The Long-term Effects of Bank Bailouts on Corporate Financing Policies

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October 17, 2024

Abstract

This study examines the long-term effects of the 1990s Japanese bank bailouts on borrower firms' financing policies. Using a two-way fixed effects model on data from Japanese banks and listed companies, I find that these interventions significantly influenced firms' financial strategies. Firms associated with banks that received bailouts exhibited persistent increases in their long-term debt-to-asset ratios and decreases in their cash-to-asset ratios. The effects diverged between zombie and non-zombie firms: while non-zombie firms exhibited minimal capital structure changes, zombie firms demonstrated pronounced increases in long-term debt ratios, decreases in cash ratios and retained earnings, and were more likely to maintain relationships with their main banks. These findings suggest that bank bailouts can influence capital allocation patterns, potentially favoring less efficient zombie firms, with implications for economic efficiency and financial stability.

Keywords: Capital injection; Banking crisis; Corporate borrowing; Cash holdings; Bank relationships.

JEL Classification: E44; G21; G31; G32.

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1 Introduction

Past financial crises have highlighted the significance of healthy financial institutions for the overall economy, including sectors far removed from banking. When banks' balance sheets deteriorate, borrower firms are found to face credit supply contraction and reduce employment and investment (Chodorow-Reich (2014), Almeida et al. (2011), and Bentolila et al. (2018)).[1] To mitigate the impact of such balance sheet deterioration, governments often recapitalize troubled banks in the wake of financial crises, despite the deep public unpopularity of these recapitalizations. The recent empirical literature on the effects of bank bailouts demonstrates that sufficient capital injections into troubled banks effectively stimulate them to increase credit supply, which in turn helps boost borrower firms' investment in the short-run (Giannetti and Simonov (2013) and Kasahara et al. (2019)).[2] While previous work has highlighted the short-term effect of bank bailouts on borrower firms, few studies have examined their long-term effects.

This paper estimates the long-term impacts of bank bailouts on borrower firms' financing policies. Specifically, I exploit the Japanese banking crisis and subsequent bank bailouts in the late 1990s to examine the long-term impact of the bailouts on borrower firms' cash-holding behaviors and financial debt positions. Following the banking crisis in fiscal year 1997 (April 1997 to March 1998), the Japanese government conducted consecutive bank recapitalizations in March 1998 (end of fiscal year 1997, 1.8 trillion yen) and March 1999 (end of fiscal year 1998, 7.5 trillion yen). I exploit the variation in the strength of the pre-existing financial relationships between firms and the bailed-out banks to understand the long-term impact of bank bailouts on borrower firms' financing policies.

This paper uses the "exposure to injection" measure compiled by Giannetti and Simonov (2013) as an indicator of the strength of firms' financial ties with bailed-out banks. This measure calculates the proportion of loans that each firm received from any of the bailed-out

[1] Other studies that show real effects of credit supply contraction include Alfaro et al. (2021), Cingano et al. (2016), Peek and Rosengren (1997), Kashyap and Stein (2000), Amiti and Weinstein (2018), and Acharya et al. (2018).

[2] In addition, capital injections are found to be effective in the growth of bank-dependent firms amid crises (Laeven and Valencia (2013)).

banks in the year preceding the recapitalizations. Using this exposure measure as the treatment indicator, I employ a two-way fixed-effects estimator to estimate the long-term effects of bank bailouts on borrower firms' financing policies. The estimated results reveal two patterns. First, borrower firms' long-term debt as a share of total assets significantly increased after the bank recapitalization and remained persistently high even after two decades. Second, borrower firms' cash-to-asset ratio declined immediately after the recapitalizations and remained persistently low.

This study also differentiates between non-zombie and zombie firms to extend the analysis. Adopting the approach of Giannetti and Simonov (2013), I identify zombie firms as those whose interest payments were lower than the 'required minimum interest rate expenses' at any point between fiscal years 1994 and 1996.[3] Non-zombie firms affected by bailouts exhibited no significant response in the debt and cash ratios. There was also a negligible response in retained earnings, suggesting no substantial shift in the capital structure for these borrower firms. In contrast, the bailout-affected zombie firms demonstrated a pronounced long-term increase in the debt ratio, coupled with a concurrent decrease in both the cash ratio and retained earnings. These results suggest a sustained shift towards borrowing in the corporate financing strategies of firms that benefited from the bank bailout. The baseline results are robust to different specifications, such as the inclusion of various controls, the use of the propensity score matching difference-in-difference estimator, and an alternative definition of the treatment group.

For the zombie firms, I find that borrower firms are more likely to maintain banking relationships with the same main banks from the pre-recapitalization periods. This finding suggests that firms reduced cash holding and increased bank loans partly because of their sustained (and thus closer) relationship with the banks, which is consistent with existing literature that discusses banks' role in mitigating financial constraints. Hu et al. (2016) reported that firms with more intense relationships with banks have lower levels of cash.

[3]The minimum interest rate expense is calculated under the assumption that the borrower pays the average short-term prime rate on short-term bank loans, the average long-term prime rate on long-term bank loans, and bears no coupon expenses on total bonds outstanding.

Chauhan et al. (2018) used Indian data to show that firms with bank-appointed directors have lower cash holdings.[4]

These findings suggest unanticipated long-term consequences of bailouts, which may have unintentionally exacerbated the zombie firms' problem in Japan over extended durations. Such zombie firms, known to have adverse effects on the real economy, consume a disproportionate amount of available credit, thus diminishing opportunities for healthier competitors and reducing aggregate productivity and investment. Zombie lending is perceived as one of the primary contributors to Japan's 'lost decade' in the 1990s (Caballero et al. (2008), Peek and Rosengren (2005)). More recent studies by Acharya et al. (2019) and Blattner et al. (2023) suggest that zombie lending has also hampered Europe's economic recovery from the debt crisis. Notably, Banerjee and Hofmann (2018) identify approximately 12% of all publicly traded firms across 14 developed economies as zombie firms, underscoring the global scale of this issue. These findings highlight the importance of considering the long-term effects of financial rescue measures. They suggest that the consequences of bank bailouts may extend well beyond the immediate crisis period, potentially influencing economic efficiency and resource allocation for years.

This paper contributes to the literature on the effects of bank bailouts. Giannetti and Simonov (2013) examined the Japanese bank bailouts in fiscal years 1997, 1998, and 2002 and showed that the first two recapitalizations were successful at stimulating bailed-out banks to extend loans to their borrower firms. Furthermore, Giannetti and Simonov (2013) show that having received a greater amount of loans, these borrower firms increased investment in the year following the recapitalizations. Kasahara et al. (2019) found a similarly positive effect of bank bailouts using the same Japanese bailout episodes.[5] While existing literature mostly focuses on short-term effects, this paper examines the long-term effects of bank bailouts on banks' client firms.

