# Creditor Rights and Allocative Distortions – Evidence from India

*By* NIRUPAMA KULKARNI*

*This paper highlights the credit reallocation channel through which stronger creditor rights improve allocative efficiency of credit and capital in the economy. Exploiting a collateral reform in India that strengthened creditor rights, I show that lenders cut credit to riskier borrowers. This is partly driven by a reduction in credit to otherwise insolvent borrowers (zombies). Importantly, credit access improved for non-zombie firms in industries that became decongested due to reductions in credit to zombie firms. As a result, non-zombie firms increased investment. Aggregate productivity of capital improved due to within-firm improvements and reallocation of capital to more productive firms, as well as due to their positive spillovers through the input-output linkages of the decongested industries.*

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The flow of credit to less productive firms misallocates resources and impairs economic growth. Misallocations of credit to weak firms is seen in many countries. A prominent example is the "zombie lending" in Japan (Caballero, Hoshi and Kashyap (2008)) but this phenomenon is not unfamiliar in other economies,

* CAFRAL, Research Department, e-mail:nirupama.kulkarni@gmail.com. I thank Viral Acharya, Sumit Agarwal, Shahswat Alok, Sreedhar Bharat, Raj Iyer, Hanh Le, Abhiroop Mookherjee, N. R. Prabhala, Raghuram Rajan, Stephan Siegal and Anand Srinivasan for helpful discussions.

particularly those in which there is a heavy hand of the state. See Rajan (2018) on misallocations in India and Li and Ponticelli (2019) on China. Financing frictions leading to misallocation are also seen in the peripheral countries in the EU zone such as Spain and Portugal (Gopinath et al. (2017)).

A particular problem in many developing countries is a legal system that favors debtors over creditors, compounded by difficulties in enforcement. Stronger creditor rights are an obvious remedy. With better creditor rights, lenders are better incentivized to make loans and potentially lower the costs of credit (La Porta et al. (1998)) although the lowered insurance value of default to borrowers could undo some of these effects (Aghion, Hart and Moore (1992)).

My study asks whether creditor rights have this positive effect on credit flow. I focus, in particular, on the reallocation channel in which enhancing creditor rights improves the portions of credit flowing to the better firms. That is, I test whether improving creditor rights correct for misallocation of credit by cutting credit to weak borrowers and expands it for better borrowers, resulting in a more productive allocation of capital in the economy.

The setting in my study is a 2002 collateral reform in India that made it easier for secured creditors to seize defaulters' assets. The law gives creditors more ready access to collateral in cases where creditors make secured loans and lets creditors bypass the long and costly judicial process in place before the law. I use this natural experiment to examine the reallocation of credit and capital across firms.

My analysis produces two main findings. First, following the 2002 collateral reform, lenders reallocated secured debt in beneficial ways through reduction in continued financing or "evergreening" of loans to insolvent borrowers, i.e., zombie firms. My second finding is that this collateral reform had significant

spillover effects. Healthy non-zombie firms that operated in the newly zombie-decongested industries increased secured debt and capital expenditure. As a result, the productivity of capital in these industries improved as within-firm productivity improved and capital was reallocated to firms with a higher marginal product of capital. Additionally, firms in industries connected to decongested industries through input-output linkages also witnessed an improvement in productivity. This reallocation and the resulting spillover are the economic channels that I focus on in my study.

In the baseline specification, I analyze the impact of the collateral reform on riskier borrowers relative to safer borrowers. Firms are divided into low- and high-quality borrowers based on their riskiness, that is, their ability to service existing debt based on their interest coverage ratio (ICR). I defer the details on exact definitions to Section 2. I find that the difference-in-difference (DD) estimate comparing low-quality to high-quality borrowers is biased due to pre-trends. Instead, using the tangibility of assets as a measure of collateralizability, I set up a triple difference (DDD) specification. The DDD estimate then compares the double difference between low- and high-quality firms for the treated group (high-tangibility firms), with the same estimate for the control group (low-tangibility firms). The key exogeneity assumption is that the low-tangibility firms provide an unbiased benchmark for the DD estimate in the absence of a collateral reform.

The first set of results shows that secured borrowing of low-quality borrowers relative to high-quality borrowers (using the DDD specification) declined by INR 39 million, representing a 75 percent decline relative to the pre-period. Interest rates of low-quality borrowers also increased by 72 basis points post reform, plausibly because the threat of liquidation allowed lenders to adjust pricing to reflect true borrower quality. While one could argue that the effects on the quantity

of loans is driven by low-quality borrowers preemptively cutting back on borrowing due to the threat of liquidation (Hart and Moore (1999) and Vig (2007)), this would imply a *decline* in interest rates as the low-quality firms leave the pool of borrowers. Our results instead point to lenders increasing interest rates of the bad borrowers, possibly reflecting their true riskiness.

Building on the above finding, I further hypothesize that the threat of liquidation allows lenders to stop extending subsidized credit (or "evergreening loans") to borrowers who (inefficiently) had cheaper access to credit prior to the reform. Following Caballero, Hoshi and Kashyap (2008), I define zombies as unprofitable firms who borrow at interest rates below the minimum prime lending rate. Zombie firms reduced secured borrowing by an average of INR 35 million (62 percent decline). Firms were 13 percent more likely to transition to non-zombie status post reform, reflecting lenders' reduced incentive to evergreen loans. Lenders may have been more likely to evergreen loans prior to the reform due to the higher risk-capital and provisioning requirements for non-performing assets.[1] Facing a cut in secured debt, low-quality firms cut capital expenditure by 65 percent.

The second set of results show that there are distributional and contagious spillover effects of the reform on borrowing and investment of the healthy non-zombie firms.[2] Post reform, the fraction of zombies declined in industries most affected by the reform, that is, the industries with higher tangibility. Using the average tangibility at the industry-level as the treatment, I show that secured borrowing of non-zombies in these industries increased by INR 39 million (62

[1]The provisioning requirement just prior to the reform in 2001 for sub-standard assets was 10 percent as opposed to a mere 0.25 percent for standard assets.

[2]The analysis is similar in spirit to Caballero, Hoshi and Kashyap (2008) who find the presence of zombies depressed investment and employment of non-zombies in zombie-dominated industries.

percent). Capital expenditure of these firms also increased by INR 34 million (39 percent).

Subsidized credit in the form of zombie lending can also have adverse effects on overall productivity of capital. Assuming firms equate marginal product of capital and interest rate, the marginal product of capital of the firms which access subsidized credit would be lower than the marginal product of the firms that access credit at higher cost. Reducing inefficient access to cheap credit in the form of zombie-lending should improve capital productivity of firms. Consistent with this intuition, productivity of capital improved in industries most affected by the reform. In addition, capital was also reallocated to firms with higher marginal productivity of capital in these industries. Within-firm productivity gains accounts for 69 percent of overall gains and reallocation of capital accounts for the remaining 31 percent.

These productivity improvements can also propagate through intersectoral input-output linkages, amplifying the aggregate effects of the reform (Gabaix (2011)). I find that productivity improved for industries whose downstream industries were connected to the treated industries through input-output linkages. However, effects are muted for upstream industries, consistent with Acemoglu, Akcigit and Kerr (2016) who show that theory predicts that supply-side (productivity) shocks propagate downstream much more powerfully than upstream shocks. That is, downstream customers of the industries treated by the reform are affected more strongly than their upstream suppliers.

Finally, I show evidence for the collateral channel as the mechanism driving credit reallocation. Lenders with higher exposure to low-quality firms prior to the reform were able to free up capital tied to unprofitable borrowers and reallocate it to more productive firms. Industries that witnessed productivity improvements

only indirectly through the input-output linkages but did not see an improvement in lenders' ability to seize their collateral saw no similar increase in access to credit. This further confirms that the collateral channel is the key mechanism driving credit reallocation.

My paper relates to two distinct branches of literature. The first is the law and finance literature which finds conflicting evidence that improved creditor rights can improve credit access (La Porta et al. (1998)) but can also reduce it (Levine (1998), Lilienfeld-Toal, Mookherjee and Visaria (2012) and Vig (2007)). My paper underscores that what matters is who sees a decline in credit. Cutting back lending to unproductive firms allows lenders to free up capital and reallocate it to better firms in the economy, thereby improving overall productive efficiency. The paper also relates to the macro-development literature on the misallocation of resources (Hsieh and Klenow (2009) and Restuccia and Rogerson (2008)), specifically due to financial frictions (Buera, Kaboski and Shin (2011), Moll (2014)). Improving creditor rights is a way to correct for some of these inefficiencies. This paper is closest to Li and Ponticelli (2019) who find reductions in zombie-lending to state-owned firms in China after the introduction of specialized courts that had limited political influence. My paper applies more broadly to all firms (and not just state-owned firms) and emphasizes that creditor rights can lower zombie-lending and importantly, have spillover effects on remaining healthy firms in the economy.

To sum, this paper highlights that stronger creditor rights can correct for existing market imperfections by reallocating credit and cutting inefficient subsidized credit to zombie firms. Importantly, this has large spillover effects on healthy firms leading to aggregate improvements in productivity of capital.

The paper is organized as follows. Section 1, Section 2 and Section 3 describe

the institutional details, data and the identification strategy. Section 4, Section 5 and Section 6 look at the direct, distributional and productivity impact of the reform. Section 7 provides evidence for the key mechanism and Section 8 concludes.

## 1 Institutional Details and the collateral reform

Historically, enforcement of creditor rights in India has been accompanied by significant judicial delays. In 1993, the government introduced Debt Recovery Tribunals (DRTs) based on the recommendations of the Narasimham Committee I. These were quasi-legal institutions that streamlined the legal procedure and were meant to allow speedy adjudication and swift execution of judgements (see Visaria (2009)). Due to inadequate infrastructure and shortage of recovery personnel, however, the DRTs too soon got clogged with excessive cases and ended up being ineffective. Additionally, defaulters found ways to stall the process, such as by simultaneously filing at the Board for Industrial and Financial Reconstruction (BIFR) which adjudicates cases between creditors and delinquent but bankrupt firms. Delinquent borrowers despite being able to repay their debts, strategically delayed the DRT process by simultaneously filing at the BIFR.

Based on the recommendations of the Narasimham Committee II and the Andhyarujina Committee, the government enacted the Securitization and Reconstruction of Financial Assets and Enforcement of Security Interests Act of 2002 (SARFAESI). This collateral reform allowed secured creditors to recover their non-performing assets by taking possession, managing and selling the securities *without* the intervention of a court or tribunal. Secured creditors could thus circumvent the lengthy judicial process and seize the assets securing the loan. Both pre-existing contracts as well as new contracts were covered. A secured creditor can start the recovery process by filing a notice on a loan classified as

a non-performing asset (NPA). If the loan is not repaid within 60 days from the date of notice, the creditor is then allowed to take possession of the secured assets. Although the reform only applied to banks and financial institutions and not to non-banking financial companies (NBFCs), it did not stop these institutions from seizing assets of firms under the reform. After a long legal battle, the supreme court clarified that NBFCs could not seize collateral under the SARFAESI.[3] While the reform and was promulgated on 21$^{st}$ June, 2002, it is difficult to pin down the exact date since discussions in the press started as early as 1999 (Vig (2007)). After the reform was passed, on 27$^{th}$ November 2002, ICICI Bank took possession of Mardia Chemical plant in Vatva, Ahmedabad district, Gujarat since it was owed INR 300 crores. While there was initially some uncertainty on whether the SARFAESI was constitutionally valid, on 8$^{th}$ April 2004, the Supreme Court of India declared the SARFAESI to be constitutionally valid.

The reform had significant immediate impact. As per the Reserve Bank of India (RBI),[4] the reform allowed banks to recover around INR 5 billion by June 2003, within a year of the reform. The accretion to NPAs also declined drastically following the enactment of the reform. Figure 1, panel A shows the accretion to NPAs and the ratio of the accretion to NPAs to gross advances. During 2002–03, reductions outpaced NPA additions with an overall reduction of NPAs from 14.0 percent of gross advances in 1999-2000 to 9.4 percent in 2002-2003. Further, since the reform allowed secured creditors to bypass the judicial court, it fixed one important loophole through which defaulters could delay the judicial process,

[3]Kotak Mahindra Bank Ltd vs Trupti Sanjay Mehta And 8 Ors Judgment dated July 16, 2015 in W.P. (C) No. 722 of 2015 . More recently, since 2016 certain NBFCs are also covered under the SARFAESI. see The Economics Times, NBFCs allowed to use Sarfaesi for cases above Rs 1 crore, Aug 17, 2016, (https://economictimes.indiatimes.com/news/economy/policy/nbfcs-allowed-to-use-sarfaesi-for-cases-above-rs-1-crore/articleshow/53739430.cms?from=mdr.

[4]See Reserve Bank of India (2003), Report on Trend and Progress of Banking in India, 2002-03, Nov 17, 2003 https://rbidocs.rbi.org.in/rdocs/Publications/PDFs/40092.pdf

namely by filing at the BIFR. Figure 2 shows that the number of cases filed under BIFR fell drastically post reform. Figure 1, panel B shows that the post reform there was a decline in distressed borrowers (those with interest coverage less than one)[5], as well as a decline in unprofitable borrowers. At least in the aggregate, the collateral reform seems to have had potentially a significant and immediate impact on the credit culture in the India.

## 2 Data

Financial data is primarily from ProwessDx, maintained by Centre for Monitoring Indian Economy (CMIE). Data pertains to annual financial statement data of Indian firms. Due to reporting requirements, coverage of listed firms is comprehensive but limited for unlisted firms. I focus on data between April 01, 1997 to March 31, 2007 from the March 2016 vintage. While India was relatively well insulated from the global financial crisis of 2007–2009, there has been a steady increase in NPAs of Indian banks since 2008 arising out of the spillover effects of the global financial crisis starting 2007 (see Acharya and Kulkarni (2017)). To avoid the confounding effects of the global crisis, I confine my analysis to the period before the crisis.

Supplemental data on projects and employment is from CapExDx and the Annual Survey of Industries (ASI). For further details on data construction, refer to the data appendix in Section A1.

Low- and high-quality borrowers are defined based on their ability to service their debt. Low-quality borrowers are defined as firms with average interest coverage ratio (ICR) in 2000 and 2001 less than 1. ICR is the ratio of earnings before interest and taxes to total interest expense. To classify zombie firms, I

[5]Interest coverage ratio (ICR) is the ratio of profits (EBITDA) to interest expense and measures whether a firm is able to cover its debt expenses.

build on the definition in Caballero, Hoshi and Kashyap (2008). A zombie is defined as a firm that receives subsidized credit, that is, it satisfies all the following conditions: (i) interest rate of the firm is below the minimum prime lending rate, (ii) interest coverage ratio (ICR) is less than 1, (iii) leverage (total external debt to total assets) is greater than 0.20, and (iv) change in debt is greater than zero. Further details on the choice of cutoffs is provided in the data appendix in Section A1.

A few comments are in order regarding the use of debt-based cutoffs to measure low-quality and zombie firms. As Caballero, Hoshi and Kashyap (2008) also argue, this strategy permits evaluation of the effect of zombies on the economy. If instead we were to define zombie or low-quality borrowers based on their profitability or productivity characteristics, then by definition industries dominated by zombie firms would have low profitability. To avoid hard-coding this into the definition of low-quality and zombie firms, I focus on debt-based definitions in the analysis. Section A2 shows results are robust to using alternate definitions.

Table 1 shows the summary statistics of the variables used in our analysis. The mean and standard deviation are shown. In Panel A, I separate firms into low- and high-quality for the pre and post period. Panel A shows the data for all the 6,927 firms used in this analysis. The data is for 52,152 firm-year observations. There are 3,371 listed firms (roughly 50 percent). Of the 6,927 firms, 2,267 (33 percent) firms are classified as low-quality borrowers and the remaining 4,660 firms are classified as high-quality borrowers. The table shows that there are 16,457 firm-year observations for low-quality borrower data and 35,695 firms for high-quality borrower data. Panel B shows the summary statistics for zombie firms (8,791 firm-year observations for 1,073 firms) and non-zombie firms (43,361 firm-year observations for 5,239 firms) pre and post reform.

## 3 Identification Strategy

In the baseline specification, I want to analyze the impact of the collateral reform on low- versus high-quality borrowers. The key identifying assumption in a DD specification is that the trends in the outcome variable of interest should be the same for low- and high-quality borrowers in the absence of treatment even if low- and high-quality borrowers in other ways. This common trends assumption, also known as the parallel trends assumption can be tested in the data. Section 4 shows that the parallel trends assumption for the DD specification can be rejected.

