markets. The negative overall growth in real economic activity as measured by the night lights data assures us that firms were not able to undo the detrimental effects of the panic flows from private sector banks by accessing alternate lending markets. Thus, panic flows had permanent and persistent effects on the districts that witnessed them.

## 9 Conclusion

In this paper we looked at the distributional effects of banking panics during crises. There was panic in the Indian banking sector following the Lehman bankruptcy. Using this as a source of exogenous variation in the depositors' perception of bank fragility in India, we show that banks that were not state-owned — private sector banks — were more susceptible to runs. Exploiting rich branch-level data of the entire banking network in India, we show that there was significant geographical heterogeneity in private sector bank branches that experienced runs. Using three different measures of bank-runs, we show that private sector branches which experienced runs were the "better" branches: they were located in urban areas, had more skilled officers and were not deposit poor. In contrast, state-owned banks which were located in regions with more runs on private sector bank branches witnessed an inflow of deposits during this period. While the flight-to-safety from private sector banks lost both short-term and long-term deposits, public sector banks grew their long-term deposits. Further, the impact of these deposit

flows on bank lending was highly localized. Private sector banks reduced their lending predominantly to the retail sector. Public sector banks which were flush with deposits increased their lending. Our results highlight the geographic heterogeneity in the effects of a banking panic.

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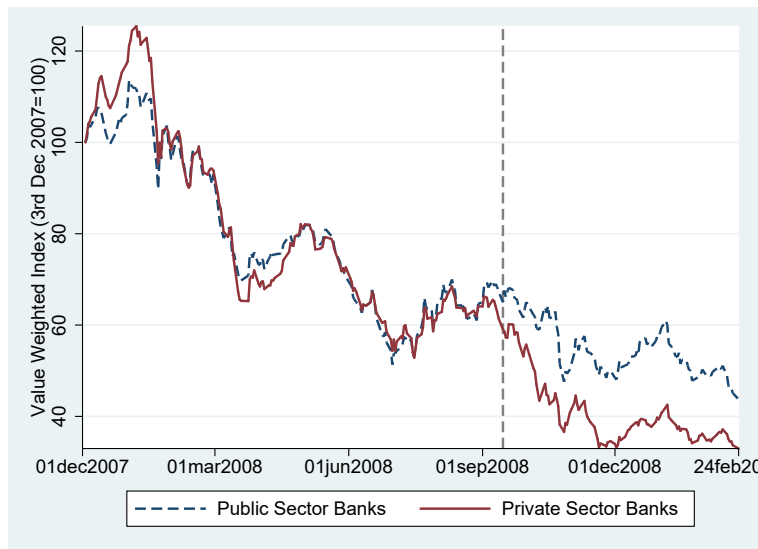
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Figure 1: Market Reaction and Quarterly Deposit Growth

The top panel shows the stock index for the period December 2007 to February 2009. The bottom panel shows the cumulative quarterly deposit growth for private sector and public sector banks respectively for the period December 2007 to March 2009. The stock index is the value weighted (with the outstanding market value of each stock) index calculated separately for public and private sector banks. The index has been normalized to 100 as of December 2007. The dashed line is shown as of the day of the bankruptcy of Lehman Brothers on September 15, 2008. Data for quarterly deposit growth has been provided by the the Reserve Bank of India. Stock return data is from Bloomberg.

**Panel A: Stock Index**



**Panel B: Quarterly Deposit Growth**

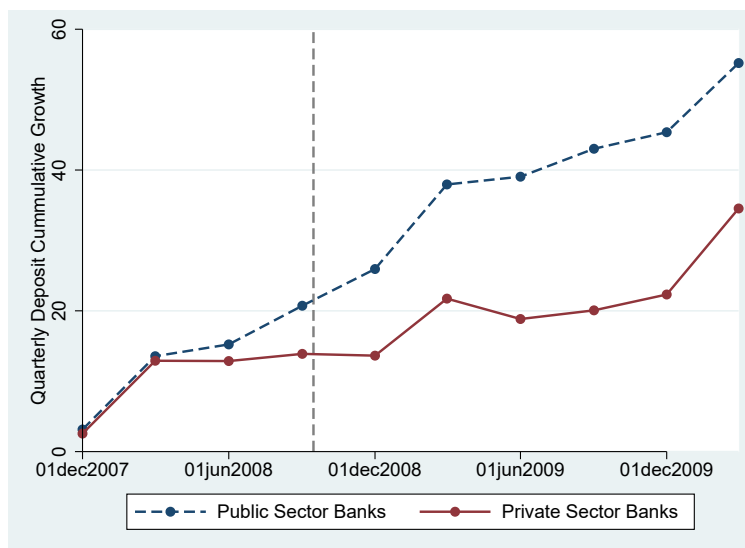


Figure 2: Deposit Growth and Bank Runs

The figures below show the heatmap at the district-level the deposit growth for private and public sector banks. Deposit growth is from 2008 to 2009. We have retained only the public and private sector banks. 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. The greyed out areas either have no data available.

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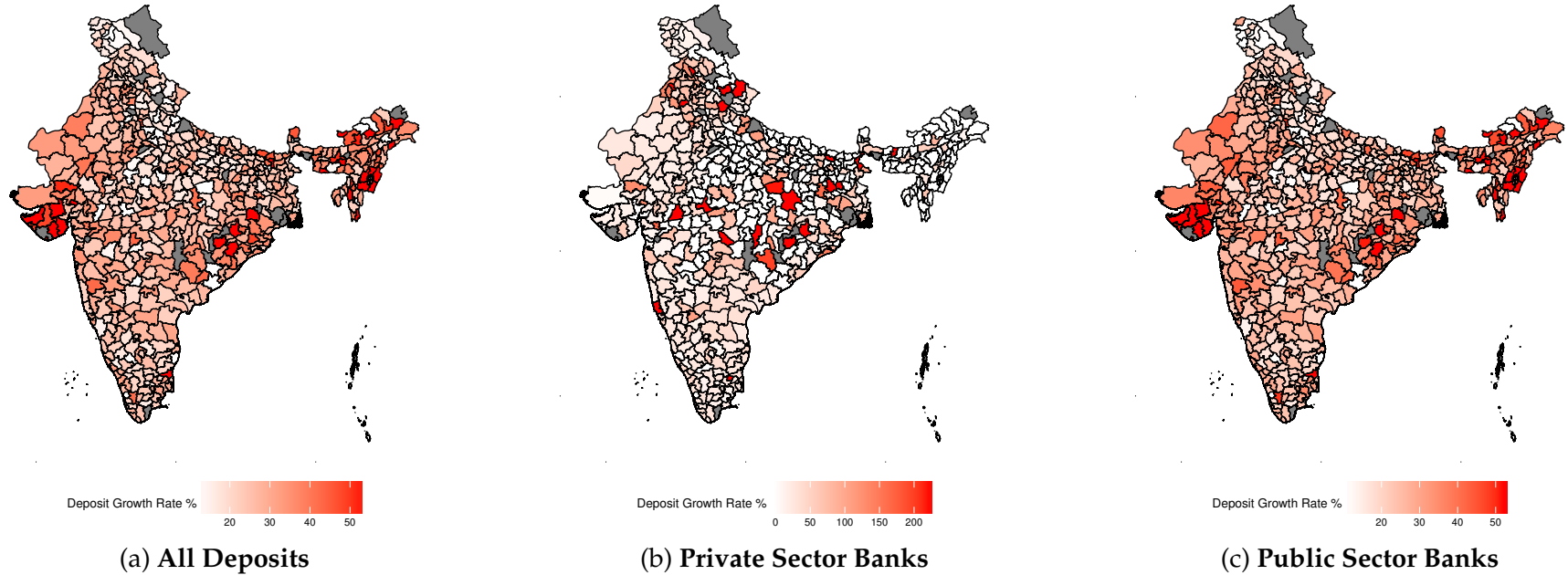