This paper also contributes to the literature on the determinants of corporate cash hold-

[4]However, their findings are in contrast to Nakajima and Sasaki (2016) and Shikimi (2019), who find that bank-dependent firms hold more cash.

[5]In addition, Veronesi and Zingales (2010) and Bayazitova and Shivdasani (2012) examine the impacts of the US government's equity infusion on the value of banks' financial claims.

ing. According to Keynes (1936), there are two reasons for corporate cash holdings: the reduction of transaction costs and the precautionary motive.[6] In particular, the precautionary demand for cash theory states that firms accumulate cash to protect themselves against adverse cash flow shocks that increase external financing costs. Without sufficient cash on hand, firms hit by adverse cash flow shocks could be forced to forgo profitable investment opportunities. Empirical papers such as Opler et al. (1999), Kahle and Stulz (2013), and Duchin (2010) generally find the existence of this precautionary motive.

The findings in this paper are consistent with the precautionary motive for cash holding, especially in the context of financial constraints. Previous studies have documented that financially constrained firms hold higher levels of cash (e.g., Almeida et al. (2004); Faulkender and Wang (2006); Acharya et al. (2007); Denis and Sibilkov (2010); Harford et al. (2014)). In particular, banks play an important role in alleviating borrower firms' financial constraints. Sasaki and Suzuki (2019) finds that worsening bank health causes firms to increase their cash holdings from their cash flows. In line with this, my study reveals that bank bailouts encourage borrower firms to maintain enduring relationships with their main banks. Such relationships can reduce informational asymmetry and ease external financing costs, facilitating reduced cash holdings.

The rest of the paper proceeds as follows: Section 2 discusses the background of the Japanese banking crisis of the 1990s and the following successive bank bailouts. Section 3 delineates the empirical approach employed in this paper. Section 4 explains the data used in the study. Section 5 summarizes the main results and investigates the potential mechanism that drives the main results. Section 6 presents various robustness checks of the main results. Finally, Section 7 discusses the results and concludes this paper.

2 Background of the Japanese banking crisis and bailouts in the 1990s

Hoshi and Kashyap (2010) noted that the banking crisis in Japan during the 1990s bears

[6]Other theories include the agency costs of free cash flow (Jensen (1986); Ozkan and Ozkan (2004)) and the corporate governance structure (Dittmar et al. (2003); Harford et al. (2008); Pinkowitz et al. (2006)).

many similarities to the 2008 global financial crisis. The experience of Japan, particularly in terms of the long-term impact of bank bailouts on borrower firms' financing strategies, offers valuable insights into the potential repercussions of financial institutions' recapitalizations.

This section offers a brief overview of the Japanese banking crisis and the subsequent bank bailouts that occurred during the 1990s. Japan's stock market hit its peak in late 1989, which was then followed by the burst of the housing and real estate bubble. This sequence of events gradually destabilized the financial system. By 1991, smaller financial institutions began to falter, triggering the use of the deposit insurance system for the first time in Japanese history. Despite these interventions, these smaller institutions continued to face hardships, with many banks accumulating an increasing volume of non-performing loans.

Around 1995, public concern over the potential systemic implications of non-bank companies specializing in housing finance defaulting began to grow. By 1996, seven housing finance companies had declared bankruptcy, with public funds being utilized to address some of these bankruptcies. This use of public money drew heavy criticism toward the government and the ruling party.

In November 1997, both the largest bank in northern Japan, Hokkaido Takushoku Bank, and Japan's fourth largest securities company, Yamaichi Securities, declared bankruptcy. The following year saw the bankruptcy of two major banks: the Long-Term Credit Bank of Japan and the Nippon Credit Bank. To counter these events, the government initiated a series of public capital injections into the major banks from March 1998 to March 1999.

The first round of recapitalization in March 1998 (fiscal year 1997) saw an injection of 1.8 trillion yen, with most banks receiving 100 billion yen and smaller banks receiving between 20 and 60 billion yen. On average, this represented 1.9 percent of banks' risk-weighted assets. Given the intense public criticism over the use of public funds, recapitalization was kept to a minimum. Furthermore, the capital injection was structured to avoid revealing the health of the financial institutions to the market. According to Giannetti and Simonov (2013), the size of the injection each bank received was solely based on the size of the banks.

The second round of recapitalization occurred in March 1999 (fiscal year 1998), addressing the continued undercapitalization of banks following the modest first round. This initiative injected 7.5 trillion yen, with individual banks receiving between 200 and 1,000 billion yen, averaging approximately 5.1 percent of each bank's risk-weighted assets. As Kasahara et al. (2019) noted, these injections, executed through government purchases of preferred stock or subordinated debt, enabled many banks to meet the capital standards required under the 1988 Basel Accord.[7]

I mainly exploit the second recapitalization for the construction of the treatment variable because of its larger size.[8] The analysis using the first recapitalization delivers similar results, as the indicators of firms' exposure to the first and second recapitalizations are highly correlated.

3 Empirical approach

This paper examines the long-term effects of bank bailouts on borrower firms' financing policies using a two-way fixed effects estimator. The key variable is a firm's capital injection exposure, denoted as Exposure Intervention$_i$. Following Giannetti and Simonov (2013), this is defined as the proportion of loans that firm i received from banks benefiting from the second recapitalization in the year preceding the event. Specifically:

[7]While these capital injections were crucial in averting a systemic banking crisis, they were insufficient to resolve Japan's non-performing loan (NPL) crisis, which had begun in the early 1990s. Significant progress in resolving the NPL problem only came with the implementation of the Financial Revitalization Program in 2002. This comprehensive initiative, spearheaded by Financial Services Minister Heizo Takenaka, established specific NPL reduction targets, improved asset assessment accuracy, and bolstered bank governance. Consequently, the NPL ratio of major banks decreased dramatically from 8.4% in March 2002 to 2.9% in March 2005, effectively concluding the protracted NPL crisis and contributing to the stabilization of Japan's financial system.