Hence, differences in say the relative outcomes of low and high-quality borrowers could simply reflect broader trends and not be caused by the reform. The challenge for identification of the differential impact of the collateral reform is that the reform was implemented nationwide. To overcome this, I generate variation in the treatment by exploiting the fact that in India, only tangible assets of a firm can be collateralized. Using the tangibility of assets in the period prior to the reform as the intensity of treatment, I set up a triple difference (DDD) framework. The treatment group comprises firms with high tangibility of assets whereas the control group comprises firms with low tangibility of assets. The DDD estimate compares the DD estimate for firms with high tangibility of assets (the treated group), with the same estimate for the firms with low tangibility of assets. Section 4 will show that the parallel trends assumption implicit in the triple difference is satisfied and hence this is the preferred estimate to measure the impact of the collateral reform. The key exogeneity assumption is that the low-tangibility firms provide an unbiased benchmark of how low-quality and high-quality borrowers would have differed in the absence of a collateral reform.

While the DDD estimate can plausibly be attributed to the collateral reform, we still cannot rule out the possibility that the estimate is confounded by other

factors that changed at the same time (such as differential trends in lending to high- and low-tangibility firms). I address this concern by conducting a placebo test and showing that the results still hold.

The baseline uses variation in the treatment, that is, tangibility of assets at the firm level. When I need to examine spillover effects at the industry-level, I simply use the median tangibility at the industry level to generate variation in treatment intensity at the industry level. Section 5 provides justification for using this variation as the industry-level treatment.

One concern in verifying the parallel trends assumption is that the DD (and by extension DDD) estimate is sensitive to the choice of the functional form of the dependent variable. As Angrist and Pischke (2009) note, the common trends assumption can be applied to transformed data, but common trends in logs rule out common trends in levels and vice versa. Hence, as a robustness check I show that results are robust to using the changes-in-changes method — a semiparametric estimate introduced by Athey and Imbens (2006) — which allows us to examine the common trends assumption after an unspecified transformation of the dependent variable.

Interpreting the DDD estimates is hard because it is difficult to see what variation in the data is captured by the estimate. To transparently show the components driving the DDD variation, I will attempt to build up to the DDD estimate by analyzing each of the differences in the DDD estimate. Hence, in the next section I will start by: (i) analyzing the pre- and post- data for the sub-samples of low- and high-quality borrowers (this is analogous to an event study analysis), (ii) analyzing the DD estimates for low- and high-quality borrowers, (iii) analyzing time trends in event study plots of the treated (high-tangibility) and control (low-tangibility) groups to graphically examine where the variation in the DDD

estimate is coming from, and (iv) finally, showing the preferred DDD estimate.

# 4 Direct effect on firms

This section contains the first step of the empirical analysis. In this section, I first examine the direct impact of the reform on secured borrowing of low- and high-quality borrowers. I also provide justification for the identification strategy used in the study. Then, I link the decline in secured borrowing to zombie lending. The section concludes by examining the impact on capital expenditure.

## 4.1 Empirical strategy

The structural relationship of interest is the effect of the collateral reform on low-quality borrowers relative to high-quality borrowers:

$$y_{it} = \alpha_i + \gamma_t + \eta \times \mathbb{1}_{Post,t} \times \mathbb{1}_{Low-Quality,i} + \varepsilon_{it} \tag{1}$$

where $i$ indexes firms and $t$ indexes time. $\alpha_i$ and $\gamma_t$ are firm and year fixed effects. $\mathbb{1}_{Post,t} = 1$ for years when the reform is in effect ($>= 2002$). Firms are split into low-quality ($\mathbb{1}_{Low-Quality,i} = 1$) and high-quality ($\mathbb{1}_{Low-Quality,i} = 0$) prior to the reform as described in Section 2. The uninteracted terms ($\mathbb{1}_{Low-Quality,i} = 1$ and $\mathbb{1}_{Post,t} = 1$) are absorbed by the the firm and year fixed effects. In the baseline, $y_{it}$ is secured borrowing, a flow variable, defined as the change in secured debt between $t-1$ and $t$. The main real outcome variable of interest is capital expenditure between $t-1$ and $t$. For completeness, in the appendix, I also look at change in employment between $t-1$ and $t$.

The coefficient of interest is $\eta$ on the interaction term ($\mathbb{1}_{Post,t} \times \mathbb{1}_{Low-Quality,i}$) and measures the difference, conditional on controls, in outcome $y$ between low- and high-quality borrowers after the collateral reform relative to before the reform. $\eta$ is analogous to a difference-in-difference (DD) estimate. The OLS

estimate for $\eta$ is unbiased if $\mathbb{1}_{Post,t} \times \mathbb{1}_{Low-Quality,i}$ is orthogonal to $\varepsilon_{it}$.

The key identifying assumption for the DD estimate to be valid is that *trends* in the outcome variable should be the same for low- and high-quality borrowers in the absence of treatment. Note however, low- and high-quality firms can differ and this difference is captured by the firm fixed effects. To examine the common trends assumption — also known as the parallel trends assumption — I estimate a year-by-year specification and present the results as event study plots.

$$y_{it} = \alpha_i + \gamma_t + \sum_{\tau} \eta_\tau \times (\mathbb{1}_\tau \times \mathbb{1}_{Low-Quality,i}) + \varepsilon_{ijt} \tag{2}$$

where $\tau$ ranges from 1997 to 2007, $\mathbb{1}_\tau = 1$ if year is $\tau$ and $\eta_\tau$ is coefficient of interest. Bars show the 95% confidence intervals, $\tau = 0$ is the year the reform is announced, and all coefficients are normalized relative to $\tau = -1$. Robust standard errors are clustered at the firm level. The coefficient of interest, $\eta_\tau$, measures the difference, conditional on controls, in outcome $y$ between low- and high-quality borrowers $\tau$ years after the reform.

Figure 3 in the appendix tests for this parallel trends assumption in the DD specification where the dependent variable is secured borrowing (panel a) and capital expenditure (panel b). We observe from the graphs that there is a pre-trend for capital expenditure prior to the reform and that the null hypothesis of parallel trends can be rejected.

Since the parallel trends assumption for the DD specification can be rejected, I construct a triple difference strategy. Since only tangible assets can effectively be collateralized in India, I use the cross-sectional variation in tangibility to generate variation in the treatment intensity at the firm-level. The empirical specification

is:

$$y_{it} = \alpha_i + \gamma_t + \eta \times \mathbb{1}_{Post,t} \times \mathbb{1}_{Low-Quality,i} + \nu \times \mathbb{1}_{Post,t} \times \mathbb{1}_{High-Tangibility,i}$$
$$+\phi \times \mathbb{1}_{Post,t} \times \mathbb{1}_{Low-Quality,i} \times \mathbb{1}_{High-Tangibility,i} + \varepsilon_{it} \quad (3)$$

where $i$ indexes firms, $t$ indexes time, $\alpha_i$ and $\gamma_t$ are firm and year fixed effects. Firms are split into high-tangibility ($\mathbb{1}_{High-Tangibility,i} = 1$) and low-tangibility ($\mathbb{1}_{High-Tangibility,i} = 1$) prior to the reform as described in Section 2. Standard errors are clustered at the firm level. More robust specifications also control for firm-level time varying measures of firm profitability and sales and also include industry-year fixed effects.

The estimate of interest, $\phi$, compares the differential effect — between low- and high-quality borrowers — of the collateral reform on the treated group (high-tangibility) firms relative to the control group (low-tangibility firms). The rationale for this specification is that the DD estimate with just the low- and high-quality borrowers does not take into account the non-reform factors that differentially affected the low-quality borrowers relative to high-quality borrowers. However, the firms with low-tangibility of assets were not affected (or affected to a lesser extent) by the reform. So the DD estimate for the low- and high-quality firms with *low-tangibility* provides an estimate of the non-reform factors that differentially affected low-quality borrowers. Subtracting the second DD estimate from the first DD estimate, the DDD estimate, therefore accounts for these endogeneities. The key exogeneity assumption is that the low-tangibility firms provide an unbiased benchmark of how the low-quality and high-quality borrowers would have differed had there been no collateral reform.

To facilitate transparent examination of parallel trends assumption in the DDD

specification, I plot the coefficients of the DDD specification over time ($\phi_\tau$) below in event study plots.

$$y_{it} = \alpha_i + \gamma_t + \sum_\tau \eta_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{Low-Quality,i} + \sum_\tau \nu_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{High-Tangibility,i} + \sum_\tau \phi_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{Low-Quality,i} \times \mathbb{1}_{High-Tangibility,i} + \varepsilon_{it} \quad (4)$$

where $\tau$ ranges from 1997 to 2007, $\mathbb{1}_\tau = 1$ if year is $\tau$ and $\eta_\tau$ is coefficient of interest. Bars show the 95% confidence intervals, $\tau = 0$ is the year the reform was announced, and all coefficients are normalized relative to $\tau = -1$. Robust standard errors are clustered at the firm level. The dependent variable is the outcome of interest. The coefficient of interest is $\phi_\tau$, measures the difference (conditional on controls) in outcome $y$ between low- and high-quality borrowers for the treatment group (high-tangibility firms) relative to the control group $\tau$ years after the reform.

Panel (b) in Figure 1 and Figure 2 plots the coefficients of the DDD estimate using Equation 4 and allows for a more transparent examination of the parallel trends assumption. All coefficients are normalized relative to 2001, the year before the reform was enacted. Bars show the 95 percent confidence intervals. Prior to the reform both the treated and control groups were on similar trajectories and hence the parallel trends assumption in the DDD specification cannot be rejected.

To determine whether the decline in borrowing is driven by zombie lending motives, I split firms into zombie firms based on whether they were receiving

subsidized credit prior to the reform. The empirical specification is:

$$y_{it} = \alpha_i + \gamma_t + \eta \times \mathbb{1}_{Post,t} \times \mathbb{1}_{Zombie,i} + \nu \times \mathbb{1}_{Post,t} \times \mathbb{1}_{High-Tangibility,i}$$
$$+\phi \times \mathbb{1}_{Post,t} \times \mathbb{1}_{Zombie,i} \times \mathbb{1}_{High-Tangibility,i} + \beta \times X_{it} + \varepsilon_{it} \quad (5)$$

where $i$ indexes firms, $t$ indexes time, $\alpha_i$ and $\gamma_t$ are firm and year fixed effects. $\mathbb{1}_{Zombie,i} = 1$ for zombie firms as defined in Section 2. Other terms are as defined before. $\phi$ is the coefficient estimate of interest and compares the outcome variable, $y_{it}$ of zombie firms relative to non-zombie firms in the treated group (high-tangibility firms) relative to the control group (low-tangibility) firms. Standard errors are clustered at the firm level.

## 4.2 Results

First, I examine the direct effect of the collateral reform on secured borrowing, a flow variable, defined as the year to year change in secured debt. A positive value depicts an increase in the stock of secured debt and a negative value depicts a decline in the stock of secured debt. To clearly understand the variation in the data, I first present estimates for different sub-samples and then build up to the DDD estimate.

The summary statistics in Table 1 show secured borrowing of low-quality borrowers declined from INR 52 milllion in the pre-reform period to INR 38 million in the post-reform period. This is striking since a strengthening of creditor rights led to a reduction in secured borrowing of these firms. In contrast, secured borrowing of high-quality borrowers increased from INR 31 million to INR 56 million, consistent with stronger creditor rights leading to better credit access. More formal estimates from regression specifications are consistent with these trends. Table 2, column 1 estimates that secured borrowing of the sub-sample

of low-quality firms declined by INR 20 million (38 percent) but increased by INR 18 million for the sub-sample of high-quality borrowers (column 2). The DD estimate from Equation 1 shows a relative decline of INR 40 million for low-quality borrowers compared to high-quality borrowers (column 4). The previous subsection showed, however, that the parallel trends assumption in this DD specification can be rejected.

Before turning to the formal DDD estimates, Figure 1 graphically examines the impact on secured borrowing for the treated and control groups. Figure 1, panel (a) plots the coefficients from the specification in Equation 2 for high- and low-tangibility firms. All coefficients are normalized relative to 2001, the year before the reform was enacted. Bars show the 95 percent confidence intervals. Secured borrowing of low-quality borrowers relative to high-quality borrowers declined for high-tangibility firms (treated group shown in red in Panel (a)), but the effect was muted for the low-tangibility firms (control group shown in blue in Panel (a)). Panel (b) shows the dynamics of the DDD specification using Equation 4 and shows the decline in secured borrowing of low-quality borrowers.[6] The effects ramp up over the years following the law as the initial uncertainty in the constitutional validity of the reform was settled. Taken together, the DD and DDD plots clearly illuminate that the variation in the DDD estimate comes from the decline in secured borrowing of the treated group.

Table 2 shows this more formally and presents estimates from Equation 3. Column 1 documents that secured borrowing of low-quality borrowers fell by INR 39 million (DDD estimate). This represents a 76 percent decline relative to the pre-reform average of INR 51.74 million. On adding industry-year fixed effects and

[6]This is in the DDD sense, where the decline is for low-quality borrowers *relative* to the high-quality borrowers for the treated group, that is, high-tangibility firms as compared to the same difference for the control group (low-tangibility firms). For ease of exposition, I simply refer to this as a decline in low-quality borrowers henceforth.

time-varying firm-level controls, we estimate a similar decline of INR 37 million. Section A2 shows that these results are robust to a number of different specifications. The effects persist across different subsets of borrowers (Figure 4) but are stronger for manufacturing firms, older firms and listed firms. Estimates are remarkably robust to using alternate definitions of quality based on profitability, investment opportunity and across different specifications (Table 3). The effects are also externally valid and are similar during the earlier implementation of the DRTs which strengthened legal enforcement by reducing judicial delay (Table 4).

There was no impact on unsecured borrowing (columns 3 and 4 in Table 2) and interest rates of low-quality borrowers increased by 72 basis points[7] (column 6, Table 2). At face value, the results on the quantity of secured borrowing is consistent with a demand-driven story wherein borrowers, fearing premature liquidation, preemptively cutback on secured debt post reform. This would, however, predict an increase in unsecured borrowing as borrower demand for unsecured debt increases. My results instead show that low-quality borrowers are not able to switch into unsecured debt to compensate for the decline in secured borrowing. The reform empowered lenders to seize collateral and discontinue lending to poor-quality distressed firms and thus it is unlikely that they would be willing to lend unsecured debt to these borrowers. Of course, one can argue that unsecured lending is not well-developed in India (it stood at only 6.2 percent of secured lending in 2001) and hence firms may not have been able to switch seamlessly.

The increase in interest rates of the low-quality borrowers post reform provides another piece of evidence consistent with a supply-side story. A liquidation bias story would predict an increase in interest rates as risky firms leave the pool of borrowers. Interest rates of the low-quality borrowers, however, increased

[7]Results are significant only at the 10 percent level due to measurement error. Interest rates are calculated from annual financial statements and are hence noisy.

consistent with a supply-side hypothesis wherein lenders were able to increase interest rates for the riskier borrowers post reform. Can the drop in borrowing be attributed to a reduction in evergreening of loans by lenders? I hypothesize that prior to the reform, in a weak creditor rights regime, lenders had no other recourse and hence continued refinancing or rolling-over bad loans. Lenders may also be more likely to evergreen given the higher provisioning and risk-capital requirements for non-performing loans. Post reform, the access to the collateral underlying loans increased and lenders no longer needed to continue evergreening loans. The reduction in zombie lending is further expanding on the idea that poor-quality borrowers witnessed an increase in their interest rates. Specifically, here we capture the idea of whether there was a reduction in firms that received loans at *sub-optimally* lower interest rates post the reform.

Post reform, the fraction of zombie firms fell from 5.5 percent in 2002 to 3.5 percent (Figure 4, panel (a)). Restricting zombie definition to firms that had non-zero secured lending prior to the reform yields similar trends. Asset-weighted fraction of zombies fell from 6.5 percent to 3 percent post reform (panel (b). Table 1 Panel B shows that secured borrowing declined for zombie firms, but increased for non-zombie firms. Similarly, the more robust specification in column 1 of Table 2 shows secured debt of zombie borrowers declined by INR 28 million compared to an increase of INR 20 million for non-zombie firms. The DD estimate shows secured borrowing of zombies relative to non-zombies increased by INR 40 million (column 4).

The preferred DDD estimate in Table 3 shows that the secured borrowing of zombies declined by INR 37 million compared to a pre-reform average of INR 62 million representing a 60 percent decline (column 1). Adding industry-year fixed effects and time-varying firm level controls, yields a similar estimate of INR 38

million. Figure 5, panel (a) allows us to examine the parallel trends assumption of this DDD estimate and we observe that the parallel trends assumption cannot be rejected.

Now I answer the question: were zombies more likely to transition to non-zombie status post reform? I track the zombie status of each firm prior to the reform and compare it to the zombie status post-reform. I examine the probability of a firm transitioning to zombie status in a linear probability model. A firm that was classified as a zombie pre-reform, was 13 percent less likely to be classified as zombie post-reform (Table 3, column 3). Note, the number of observations in column 3 differs from columns 1-2 because we collapse the observations to pre- and post- reform period. The threat of liquidation post reform possibly allowed creditors to stop extending loans at terms more favorable than the high rated borrowers, explaining this transition from zombie to non-zombie status.