Figure 3: Deposit Growth and Bank Runs: Lower Growth

The figures below show the heatmap at the district-level the deposit growth for private and public sector banks. Deposit growth is from 2008 to 2009. We have retained only the public and private sector banks. Panel (a) shows the deposit growth for private sector banks and panel (b) shows the deposit growth for the public sector banks. To make the graphs comparable we show only graphs with negative deposit growths are shown.

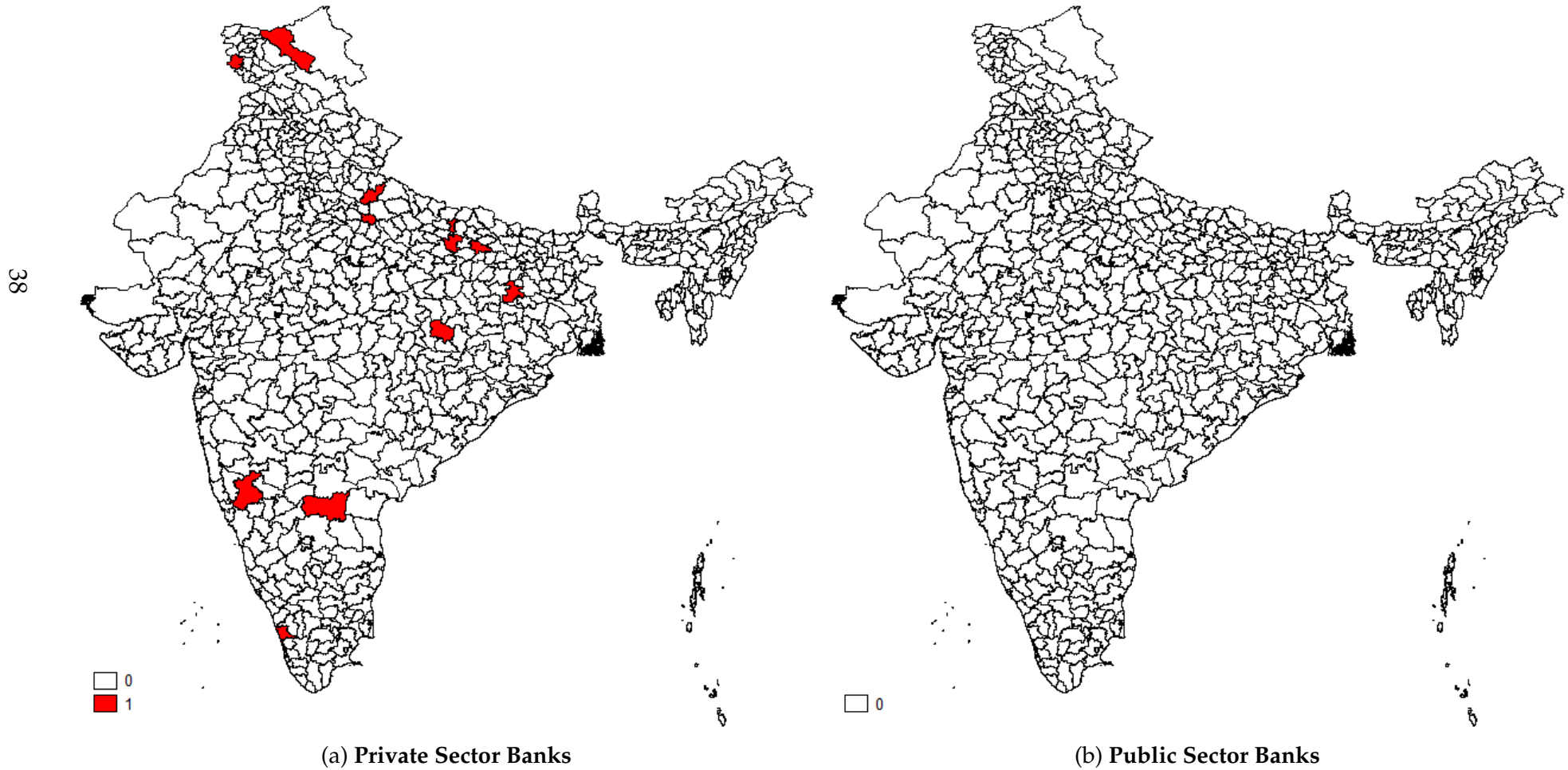


Figure 4: Testing the parallel trends assumption

The figure below shows the parallel trends assumption for the bank run measure used in our analysis. We plot the coefficients for the event study plot as explained in Section 3. The event study plot for our baseline branch run measure is provided here.