[8]The sample in our study can be classified into four groups: 1) firms that are never affected, 2) firms that are only affected by the first round of recapitalization, 3) firms that are only affected by the second round of recapitalization, and 4) firms that are affected by both the first and second rounds of recapitalization. The baseline analysis uses the first and second groups (firms that are never affected and firms that are affected by the first round only) as the control group and the third and fourth groups (firms that are affected by the second round only and firms that are affected by both rounds) as the treatment group. In Section 6, I check the robustness of the baseline results to a different definition of the control and treatment groups, where the control group consists of only the firms that are never treated, and the treatment group consists of only the firms that are affected by both rounds of recapitalizations. The baseline results are robust to this alternative definition of control and treatment groups.

$$\text{Exposure Intervention}_i = \sum_k \text{loans}_{i,k} / \text{total amount of loans}_i, \tag{1}$$

where $\text{loans}_{i,k}$ is the loan amount firm i received from bailed-out bank k in the year before recapitalization, and total amount of loans_i is the aggregate loan amount firm i received from all banks during the same period. Appendix 8.1 presents the distribution of exposure to the second intervention. Using this measure, the treatment indicator T_i is defined as 1 if Exposure $\text{Intervention}_i > 0$, and 0 otherwise.[9] This indicator approach is preferred over directly using Exposure Intervention_i due to observed non-linear patterns in the bailout's effects, as detailed in Appendix 8.2. For instance, firms with the least exposure to bailed-out banks exhibited substantial increases in long-term debt-to-asset ratios, nearly matching the effects seen in firms with the highest exposure. While using Exposure Intervention_i as the treatment variable yields qualitatively similar results, it increases standard errors in the regression.

To assess robustness, alternative thresholds for defining the treatment group were analyzed. These sensitivity checks, considering different levels of exposure to bailed-out banks, yielded results consistent with baseline findings, as presented in Appendix 8.3. This consistency across specifications supports the validity of the main findings and suggests that the effects of bank bailouts on corporate financing policies are not highly sensitive to the specific treatment threshold.

The main estimation equation is:

$$Y_t = \sum_{t=1992}^{2016} \beta_t \left(\text{Year}_t \times T_i\right) + \psi \mathbf{X}_{i,t} + \text{Firm}_i + \text{Industry}_h \times \text{Year}_t + u_{i,t}, \tag{2}$$

where Y_t is the dependent variable and $\mathbf{X}_{i,t}$ are time-variant control variables. To address

[9] It is important to note that Japan underwent a period of successive bank mergers affecting nearly all banks in the sample, which complicates the interpretation of the treatment. The treatment is defined as firms receiving any loans from bailed-out banks at the time of the bailout. This definition excludes from treatment those firms that had relationships with banks that did not receive bailouts but later merged with bailed-out banks. Conversely, it includes firms that had relationships with bailed-out banks that later merged with non-bailed-out banks. The effects of bank mergers are addressed in Section 6.5.

potential bias from size differences between borrowers of bailed-out and non-bailed-out banks, the log of total assets and log of employment are included in $\mathbf{X}_{i,t}$. The model is also estimated without time-variant controls, yielding similar results.

In equation 2, β_{1992} to β_{1996} are expected to be insignificant if the parallel trend assumption holds. The year 1996 is designated as the base year. Short and long-term effects of capital injection are captured by β_{1997} to β_{2016}, as the first recapitalization occurred in March 1998 (fiscal year 1997). Firm_i denotes firm-level fixed effects, and industry-year interaction terms absorb unobserved industry time-varying effects. Standard errors are clustered at the firm level.

4 Data

The primary data source is Nikkei NEEDS FinancialQUEST. Utilizing the NEEDS database, I gather accounting and loan data for all listed companies in Japan spanning the period from 1992 to 2016. It is important to note that for the rest of this paper, all years referenced are fiscal years, as both firm and bank data in the NEEDS database are reported on a fiscal year basis. Fiscal year 1997, for example, refers to the 12-month period from April 1997 to March 1998. Key variables for our analysis are the ratios of long-term debt to total assets and cash to total assets. Long-term financial debt is characterized as obligations with a maturity period exceeding one year. Cash is defined as the sum of cash holdings and deposits. Other variables utilized in the analysis, including total assets and the number of employees, are all retrieved from the Nikkei NEEDS data. Specifically, the NEEDS data includes loan amounts and the names of the banks for all listed companies in Japan.

Furthermore, I employ the data compiled by Giannetti and Simonov (2013) to measure the strength of each firm's pre-existing relationship with the bailed-out banks during the pre-bailout period as defined in equation 1. After constructing the exposure to intervention measure using Giannetti and Simonov (2013)'s methodology, I restrict the sample to firms that were operational during the bailout periods in the 1990s and were recorded in Giannetti and Simonov (2013)'s dataset. Table 1 presents the descriptive statistics for the main variables used in the analysis, while Table 2 provides the summary statistics separately for

Table 1: Descriptive Statistics

	Observations	Mean	SD	Median	1st	99th
Long-term debt/TA	70,771	0.084	0.112	0.045	0	0.463
Cash/TA	70,771	0.175	0.145	0.133	0.012	0.707
log(total assets)	70,771	10.293	1.819	10.195	5.969	15.157
log(employees)	66,709	6.600	1.666	6.488	2.773	10.895
Interest Coverage ratio	64,858	1.094	8.528	0.106	0	16.755
Corporate tax/TA	70,771	0.024	0.025	0.017	0	0.118
Investment	68,221	0.056	0.214	0.012	-0.367	1.024
Retained Earnings/TA	53,853	0.315	0.539	0.254	0.006	1.154
Zombie dummy	70,846	0.199	0.399	0	0	1
T (*treatment indicator*)	70,846	0.784	0.411	1	0	1