Table 4, columns 1-2 estimate that the decline in secured borrowing led to a relative decline in capital expenditure of low-quality borrowers by INR 37 million (62 percent decline) as shown by the DDD estimate. This decline is driven by zombie firms (columns 3–4). Capital expenditure of zombies relative to non-zombies for the treated group declined by INR 41 million, representing a 57 percent decline relative to the pre-reform average. Panel (b) in Figure 2 and Figure 5 confirm that the parallel trend assumptions for the specifications in Equation 3 and Equation 5 cannot be rejected.[8].

What investments do these firms cut? A subset of the firms (1,288) have data on individual projects. I spilt the projects into core and non-core projects based on whether the project industry code matches the industry code for the company. Table 5 then examines the completion of core and non-core projects within firms

[8]Section A2 also examines the impact on labor outcomes. Table 6 shows that employment at low-quality firms also declined, consistent with our results

using our DDD specification. Columns 1 and 2 show that low-quality borrowers were 6.7 percent less likely to complete non-core projects. For zombie firms, core projects were 47 percent more likely to be completed. Point estimates are noisy and results are far from definitive (column 1 and column 4), due to the limited number of firms for which project-wise data is available.[9] Nonetheless, this project-wise analysis gives some insight into where the within-firm improvements (that I document later) in productivity are coming from. Ersahin, Irani and Le (2016) show that creditors can force firms which violate their loan covenants to refocus their operations. Consistent with this, the threat of liquidation plausibly allowed lenders to slash credit forcing low-quality borrowers to cut non-core investments, thus streamlining their operations.

## 5 Distributional and spillover effects

Having established the significant direct effects of the reform, I now turn to the distributional and spillover effects on healthy firms. The previous section established that the reform led to a fall in zombie lending. Caballero, Hoshi and Kashyap (2008) find that the increase in zombie firms in Japan in the 1990s depressed investment and employment growth of healthy non-zombie firms, especially in industries that experienced the greatest zombie-congestion. In the context of my paper, it follows that the reduction in zombie firms post reform should have an analogous *positive* spillover effect on non-zombie firms.

### 5.1 Empirical Specification

To examine spillover effects, Caballero, Hoshi and Kashyap (2008) compare the outcomes of non-zombie firms in industries that witnessed the greatest in-

[9] As Section A1 discusses, the project data is collected by CMIE through surveys and from news articles and not from regulatory data. Though coverage has improved over the years, for the period under consideration data quality is a problem.

crease in zombie firms to the outcomes of non-zombie firms in industries that did not see such an increase in zombie lending. I use their specification as the starting point. My setup, however, allows me to improve on their simple reduced-form estimates. I exploit the cross-sectional variation in tangibility at the industry-level to get variation in the treatment intensity at the industry-level. Building on the identification strategy in the previous section, I classify industries as high-tangibility industries if they have above median average tangibility in 2001, the year before the reform.

Figure 5 justifies the use of this high-tangibility measure as the treatment at the industry-level. We see from the figure that post reform, the fraction of zombies declined most in sectors with higher average tangibility. The manufacturing sector which has high tangibility experienced a 10 percent decline in the fraction of zombies post reform relative to the pre-reform period. In comparison, the education sector with low tangibility saw almost no impact on the fraction of zombies.

The regression specification to examine spillover effects on non-zombie firms is as follows:

$$y_{ijt} = \alpha_i + \gamma_t + \beta_1 \times \mathbb{1}_{High-Industry\,Tangibility,j} \times \mathbb{1}_{Post,t} + \beta_2 \times \mathbb{1}_{Non-Zombie,i} \times \mathbb{1}_{Post,t}$$
$$+\beta_3 \times \mathbb{1}_{Non-Zombie,i} \times \mathbb{1}_{High-Industry\,Tangibility,j} \times \mathbb{1}_{Post,t} + \beta \times X_{it} + \varepsilon_{ijt} \quad (6)$$

where $i$ indexes firms, $t$ indexes time and $j$ indexes industry. $\alpha_i$ and $\gamma_t$ are firm and year fixed effects. $\mathbb{1}_{Post,t}$, $\mathbb{1}_{Non-Zombie,i}$ and $\mathbb{1}_{High-Industry\,Tangibility,j}$ are indicators for the post period, for whether a firm is classified as a non-zombie, and for whether the firms is in a high-tangibility industry. Standard errors are clustered at the firm level.

The coefficient of interest is $\beta_3$ and compares the relative difference in zombie versus non-zombie firms in the treated industries (high-tangibility industries) compared to the same relative difference in the control industries (low-tangibility industries). The identification strategy for this DDD estimate builds on the idea that since only tangible assets can be collateralized, industries where average tangibility of firms was higher were treated to a greater extent.

## 5.2 Results

Table 5 reports estimates from equation 6. Non-zombies (relative to zombie firms) in the treated industries increased secured borrowing by an average of INR 34 million (column 1), representing a 55 percent average increase. Point estimates are similar (INR 36 million increase) on adding time-varying firm level controls and industry-year fixed effects.[10] Figure 3, Panel A shows that evidence for the parallel trends assumption implicit in the DDD specification using the industry-level variation in tangibility as the treatment variable.

The result on secured borrowing emphasizes that not only do the improved creditor rights allow lenders to cut back on credit to low-quality borrowers — as we saw in Section 4 — but they also help creditors free up capital and thus redirect lending to the more qualified healthy non-zombie borrowers. In contrast to the law and finance literature which has emphasized greater credit access to certain sets of borrowers, these results show that an improvement in creditor rights allows credit to be allocated away from worse (zombies) to better (non-zombies) borrowers. This is the credit reallocation channel that I emphasize in this paper.

Prior literature has identified two separate hypotheses to explain the decline

[10] As before, we do not find that the reform had an impact on unsecured debt and there were no spillover effects on unsecured debt. Results are available upon request.

in credit for some borrowers when creditor rights strengthen: (i) the inelastic supply hypothesis, and (ii) the insurance channel hypothesis. Lilienfeld-Toal, Mookherjee and Visaria (2012) argue that with inelastic supply, poorer borrowers may see a decline in credit access because interest rates rise post reform due to a higher overall demand for credit. Under the insurance channel (Gropp, Scholz and White (1997)), debtor friendly laws protect the borrower which provides insurance value for borrowers. When creditor rights improve, borrowers fearing premature liquidation of their assets cut back on credit. The emphasis of both the above two hypotheses is on the unintended consequences of, in some sense, *excessive* creditor rights which leads to a decline in credit to certain borrowers. Contrary to the above, my hypothesis focuses on the redistribution of credit away from inefficient units which has very different (and positive) welfare implications.

There are two ways in which zombie lending can affect healthy firms in the economy. First, it can keep subsidised credit flowing to the existing distressed zombie borrowers thus crowding out credit to more productive creditworthy firms operating in these industries. The results above show that there are positive spillovers from the direct reduction of this subsidised credit. A second way in which zombie lending can impact healthy firms is by keeping distressed borrowers artificially alive, congesting the industries they operate in, for example, by letting unproductive firms hang onto capital which may be more productive if deployed elsewhere. I next examine whether the reform affected capital expenditure of the healthy non-zombie firms. Columns 3 and 4 in Table 5 show that post reform, non-zombies in treated industries also increased capital expenditure by INR 31 million, representing a 44 percent increase. Adding firm-level time-varying controls and industry-year fixed effects yields a similar point estimate

of INR 40 million increase. Figure 3, Panel B shows that the parallel trends assumption cannot be rejected.[11]

Overall, the findings in this section also relate to the "sclerosis" and "scrambling" effects emphasized in the creative destruction literature (Caballero and Hammour (1998), Caballero and Hammour (2001), and Caballero, Hoshi and Kashyap (2008)). Sclerosis is the preservation of inefficient firms that would otherwise have not survived prior to the reform, possibly due to evergreening of loans or simply arising from an inability of creditors to force firms to streamline their operations. Scrambling is the survival of less productive firms which keeps creditors from allocating resources to more productive firms. When the impediments to creative destruction — in my setting, the inability to liquidate quickly by lenders — are removed, both sclerosis and scrambling decline and hence credit *and* capital gets reallocated. This potentially affects productivity and allocative efficiency in the economy, which I explore next.

## 6 Implications for the marginal productivity of capital

I now turn to examining the effects of the reform on the productive efficiency of capital in the economy. First, I examine the impact on productivity and reallocation of capital. Second, I examine the spillover effects of the improved productivity on industries connected through input-output linkages to the industries treated by the reform. Third, I examine the proportion of productivity improvements attributable to within-firm improvements and to across-firm reallocation.

[11]For completeness, I also examine labor outcomes in Section A2 and find positive spillover effects on employment of non-zombie firms (see Table 6).

## 6.1 Empirical Strategy

*Aggregate productivity implications:* First, to examine the impact on marginal productivity of firms post reform, I run the following specification

$$Ln(MPK_{ijt}) = \alpha_i + \gamma_t + \beta \times \mathbb{1}_{High-Industry\,Tangibility,j} \times \mathbb{1}_{Post,t} + \varepsilon_{ijt} \tag{7}$$

where $i$ indexes firms, $t$ indexes time, $\alpha_i$ and $\gamma_t$ are firm and year fixed effects. $\mathbb{1}_{High-Industry\,Tangibility,j}$ and $\mathbb{1}_{Post,t}$ are indicators for high-tangibility industries and the post period. Standard errors are clustered at the firm level. The outcome variable of interest is the log of the marginal product of capital calculated as log of the ratio of sales to capital. While this is the average capital productivity, one can also motivate this as a measure of marginal productivity of capital using a Cobb-Douglas utility function (see Bai, Carvalho and Philips (2018)). Hence, I use the term marginal productivity of capital. The coefficient of interest is $\beta_3$ which measures the impact of the reform on the average marginal productivity of the treated industries (high-tangibility industries).

To examine reallocation effects, I examine whether the share of capital allocated to productive firms changed post reform. I run the followings specification:.

$$\begin{aligned} Ln\left(\Delta Capital\ Share_{ijt}\right) &= \alpha_i + \gamma_t + \beta_0 \times Ln(MPK_{ijt}) \\ &+ \beta_1 \times \mathbb{1}_{Post,t} \times MPK_{ijt} + \beta_2 \times \mathbb{1}_{High-Industry\,Tangibility,j} \times Ln(MPK_{ijt}) \\ &+ \beta_3 \times \mathbb{1}_{High-Industry\,Tangibility,j} \times Ln(MPK_{ijt}) \times \mathbb{1}_{Post,t} + \varepsilon_{ijt} \end{aligned} \tag{8}$$

where $i$ indexes firms, $t$ indexes time, $j$ indexes the industry in which the firm operates. $\beta_3$ is the estimate of interest capturing the sensitivity of capital reallo-

cation to the marginal product of capital post reform relative to the pre-reform period in the treated (high-tangibility) industries.

*Productivity spillovers on connected industries:* I then link the spillover effects on the productivity of firms linked to the treated markets through input-output linkages. The upstream and downstream terminology in network analysis is somewhat ambiguous and I follow Acemoglu, Akcigit and Kerr (2016) in their terminology. "Upstream effects" arise from shocks to customers of an industry and will flow up the input-output chain. "Downstream effects" arise from shocks to suppliers to an industry and will flow down the input-output chain. Upstream and downstream terms will thus refer to the effects. The treatment (high-tangibility industry) is either for the customer in case of calculating upstream effects and for the supplier in case of downstream effects.

Downstream exposure measures downstream effects due to supplier shocks as follows:

$$(9) \quad Exposure_{Down,j} = \sum_i Downstream\,Weight_i \times \mathbb{1}_{High-Industry\,Tangibility,i}$$

where $j$ indexes industry. $Downstream\,Weight_i$ is the coefficient from the industry input-output matrix as discussed in Section 2 and measures the proportion of total sales of inputs from industry $i$ to industry $j$ normalized by the total sales of industry $j$. I also standardize the exposure variables so that a unit increase corresponds to a one standard-deviation higher exposure to the treated industries in the input industries. $Exposure_{Up,j}$ is analogously defined with the weights replaced using the output weights and will measure upstream effects.

To measure the spillover on average productivity of industries whose upstream

(input industries) were treated, I run the following specification:

$$Ln(MPK_{ijt}) = \alpha_i + \gamma_t + \beta \times Exposure_{Down,j} \times \mathbb{1}_{Post,t} + \varepsilon_{ijt} \tag{10}$$

where $i$ indexes firms, $t$ indexes time, $j$ indexes the industry in which the firm operates. $\alpha_i$ and $\gamma_t$ are firm and year fixed effects. To capture *only* the spillover effects of the reform I exclude the high-tangibility firms from these regressions. Standard errors are clustered at the firm level. The outcome variable of interest is the log of the marginal product of capital calculated as log of the ratio of sales to capital. The coefficient of interest is $\beta_3$ which measures the impact of the reform on the average marginal productivity of the industries whose suppliers have higher exposure in the to the treated industries (high-tangibility industries).

Analogous to Equation 8, I run the followings specification to examine reallocation in the connected firms:

$$\begin{aligned} Ln\left(\Delta Capital\ Share_{ijt}\right) &= \alpha_i + \gamma_t + \beta_0 \times MPK_{ijt} \\ &+ \beta_1 \times \mathbb{1}_{Post,t} \times MPK_{ijt} + \beta_2 \times Exposure_{UP,j} \times MPK_{ijt} \\ &+ \beta_3 \times Exposure_{UP,j} \times MPK_{ijt} \times \mathbb{1}_{Post,t} + \varepsilon_{ijt} \end{aligned} \tag{11}$$

where $i$ indexes firms, $t$ indexes time, $j$ indexes the industry in which the firm operates. $\beta_3$ is the estimate of interest capturing the sensitivity of capital reallocation to the marginal product of capital post reform relative to the pre-reform period in industries whose supplier firms have a high exposure to the treated (high-tangibility) industries.

*Allocative efficiency:* Finally, to examine allocative efficiency, I decompose productivity gains into the part attributable to improvements in average productivity and the part attributable to reallocation following Olley and Pakes (1996).

Aggregate marginal productivity of capital can be written as:

$$\Phi_t = \sum_i s_{it} mpk_{it} = \overline{mpk_t} + \sum_i (s_{it} - \overline{s_t})(mpk_{it} - \overline{mpk_t}) \tag{12}$$

$\Phi_t$ 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 sales to capital as before.[12] $s_{it}$ 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.

I calculate the above components for each industry-year cell and then run the following specification at the industry-level:

$$y_{jt} = \alpha_j + \gamma_t + \beta \times \mathbb{1}_{High-Industry\,Tangibility,j} \times \mathbb{1}_{Post,t} + \varepsilon_{jt} \tag{13}$$

$y_{jt}$ are the outcome variables of interest: (i) the overall weighted marginal productivity, (ii) the technical productivity, and (iii) the covariance term for industry $j$ at time $t$. $\beta$ is the coefficient of interest and measures the impact on each term for the treated industries. $\alpha_j$ and $\gamma_t$ are industry and time fixed effects. Remaining terms are as defined before.

[12]Consistent with the literature, I 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.

## 6.2 Results

What implications does the direct and distributional effect on capital expenditure that we observed in Section 4 and Section 5 have for the allocative efficiency of capital in the economy? This section investigates the allocative efficiency implications of improved creditor rights in Table 6. Marginal productivity of capital in the treated industries improved by 17 percent (column 1) post reform. Column 4 shows that reallocation of capital shares towards firms with higher marginal productivity of capital increased post reform (24 percent), particularly so in the treated industries (24 + 14 = 38 percent).

Improvements in capital allocation in the treated industries also propagate to downstream industries. Productivity of capital increased by 22 percent (column 3) for firms whose suppliers had 1 SD higher exposure to the treatment (high-tangibility industries). Sensitivity of capital market share of firms to marginal productivity of capital also increased by 68 percent for 1 SD higher exposure of suppliers to the treated industries (column 7). Effects are more muted for firms whose customer industries were more exposed to the treatment (columns 2 and 6). This is consistent with Acemoglu, Akcigit and Kerr (2016) who theoretically show that supply-side shocks such as improvements in productivity propagate more strongly downstream than upstream. This is because supply-side shocks (such as productivity improvements) change the prices faced by customer industries, creating strong downstream propagation.