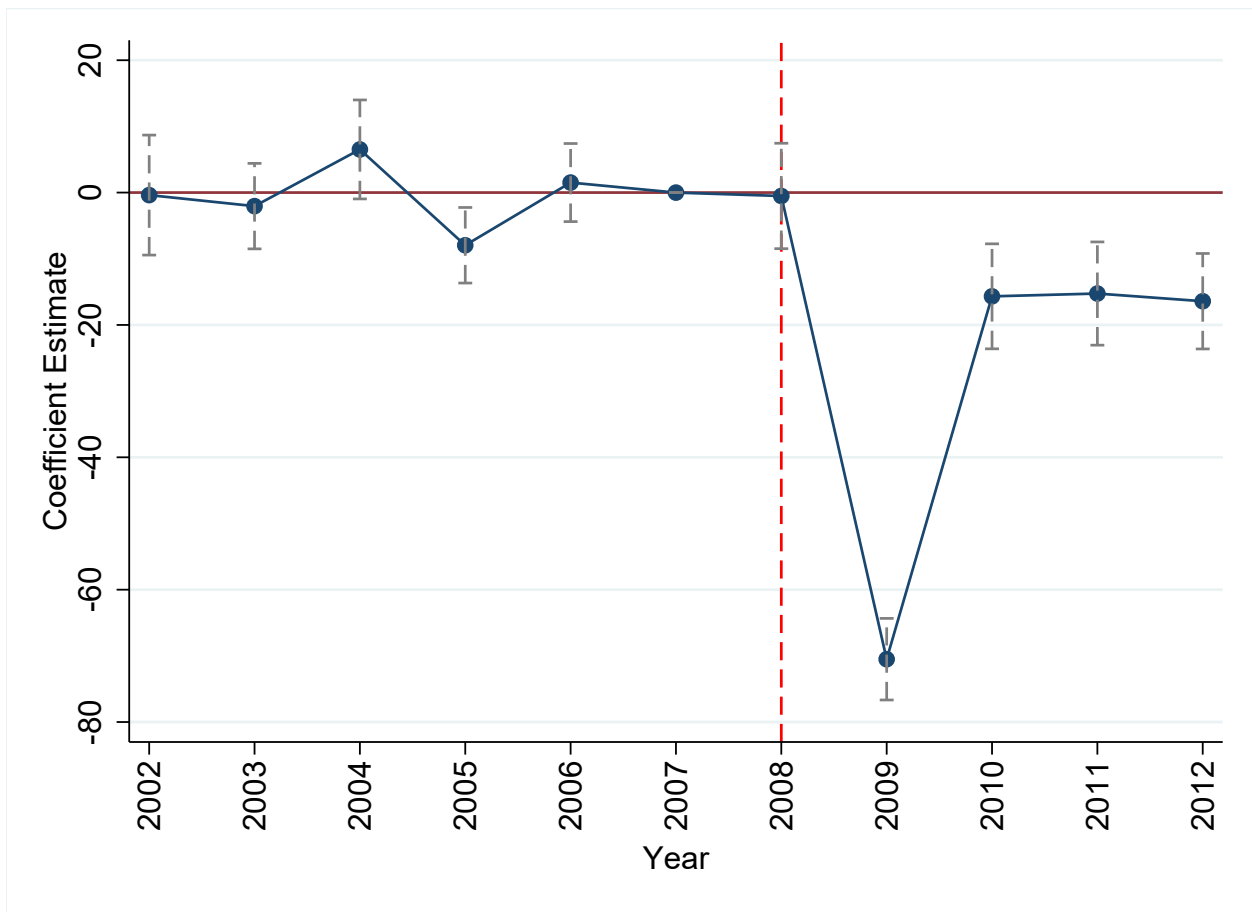


Table 1: Summary Statistics: Branch Characteristics

Summary statistics for all branches in our analysis. There are four measures to classify private sector bank branches with runs. Percentage of banks with runs is then calculated at the district level and is the ratio of the number of banks which were classified as “runs” for each of these measures to the total number of branches in a district. We further divide this district level propensity of runs into a binary variable for districts with above median runs along each of the three measures. Deposit growth and credit growth is from March 2008 to March 2009. Deposit growth is further classified as demand deposits, term deposits and savings deposits. Credit growth is further classified as agricultural loans, industrial loans, loans to the professional sector, personal loans, trade loans and loans to the financial sector. Variables have been winsorized at the 2 percent level.

	Mean	SD	p10	p25	p50	p75	p90
<b>All Branches: N = 56,702</b>							
Deposit growth 08–09	29.34	38.61	-0.41	11.07	22.03	35.17	60.63
Credit growth 08–09	29.45	71.52	-12.13	0.01	12.35	30.22	67.20
<b>Private Sector Branches: N = 8,075</b>							
Deposit growth 08–09	35.40	49.68	-9.22	9.19	24.15	43.34	91.88
Credit growth 08–09	47.81	108.31	-28.57	-7.12	12.44	46.41	166.70
<b>Public Sector Branches: N = 48,627</b>							
Deposit growth 08–09	36.50	241.29	0.74	11.27	21.77	34.16	56.59
Credit growth 08–09	25.80	63.02	-9.99	0.65	12.34	28.90	58.06
<b>Branch Run Measures</b>							
Bank Run: $\Delta$ Gwt 08–09	0.06	0.24					
Bank Run: 2008 Distribution	0.01	0.10					
Bank Run: Residual	0.04	0.18					
<b>District-level Propensity of Runs: N = 630</b>							
Propensity $\Delta$ Gwt 08–09	2.92	10.69	0.00	0.00	0.00	0.00	5.47
Propensity 2008 Distribution	8.81	17.95	0.00	0.00	0.00	14.92	30.56
Propensity Residual	6.23	14.28	0.00	0.00	0.00	5.68	18.34

Table 2: Effect on branches with bank runs

The table below looks at the impact of the bank runs on deposit growth and credit growth in a difference-in-difference setting for the period 2006 to 2012. The dependent variable is growth in number of depositors (column 1), volume of depositors (column 2), overall credit growth (column 3). In columns 4–7, the dependent variable is the credit growth in the services, agricultural, manufacturing and a catch-all category “other” respectively. Post is an indicator for years post 2008. Branch run is an indicator for whether there was a run at the branch and is defined as follows. The first bankrun flag is 1 if the predicted deposit growth of private sector bank branches is more than the actual growth rate. The prediction equation is the deposit growth rate on size (lagged credit), age, whether rural, lagged credit to deposit ratio and also whether it belongs to a public sector bank (allows for PSBs to have on average lower growth rates). We use out-of-sample regression and restrict to before 2006 and predict for remaining years. For the second bankrun flag we do the following. We first identify private sector bank branches which had growth (in 2009) below the 5<sup>th</sup> percentile of growth rates in 2008. Then we look at the change in growth rates between 2009 (March 2008 to March 2009) and 2008 (March 2007 to March 2008). A private sector branch is classified as having had a run in 2009 if the above is less than zero. For the third bankrun flag, we flag private sector bank branches which had growth (in 2009) below the 5<sup>th</sup> percentile of growth rates in 2008 but with deposit growth rate above this threshold in 2008. The fourth bankrun flag is 1 for private sector bank branches if all the other three measures are 1. This measure basically takes the intersection of all the three measures defined above to identify banks with runs. We use the most stringent measure 4 in our analysis. Variables have been winsorized at the 2 percent level. All columns include branch and year fixed effects. Standard errors are clustered at the district level.

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Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Deposit growth		Credit growth				
	Acc.	Vol.	All	Services	Agri.	Manuf.	Other
Post * Branch Run	-17.20*** (1.537)	-28.47*** (1.845)	-26.78*** (3.374)	-24.45*** (6.617)	5.216 (34.31)	-110.4*** (17.66)	-10.14 (7.443)
No. of Obs.	297817	297817	297817	196624	232247	252616	189996
R squared	0.273	0.283	0.292	0.228	0.207	0.192	0.256
Branch-FE	Y	Y	Y	Y	Y	Y	Y
Year-FE	Y	Y	Y	Y	Y	Y	Y

Table 3: Local spillover effects of bank runs on nearby branches

The table below looks at the spillover impact of the bank runs on nearby branches on deposit growth and credit growth for the period 2006 to 2012. The dependent variable is growth in number of depositors (column 1), volume of depositors (column 2), overall credit growth (column 3). In columns 4–7, the dependent variable is the credit growth in the services, agricultural, manufacturing and a catch-all category “other” respectively. Post is an indicator for years post 2008. The district run variable measures the propensity of bank runs among the private sector branches at the district level. Variables have been winsorized at the 2 percent level. All columns include branch, year and district fixed effects. Standard errors are clustered at the district level.