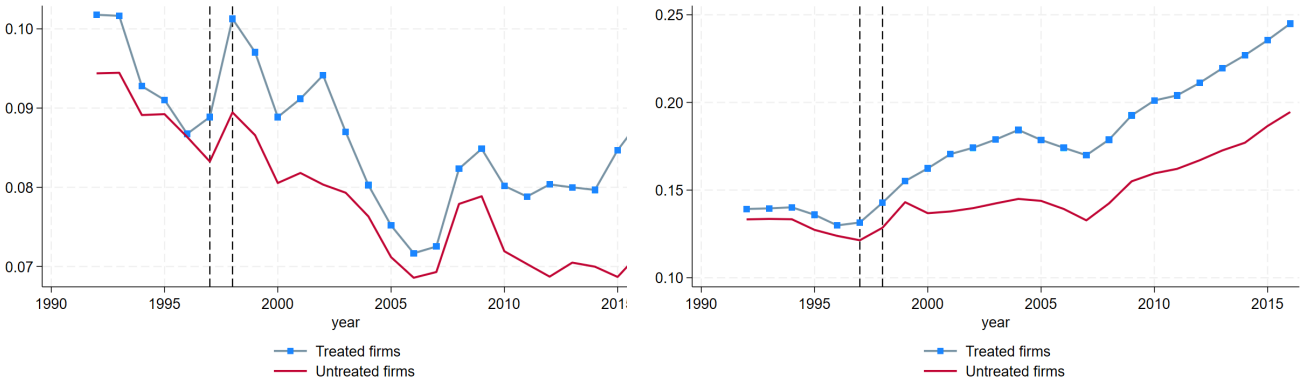
Notes. The table reports descriptive statistics for the main variables. Long-term debt/TA is the long-term financial debt of firm i in time t divided by the firm's total assets in year t. Cash/TA is the cash of firm i in year t divided by the firm's total assets in year t. Log(total assets) and log(employees) are the natural logarithm of total assets and the number of employees, respectively. I remove observations with negative asset values. Interest Rate Coverage is the interest rate coverage ratio of firm i in year t, defined as earnings before interest and taxes divided by interest expense of the firm in year t. Corporate tax/TA is the corporate tax payment by firm i in year t divided by the firm's total assets in year t. Investment represents the growth rate of firm i's fixed assets between periods t and $t+1$. To limit the impact of potential outliers, a winsorization process was applied whereby all values exceeding the top 1 percentile were set to the 99th percentile value, and all values below the bottom 1 percentile were replaced with the 1st percentile value. Retained Earnings/TA for a given firm i at time t is calculated as the ratio of retained earnings to the total assets of the firm. Zombie dummy takes the value of 1 if a firm's interest payments were lower than the required minimum at any point from 1994 to 1996. T is the treatment indicator that takes the value of 1 if a firm had a pre-existing relationship with the bailed-out banks prior to the recapitalization.

Table 2: Descriptive Statistics by Groups

	Treated firms (T=1)			Untreated firms (T=0)		
	N	Mean	SD	N	Mean	SD
Long-term debt/TA	55,499	0.085	0.115	15,272	0.078	0.101
Cash/TA	55,499	0.183	0.153	15,272	0.148	0.109
log(total assets)	55,499	10.173	1.854	15,272	10.728	1.614
log(employees)	54,712	6.505	1.694	14,997	6.948	1.510
Interest Coverage ratio	50,055	1.071	8.486	14,803	1.173	8.666
Corporate tax/TA	55,499	0.024	0.026	15,272	0.022	0.023
Investment	53,210	0.058	0.220	15,011	0.049	0.192
Retained Earnings/TA	42,470	0.317	0.579	11,383	0.308	0.349
Zombie dummy	55,565	0.183	0.387	15,281	0.259	0.438
	Zombie firms			Non-zombie firms		
	N	Mean	SD	N	Mean	SD
Long-term debt/TA	14,103	0.085	0.116	56,668	0.084	0.111
Cash/TA	14,103	0.173	0.128	56,668	0.176	0.149
log(total assets)	14,103	9.944	1.426	56,668	10.379	1.895
log(employees)	13,931	6.308	1.335	55,778	6.673	1.731
Interest Coverage ratio	13,115	1.578	10.017	51,743	0.972	8.102
Corporate tax/TA	14,103	0.026	0.025	56,668	0.023	0.025
Investment	13,703	0.054	0.209	54,518	0.056	0.215
Retained Earnings/TA	10,376	0.315	0.523	43,477	0.315	0.543
T (*treatment indicator*)	14,120	0.720	0.429	56,726	0.800	0.400

Notes. The table presents descriptive statistics for the main variables, separately for treated and untreated firms as well as for zombie and non-zombie firms. Long-term debt/TA is thelong-term financial debt of firm i in time t divided by the firm's total assets in year t. Cash/TA is the cash of firm i in year t divided by the firm's total assets in year t. Log(total assets) and log(employees) are the natural logarithm of total assets and the number of employees, respectively. I remove observations with negative asset values. Interest Rate Coverage is the interest rate coverage ratio of firm i in year t, defined as earnings before interest and taxes divided by interest expense of the firm in year t. Corporate tax/TA is the corporate tax payment by firm i in year t divided by the firm's total assets in year t. Investment represents the growth rate of firm i's fixed assets between periods t and $t+1$. To limit the impact of potential outliers, a winsorization process was applied whereby all values exceeding the top 1 percentile were set to the 99th percentile value, and all values below the bottom 1 percentile were replaced with the 1st percentile value. Retained Earnings/TA for a given firm i at time t is calculated as the ratio of retained earnings to the total assets of the firm. Zombie dummy takes the value of 1 if a firm's interest payments were lower than the required minimum at any point between 1994 and 1996. T is the treatment indicator that takes the value of 1 if a firm had a pre-existing relationship with the bailed-out banks prior to the recapitalization.

Figure 1: Average debt-to-asset and cash-to-asset ratios over time



(a) Long-term debt/TA

(b) Cash/TA

Notes. These figures present the evolution of average financial ratios over time for treated and untreated firms. Panel (a) shows the average long-term debt over total assets, while Panel (b) displays the average cash over total assets. Treated firms (those with pre-existing relationships with bailed-out banks) are represented by a blue line with markers. Untreated firms (those without pre-existing relationships with bailed-out banks) are depicted by a red line. The vertical dashed lines indicate the bank bailout years of fiscal years 1997 and 1998. All years shown are fiscal years.

treated and untreated groups, as well as for zombie and non-zombie firms. Zombie firms are identified using Giannetti and Simonov (2013)'s approach, which defines a firm as a zombie in year t if its interest payments in that year were lower than the 'required minimum interest rate expenses.' This minimum interest rate expense for year t is calculated assuming that the borrower pays the average short-term prime rate on short-term bank loans, the average long-term prime rate on long-term bank loans, and holds zero coupons on total bonds outstanding for that year. I define zombie firms as those that meet these criteria at any point during the 1994-1996 period. Consequently, non-zombie firms are those that do not meet these criteria at any point during this three-year pre-bailout period.

Finally, Figure 1 illustrates the average debt-to-asset ratio and cash-to-asset ratio over time for treated firms (blue line with markers) and untreated firms (red line). The figure reveals a notable pattern in the years following the bailouts. For treated firms, the average long-term debt-to-asset ratio exhibits a significant increase immediately after the bailout periods and appears to remain elevated for an extended time. In contrast, the cash-to-asset ratio for treated firms shows a marked decrease following the bailouts and remains

lower for a prolonged period. This divergent trend between debt and cash ratios suggests a substantial and persistent shift in the financial structure of treated firms post-bailout. These preliminary observations indicate potential long-term effects of bank bailouts on corporate financing policies, which I will examine further in our subsequent analysis.