To sum, the above results show a redistribution of capital from less- to more-productive firms pointing to allocative efficiency gains driving this improvement in capital productivity. Table 7, decomposes channels driving these productivity gains into two parts following Olley and Pakes (1996): the unweighted technical productivity and the total covariance between a firm's share of capital and its pro-

ductivity. In column 2, the dependent variable is the average unweighted MPK and represents the contribution of within firm capital productivity improvements amongst incumbents — for example, due to streamlining their operations as we saw in Section 4. This is consistent with Aghion et al. (2018) who show that there is an inverted U-shaped relationship between credit constraints and productivity growth and hence cutting back credit to certain borrowers can actually lead to productivity improvements. I find that nearly 69 percent of the capital productivity gains come from an increase in average productivity of firms in the high-tangibility industries.

In column 3, the dependent variable is the covariance between the firm's share of the capital market and its productivity and captures the reallocation effects contributing to the aggregate capital productivity gains. The remaining 31 percent of the capital productivity gains comes from reallocation of capital to the more productive firms.

## 7 Mechanism: The collateral channel

The collateral reform allowed lenders to seize collateral or at least threaten to seize collateral, allowing them to free up capital and reallocate credit to more productive firms. This section provides evidence for the collateral channel as the key mechanism driving credit reallocation.

### 7.1 Empirical specification

I test whether firms linked to banks which had greater exposure to low-quality firms witnessed a greater impact on their secured borrowing. I run the following

specification:

$$y_{ibjt} = \alpha_i + \gamma_t + \eta \times \mathbb{1}_{Post,t} \times \mathbb{1}_{Low-Quality,i} + \nu \times \mathbb{1}_{Post,t} \times \mathbb{1}_{Lender\,Exposure,b} + \phi \times \mathbb{1}_{Post,t} \times \mathbb{1}_{Low-Quality,i} \times \mathbb{1}_{Lender\,Exposure,b} + \varepsilon_{it} \quad (14)$$

where $i$ indexes firms, $t$ indexes time, $j$ indexes the industry the firm belongs to and $b$ is the lead bank for the firm. $\alpha_i$ and $\gamma_t$ are firm and year fixed effects. $\mathbb{1}_{Lender\,Exposure} = 1$ for firms whose lead bank has above median exposure to low-quality firms prior to the collateral reform. $\mathbb{1}_{Post,t}$ and $\mathbb{1}_{Low-Quality,i}$ are indicators for the post reform period and for whether a firm is low-quality.

## 7.2 Results

I hypothesize that stronger creditors allow lenders to reallocate credit. Creditors whose balance sheets were clogged by loans to distressed borrowers, were able to now readjust loan supply towards more profitable borrowers. I examine reallocation in borrowing by lenders most exposed to low-quality firms in the pre-reform period. Table 8, Panel A column 1 estimates that the reallocation of debt from low- to high-quality borrowers was higher by INR 113.5 million for firms linked to the high exposure lenders. Point estimates are similar with additional controls (INR 123.6 million). Plausibly, the ability to seize collateral allowed firms to reallocate credit.

Gianetti and Saidi (Forthcoming) find that lenders internalize the negative spillovers of industry downturns on upstream and downstream industries. Lenders could also potentially internalize the spillover effects of improved improved creditor rights on upstream and downstream industries. However, secured borrowing of non-zombies in industries exposed to treated downstream industries did not increase despite improvements in productivity (Table 8, Panel B). Similarly, I find

no significant effect on upstream industries. Thus, banks did not merely increase debt access to firms based on their productivity. The reform only indirectly affected downstream industries through their improved productivity, but had no direct impact on lender ability to seize collateral. These findings further emphasize that it is indeed the collateral channel which is the key mechanism through which lenders reallocate debt.

## 8 Conclusion

This paper highlights the credit reallocation channel through which an improvement in creditor rights can positively affect the allocative efficiency of credit and subsequently capital in the economy. Importantly, such reallocation can have substantial positive effects especially in developing economies.

India provides a natural setting to study the impact of improved creditor rights on the reallocation channel. The macro-development literature finds frictions prevent optimal allocation of resources, especially in developing countries such as India and China (Hsieh and Klenow (2009)). This particular collateral reform is also interesting to study because the rhetoric at the time focused on the slowdown in secured credit growth following the reform (Chakravarty (2003)) which is puzzling because India is not a creditor-friendly country to begin with. In some sense, the pull-back in credit pointed to markets perceiving that the collateral reform made creditor rights somewhat excessive. This study highlights, that especially in countries like India which have weak creditor rights to begin with, we should initially expect to see only muted overall growth reflecting massive churn as credit gets reallocated from unproductive to productive firms. Despite immediate pullback in credit, especially by worse performing firms, such improved creditor-friendly laws can restore the health of the economy through the spillovers on healthy firms in the economy.

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Figure 1. : Impact of the collateral reform on secured debt

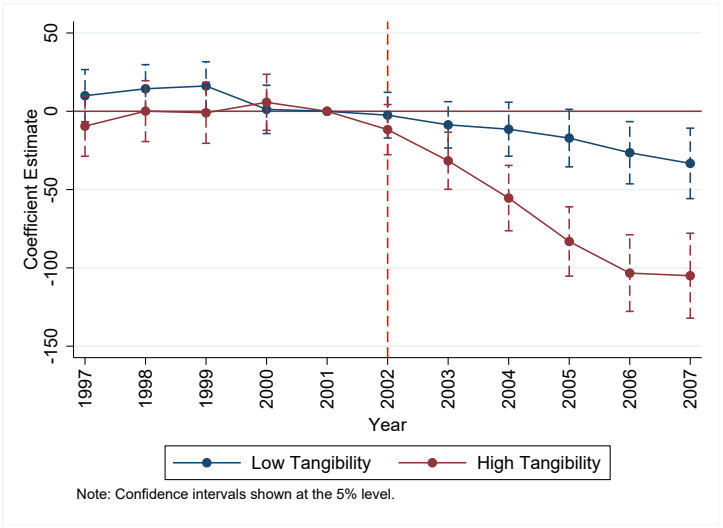
*Note:* The graph on the left-hand-side plots the coefficient $\eta_\tau$ from the following difference-in-difference (DD) specification separately for each sub-sample of high-tangibility (red line) and low-tangibility firms (blue line):

$$y_{it} = \alpha_i + \gamma_t + \sum_\tau \eta_\tau \times (\mathbb{1}_\tau \times \mathbb{1}_{Low-Quality,i}) + \varepsilon_{ijt}$$

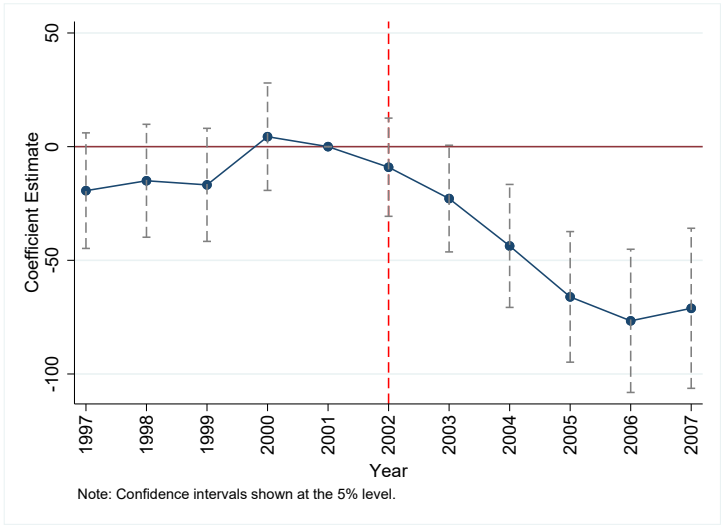
The graph on the right-hand-side plots the coefficient $\phi_\tau$ from the following triple difference (DDD) specification:

$$y_{ijt} = \alpha_i + \gamma_t + \sum_\tau \eta_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{Low-Quality} + \sum_\tau \nu_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{High-Tangibility} + \sum_\tau \phi_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{Low-Quality} \times \mathbb{1}_{High-Tangibility} + \varepsilon_{ijt}$$

where $\tau$ ranges from 1997 to 2007, $\mathbb{1}_\tau = 1$ if year is $\tau$ and $\eta_\tau$ is coefficient of interest. Bars show the 95% confidence intervals, $\tau = 0$ is the year the reform is announced, and all coefficients are normalized relative to $\tau = -1$. Robust standard errors are clustered at the firm level. $\mathbb{1}_{Post}$, $\mathbb{1}_{Low-Quality}$ and $\mathbb{1}_{High-Tangibility}$ are indicators for the post period, low-quality borrowers, and high-tangibility firms. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Low-quality borrowers are defined as firms with average interest coverage ratio (ICR) in 2000 and 2001 less than 1. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities. Firms are classified as high-tangibility if the tangibility ratio in 2001 is above the median tangibility of all firms. $y_{it}$ is the secured borrowing defined as the change in secured debt between current period and the previous period. Data is from Prowess and for the period 1997–2007.




(a) **Difference-in-Difference**




(b) **Triple Difference**

Figure 2. : Impact of the collateral reform on capital expenditure

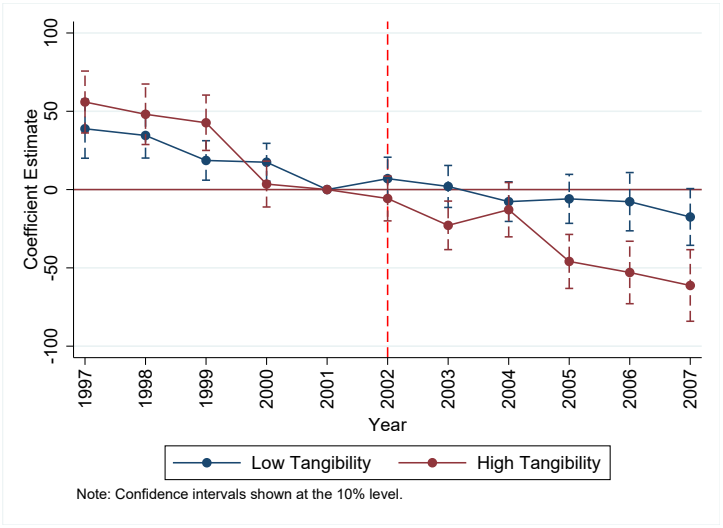
*Note:* The graph on the left-hand-side plots the coefficient $\eta_\tau$ from the following difference-in-difference (DD) specification separately for each sub-sample of high-tangibility (red line) and low-tangibility firms (blue line):

$$y_{it} = \alpha_i + \gamma_t + \sum_\tau \eta_\tau \times (\mathbb{1}_\tau \times \mathbb{1}_{Low-Quality}) + \varepsilon_{ijt}$$

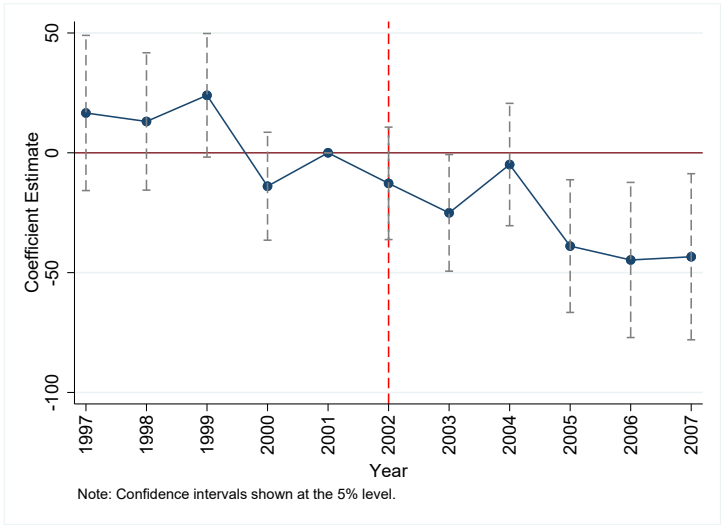
The graph on the right-hand-side plots the coefficient $\phi_\tau$ from the following triple difference (DDD) specification:

$$y_{it} = \alpha_i + \gamma_t + \sum_\tau \eta_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{Low-Quality} + \sum_\tau \nu_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{High-Tangibility} + \sum_\tau \phi_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{Low-Quality} \times \mathbb{1}_{High-Tangibility} + \varepsilon_{it}$$

where $\tau$ ranges from 1997 to 2007, $\mathbb{1}_\tau = 1$ if year is $\tau$ and $\eta_\tau$ is coefficient of interest. Bars show the 95% confidence intervals, $\tau = 0$ is the year the reform is announced, and all coefficients are normalized relative to $\tau = -1$. Robust standard errors are clustered at the firm level. $\mathbb{1}_{Post}$, $\mathbb{1}_{Low-Quality}$ and $\mathbb{1}_{High-Tangibility}$ are indicators for the post period, low-quality borrowers, and high-tangibility firms. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Low-quality borrowers are defined as firms with average interest coverage ratio (ICR) in 2000 and 2001 less than 1. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities. Firms are classified as high-tangibility if the tangibility ratio in 2001 is above the median tangibility of all firms. $y_{it}$ is capital expenditure defined as the non-negative change in gross fixed assets between current period and previous period. Data is from Prowess and for the period 1997–2007.




(a) **Difference-in-Difference**




(b) **Triple Difference**

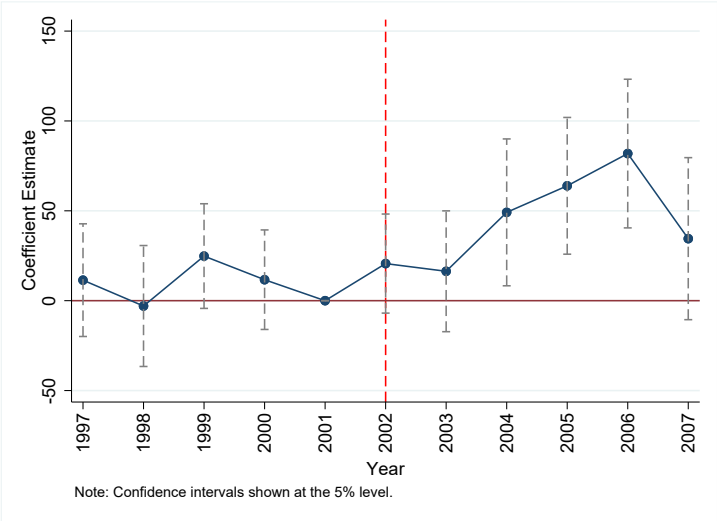
Figure 3. : Spillovers on secured debt and capital expenditure

*Note:* The graphs below plot the coefficient $\phi_\tau$ from the following triple difference (DDD) specification:

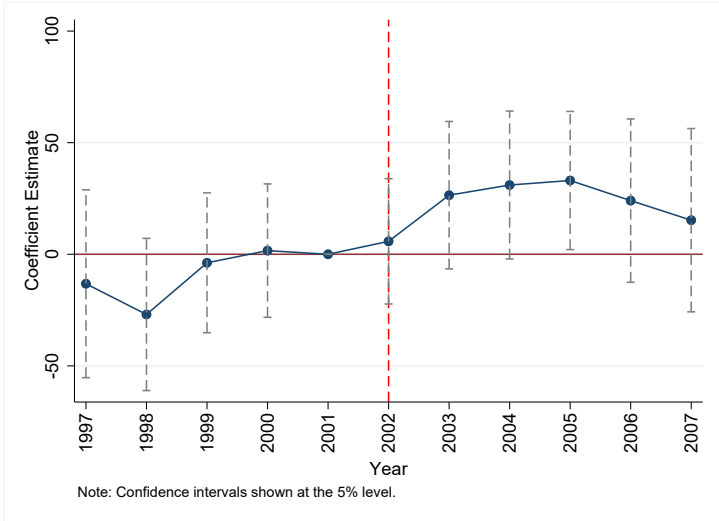
$$y_{it} = \alpha_i + \gamma_t + \sum_\tau \eta_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{Non-Zombie} + \sum_\tau \nu_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{High-Industry\,Tangibility} + \sum_\tau \phi_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{Non-Zombie} \times \mathbb{1}_{High-Industry\,Tangibility} + \varepsilon_{it}$$

where $\tau$ ranges from 1997 to 2007, $\mathbb{1}_\tau = 1$ if year is $\tau$ and $\eta_\tau$ is coefficient of interest. Bars show the 95% confidence intervals, $\tau = 0$ is the year the reform is announced, and all coefficients are normalized relative to $\tau = -1$. Robust standard errors are clustered at the firm level. $\mathbb{1}_{Post}$, $\mathbb{1}_{Low-Quality}$ and $\mathbb{1}_{High-Tangibility}$ are indicators for the post period, low-quality borrowers, and high-tangibility firms. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Low-quality borrowers are defined as firms with average interest coverage ratio (ICR) in 2000 and 2001 less than 1. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities. Firms are classified as high-tangibility if the tangibility ratio in 2001 is above the median tangibility of all firms. $y_{it}$ is the secured borrowing defined as the change between $t-1$ and $t$. Data is from Prowess and for the period 1997–2007.