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Deposit growth		Credit growth				
	Acc.	Vol.	All	Services	Agri.	Manuf.	Other
Post * District Run	-0.0790*** (0.0114)	-0.0957*** (0.0143)	-0.0964*** (0.0278)	-0.126*** (0.0357)	0.355 (0.223)	0.0703 (0.110)	-0.0498 (0.0447)
Post * District Run * Public	0.0518*** (0.0118)	0.0604*** (0.0149)	0.0225 (0.0285)	0.0912** (0.0372)	-0.350 (0.231)	-0.202* (0.115)	-0.0188 (0.0469)
No. of Obs.	297817	297817	297817	196624	232247	252616	189996
R squared	0.275	0.284	0.294	0.228	0.207	0.192	0.256
Bank-FE	Y	Y	Y	Y	Y	Y	Y
District-FE	Y	Y	Y	Y	Y	Y	Y
Branch-FE	Y	Y	Y	Y	Y	Y	Y
Year-FE	Y	Y	Y	Y	Y	Y	Y

Table 4: Aggregate district-level effect of bank runs

The table below looks at the aggregate district-level impact of bank runs on deposit growth and credit growth for the period 2006 to 2012. The dependent variables measured at the district level are: growth in number of depositors (column 1), volume of depositors (column 2), overall credit growth (column 3). In columns 4–7, the dependent variable is the district-level credit growth in the services, agricultural, manufacturing and a catch-all category “other” respectively. Post is an indicator for years post 2008. The district run variable measures the propensity of bank runs among the private sector branches at the district level. Variables have been winsorized at the 2 percent level. All columns include year and district fixed effects. Standard errors are clustered at the district level.

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Deposit growth		Credit growth				
	Acc.	Vol.	All	Services	Agri.	Manuf.	Other
Post * District Run	-0.0229 (0.0142)	-0.0604*** (0.0212)	-0.0314 (0.0285)	-0.208*** (0.0696)	0.453* (0.246)	0.0514 (0.0808)	-7.307 (6.054)
No. of Obs.	1668	1668	1668	1668	1668	1668	1668
R squared	0.252	0.337	0.200	0.169	0.176	0.161	0.167

Table 5: Effect of bank runs through the bank branch-network

The table below looks at the impact of the bank-level exposure to bank runs on deposit growth and credit growth for the period 2006 to 2012. The dependent variable is growth in number of depositors (column 1), volume of depositors (column 2), overall credit growth (column 3). In columns 4–7, the dependent variable is the credit growth in the services, agricultural, manufacturing and a catch-all category other respectively. Post is an indicator for years post 2008. The bank-level exposure is measured at the bank-level and is the deposit weighted measure of exposure to a run at the district-level, calculated across all branches of a bank. Variables have been winsorized at the 2 percent level. All columns include branch, year and district fixed effects. Standard errors are clustered at the district level.

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Deposit growth		Credit growth				
	Acc.	Vol.	All	Services	Agri.	Manuf.	Other
Post * Bank Exposure	-0.987*** (0.0350)	-1.232*** (0.0430)	-1.031*** (0.0915)	-0.714*** (0.129)	0.406 (0.763)	-0.774** (0.369)	-0.0914 (0.162)
Post * Public * Bank Exposure	0.850*** (0.0392)	1.010*** (0.0476)	0.969*** (0.0976)	0.662*** (0.136)	1.628** (0.810)	3.367*** (0.406)	0.271 (0.174)
No. of Obs.	297817	297817	297817	196624	232247	252616	189996
R squared	0.280	0.289	0.294	0.228	0.207	0.193	0.256
Branch-FE	Y	Y	Y	Y	Y	Y	Y
District-FE	Y	Y	Y	Y	Y	Y	Y
Year-FE	Y	Y	Y	Y	Y	Y	Y

Table 6: Impact on loan performance

The table below looks at the impact of bank runs on loan performance for the period 2006 to 2012. The dependent variable is annual growth in non-performing assets (NPAs). Post is an indicator for years post 2008. Branch run is an indicator for whether there was a run at the branch and is defined as follows. The first bankrun flag is 1 if the predicted deposit growth of private sector bank branches is more than the actual growth rate. The prediction equation is the deposit growth rate on size (lagged credit), age, whether rural, lagged credit to deposit ratio and also whether it belongs to a public sector bank (allows for PSBs to have on average lower growth rates). We use out-of-sample regression and restrict to before 2006 and predict for remaining years. For the second bankrun flag we do the following. We first identify private sector bank branches which had growth (in 2009) below the 5<sup>th</sup> percentile of growth rates in 2008. Then we look at the change in growth rates between 2009 (March 2008 to March 2009) and 2008 (March 2007 to March 2008). A private sector branch is classified as having had a run in 2009 if the above is less than zero. For the third bankrun flag, we flag private sector bank branches which had growth (in 2009) below the 5<sup>th</sup> percentile of growth rates in 2008 but with deposit growth rate above this threshold in 2008. The fourth bankrun flag is 1 for private sector bank branches if all the other three measures are 1. This measure basically takes the intersection of all the three measures defined above to identify banks with runs. We use the most stringent measure 4 in our analysis. The district run variable measures the propensity of bank runs among the private sector branches at the district level. The bank-level exposure is measured at the bank-level and is the deposit weighted measure of exposure to a run at the district-level, calculated across all branches of a bank. Variables have been winsorized at the 2 percent level. All columns include branch, year and district fixed effects. Standard errors are clustered at the district level.

Dependent variable:	(1)	(2)	(3)
		NPA Growth	
Post * Branch Run	-42.49*** (6.189)		
Post * District Run		-0.0836 (0.0584)	
Post * District Run * Public		0.192*** (0.0595)	
Post * Bank Exposure			-3.490*** (0.173)
Post * Public * Bank Exposure			4.314*** (0.183)
No. of Obs.	342937	342937	342937
R squared	0.292	0.295	0.299
District-FE	Y	Y	Y
Branch-FE	Y	Y	Y
Year-FE	Y	Y	Y

Table 7: Firm-exposure and credit

The table below looks at firm-level exposure to bank runs on debt for the period 2006 to 2012. The dependent variables is log of delta debt (analogous to loans) for all firms, services firms, agricultural firms, manufacturing firms and other firms in columns 1–5 respectively. Post is an indicator for years post 2008. The bank-level exposure is measured at the bank-level and is the deposit weighted measure of exposure to a run at the district-level, calculated across all branches of a bank. Variables have been winsorized at the 2 percent level. All columns include bank, year and industry-year fixed effects. Standard errors are clustered at the bank level.