5 Results

This section presents the analysis of bailout effects on corporate financing policies in three parts. First, I report the results of the baseline model, which estimates the overall impact of the bailouts. Second, I present separate analyses for zombie and non-zombie firms to examine potential heterogeneous effects. Finally, I investigate a possible mechanism related to the formation of long-term bank relationships following the bailouts.

5.1 Baseline results

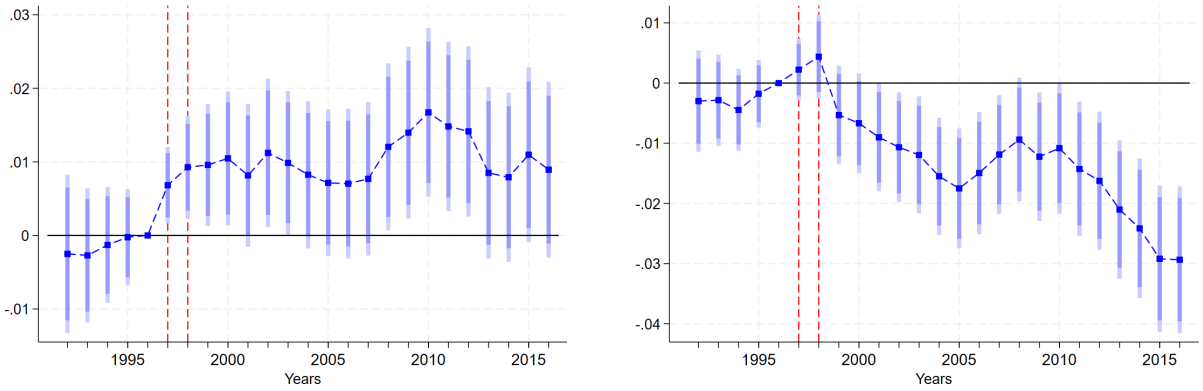
This study investigates the long-term effects of bank bailouts on corporate financing policies. The analysis employs equation 2, using two dependent variables: the long-term debt-to-total assets ratio and the cash-to-total assets ratio. Figure 2 presents the results of these estimations.

Panel (a) of Figure 2 illustrates the estimated coefficients ($\widehat{\beta}_t$) from 1992 to 2016 for the long-term debt-to-total assets ratio. The dark and light shaded areas represent 90% and 95% firm-cluster-robust confidence intervals, respectively. Vertical dotted lines indicate the first and second recapitalizations in 1997 and 1998.[10] The long-term debt-to-asset ratio exhibits a sharp increase during and immediately following the recapitalizations, with an average increase of 1 percentage point for borrower firms post-bailout. This elevated ratio remains persistently high throughout the post-recapitalization period, with statistically significant estimates for the majority of subsequent years. Notably, the $\widehat{\beta}_t$ coefficients for the pre-recapitalization period (1992-1995) are statistically insignificant, supporting the parallel trend assumption.

Panel (b) of Figure 2 presents the $\widehat{\beta}_t$ estimates for the cash-to-total assets ratio. This

[10]Both recapitalizations are depicted due to the overlapping exposure of many firms to both events, potentially resulting in effects manifesting shortly after the first recapitalization.

Figure 2: Baseline results



(a) Long-term debt/TA

(b) Cash/TA

Notes. The figure shows the coefficients on the interaction term between the treatment indicator and the year fixed effect, $\widehat{\beta}_t$ for $t = 1992 \ldots 2016$, using equation 2, when the dependent variable is long-term financial debt over total assets (TA) in Panel (a) and cash over total assets (TA) in Panel (b). The base year is 1996. Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets and log of employees). The bank bailout occurred in 1997 and in 1998. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years.

ratio demonstrates an immediate decline following the second recapitalization, continuing to decrease over an extended post-recapitalization period. By 2016, the cash-to-asset ratio for borrower firms is approximately 3 percentage points lower than for non-borrower firms. The estimates are statistically significant for most post-recapitalization years. As with the debt ratio, pre-recapitalization $\widehat{\beta}_t$ coefficients are statistically insignificant, further supporting the parallel trend assumption.

These results suggest a persistent shift in financing policies for firms with pre-existing relationships with bailed-out banks. Conversely, firms lacking such relationships, and thus experiencing credit contraction, appear to have reduced their reliance on bank financing and increased their use of internal financing over the long term. This pattern indicates a lasting impact of the bailouts on corporate financial strategies.

5.2 Differential impacts: bailout effects on zombie vs. non-zombie firms

To investigate the mechanisms influencing shifts in corporate financing policies, I divide the sample into two cohorts: non-zombie and zombie firms. I estimate equation 2 separately for these two groups. Figure 3 presents the estimated effects of bank bailouts on the long-term debt-to-asset and cash-to-asset ratios for non-zombie and zombie firms. Panels (a) and (b) show the effects on the long-term debt-to-asset ratio for non-zombie and zombie firms, respectively. For non-zombie firms, the long-term debt-to-asset ratio remains largely unchanged following the bailouts. In contrast, zombie firms exhibit an increase of approximately 4 percentage points in this ratio immediately after the bailouts, and this elevated level persists for two decades.