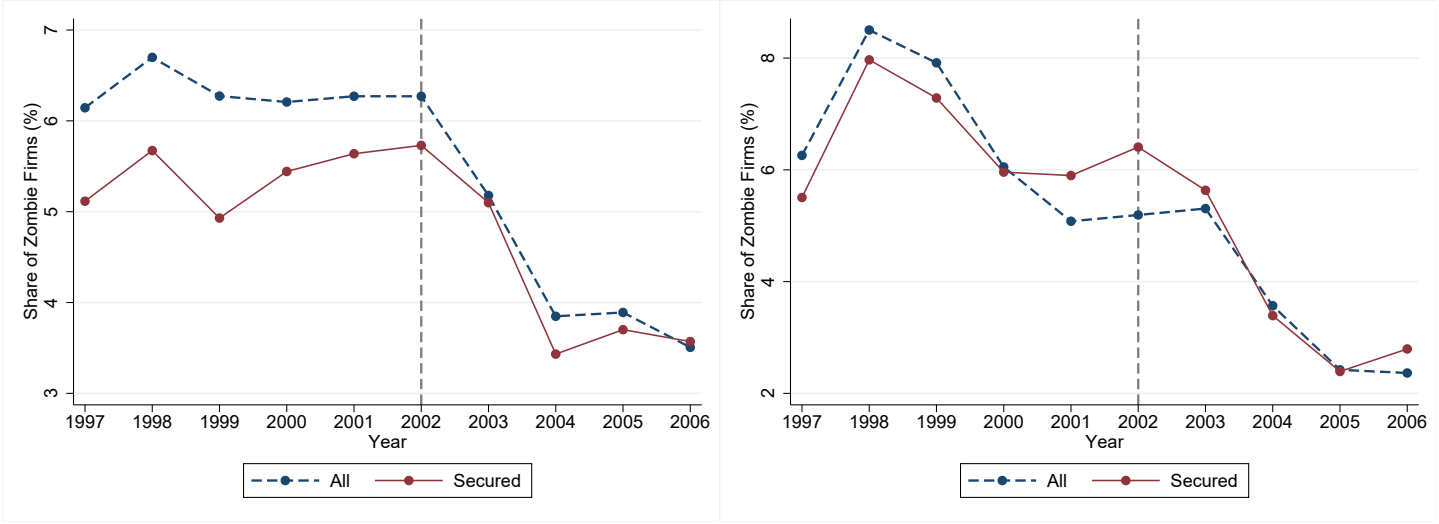

(a) **Secured Debt**




(b) **CapEx**

Figure 4. : Impact of collateral reform on percentage of firms receiving subsidized credit

*Note:* The graphs below plot the percentage of firms that are classified as zombies relative to the total number of firms. Panel (a) plots the raw numbers and panel (b) plots the asset-weighted percentage by total assets. A zombie is defined as a firm that receives subsidized credit, that is, it satisfies all the following conditions: (i) interest rate of the firm is below the minimum prime lending rate, (ii) interest coverage ratio (ICR) is less than 1, (iii) leverage (total external debt to total assets) is greater than 0.20, and (iv) change in debt is greater than zero. Since the collateral law only applies to secured debt, we also classify a firm as zombie if it satisfies all the conditions for a zombie and if the secured borrowings is greater than zero (solid red line in each graph). Data is from Prowess. Data is for the period 1997 to 2007.

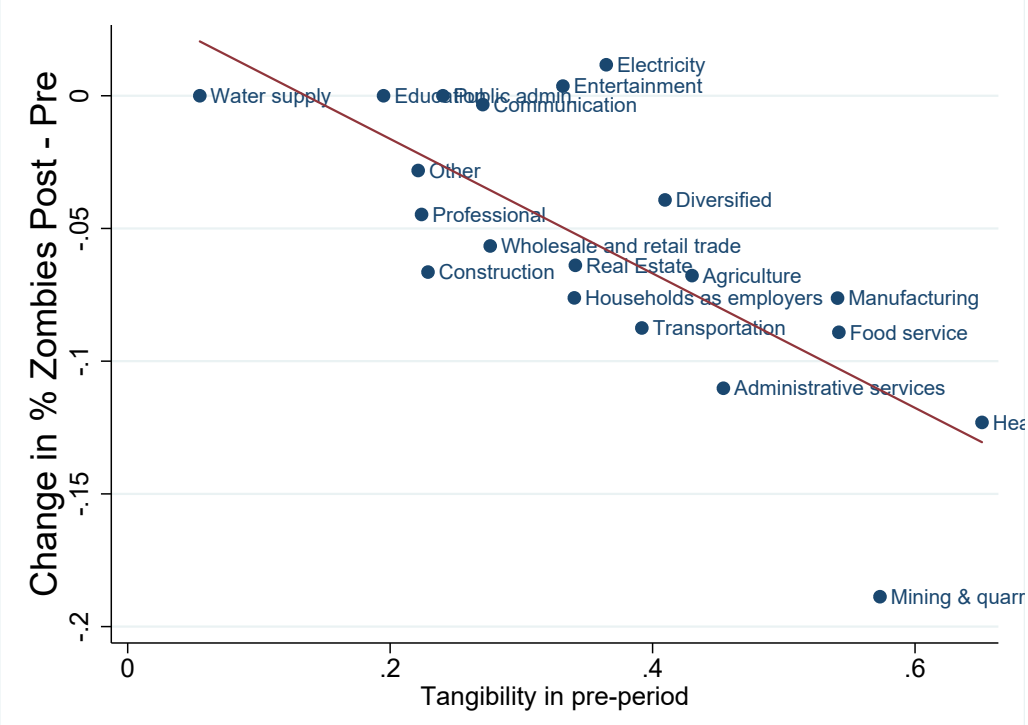



(a) **Raw**

(b) **Asset-Weighted**

Figure 5. : Impact of collateral law on change in percentage of firms receiving subsidized credit and tangibility of assets

*Note:* The plot below shows the percentage change in percentage of zombies to average tangibility of firms in each sector wherein NAICS 2 digit industries have been grouped into sectors as indicated below. A zombie is defined as a firm that receives subsidized credit, that is, it satisfies all the following conditions: (i) interest rate of the firm is below the minimum prime lending rate, (ii) interest coverage ratio (ICR) is less than 1, (iii) leverage (total external debt to total assets) is greater than 0.20, and (iv) change in debt is greater than zero. Percentage of zombies is the number of zombies to the total number of firms. The change is calculated as the average in period before the reform minus the average in the period after the reform. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities.



## Table 1—: Descriptive statistics

*Note:* The table below shows the summary statistics of all the variables used in our analysis. ICR is the ratio of earnings before interest and taxes to total interest expense. Low-quality borrowers are defined as firms with average interest coverage ratio (ICR) in 2000 and 2001 less than 1. A zombie is defined as a firm that receives subsidized credit, that is, it satisfies all the following conditions: (i) interest rate of the firm is below the minimum prime lending rate, (ii) interest coverage ratio (ICR) is less than 1, (iii) leverage (total external debt to total assets) is greater than 0.20, and (iv) change in debt is greater than zero. The mean and standard deviation are shown in columns 1 and 2. In panel a (b) Columns 3 and 4 show the average for low-quality borrowers (zombies) in the period before and after the reform, that is 2002. In panel b (a) Column 5 shows the t-statistic on the difference between the pre and post period for the low-quality borrowers (zombies). In panel a (b) Columns 6 and 7 show the average for high-quality borrowers (non-zombies) in the period before and after the reform. Column 8 shows the t-statistic on the difference between the two. For the definition of remaining variables see Table 1. Data is from Prowess for the period 1997 to 2007.

Panel A

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | All | | Low Quality | | | High Quality | | |
| Variables | Mean | SD | Pre | Post | t-stat on diff. | Pre | Post | t-stat on diff. |
| Secured borrowing$^{+}$ | 45.23 | 191.6 | 51.74 | 37.54 | (-4.78***) | 30.96 | 56.52 | (12.91***) |
| Unsecured borrowing$^{+}$ | 3.160 | 17.20 | 1.020 | 4.260 | (13.33***) | 1.530 | 4.730 | (18.28***) |
| Interest rate | 11.39 | 6.390 | 13.07 | 9.330 | (-34.21***) | 13.74 | 9.560 | (-49.91***) |
| Capital expenditure$^{+}$ | 83.45 | 259.2 | 59.81 | 59.19 | (-0.18) | 78.02 | 106.7 | (10.11) |
| Log(Sales) | 5.370 | 2.420 | 4.840 | 4.850 | (0.12) | 5.410 | 5.750 | (13.11) |
| $\frac{EBITDA}{Total\,Assets}$ | 0.100 | 0.110 | 0.0300 | 0.0700 | (23.56***) | 0.130 | 0.110 | (-14.54***) |
| **Observations** | 52152 | | 16457 | | | 35695 | | |

Panel B

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | All | | Zombies | | | Non-Zombies | | |
| Variables | Mean | SD | Pre | Post | t-stat on diff. | Pre | Post | t-stat on diff. |
| Secured borrowing$^{+}$ | 45.23 | 191.6 | 62.34 | 41.31 | (-4.82***) | 32.41 | 52.65 | (11.40***) |
| Unsecured borrowing$^{+}$ | 3.160 | 17.20 | 1.100 | 5.110 | (10.91***) | 1.410 | 4.490 | (19.96***) |
| Interest rate | 11.39 | 6.390 | 10.37 | 7.450 | (-21.68***) | 14.38 | 9.910 | (-60.84***) |
| Capital expenditure$^{+}$ | 83.45 | 259.2 | 71.84 | 63.71 | (-1.56) | 71.81 | 97.89 | (10.55) |
| Log(Sales) | 5.370 | 2.420 | 4.720 | 4.870 | (3.00***) | 5.340 | 5.590 | (11.22***) |
| $\frac{EBITDA}{Total\,Assets}$ | 0.100 | 0.110 | 0.0200 | 0.0700 | (17.10***) | 0.110 | 0.110 | (-4.03***) |
| **Observations** | 52152 | | 8791 | | | 43361 | | |

$^{+}$ *INR million.*

Table 2—: Impact of the collateral reform on borrowing

*Note:* The table reports results for the triple difference specification in Equation 3. In columns 1 and 2, the dependent variable is secured borrowing. In columns 3 and 4, the dependent variable is unsecured borrowing, and in Columns 5 and 6, the dependent variables is interest rate. Secured borrowing is the change in secured debt between current period and the previous period. Unecured borrowing is the change in unsecured debt between current period and the previous period. Interest rate is calculated as defined in Section A1. $\mathbb{1}_{Post}$, $\mathbb{1}_{Low-Quality}$ and $\mathbb{1}_{High-Tangibility}$ are indicators for the post period, low-quality borrowers, and high-tangibility firms. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Low-quality borrowers are defined as firms with average interest coverage ratio (ICR) in 2000 and 2001 less than 1. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities. Firms are classified as high-tangibility if the tangibility ratio in 2001 is above the median tangibility of all firms. All the columns include firm and year fixed effects. Columns 2, 4, 6 and 8 include industry-year fixed effects and also include controls. Firm-level controls included are log of sales and profitability (the ratio of earnings before interest and taxes, depreciation and amortization to assets). Standard errors are clustered at the firm level. Baseline mean is calculated for the low-quality borrowers in the period before the reform. Data is from Prowess for the period 1997-2007.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Secured Borr. | | Unsecured Borr. | | Interest Rate | |
| $\mathbb{1}_{Low-Quality} * \mathbb{1}_{Post}$ | -22.19*** | -16.49*** | -0.400 | -0.274 | -0.480 | -0.214 |
| | (4.869) | (5.003) | (0.592) | (0.613) | (0.340) | (0.346) |
| $\mathbb{1}_{High-Tangibility} * \mathbb{1}_{Post}$ | 12.41** | 9.715** | 1.856*** | 1.375** | -0.308 | -0.230 |
| | (4.846) | (4.810) | (0.558) | (0.600) | (0.221) | (0.236) |
| $\mathbb{1}_{Low-Quality} * \mathbb{1}_{Post} * \mathbb{1}_{High-Tangibility}$ | -39.08*** | -37.06*** | -0.777 | -0.220 | 0.489 | 0.719* |
| | (8.023) | (8.181) | (0.873) | (0.888) | (0.405) | (0.409) |
| Baseline Mean | 51.74 | | 1.02 | | 13.07 | |
| No. of Obs. | 51939 | 51939 | 51939 | 51939 | 34071 | 34071 |
| R-sq. | 0.359 | 0.388 | 0.430 | 0.456 | 0.545 | 0.574 |
| Firm FE | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |
| Industry-Year FE | N | Y | N | Y | N | Y |
| Controls | N | Y | N | Y | N | Y |

Table 3—: Impact of the collateral reform on zombie lending (evergreening)

*Note:* The table reports results for the triple difference specification in Equation 5. In columns 1 and 2, the dependent variable is secured borrowing. Secured borrowing is the change in secured debt between current period and the previous period. $\mathbb{1}_{Post}$, $\mathbb{1}_{Zombie}$ and $\mathbb{1}_{High-Tangibility}$ are indicators for the post period, low-quality borrowers, and high-tangibility firms. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Low-quality borrowers are defined as firms with average interest coverage ratio (ICR) in 2000 and 2001 less than 1. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities. Firms are classified as high-tangibility if the tangibility ratio in 2001 is above the median tangibility of all firms. All the columns include firm and year fixed effects. Column 2 also includes industry-year fixed effects and also include controls. Firm-level controls included are log of sales and profitability (the ratio of earnings before interest and taxes, depreciation and amortization to assets). In column 3, the dependent variable is whether a firm is a zombie in the pre and post period. For this specification, a firm is classified as a zombie in the pre- (post-) period if it is classified as a zombie in any of the years in the pre- (post-) period. Only firm fixed effects are included and the indicator $\mathbb{1}_{Post}$ is also included in this regression (though not shown). Standard errors are clustered at the firm level. Baseline mean is calculated for the zombie firms in the period before the reform. Data is from Prowess for the period 1997-2007.

| | (1) | (2) | (3) |
|---|---|---|---|
| | Secured Borr. | | $\mathbb{1}_{zombie\ current}$ |
| $\mathbb{1}_{High-Tangibility} * \mathbb{1}_{Post}$t | 3.699 | 2.559 | 0.0336*** |
| | (4.288) | (4.238) | (0.0120) |
| $\mathbb{1}_{Zombie} * \mathbb{1}_{Post}$ | -22.40*** | -17.28** | -0.204*** |
| | (7.281) | (7.433) | (0.0575) |
| $\mathbb{1}_{Zombie} * \mathbb{1}_{Post} * \mathbb{1}_{High-Tangibility}$ | -36.65*** | -37.75*** | -0.139* |
| | (10.63) | (10.83) | (0.0718) |
| Baseline Mean | 62.34 | | 0.08 |
| No. of Obs. | 51939 | 51939 | 11975 |
| R-sq. | 0.358 | 0.387 | 0.677 |
| Firm FE | Y | Y | Y |
| Year FE | Y | Y | |
| Industry-Year FE | N | Y | |
| Controls | N | Y | |

Table 4—: Impact of the collateral reform on capital expenditure

*Note:* The table reports results for difference-in-difference-in-difference specification in Equation 3 with the dependent variable, capital expenditure. Capital expenditure is non-negative difference in gross fixed assets between current period and the previous period. $\mathbb{1}_{Post}$, $\mathbb{1}_{Low-Quality}$, $\mathbb{1}_{Zombie}$ and $\mathbb{1}_{High-Tangibility}$ are indicators for the post-period, low-quality borrowers, zombie borrowers and high-tangibility firms. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Low-quality borrowers are defined as firms with average interest coverage ratio (ICR) in 2000 and 2001 less than 1. A zombie is defined as a firm that receives subsidized credit, that is, it satisfies all the following conditions: (i) interest rate of the firm is below the minimum prime lending rate, (ii) interest coverage ratio (ICR) is less than 1, (iii) leverage (total external debt to total assets) is greater than 0.20, and (iv) change in debt is greater than zero. Firm-level controls included are log of sales and profitability (the ratio of earnings before interest and taxes, depreciation and amortization to assets). All the columns include firm fixed effects and year fixed effects. Columns 2 and 4 include industry-year fixed effects and controls. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities. Firms are classified as high-tangibility if the tangibility ratio in 2001 is above the median tangibility of all firms. Standard errors are clustered at the firm level. Data is from Prowess for the period 1997-2007. Baseline mean is calculated for the low-quality borrowers in the period before the reform in columns 1–2 and for zombie firms in years 3–4. Data is from Prowess for the period 1997-2007.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\mathbb{1}_{Low-Quality} * \mathbb{1}_{Post}$ | -21.86*** | -8.990 | | |
| | (6.181) | (6.188) | | |
| $\mathbb{1}_{High-Tangibility} * \mathbb{1}_{Post}$ | 19.63*** | 18.85*** | 12.68** | 12.84*** |
| | (5.759) | (5.703) | (4.989) | (4.954) |
| $\mathbb{1}_{Low-Quality} * \mathbb{1}_{Post} * \mathbb{1}_{High-Tangibility}$ | -36.77*** | -37.18*** | | |
| | (9.276) | (9.012) | | |
| $\mathbb{1}_{Zombie} * \mathbb{1}_{Post}$ | | | -21.25** | -12.08 |
| | | | (9.789) | (8.730) |
| $\mathbb{1}_{Zombie} * \mathbb{1}_{Post} * \mathbb{1}_{High-Tangibility}$ | | | -40.91*** | -40.74*** |
| | | | (12.57) | (11.59) |
| Baseline Mean | 59.81 | | 71.84 | |
| No. of Obs. | 51939 | 51939 | 51939 | 51939 |
| R-sq. | 0.617 | 0.633 | 0.617 | 0.633 |
| Firm FE | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y |
| Industry-Year FE | N | Y | N | Y |
| Controls | N | Y | N | Y |