	(1)	(2)	(3)	(4)	(5)
	Ln( $\Delta$ Debt)				
	All	Services	Agriculture	Manufacturing	Other
Post * Bank Exposure	-0.0202** (0.00796)	-0.467 (0.824)	0.0834* (0.0436)	-0.0345** (0.0162)	-0.0174 (0.0130)
Post * Public * Bank Exposure	0.0230* (0.0136)	0.472 (0.919)	-0.0891* (0.0500)	0.0396** (0.0182)	0.0194 (0.0211)
No. of Obs.	9376	115	701	5045	3515
R squared	0.211	0.609	0.296	0.169	0.258
Bank-FE	Y	Y	Y	Y	Y
Year-FE	Y	Y	Y	Y	Y
Industry-Year FE	Y	Y	Y	Y	Y

Standard errors in parentheses

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

Table 8: Firm-exposure, capital investment and marginal productivity of capital growth

The table below looks at firm-level exposure to bank runs on employment, capital expenditure and the total factor productivity for the period 2006 to 2012. The dependent variables are log of wages, capital expenditure and marginal productivity of capital in columns 1–3. Post is an indicator for years post 2008. The bank-level exposure is measured at the bank-level and is the deposit weighted measure of exposure to a run at the district-level, calculated across all branches of a bank. Variables have been winsorized at the 2 percent level. Variables have been winsorized at the 2 percent level. All columns include firm, bank and year fixed effects. Standard errors are clustered at the firm level.

	(1)	(2)	(3)
	Ln(Wages)	Ln(CapEx)	Ln(MPK)
Post * Bank Exposure	-0.0143*** (0.00482)	-0.0659*** (0.0153)	0.0559* (0.0325)
Post * Public * Bank Exposure	0.0132* (0.00658)	0.0611*** (0.0169)	-0.118** (0.0454)
No. of Obs.	21760	17590	21504
R squared	0.216	0.148	0.0692
Bank-FE	Y	Y	Y
Year-FE	Y	Y	Y
Industry-Year FE	Y	Y	Y

Standard errors in parentheses

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

Table 9: Industry-exposure and spillover effects on firms that borrow from private sector banks

The table below looks at spillovers on employment, capital expenditure and the marginal productivity of capital for the period 2006 to 2012 separately for firms that borrow from private sector banks operating in industries congested by affected public sector banks.  $\mathbb{1}_{\text{Private}}$  is an indicator for whether a firm borrows has pre-existing relationship (before 2008) with a private sector bank. The dependent variables are log of wages and capital expenditure in columns 1–2. Column 3 measures the marginal productivity of capital. Post is an indicator for years post 2008. Industry exposure measures whether a firm predominantly borrows from public sector banks which were exposed to bank runs. Variables have been winsorized at the 2 percent level. All columns include firm, bank and year fixed effects. Standard errors are clustered at the firm level.

	(1) Ln(Wages)	(2) Ln(CapEx)	(3) Ln(MPK)
Post * Private * Industry Exposure	-2.984** (1.260)	-6.283*** (2.113)	1.133 (1.192)
No. of Obs.	10534	11686	10222
R squared	0.244	0.147	0.234
Bank FE	Y	Y	Y
Year FE	Y	Y	Y
Industry-Year FE	Y	Y	Y

Standard errors in parentheses

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

Table 10: Industry-exposure and allocative efficiency

The table below looks at capital reallocation within industries for the period 2006 to 2012. Columns 1–3 measures the productivity decomposition using the Olley-Pakes decomposition. In column 1, the dependent variable is marginal productivity of capital and the regression is weighted by total sales. In Column 2, the dependent variable is marginal productivity of capital and is unweighted. In column 3, the dependent variable is the covariance between marginal productivity of capital and share of sales within an industry-year. Post is an indicator for years post FY 2008. Industry exposure measures whether a firm pre-dominantly borrows from public sector banks which were exposed to bank runs. Variables have been winsorized at the 2 percent level. All columns include bank and year fixed effects. Standard errors are clustered at the firm level.

	(1) Aggregate Productivity	(2) Within-firm Productivity	(3) Reallocation
Post * Industry Exposure	-0.516** (0.236)	-0.386** (0.197)	-0.000750 (0.0268)
No. of Obs.	21214	21214	21214
R squared	0.950	0.878	0.800
Bank FE	Y	Y	Y
Year FE	Y	Y	Y

Standard errors in parentheses

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

Table 11: Overall impact on economic activity

The table below looks at the impact of runs on district-level economic activity as measured by night lights for the period 2006 to 2012. The dependent variable is log of the district-level night light luminosity. Post is an indicator for years post 2008. The district run variable measures the propensity of bank runs among the private sector branches at the district level. The bank-level exposure is measured at the bank-level and is the deposit weighted measure of exposure to a run at the district-level, calculated across all branches of a bank. Variables have been winsorized at the 2 percent level. All columns include branch, year and district fixed effects. Standard errors are clustered at the district level.

	(1)	(2)	(3)
Post * District Run	-0.00160*** (0.000435)		
Post * Bank Exposure		-0.0113*** (0.00306)	-0.0295*** (0.00693)
Post * Fraction Public * Bank Exposure			0.0294*** (0.00955)
No. of Obs.	1946	1946	1946
R squared	0.989	0.989	0.989
District-FE	Y	Y	Y
Year-FE	Y	Y	Y

Standard errors in parentheses

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

# **Anatomy of a Banking Panic**

## **Online Appendix**

Viral Acharya   Abhiman Das   Nirupama Kulkarni

Prachi Mishra   N. R. Prabhala

Figure A1: Distribution of  $\Delta$ Deposit Growth Rates

The graphs below show the kernel density of the distribution of the change in growth rates of deposits. Panel (a) shows the difference in growth rates during March 2006–March 2007 and March 2007–March 2008 ( $\Delta$  of growth rates). Panel (b) shows the difference in growth rates during March 2007–March 2008 and March 2008–March 2009 ( $\Delta$  of growth rates).