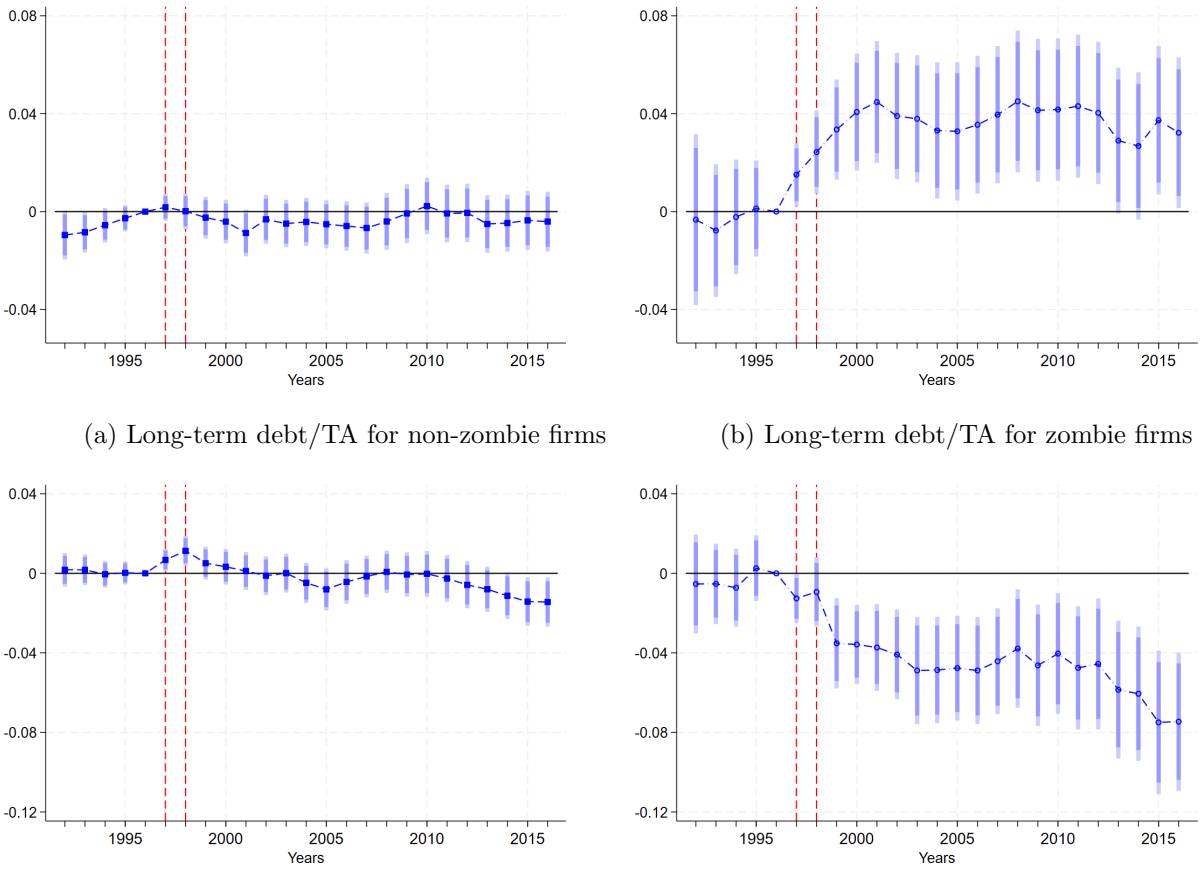
Panels (c) and (d) of Figure 3 illustrate the estimated effects of the bailouts on the cash-to-asset ratio for non-zombie and zombie firms. The ratio for non-zombie firms shows little change post-recapitalization. However, for zombie firms, the ratio declines shortly after the second recapitalization and continues to decrease over an extended period.

In summary, Figure 3 demonstrates that the bailouts had a notable influence on the financing policies of zombie firms, affecting both their long-term debt-to-asset and cash-to-asset ratios. Non-zombie firms, by comparison, show minimal changes in these financial metrics following the bailouts. These results not only indicate a distinct difference in how zombie and non-zombie firms responded to the financial intervention, but also suggest that the long-term effects of the bailouts on borrower firms are primarily driven by the responses of zombie firms.

5.3 Mechanism

To examine the underlying mechanisms more closely, I evaluate the impact of the bailouts on several relevant variables. First, I analyze the retained earnings over total assets. The observed increases in debt and decreases in cash reserves suggest potential changes in retained earnings, which constitute part of the net worth on the balance sheet. Second, I investigate the probability of firms maintaining relationships with their primary lenders. This anal-

Figure 3: Responses of debt and cash holdings for non-zombie and zombie firms



(a) Long-term debt/TA for non-zombie firms

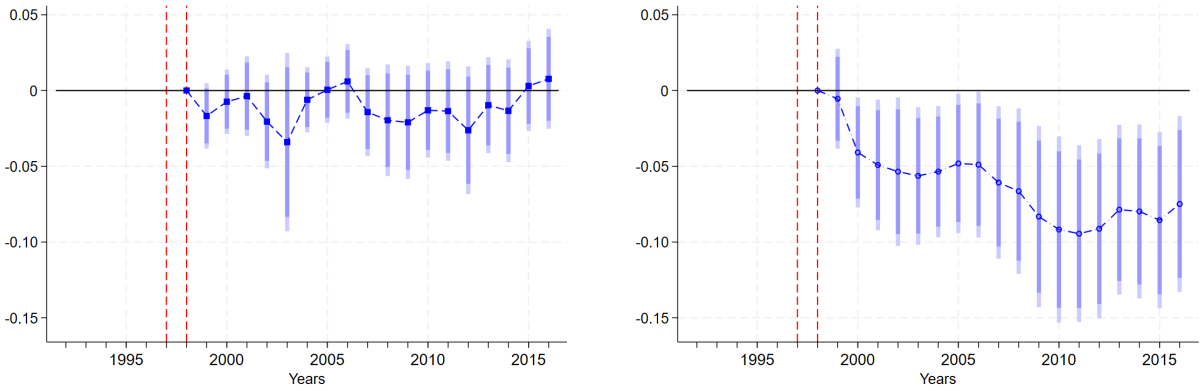
(b) Long-term debt/TA for zombie firms

(c) Cash/TA for non-zombie firms

(d) Cash/TA for zombie firms

Notes. The figure shows the coefficients on the interaction term between the treatment indicator and the year fixed effect, $\widehat{\beta}_t$ for $t = 1992 \ldots 2016$, using equation 2, when the dependent variable is long-term financial debt over total assets (TA) in Panel (a) and cash over total assets (TA) in Panel (b). The base year is 1996. Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets and log of employees). The bank bailout occurred in 1997 and in 1998. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years.

Figure 4: Responses of retained earnings for non-zombie and zombie firms



(a) Retained earnings/TA for non-zombie firms

(b) Retained earnings/TA for zombie firms

Notes. The figure shows the coefficients on the interaction term between the treatment indicator and the year fixed effect, $\widehat{\beta}_t$ for $t = 1992 \ldots 2016$, using equation 2, when the dependent variable is retained earnings over total assets in Panels (a) and (b). The base year is 1996. Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets and log of employees). The bank bailouts occurred in 1997 and in 1998. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years.

ysis aims to illuminate how bailouts may influence the duration and nature of bank-firm relationships, potentially explaining the observed shifts in financing patterns.[11]

Panels (a) and (b) in Figure 4 represent the responses of the retained earnings-to-asset ratio for non-zombie and zombie firms, respectively. Unfortunately, our ability to evaluate the behavior of the retained earnings-to-total asset ratio during the pre-bailout periods is hindered, as the consistently available data on retained earnings only starts from 1998. Consequently, our estimations are benchmarked to 1998. However, as Figure 4 demonstrates, the results seem to align with our expectations, indicating a decrease in the retained earnings-to-asset ratio, particularly for zombie firms.