Table 5—: Zombie distortions: Impact on secured borrowing and capital expenditure in decongested industries

*Note:* In this table, we show the results for the zombie distortions specification in Equation 6. The dependent variables used in the regression are secured debt (columns 1 and 2) and capital expenditure (columns 3 and 4). Secured borrowing is the change in secured debt between current period and the previous period. Capital expenditure is non-negative difference in gross fixed assets between current period and the previous period. $\mathbb{1}_{Post}$, $\mathbb{1}_{Non-Zombie}$ and $\mathbb{1}_{High-Industry\,Tangibility}$ are indicators for the post-period, non-zombie borrowers, and high-industry tangibility. A zombie is defined as a firm that receives subsidized credit, that is, it satisfies all the following conditions: (i) interest rate of the firm is below the minimum prime lending rate, (ii) interest coverage ratio (ICR) is less than 1, (iii) leverage (total external debt to total assets) is greater than 0.20, and (iv) change in debt is greater than zero. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities. Firms are classified as high-tangibility if the tangibility ratio in 2001 is above the median tangibility of all firms. Firm-level controls included are log of sales and profitability (the ratio of earnings before interest and taxes, depreciation and amortization to assets). Industries with average tangibility of firms in 2000 above median are high-tangibility industries. All regressions include year fixed effects. Even numbered columns also include controls and industry-year fixed effects. All columns include firm fixed effects. Standard errors are clustered at the firm level. The data is from Prowess for the period 1997-2007. Baseline mean is calculated for the non-zombies in the period before the reform.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Secured Borr. | | CapEx | |
| $\mathbb{1}_{High-Industry\,Tangibility} * \mathbb{1}_{Post}$ | -24.74*** | -70.22 | -14.05 | -35.45 |
| | (9.055) | (73.85) | (11.94) | (36.05) |
| $\mathbb{1}_{Post} * \mathbb{1}_{Non-Zombie}$ | 22.91*** | 16.97** | 25.69** | 9.087 |
| | (6.633) | (6.614) | (10.46) | (9.266) |
| $\mathbb{1}_{Non-Zombie} * \mathbb{1}_{High-Industry\,Tangibility} * \mathbb{1}_{Post}$ | 34.06*** | 35.74*** | 31.43** | 40.16*** |
| | (9.948) | (9.987) | (12.84) | (11.80) |
| Baseline Mean | 62.34 | | 71.84 | |
| No. of Obs. | 52152 | 52152 | 52152 | 52152 |
| R-sq. | 0.359 | 0.378 | 0.617 | 0.633 |
| Firm FE | Y | Y | N | Y |
| Year FE | Y | Y | Y | Y |
| Industry-Year FE | N | Y | N | Y |
| Controls | N | Y | N | Y |

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

Table 6—: Productivity and market shares of productive firms

*Note:* The dependent variable in columns 1–3 is the log of marginal productivity of capital and the dependent variable in columns 4–7 is the logarithm of the change in capital share of a firm relative to the industry in which it operates. Log of marginal productivity of capital (MPK) is calculated as the log of the ratio of sales to capital. Capital is gross fixed assets. $\mathbb{1}_{Post}$ and $\mathbb{1}_{High-Industry\,Tangibility}$ are indicators for the post-period and high-industry tangibility. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities. Firms are classified as high-tangibility if the tangibility ratio in 2001 is above the median tangibility of all firms. Industries with average tangibility of firms in 2000 above median are high-tangibility industries. Exposure$_{Up}$ is the weighted average of all the customer industries which have are classified as having high-tangibility, that is, $\mathbb{1}_{High-Industry\,Tangibility}$ is equal to 1. Exposure$_{Down}$ is the weighted average of all the supplier industries which are classified as having high-tangibility, that is, $\mathbb{1}_{High-Industry\,Tangibility}$ is equal to 1. Weights are from the input-output linkages (M3 matrix) provided by Ministry of statistics and programme implementation. All regressions include firms and year fixed effects. Standard errors are clustered at the firm level. The data is from Prowess for the period from 1997-2007.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Ln(MPK) | | | Ln (Δ Capital share) | | | |
| $\mathbb{1}_{High\,Sector\,Tangibility}$*$\mathbb{1}_{Post}$ | 0.169*** | | | | 0.000819 | | |
| | (0.0363) | | | | (0.100) | | |
| Exposure$_{Up}$*$\mathbb{1}_{Post}$ | | 0.0295 | | | | -0.0262 | |
| | | (0.0219) | | | | (0.0799) | |
| Exposure$_{Down}$*$\mathbb{1}_{Post}$ | | | 0.0356** | | | | -0.118 |
| | | | (0.0155) | | | | (0.0752) |
| Ln(MPK )* $\mathbb{1}_{Post}$ | | | | 0.296*** | 0.239*** | 0.256*** | 0.268*** |
| | | | | (0.0315) | (0.0421) | (0.0440) | (0.0422) |
| Ln(MPK)*$\mathbb{1}_{Post}$* $\mathbb{1}_{High\,Sector\,Tangibility}$ | | | | | 0.135** | | |
| | | | | | (0.0653) | | |
| MPK*$\mathbb{1}_{Post}$*Exposure$_{Up}$ | | | | | | 0.0486 | |
| | | | | | | (0.0474) | |
| MPK*$\mathbb{1}_{Post}$*Exposure$_{Down}$ | | | | | | | 0.109** |
| | | | | | | | (0.0537) |
| No. of Obs. | 51568 | 24060 | 24060 | 18278 | 18278 | 8787 | 8787 |
| R-sq. | 0.771 | 0.798 | 0.798 | 0.792 | 0.793 | 0.816 | 0.816 |
| Firm FE | Y | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y | Y |

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

Table 7—: Decomposition of marginal productivity of capital

*Note:* The table below shows the decomposition of the marginal productivity of capital into within-firm and across-firm productivity. The dependent variable in column 1 is the weighted average marginal productivity where the weights are the share in capital of a firm to the capital in the firm's industry. The dependent variable in column 2 is the unweighted average productivity of all firms in the industry. The dependent variable in column 3 is the covariance between marginal productivity of capital and the firm share of capital relative to the industry that the firm operates in. Marginal productivity of capital is measured in logs and calculated as the log of the ratio of sales to capital. $\mathbb{1}_{Post}$ and $\mathbb{1}_{High-Industry\,Tangibility}$ are indicators for the post-period and high-industry tangibility. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities. Firms are classified as high-tangibility if the tangibility ratio in 2001 is above the median tangibility of all firms. Industries with average tangibility of firms in 2000 above median are high-tangibility industries. All regressions include firm and year fixed effects. Data is from Prowess for the period from 1997-2007.

| | (1) Aggregate productivity | (2) Within-firm productivity | (3) Reallocation |
|---|---|---|---|
| $\mathbb{1}_{High-Industry\,Tangibility}$*$\mathbb{1}_{Post}$ | 0.359*** | 0.249*** | 0.110* |
| | (0.0690) | (0.0472) | (0.0629) |
| No. of Obs. | 571 | 571 | 571 |
| R-sq. | 0.836 | 0.843 | 0.724 |
| Industry FE | Y | Y | Y |
| Year FE | Y | Y | Y |

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

Table 8—: Mechanism: The collateral channel

*Note:* Panel A studies the effect of exposure on secured lending to low-quality borrowers. The dependent variable in both panels is the change in secured borrowing. Low-quality borrowers are defined as firms with average interest coverage ratio (ICR) in 2000 and 2001 less than 1. Lender-level exposure is measured as the number of low-quality firms a bank was designated as the primary lender in 2000 or 2001 (year before SARFAESI was enacted). Low exposure refers to lenders in the bottom quintile of exposure measure. Remaining are classified as high exposure. Each firm has one lender designated as the primary lender. When there are more than 2 primary lenders (less than 2 percent of entire sample) I arbitrarily designate one bank as the prime lender. All regression include firm and year fixed effects. Column 2 also includes industry-year fixed effects. Panel B studies the impact on secured borrowing of non-zombies in upstream and downstream industries. Industries with average tangibility of firms in 2000 above median are high-tangibility industries. $\text{Exposure}_{Up}$ is the weighted average of all the customer industries which have are classified as having high-tangibility, that is, $\mathbb{1}_{High-IndustryTangibility}$ is equal to 1. $\text{Exposure}_{Down}$ is the weighted average of all the supplier industries which have are classified as having high-tangibility, that is, $\mathbb{1}_{High-IndustryTangibility}$ is equal to 1. Weights are from the input-output linkages provided by Ministry of statistics and programme implementation. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Standard errors are clustered at the firm level. Firm-level controls included are log of sales and profitability (the ratio of earnings before interest and taxes, depreciation and amortization to assets). Remaining uninteracted terms have been included though not shown in the table.

Panel A: Lender-level analysis

| | (1) | (2) |
|---|---|---|
| $\mathbb{1}_{Low-Quality} * \mathbb{1}_{Post} * \mathbb{1}_{High-Exposure}$ | -113.5*** | -123.6*** |
| | (20.25) | (16.77) |
| No. of Obs. | 17587 | 17587 |
| R-sq. | 0.432 | 0.482 |
| Firm FE | Y | Y |
| Year FE | Y | Y |
| Industry-Year FE | N | Y |
| Controls | Y | Y |

Panel B: Spillover mechanism

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\mathbb{1}_{Non-Zombie}$*$\text{Exposure}_{Down}$*$\mathbb{1}_{Post}$ | 8.981 | 11.22 | | |
| | (39.73) | (40.23) | | |
| $\mathbb{1}_{Non-Zombie}$*$\text{Exposure}_{Up}$*$\mathbb{1}_{Post}$ | | | 10.23 | 8.935 |
| | | | (14.55) | (14.75) |
| No. of Obs. | 24576 | 24576 | 24576 | 24576 |
| R-sq. | 0.354 | 0.388 | 0.354 | 0.388 |
| Firm FE | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y |
| Industry-Year FE | N | Y | N | Y |
| Controls | N | Y | N | Y |

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

For Online Publication: Appendix

## A1 Data construction

Financial data is primarily from ProwessDx, maintained by Centre for Monitoring Indian Economy (CMIE). Data pertains to annual financial statement data for Indian firms. Coverage of listed firms is comprehensive (due to reporting requirements) but limited for unlisted firms. I focus on data between April 01, 1997 to March 31, 2007 from the March 2016 vintage. Table 1 describes variables used in the analysis. There are a total of 50,039 firm-year observations. Data for most firms is as of the fiscal year ending March 31. 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.

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 a strong assumption that all increase in debt of a firm is from the top banker. The remaining variables pertaining to banks in our dataset is extracted from DBIE (Database on Indian Economy) and Reserve Bank of India. For easy extraction of some of the RBI related data we also relied on IndiaStat.

For the analysis on capital expenditures, we use the CapExDx database on planned investment projects. This dataset is provided by the CMIE and provides data on planned capital expenditure at the project level. An investment project in the database is any project that involves some capital expenditure and some capacity expansion. It tracks the announcement, implementation and completion of projects. The database excludes financial investment projects such as investment in secondary capital markets. The database captures projects with capital expenditure greater than INR 10 million. The data is collected by the CMIE team from publicly available sources, by contacting the firm and internal experts. It is not based on official or regulatory data, but is useful for our purposes because it supplements the analysis on actual capital expenditure from the Prowess data. Importantly, CMIE provides a link between the projects and the Prowess database based on the company identifier. Thus, we restrict to companies for which CapExDx has at least one project for any company used in our analysis. Not all projects in Prowess are covered by CapexDx and not all CapexDx companies appear in Prowess. The expenditure amount of implemented projects, an-

nounced projects and completed projects is aggregated to company level and we have 25,623 firm-year observations. CMIE has been monitoring projects since 1976 and reliable information on data is available only starting 1996. The project also lists an industry code. I define non-core projects as those where the project industry code does not match the firm industry code. The CapExDx database also tracks the life-cycle of the project since it is first announced.

Employment data is not well populated in the CMIE. I supplement the analysis on employment with data from the Annual Survey of Industries (ASI). The survey is conducted by the Ministry of Statistics and Program Implementation (MoSPI) in India and provides information about industrial units with firms employing 10 or more workers using electricity (20 or more if the unit does not use electricity). To generate employment related statistics I use data on average number of all workers, permanent workers, contract workers and factory staff as reported in ASI. One caveat in using the ASI data is that it captures only manufacturing firms and is available only starting 1999.

The input-output linkages are from MOSPI, specifically Table M3 which provides the input-output coefficient matrix.

## 1.1 Zombie definition

I follow Caballero, Hoshi and Kashyap (2008) to define zombies. A firm is classified as a zombie if it obtains subsidized credit from its bank or the actual interest payment of the firm is below the interest expense of the most creditworthy firms in the economy. I define zombie as a firm that has borrowed funds on interest rate below prevailing prime lending rates, despite not being the highest rated firm, has an interest coverage ratio (ICR) less than equal to 1, leverage (total external debt to total assets) of greater than 0.20 and has taken additional loan in year t. Below I define the reasoning behind using this criteria.

In their seminal paper, Caballero, Hoshi and Kashyap (2008) determine a zombie firm as one whose interest payment is lower than the risk-free interest payments. However, this criteria does not take into account evergreening of loans. Additionally, it is likely that during the times of weak demand, banks might commit to offer credit below their prime lending rates in order to attract reputable firms. Hence, I modify the Caballero, Hoshi and Kashyap (2008) definition of zombies following Fukuda and Nakamura (2013) and avoid the mistreatment of any firm, which otherwise is healthy, as a zombie. The definition also needs to look at zombie credibility, profitability and most importantly, any evidence of evergreening. Thus, the following criteria also need to be accounted for. If a firm is high rated or if the ICR is more than one, then it is not classified as a zombie. Firm's may have low interest payments if they have low leverage. Hence, firms with debt less than 20 percent of their total assets are not classified as zombies.

To ensure the zombie definition captures evergreening of loans, zombie firms also increased borrowing relative to the previous year.

A zombie firm has interest rates below the minimum prime lending rate. I use prime lending rates from the State Bank of India (the largest public sector bank in India) as the benchmark or cut-off rate and calculate if the interest cost on long term loans for a firm is lower than the minimum prime lending rate. SBI is the largest public sector bank in India, its prime lending rate is an indication of the interest rate at which most creditworthy firms in the economy avail credit. Since we do not have the exact interest payments on new loans, we see if the interest expense under the prime lending rate is less than what the firm currently pays and infer this to mean the firm has borrowed funds on interest rate below prevailing prime lending rates.

## A2 Robustness

In this section, I show that the baseline results discussed in Section 4 are robust (i) across different subsets of borrowers, (ii) alternate specifications, (iii) alternate definitions of low-quality, (iv) externally valid using another law that improved creditor rights, and (v) using a different control group.

### Different subsets of borrowers

Figure 4 shows the estimates for different sub-samples of borrowers . The relative decline in secured borrowing of low-quality borrowers for the treated group is stronger for manufacturing firms, older firms, listed firms, and firms with higher investment opportunity as measured by Tobin's Q (reflecting possibly a higher transfer *to* high-quality borrowers). Notably, the effect persists across all subsets except the young firms. The build up in inefficient lending in the pre-reform period was plausibly limited for younger firms and hence we do not see a relative difference in secured borrowing of young firms.