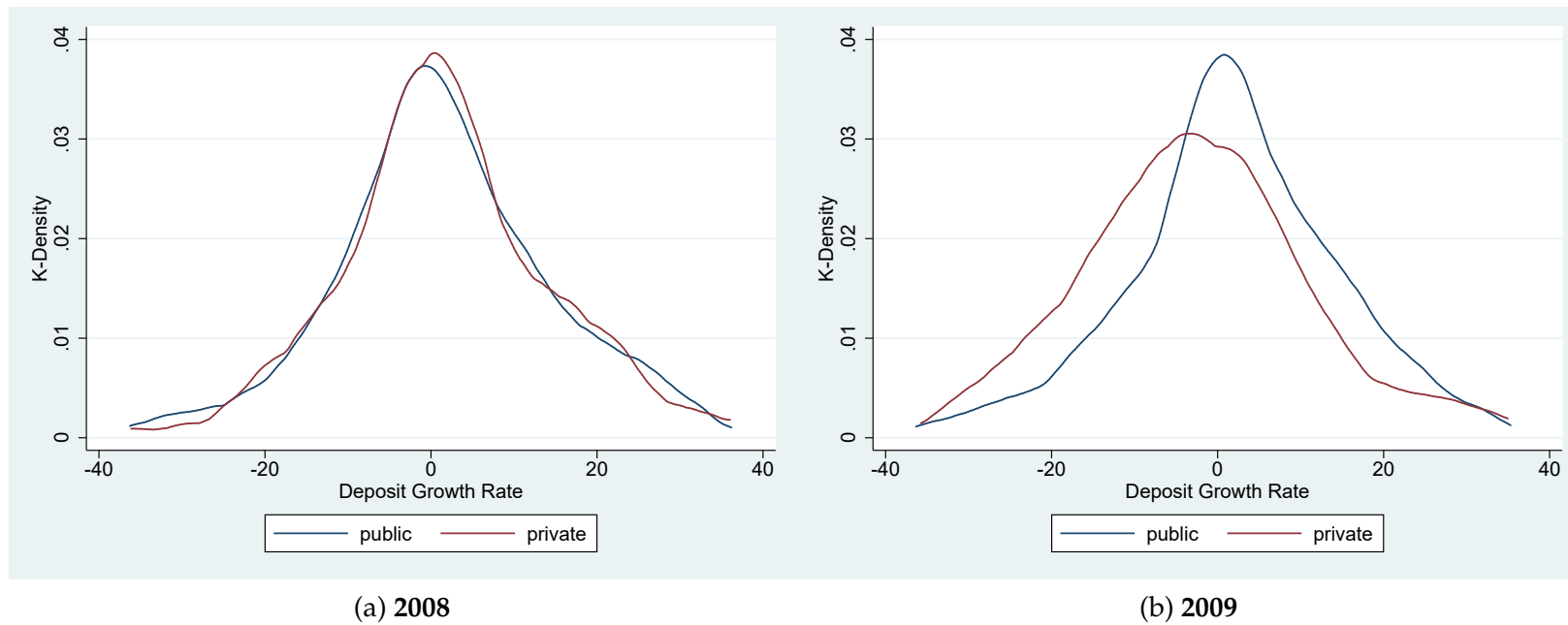
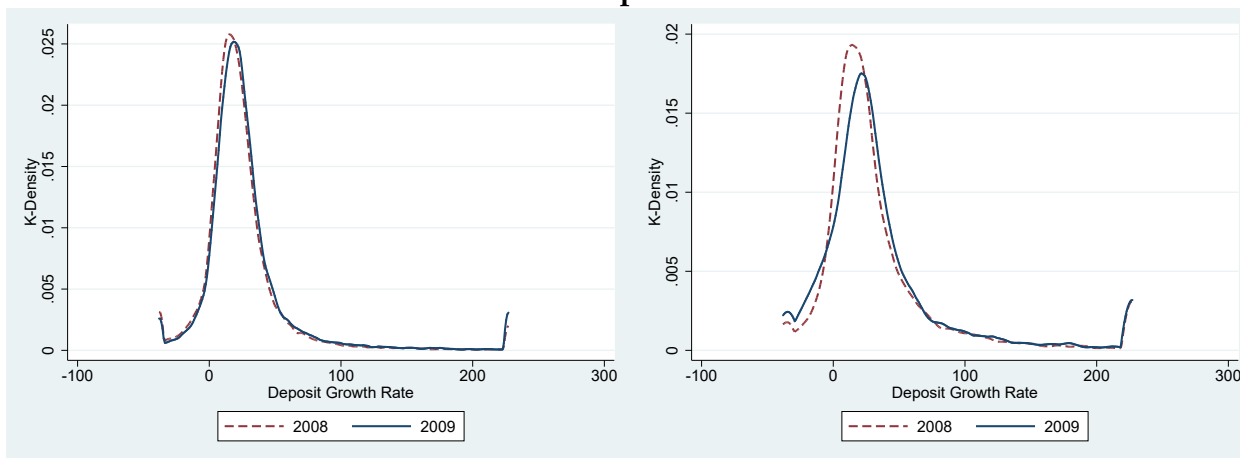


Figure A2: Distribution of Deposit Growth

Panel A shows the distribution of deposit growth rate for 2008 (March 2007 to March 2008) and 2009 (March 2008 to March 2009). Panel B shows the corresponding distribution of number of deposit account growth. We repeat the previous graph and restrict to branches with deposit growth rates below zero in Panel B. Winsorized at the 1 percent level.