What led borrower firms impacted by the bailouts to alter their corporate financing policies over a prolonged period? One plausible explanation lies in these firms' relationships with their primary lenders. Empirical studies have consistently shown that financial con-

[11] Additional analyses of corporate bond outstanding to asset ratio, investment, and labor productivity were also conducted. However, these variables did not exhibit consistent patterns in response to the bailouts. For detailed results, see Appendix 8.5.

straints significantly influence firms' cash holding behaviors,[12] and that strong relationships with key banks help alleviate these constraints. The bailouts provided treated firms with access to additional loans during the financial crisis, potentially enabling them to maintain their existing bank relationships for extended periods. This continuity could, in turn, reduce informational asymmetry and financial constraints.

To investigate this mechanism, I examine the probability of firms maintaining relationships with their three most significant lenders from the pre-bailout period (1992-1996) in subsequent years. These "top 3 banks" are defined as the three financial institutions from which a firm had the largest outstanding debt balances. In cases where a firm's top 3 banks underwent mergers, the relationship is considered maintained if the firm continues to have a significant relationship with the merged bank. Specifically, if a firm's outstanding debt balance with the merged bank remains among its top 3 largest balances, the relationship is counted as maintained. This approach allows for continuity in tracking banking relationships despite the widespread consolidation in the banking sector during this period. I estimate the following linear probability model:

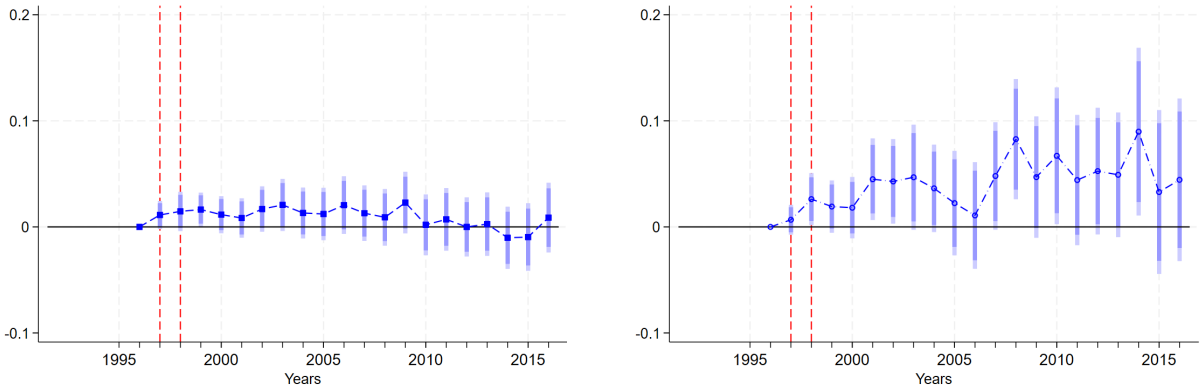
$$I_{i,t}^{\text{same banks}} = \sum_{t=1997}^{2016} \beta_t \left(\text{Year}_t \times T_i\right) + \psi \mathbf{X}_{i,t} + \text{Firm}_i + \text{Industry}_h \times \text{Year}_t + u_{i,t}, \tag{3}$$

where $I_{i,t}^{\text{same banks}}$ is an indicator variable equal to 1 if any of firm i's three largest lenders in year t is among its three largest lenders from the 1992-1996 period. $\mathbf{X}_{i,t}$ includes the same control variables as in equation 2.

Figure 5, panels (a) and (b), illustrates the conditional probability of non-zombie and zombie firms, respectively, maintaining at least one of their top 3 bank relationships from the pre-bailout period (1992-1996). Zombie firms associated with bailed-out banks exhibit a significantly higher likelihood of preserving these key banking relationships compared to their untreated counterparts, with the difference peaking at approximately 9 percentage points. In

[12] For instance, refer to Almeida et al. (2004), Faulkender and Wang (2006), Acharya et al. (2007), Denis and Sibilkov (2010), and Harford et al. (2014).

Figure 5: Probability of retaining banking relationships



(a) Non-zombie firms

(b) Zombie firms

Notes. The figure shows the coefficients on the interaction term between the treatment indicator and the year fixed effect, $\widehat{\beta}_t$ for $t = 1997 \ldots 2016$, using equation 3. The dependent variable is an indicator for whether a firm maintains at least one of its top 3 banks from the pre-bailout period (1992-1996) in Panels (a) and (b). The 'top 3 banks' are defined as the three financial institutions from which a firm had the largest outstanding debt balances. The base year is 1996. Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets and log of employees). The bank bailout occurred in 1997 and in 1998. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years.

contrast, non-zombie firms affected by the bailouts show no discernible impact. For zombie firms, this statistically significant effect persists until after 2014, underscoring the long-term nature of these banking relationships. This persistence aligns with previous research highlighting banks' crucial role in mitigating firms' financial constraints. Consequently, these enduring relationships with major lenders may have enhanced the attractiveness of debt financing while simultaneously reducing the necessity for substantial cash reserves among borrower firms.

5.4 Effects on the probability of exit

A potential mechanism that could explain the baseline results is a shift in the composition of firms in the treated and untreated groups. Untreated firms, not receiving additional bank loans during the crisis, might have exited the stock exchange more frequently than treated firms. This scenario could result in a greater number of unhealthy firms disappearing from the untreated group, potentially explaining why the remaining untreated firms in the sample accumulate less debt and more cash. To investigate this composition effect, I conducted two analyses: first, calculating the effect of bailouts on predicted probabilities of delisting from the stock exchange; second, calculating the effect on predicted probabilities of bankruptcy.[13] Out of 1,311 firms recorded in the dataset in 2000, 387 firms (29.52%) were delisted by 2017, and 38 firms (2.9%) declared bankruptcy by 2017. I estimate the following regression:

$$I^m_{i,2017} = \mathbf{f}(\alpha + \gamma T_i + \Phi \mathbf{W}_{i,1998...2000} + \epsilon_{i,2017}) \quad \text{where } m \in \{\text{deslited, bankrupt}\}, \tag{4}$$

where $I^m_{i,2017}$ is an indicator for firms that became delisted or declared bankruptcy by 2017. Control variables in $\mathbf{W}_{i,1998...2000}$ include industry fixed effects, zombie index, log of market capitalization, investment, interest coverage ratio, financial debt over total assets, and cash over total assets between 1998 and 2000.

I estimate equation 4 using both linear probability and probit models. Columns (1) and

[13] Bankruptcy is defined as a firm undergoing any of the following procedures: Corporate Reorganization Law proceedings (Kaisha Kosei Ho), Civil Rehabilitation Law proceedings (Minji Saisei Ho), liquidation bankruptcy (Hasan), or voluntary liquidation (Nin'i Seiri).