### Alternate specifications

I show that results are robust to alternate specifications in columns 1-3 in Table 3. Column 1 shows that results are robust to controlling for investment opportunity (adding Tobin's Q). Since the sample also includes unlisted firms, I do not include Tobin's Q in the baseline regressions. Column 2 normalizes the dependent variable by assets. Column 3 uses log of secured borrowing as the dependent variable. All estimates confirm the relative decline in borrowing for low-quality borrowers. The point estimates are comparable to the baseline estimates in Section 4

## Alternate definitions of low-quality

I show results are robust to alternate definitions of low-quality in columns 4-7 in Table 3. In the baseline analysis, I define low-quality based on the firm's ability to service debt since the central hypothesis in this study focuses on quality of lending. Nonetheless, the results are similar using alternate definitions of low-quality based on profitability (column 4) and investment opportunity (column 5). Column 6 defines low-quality based on the ICR measure in 2001 (as opposed to using the average between 2000 and 2001 in the baseline specification which is more stable). Results are also robust to defining low-quality borrowers based on ICR *within* industries (column 7) and on whether a firm has persistently low ICR (less than one) throughout the pre-period (column 8).

## External Validity

Table 4, columns 1-2 examine whether the results are externally valid. I find a similar relative decline in borrowing when I use the staggered implementation of another reform, the setting up of the DRTs in the 1990s. DRTs strengthened legal enforcement by reducing judicial delay (Lilienfeld-Toal, Mookherjee and Visaria (2012)). I do not use this as the main identification strategy in my analysis because, in effect, the creditor rights through the DRTs were weak. The quasi-legal courts started getting clogged up as the cases piled on. Additionally, defaulters could simultaneously file at BIFR indefinitely delaying the recovery process.

## Alternate control group

Table 4, columns 3-4 use an alternate control group, namely the non-banking financing companies (NBFCs) which were not covered by the collateral reform. Consistent with our baseline results, low-quality firms financed by banks cut their secured borrowing by INR 32 million relative to low-quality firms financed by NBFCs. I do not focus on this as the baseline specification, since initially there was some uncertainty as to whether the reform applied to NBFCs.

## Impact on employment

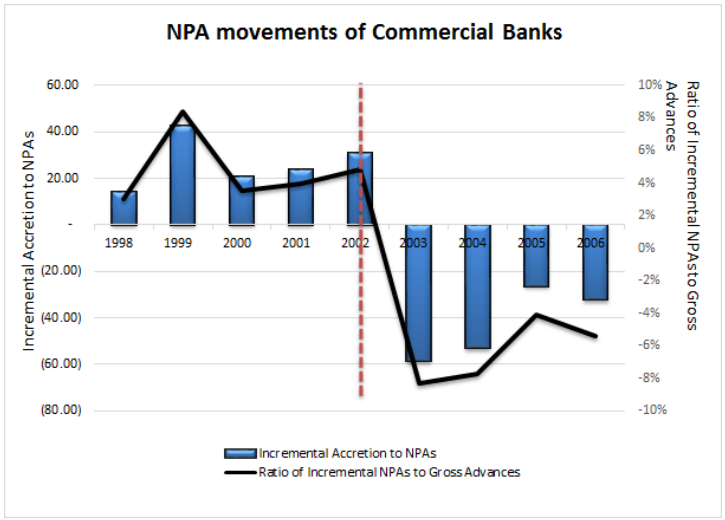
For completeness, Table 6 also examines labor outcomes. There is no significant effect on employment using CMIE data (columns 1–2). Because CMIE poorly captures employment data, I repeat the analysis using ASI data (columns 5–6) with the caveat that this pertains only to the manufacturing firms. $\Delta Employment$ declined by 7 employees relative to a pre-period average of 0.089. Alok, Chaurey and Nukala (2018) build on the hypothesis in Vig (2007) that borrowers preemptively cut back on secured borrowing and switch from capital-intensive to labor-intensive industries post reform to circumvent lender access to their assets (collateral). My results, however, show a significant decline in employment

at low-quality firms since these firms become financially constrained as lenders pare back credit consistent with a supply-side hypothesis.

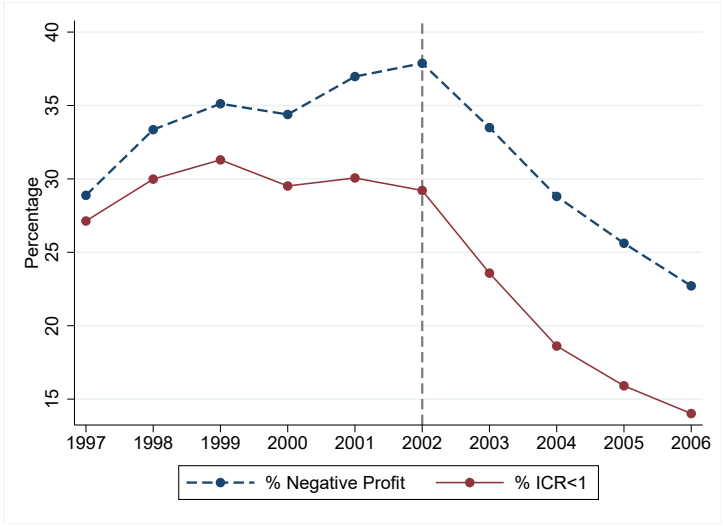
I also examine the spillover effects on employment of healthy firms. Non-zombies in treated industries witnessed an addition of 7 employeees per year relative to an average decline of 5 employees prior to the reform (Table 6, columns 7 and 8 using ASI data). As before, estimates using CMIE are noisy due to data quality issues (Table 6, columns 3 and 4).

Figure 1. : Effectiveness of the collateral reform

*Note:* Panel A shows incremental additions in non-performing assets (NPAs) on the left-hand-side vertical axis and the ratio of incremental NPAs to gross advances on the right-hand-side vertical axis. Data is from the Reserve Bank of India and collected from IndiaStat. Data is at the annual level and as of March of each year. Panel B shows the percentage of firms with negative profit and the percentage of firms with interest coverage ratio (ICR) below 1. ICR is the ratio of earnings before interest and taxes to total interest expense. Return on assets is the ratio of earnings before interest, taxes, depreciation and amortization to total assets. Data from Prowess. All data is for the period 1997 to 2006.




(a) **NPA movements**




(b) **Aggregate impact**

Figure 2. : Collateral reform: Closing the liquidation loophole

*Note:* The graph below shows the number of cases filed under the Board for Industrial and Financial Reconstruction (BIFR). Data is hand-collected from the BIFR website. Data is for the period 1997 to 2007.

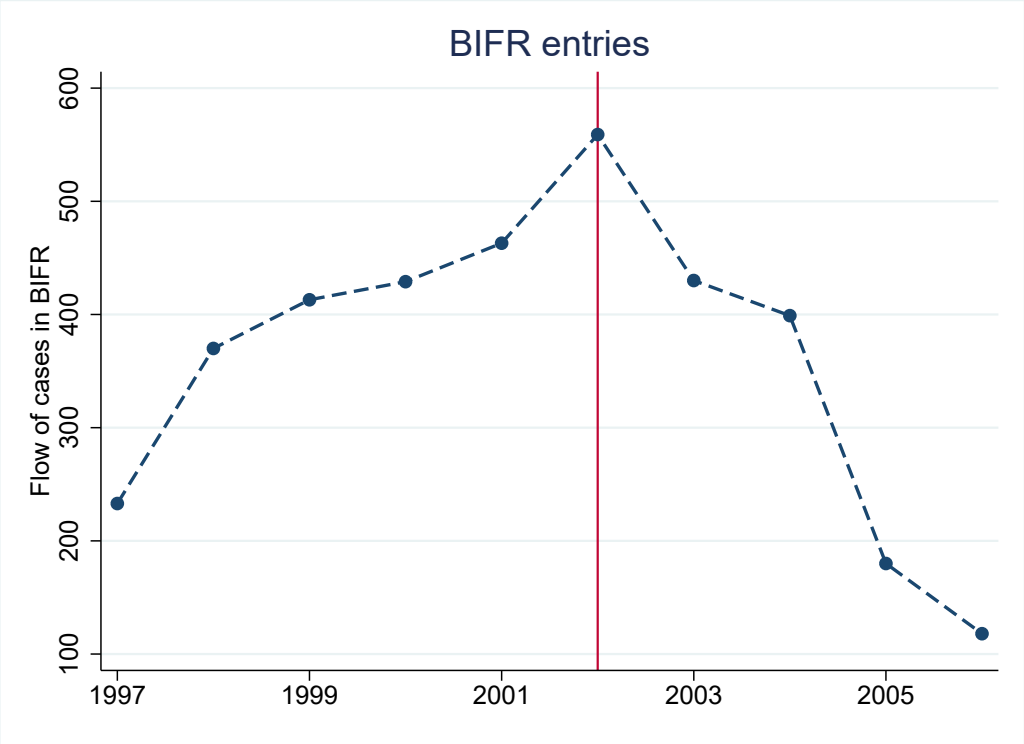
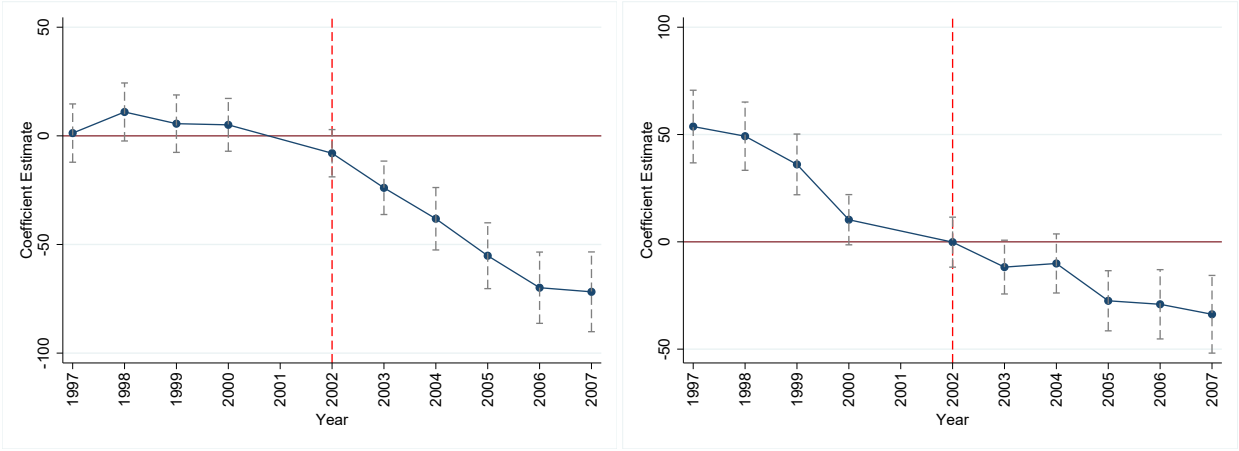


Figure 3. : Impact of the collateral reform on secured debt and capital expenditure

*Note:* The graphs below plot the coefficient $\eta_\tau$ from the following difference-in-difference (DD) specification:

$$y_{it} = \alpha_i + \gamma_t + \sum_\tau \eta_\tau \times (\mathbb{1}_\tau \times \mathbb{1}_{Low-Quality,i}) + \varepsilon_{ijt}$$

where $\tau$ ranges from 1997 to 2007, $\mathbb{1}_\tau = 1$ if year is $\tau$ and $\eta_\tau$ is coefficient of interest. Bars show the 95% confidence intervals, $\tau = 0$ is the year the reform is announced, and all coefficients are normalized relative to $\tau = -1$. Robust standard errors are clustered at the firm level. $\mathbb{1}_{Post}$ and $\mathbb{1}_{Low-Quality}$ are indicators for the post period and low-quality borrowers. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Low-quality borrowers are defined as firms with average interest coverage ratio (ICR) in 2000 and 2001 less than 1. $y_{it}$ is the dependent variable, secured borrowing (panel (a)) and capital expenditure (panel (b)). Secured borrowing is the change in secured debt between current period and the previous period. Capital expenditure is non-negative difference in gross fixed assets between current period and the previous period. Data is from Prowess and for the period 1997–2007.




(a) **Secured Borrowings**

(b) **Capex**

Figure 4. : Heterogeneity of effect of collateral reform on borrowing

*Note:* This figure shows the coefficients for the triple difference estimate in Equation 3 for various subsets of firms. The dependent variable is secured borrowing. Secured borrowing is the change in secured debt between current period and the previous period. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Low-quality borrowers are defined as firms with average interest coverage ratio (ICR) in 2000 and 2001 less than 1. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities. Firms are classified as high-tangibility if the tangibility ratio in 2001 is above the median tangibility of all firms. All regressions include firm and year fixed effects. Standard errors are clustered at the firm level. The figure below plots the coefficients for the following subsets of firms from top to bottom: (a) manufacturing (b) non-manufacturing (c) young firms defined as firms with age less than or equal to 5 years in 2001 (d) old firms defined as firms with age greater than 5 years in 2001 (e) listed (f) non-listed (g) restricting to 3 years post reform, i.e. 2005 (h) restricting to 2 years post reform, i.e. 2004 (i) firms with above median Tobin's Q in 2001, and (j) firms with below median Tobin's Q in 2001.

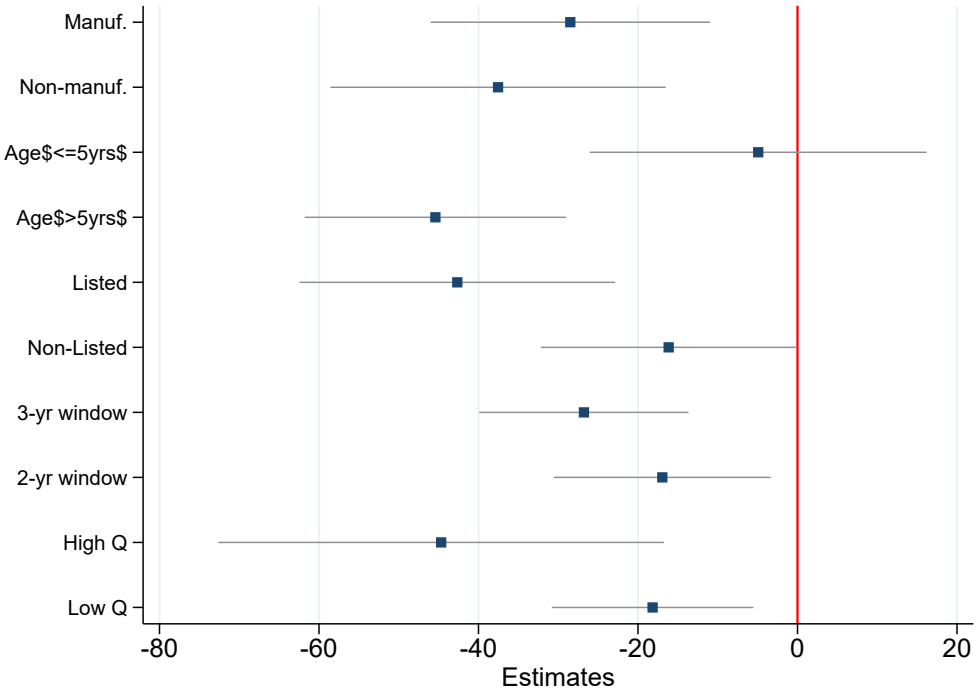


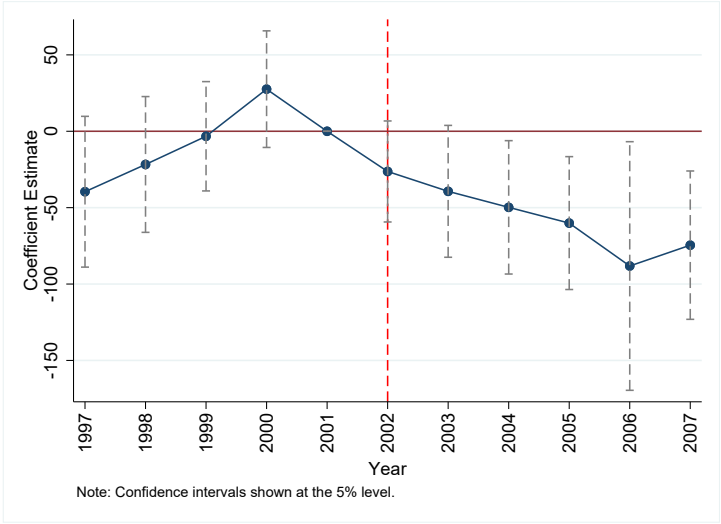
Figure 5. : Triple difference specifications using zombies

*Note:* The graph on the right-hand-side plots the coefficient $\phi_\tau$ from the following triple difference (DDD) specification:

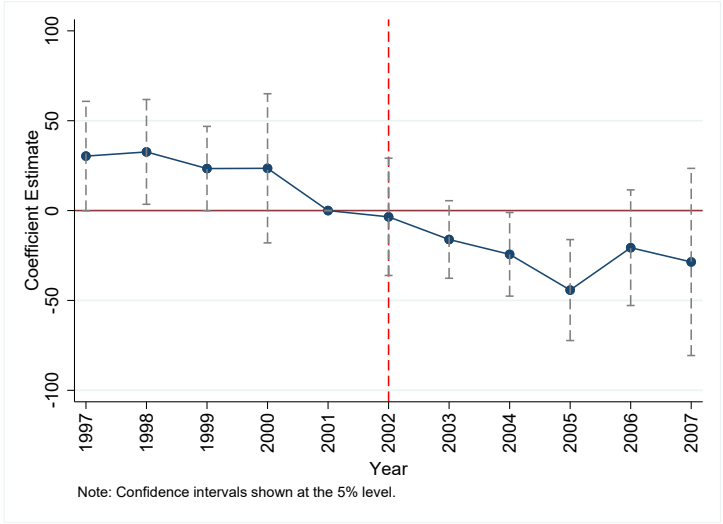
$$y_{ijt} = \alpha_i + \gamma_t + \sum_\tau \eta_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{Zombie} + \sum_\tau \nu_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{High-Tangibility} + \sum_\tau \phi_\tau \times \mathbb{1}_{tau} \times \mathbb{1}_{Zombie} \times \mathbb{1}_{High-Tangibility} + \varepsilon_{ijt}$$

where $\tau$ ranges from 1997 to 2007, $\mathbb{1}_\tau = 1$ if year is $\tau$ and $\eta_\tau$ is coefficient of interest. Bars show the 95% confidence intervals, $\tau = 0$ is the year the reform is announced, and all coefficients are normalized relative to $\tau = -1$. Robust standard errors are clustered at the firm level. $\mathbb{1}_{Post}$, $\mathbb{1}_{Zombie}$ and $\mathbb{1}_{High-Tangibility}$ are indicators for the post period, zombie borrowers, and high-tangibility firms. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Low-quality borrowers are defined as firms with average interest coverage ratio (ICR) in 2000 and 2001 less than 1. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities. Firms are classified as high-tangibility if the tangibility ratio in 2001 is above the median tangibility of all firms. $y_{it}$ is the dependent variable, secured borrowing (panel (a)) and capital expenditure (panel (b)). Secured borrowing is the change in secured debt between current period and the previous period. Capital expenditure is non-negative difference in gross fixed assets between current period and the previous period. Data is from Prowess and for the period 1997–2007.