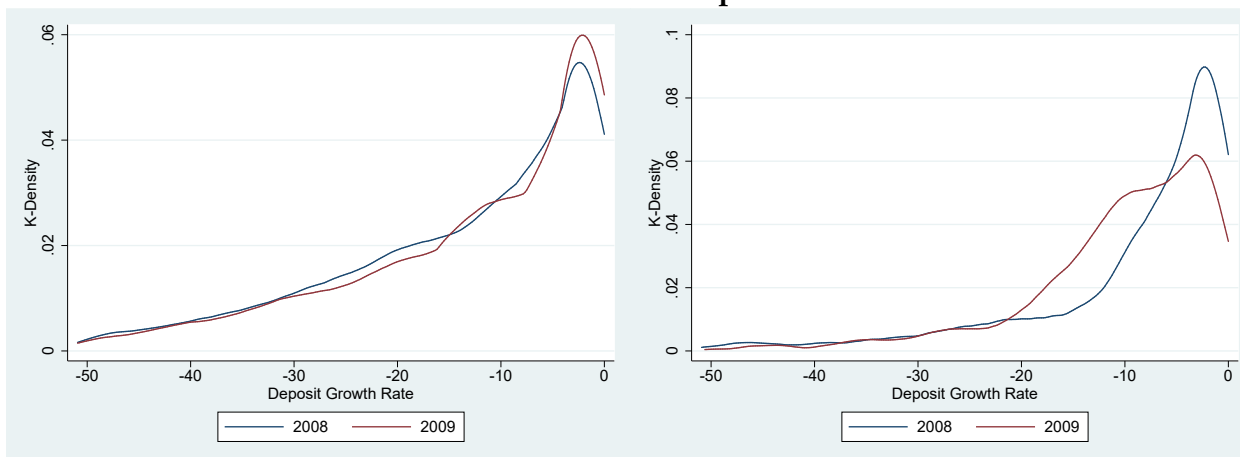
Panel A: Deposit Growth



(a) Public Sector Banks

(b) Private Sector Banks

Panel B: Lower Tail of Deposit Growth

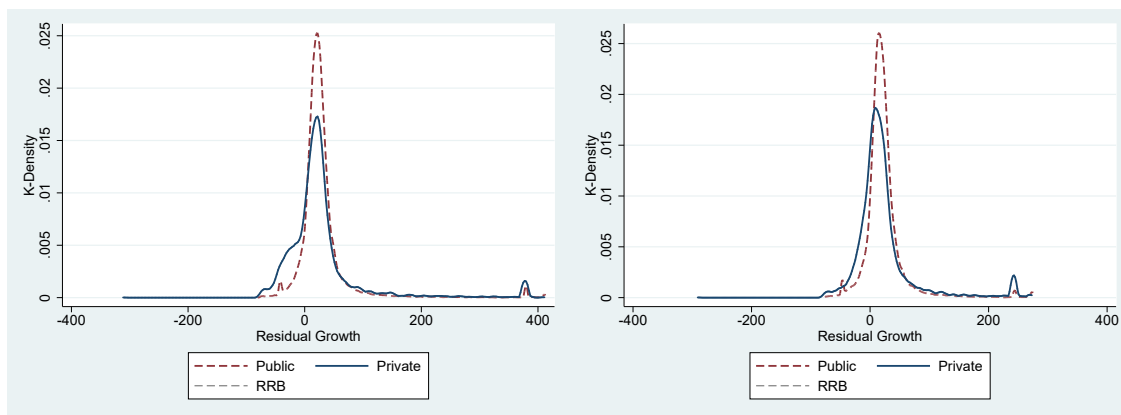


(c) Public Sector Banks

(d) Private Sector Banks

Figure A3: Residuals: Distribution of Deposit Growth

The graphs below show deposit growth rate controlling for size (lagged credit), age, whether rural, lagged credit to deposit ratio and also whether public (allows for PSBs to have on average lower growth rates). We use out-of-sample regression and restrict to before 2006 and predict for remaining years.



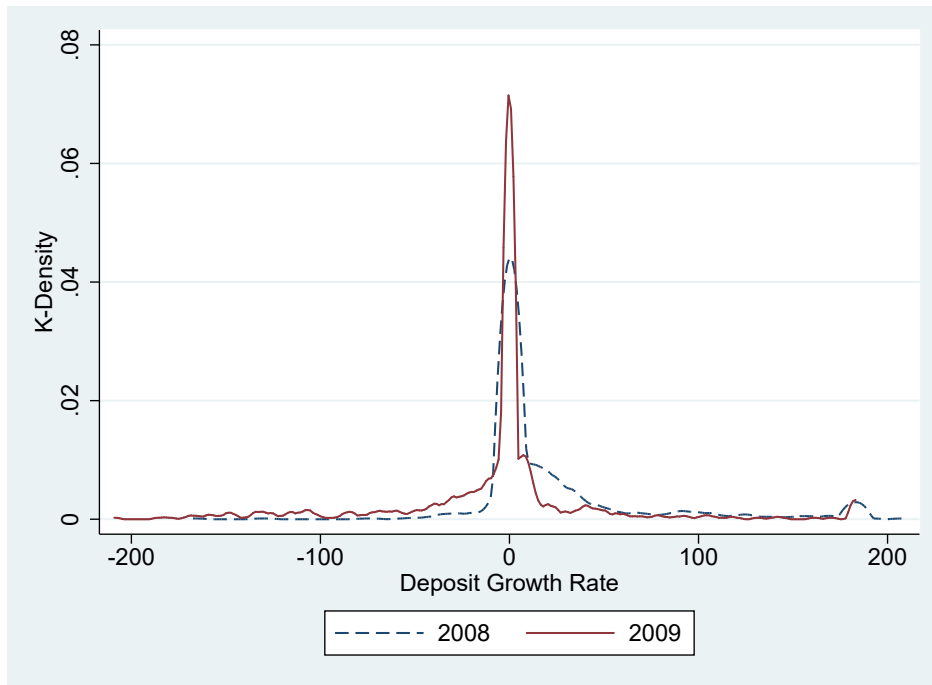
(a) 2009

(b) 2008

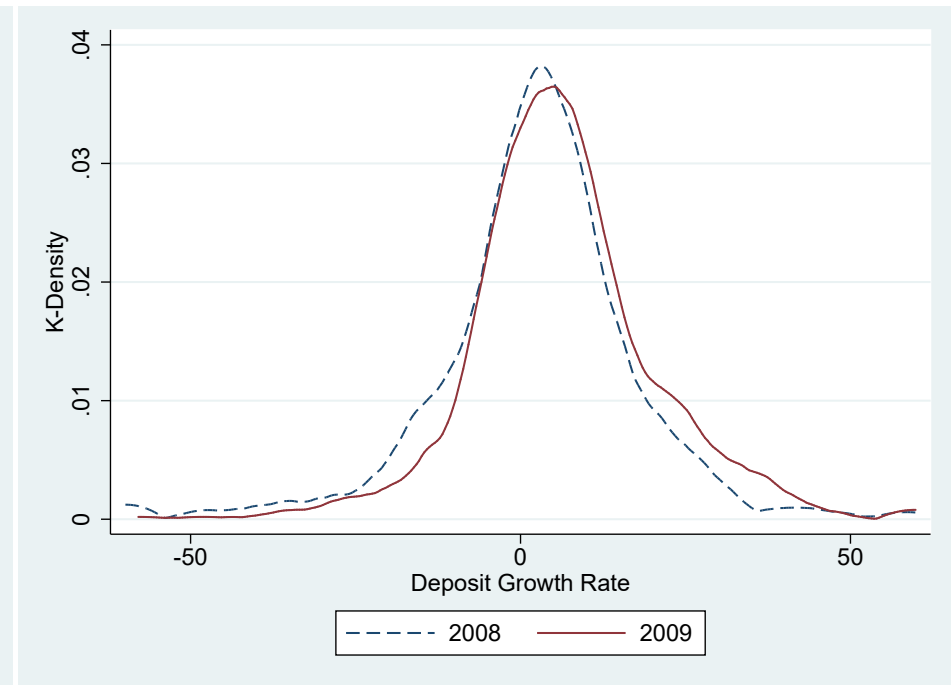
Figure A4: District Level:  $\Delta$  Growth Rates

The figures below show the distribution of the change in deposit growth at the district-level for private and public sector banks. That is the change in growth rates between 2007–2008 and growth rate in 2008–2009. We have retained only the public and private sector banks. Panel (a) shows the distribution for private sector banks and panel (b) shows the distribution for the public sector banks.