(a) **Diff-in-Diff**




(b) **Diff-in-Diff-in-diff**

Table 1—: Variable Description

*Note:* The table below describes all the variables used in our main analysis.

| Data Item | Variables Used | Source |
|---|---|---|
| Item 1 | Current Portion of Secured Debt | Prowess |
| Item 2 | Current portion of unsecured debt | Prowess |
| Item 3 | Secured Debt (Secured by tangible assets) | Prowess |
| Item 4 | Unsecured Debt (Not secured by tangible assets) | Prowess |
| Item 5 | Number of employees | Prowess |
| Item 6 | Total Sales | Prowess |
| Item 7 | Long-term Borrowings | Prowess |
| Item 8 | Total assets (Book Value of Assets) | Prowess |
| Item 9 | Plant and Machinery | Prowess |
| Item 10 | Land and Building | Prowess |
| Item 11 | Capital Work in Progress | Prowess |
| Item 12 | Other Fixed Assets | Prowess |
| Item 13 | Cash and Bank Balance | Prowess |
| Item 14 | Marketable Securities | Prowess |
| Item 15 | Specific Assets= Item 9 + Item 12 | Derived from Prowess |
| Item 16 | Non-specific Assets = Item 10+ Item 13+ Item 14 | Derived from Prowess |
| Item 17 | Total Debt = Item 6+ Item 7 or item 3+Item 4 | Derived from Prowess |
| Item 18 | Secured Borrowings = max(0, Item 3 -(lagged Item 3 -Item 1)) | Derived from Prowess |
| Item 19 | Unsecured Borrowings = max(0, Item 4 -(lagged Item 4 -Item 2)) | Derived from Prowess |
| Item 20 | Gross Fixed Assets = Item 9 + Item 10 + Item 11 + Item 12 | Derived from Prowess |
| Item 21 | CapEx = max (0, Item 20 - Lagged Item 20) | Derived from Prowess |
| Item 22 | Tangibility = Specific assets / (Specific+Non-specific assets) | Derived from Prowess |
| Item 23 | Interest Rate Expense | Prowess |
| Item 24 | Prime Lending Rate for Long-term Loans | SBI |
| Item 25 | Lending Rate for Short-term Loans | RBI/Prowess |
| Item 26 | Interest Coverage Ratio (ICR) = EBIT/Interest Expense | Prowess |
| Item 27 | Interest Rate = Interest Rate Expense/(Secured debt + unsecured debt) | Prowess |
| Item 28 | Interest Coverage Ratio (ICR) = EBIT/Interest Expense | Prowess |
| Item 29 | Log(MPK) = Log(Item 6/Item 20) | Derived from Prowess |
| Item 30 | Tobin's Q = Market Value of Assets/Book Value of Assets | Derived from Prowess |

Table 2—: Difference-in-difference specifications

*Note:* This table looks at the impact of secured borrowing using event study and difference-in-difference estimates. Column 1, panel (a) shows the estimate on the pre- versus post-period (similar to an event study estimate) for the sub-sample of low-quality firms. Similarly column 2 in panel (a), column 1 in panel (b), and column 2 in panel (b) show the same estimate for the sub-sample of high-quality, zombie and non-zombie firms respectively. The dependent variable in both panels is secured borrowing. Secured borrowing is the change in secured debt between current period and the previous period. Columns 3–4 in panel (a) report the results for difference-in-difference specification in Equation 1. Columns 3–4 in panel (b) report the results for difference-in-difference specification in Equation 1 with a zombie indicator instead of an indicator for low-quality borrowers. Baseline mean is calculated for the low-quality borrowers in the period before the reform in columns 1, 3 and 4 in panel (a); for high-quality borrowers in column 2 in panel (a); for zombie firms in columns 1, 3 and 4; and for non-zombie firms in column 2. Refer to Table 2 for the definitions of the remaining variables.

**Panel A: By quality**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Low Quality | High Quality | Secured Borr. | |
| $\mathbb{1}_{Post}$ | -19.68*** | 18.29*** | | |
| | (3.824) | (2.237) | | |
| $\mathbb{1}_{Low-Quality} * \mathbb{1}_{Post}$ | | | -46.11*** | -39.92*** |
| | | | (4.320) | (4.495) |
| Baseline Mean | 51.74 | 30.96 | 51.74 | |
| No. of Obs. | 16457 | 35695 | 52152 | 52152 |
| R-sq. | 0.399 | 0.341 | 0.360 | 0.366 |
| Firm FE | Y | Y | Y | Y |
| Year FE | N | N | Y | Y |
| Industry-Year FE | N | N | N | Y |
| Controls | Y | Y | N | Y |

**Panel B: By zombie**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Zombie | Non-Zombie | Secured Borr. | |
| $\mathbb{1}_{Post}$ | -27.63*** | 20.15*** | | |
| | (5.241) | (2.165) | | |
| $\mathbb{1}_{Zombie} * \mathbb{1}_{Post}$ | | | -47.07*** | -43.29*** |
| | | | (5.688) | (5.896) |
| Baseline Mean | 62.34 | 32.41 | 62.34 | |
| No. of Obs. | 8791 | 43361 | 52152 | 52152 |
| R-sq. | 0.413 | 0.339 | 0.359 | 0.366 |
| Firm FE | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y |
| Industry-Year FE | N | N | N | Y |
| Controls | N | N | N | Y |

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

Table 3—: Robustness to alternate specifications and definitions of quality

*Note:* The table reports results for difference-in-difference-in-difference specification in Equation 3. It repeats the specification in column 1 of Table 2 with alternate definitions of low quality borrowers and alternate controls. The dependent variable in columns 1 and columns 4 to 8 is secured borrowing which is the change in secured debt. The dependent variable in column 2 is secured borrowing normalized by total assets. In column 3 the dependent variable is log(1+secured borrowing). Low quality borrowers in columns 1–3 are defined as firms with the median interest coverage ratio in 2000 and 2001 less than 1. In all columns firm-level controls included are log of sales and EBITDA/assets. In column 1, we also include Tobin's Q as the control variable. Low quality borrower in column 4 is defined as firms with the below median return on assets in 2001. Low quality borrower in column 5 is defined as firms with the below median Tobin's Q in 2001. Low quality borrower in column 6 is defined as firms with the median interest coverage ratio in 2001 less than 1. Low quality borrowers in columns 7 are defined as firms with the below median interest coverage ratio in 2001 within an industry. Low quality borrowers in columns 8 are defined as firms with interest coverage ratio less than 1 in the entire pre-period from 1997 to 2001. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities. Firms are classified as high-tangibility if the tangibility ratio in 2001 is above the median tangibility of all firms. Standard errors are clustered at the firm level.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | Alternate Specifications | | | Alternate definitions of low-quality | | | | |
| | Tobin's Q | $\frac{SecuredBorrowings}{Assets}$ | Ln(1+ Secured Borrowings) | ROA | Tobin's Q | ICR in 2001 | Within Industry | ICR$\leq$1 Persists |
| $\mathbb{1}_{Low-Quality} * \mathbb{1}_{Post} * \mathbb{1}_{High-Tangibility}$ | -50.58*** | -0.0147*** | -0.248** | -24.88*** | -54.49*** | -22.95*** | -35.60*** | -29.11*** |
| | (18.96) | (0.00571) | (0.100) | (7.943) | (13.86) | (8.101) | (8.237) | (11.06) |
| No. of Obs. | 21080 | 42506 | 35385 | 47870 | 47870 | 47870 | 47870 | 47870 |
| R-sq. | 0.362 | 0.257 | 0.650 | 0.355 | 0.355 | 0.356 | 0.356 | 0.355 |
| Firm FE | Y | Y | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y | Y | Y |
| Controls | Y | Y | Y | Y | Y | Y | Y | Y |

Table 4—: External validity and alternate control group

*Note:* Columns 1–2 reports results for an external validity test using the staggered introduction of the Debt Recovery Tribunals (DRTs). Columns 3–4 use non-banking financial corporations (NBFCs) as the control group for whom the collateral did not apply. The dependent variable in all columns is secured borrowing. $\mathbb{1}_{Post}$, $\mathbb{1}_{DRT}$ and $\mathbb{1}_{Banks}$ are indicators for the post period, whether the DRT is in effect and whether a firm's lead lender is a bank (as opposed to an NBFC). $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. All the columns include firm and year fixed effects. Even numbered columns also include industry-year fixed effects and controls. Firm-level controls included are log of sales and profitability (the ratio of earnings before interest and taxes, depreciation and amortization to assets). Standard errors are clustered at the firm level. Data is from Prowess for the period 1997-2007.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | External Validity | | Alternate Control Group | |
| $\mathbb{1}_{Low-Quality}$ * DRT | -24.03** | -21.57* | | |
| | (12.13) | (12.08) | | |
| $\mathbb{1}_{Low-Quality}$ * $\mathbb{1}_{Post}$ * Banks | | | -31.90*** | -29.49* |
| | | | (11.33) | (17.28) |
| No. of Obs. | 21869 | 21869 | 28156 | 28156 |
| R-sq. | 0.320 | 0.332 | 0.357 | 0.388 |
| Firm FE | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y |
| Industry-Year FE | N | Y | N | Y |
| Controls | N | Y | N | Y |

Table 5—: Project-level analysis: Impact of the collateral reform on capital expenditure

*Note:* The table reports results for difference-in-difference-in-difference specification in Equation 3 using project-level data. The dependent variable is an indicator for whether a project was completed. $\mathbb{1}_{Post}$, $\mathbb{1}_{Low-Quality}$ and $\mathbb{1}_{High-Tangibility}$ are indicators for the post period, low-quality borrowers, and high-tangibility firms. $\mathbb{1}_{Post}$ is an indicator equal to 1 if year is greater than 2002. Low-quality borrowers are defined as firms with average interest coverage ratio (ICR) in 2000 and 2001 less than 1. Tangibility measure is from Rajan and Zingales (1995) and is the ratio of specific assets to the total specific assets plus non-specific assets. Specific assets is the sum of plant and machinery and other fixed assets. Non-specific assets is the sum of land and building; cash and bank balance; and marketable securities. Firms are classified as high-tangibility if the tangibility ratio in 2001 is above the median tangibility of all firms. All the columns include firm and year fixed effects. Core (non-core) projects refer to projects where the project industry is the same (differs) as the firm industry. Standard errors are clustered at the firm level. Data is for the period 1997-2007 from CapExDx and provided by CMIE.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Core | Non-core | Core | Non-core |
| $\mathbb{1}_{Low-Quality} * \mathbb{1}_{Post}$ | 0.448* | 0.454 | | |
| | (0.252) | (0.314) | | |
| $\mathbb{1}_{High-Tangibility} * \mathbb{1}_{Post}$ | 0.0726 | -0.101 | | |
| | (0.146) | (0.167) | | |
| $\mathbb{1}_{Low-Quality} * \mathbb{1}_{Post} * \mathbb{1}_{High-Tangibility}$ | -0.433 | -0.669* | | |
| | (0.281) | (0.369) | | |
| $\mathbb{1}_{Zombie} * \mathbb{1}_{Post}$ | | | -0.382** | 0.288 |
| | | | (0.162) | (0.351) |
| $\mathbb{1}_{High-Tangibility} * \mathbb{1}_{Post}$ | | | -0.0388 | -0.134 |
| | | | (0.168) | (0.160) |
| $\mathbb{1}_{Zombie} * \mathbb{1}_{Post} * \mathbb{1}_{High-Tangibility}$ | | | 0.468** | -0.501 |
| | | | (0.213) | (0.460) |
| No. of Obs. | 2267 | 1661 | 2267 | 1661 |
| R-sq. | 0.571 | 0.641 | 0.570 | 0.639 |
| Firm FE | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y |
| Industry-Year FE | Y | Y | Y | Y |

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

Table 6—: Impact of collateral reform on employment and the effect of zombie distortions

*Note:* The table reports results for difference-in-difference-in-difference specification in Equation 3 in columns 1–2 and columns 5–6. Columns 3–4 and 7–8 show the results for the zombie distortions specification in Equation 6. The dependent variable is the employment change from the current period relative to the previous period. All the columns include firm fixed effects and year fixed effects. Alternate columns also include industry-year fixed effects and controls. Standard errors are clustered at the firm level. Data is from Prowess for the period 1997-2007. Baseline mean is calculated for the low-quality borrowers in the period before the reform in columns 1–2 and 5–6 and for non-zombie firms in years 3–4 and 7–8. Data is from Prowess for columns 1–4 and from Annual Survey of Industries (ASI) in columns 5–8. Data is for the period 1997-2007. Refer to Table 4 and Table 5 for the definition of variables.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| $\mathbb{1}_{Low-Quality} * \mathbb{1}_{Post}$t | -0.00316** | -0.00176 | | | -5.431*** | -3.891*** | | |
| | (0.00140) | (0.00127) | | | (1.491) | (1.480) | | |
| $\mathbb{1}_{High-Tangibility} * \mathbb{1}_{Post}$ | -0.000877 | -0.000642 | | | 4.566** | 3.484** | | |
| | (0.00110) | (0.00113) | | | (1.773) | (1.758) | | |
| $\mathbb{1}_{Low-Quality} * \mathbb{1}_{Post} * \mathbb{1}_{High-Tangibility}$ | -0.000819 | -0.000706 | | | -7.299** | -6.193* | | |
| | (0.00183) | (0.00183) | | | (3.364) | (3.320) | | |
| $\mathbb{1}_{High\,Sector\,Tangibility} * \mathbb{1}_{Post}$ | | | -0.00415** | -0.0000808 | | | -6.800 | 7.899 |
| | | | (0.00207) | (0.00575) | | | (4.493) | (11.57) |
| $\mathbb{1}_{Post} * \mathbb{1}_{Non-Zombie}$ | | | 0.000475 | -0.00124 | | | 7.968*** | 6.778*** |
| | | | (0.00185) | (0.00177) | | | (1.739) | (1.719) |
| $\mathbb{1}_{Non-Zombie} * \mathbb{1}_{High\,Sector\,Tangibility} * \mathbb{1}_{Post}$ | | | 0.00302 | 0.00403* | | | 7.539** | 6.728* |
| | | | (0.00231) | (0.00223) | | | (3.724) | (3.625) |
| Baseline Mean | 0.180 | | 0.720 | | .089 | | -5.07 | |
| No. of Obs. | 51939 | 51939 | 51939 | 51939 | 113424 | 113424 | 113424 | 113424 |
| R-sq. | 0.125 | 0.137 | 0.125 | 0.137 | 0.131 | 0.141 | 0.130 | 0.141 |
| Firm FE | Y | Y | N | N | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y | Y | Y |
| Industry-Year FE | N | Y | N | Y | N | Y | N | Y |
| Controls | N | Y | N | Y | N | Y | N | Y |
| Dataset | CMIE | CMIE | CMIE | CMIE | ASI | ASI | ASI | ASI |

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