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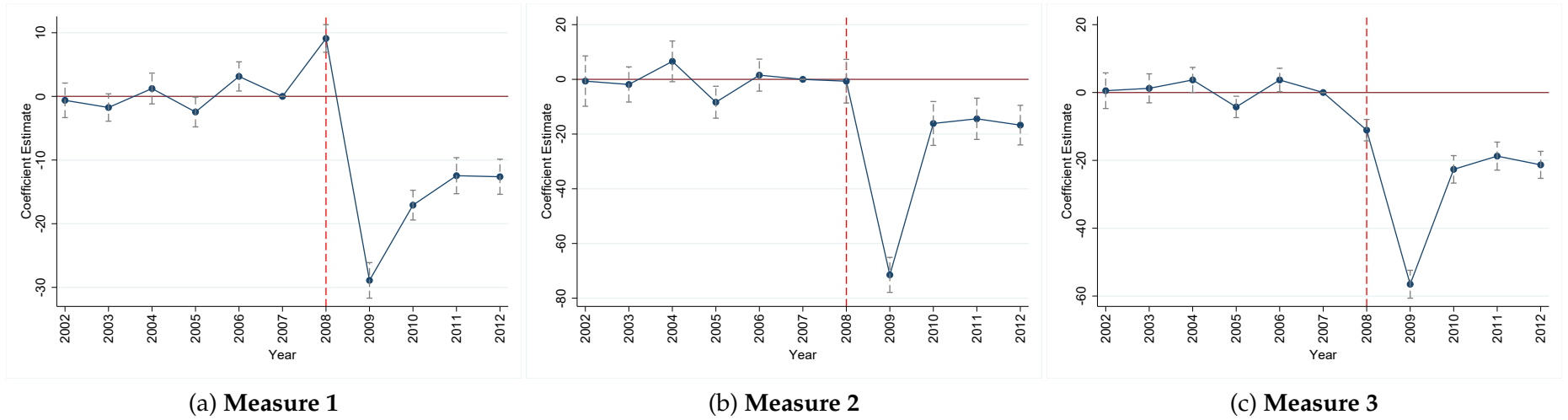


(a) Private Sector Banks



(b) Public Sector Banks

Figure A5: Parallel trends assumption for Run measures



The figures above show the parallel trends assumption for the bank run measures used in our analysis. We plot the coefficients for the event study plots as explained in Section 3. The first bankrun flag is 1 if the predicted deposit growth of private sector bank branches is more than the actual growth rate. The prediction equation is the deposit growth rate on size (lagged credit), age, whether rural, lagged credit to deposit ratio and also whether it belongs to a public sector bank (allows for PSBs to have on average lower growth rates). We use out-of-sample regression and restrict to before 2006 and predict for remaining years. For the second bankrun flag we do the following. We first identify private sector bank branches which had growth (in 2009) below the 5<sup>th</sup> percentile of growth rates in 2008. Then we look at the change in growth rates between 2009 (March 2008 to March 2009) and 2008 (March 2007 to March 2008). A private sector branch is classified as having had a run in 2009 if the above is less than zero. For the third bankrun flag, we flag private sector bank branches which had growth (in 2009) below the 5<sup>th</sup> percentile of growth rates in 2008 but with deposit growth rate above this threshold in 2008. The event study plots for the respective measures are in plot (a), plot (b) and plot (c) respectively.

Table A1: Summary Statistics: Deposit Growth By Year

Summary statistics for all branches in our analysis. Deposit growth is calculated from the March of the year indicated relative to March of the previous year.

Year	Private Sector Branches					Public Sector Branches				
	P10	P25	P50	P75	P90	P10	P25	P50	P75	P90
1997	-1.8	6.8	22.0	36.1	54.4	0.2	9.9	18.4	26.7	39.1
1998	4.7	15.4	25.7	38.7	62.1	0.0	8.8	17.1	25.5	38.3
1999	-2.6	9.5	20.4	31.7	47.8	1.4	10.1	17.6	25.5	37.0
2000	-1.1	8.4	18.4	29.2	47.1	2.4	10.2	17.2	24.8	35.7
2001	-0.8	8.9	17.3	27.5	47.1	0.0	7.9	14.9	22.2	32.4
2002	-4.6	6.7	16.1	26.4	47.6	-1.3	6.5	13.9	22.2	33.9
2003	-5.5	4.0	12.8	23.0	40.0	-1.7	4.8	11.1	19.0	29.3
2004	-6.3	2.9	11.9	24.9	55.2	-2.8	3.5	9.5	17.9	30.0
2005	-10.8	-0.9	8.2	21.8	52.1	-5.7	1.7	8.6	17.5	30.4
2006	-6.1	4.4	14.3	32.0	93.0	-3.1	4.2	11.4	21.4	36.3
2007	-3.8	8.1	19.9	39.4	90.9	-0.3	7.6	16.0	26.7	44.6
2008	-2.3	8.6	21.3	41.0	87.7	-0.4	9.3	19.2	31.2	50.3
2009	-9.2	9.3	24.5	44.5	97.0	1.1	11.0	21.3	33.6	55.9
2010	-7.2	4.7	16.9	38.0	91.2	-2.0	7.5	16.4	28.2	50.0
2011	-2.9	8.5	20.2	40.1	76.7	-3.7	6.3	15.1	26.5	44.4
2012	-3.7	8.8	20.5	35.1	56.3	-2.9	7.1	15.8	26.1	40.5
2013	-3.1	6.6	16.4	27.9	44.4	-1.6	7.6	15.5	24.5	36.6
<b>Total</b>	-4.8	6.5	18.0	33.3	65.4	-1.5	6.8	15.2	24.9	39.5

Table A2: Summary Statistics: Credit Growth By Year

Summary statistics for all branches in our analysis. Credit growth is calculated from the March of the year indicated relative to March of the previous year.

Year	Private Sector Branches					Public Sector Branches				
	P10	P25	P50	P75	P9	P10	P25	P50	P75	P90
1997	-11.8	1.4	18.2	41.3	86.2	-16.8	-1.7	10.8	28.6	59.2
1998	-15	1.5	19.5	47.8	96.6	-13	0	13.4	31.1	63.3
1999	-15	-0.1	16.4	41.7	95.7	-11.8	1.9	16.1	35.2	66.9
2000	-14.6	0.1	16.3	42	92.6	-13.7	-0.8	11.9	30.2	62.8
2001	-19.1	-4.8	9.2	34.7	96.3	-24.1	-10.2	3.5	20.8	47.2
2002	-19.6	-1.1	14.6	38.7	84.5	-11.8	3.8	21.4	43.3	75.4
2003	-20.8	-4.1	12.4	35.1	96.3	-7.9	3	16.2	33.5	62.8
2004	-26.6	-4.7	15.3	40.8	112.4	-9.9	3.2	17.8	35.9	64.7
2005	-12.8	4.8	25.5	61.3	174.9	-1.6	10.2	25.5	44.9	75.3
2006	-13.5	3.7	24.1	61.2	218.9	-2.6	9.7	25.7	46.1	80.3
2007	-20.6	1.7	26.6	70.4	201.4	-6.3	5.7	20.1	38.1	68.5
2008	-21.6	0.6	23.8	72.5	237.6	-5.7	5.1	17.7	33.5	59.7
2009	-28.6	-7.1	12.7	48.2	182.3	-10.4	0.3	11.9	28.2	56.2
2010	-28.2	-3.4	18	58.5	302.2	-4.1	5.7	18.3	36.1	77.3
2011	-22.4	3.3	29.2	74.4	254.5	-8.5	2.1	14.1	31.2	59.9
2012	-21	3.9	29.5	70.7	215.4	-10	2.4	14.4	30.2	50.3
2013	-18.4	3.6	24	54.3	127.8	-7.2	3	14.2	28.4	47.4
<b>Total</b>	-20.6	0	20.5	54.8	161.9	-10.3	2.2	16	34.2	63.6