(2) of Table 3 show the estimated effects of bank bailouts on the probability of eventual delisting, which are statistically indistinguishable from zero. Columns (3) and (4) show the effect on the probability of eventual bankruptcy. Treatment predicts eventual bankruptcy at a 10% significance level, with treated firms' likelihood of declaring bankruptcy increasing by about 1.3-2.4 percentage points.

Table 3: Impact of bailout exposure on firm delisting and bankruptcy probabilities

	Unlisted		Bankruptcy	
	(1)	(2)	(3)	(4)
	Linear Prob. Model	Probit Model	Linear Prob. Model	Probit Model
T_i (Treatment)	0.013	0.016	0.013	0.024
	(0.032)	(0.032)	(0.007)	(0.013)
Number of obs.	1138	1138	1138	1138
R^2	0.081	0.058	0.074	0.286

Notes. This table presents the marginal effects of injection exposure on firm outcomes by 2017. Columns (1) and (2) show the probability of delisting using linear probability and probit models, respectively. Columns (3) and (4) show the probability of bankruptcy using linear probability and probit models, respectively. All models include industry fixed effects and the following control variables from 1998 to 2000: zombie index, log of market capitalization, investment, interest coverage ratio, financial debt over total assets, and cash over total assets. Robust standard errors are in parentheses. The R^2 for probit models is a pseudo-R^2.

These findings suggest that the main results are unlikely to be caused by differential exit rates between treated and untreated firms. Treatment does not predict delisting in a statistically significant manner, which is particularly relevant as the study observes corporate financing policies of firms that remain listed. While treatment does predict eventual bankruptcy at a 10% significance level,[14] the limited number of bankruptcy incidents (38 firms) constrains the validity and generalizability of this finding. Moreover, the small number of firms that eventually went bankrupt likely limits the magnitude of effects on overall corporate financing trends. Importantly, the detected finding of treatment-induced bankruptcy, rather than firm preservation, aligns with the main findings that treated firms are more likely to accumulate external debt and reduce cash, potentially leading to increased bankruptcy risk.

[14] Additional analyses using two alternative treatment indicators, presented in Appendix 6.4, show similar predictive power for eventual bankruptcy, though the results are not statistically significant.

Given these observations, it appears that the effects of the bailouts are not primarily driven by changes in the composition of firms among treated and untreated groups. Instead, the impacts are likely manifested through the intensive margin - that is, through changes in the financial decisions of existing firms. This interpretation supports the view that the observed differences in debt and cash accumulation are primarily driven by how firms adjusted their financial strategies in response to the bailouts, rather than by shifts in market composition.

6 Robustness check

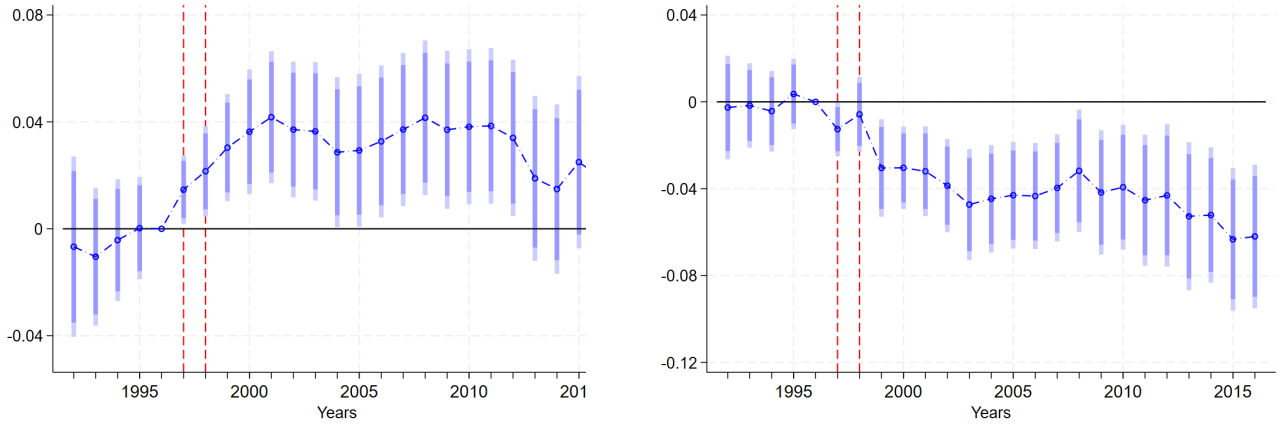
This section examines the robustness of the main results through several strategies. First, I incorporate additional firm-specific time-varying control variables into the model. Second, I implement a placebo test using an alternative treatment indicator. Third, I employ a propensity score matching difference-in-differences estimator. Fourth, I apply an alternative definition of control and treatment groups. Finally, I account for the potential effects of the widespread bank mergers that occurred in Japan during the early 2000s. For conciseness, I present results only for zombie firms. The main findings remain consistent across all these alternative specifications and checks.

6.1 Controlling for additional firm characteristics

In order to assess the robustness of the baseline results, I first incorporate several additional control variables into the baseline model. Specifically, I introduce the following eight variables into $\mathbf{X}_{i,t}$ in equation 2: interest coverage ratio, total liquid liability over total assets, firm age and age squared, corporate income tax payment over total assets, a lag of investment, and a lag of employee growth rate. Firm age serves as an indicator of the firm's growth opportunities and the degree of uncertainty the firms faced, both of which influence external financing costs and the need for cash holding. The interest coverage ratio, liquid liability, tax-to-asset ratio, investment, and employee growth rate are included to reflect the firm's need to accumulate cash, given that these factors often necessitate cash payments. Figure 6 illustrates the results for zombie firms.

Figure 6 illustrates the estimated effects of bailouts with additional control variables.

Figure 6: Results with additional control variables



(a) Long-term debt/TA for zombie firms

(b) Cash/TA for zombie firms

Notes. The figure shows $\widehat{\beta}_t$ for $t = 1992 \ldots 2016$ using equation 2 when the dependent variable is long-term financial debt over total assets in Panel (a) and cash over total assets in Panel (b). The base year is 1995. Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets, log of the number of employees, interest coverage ratio, total liquid liability over total assets, firm age and age squared, corporate income tax over total assets, a lagged investment, and a lagged employee growth rate). The bank bailout occurred in 1997 and in 1998. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years.

Panel (a) shows the impact on the long-term debt-to-asset ratio, which maintains a significant and persistent increase, consistent with our baseline findings. Panel (b) depicts the effects on the cash-to-asset ratio, where the pattern of decline remains largely unchanged. The inclusion of these additional firm-specific controls does not substantially alter the estimated results, suggesting that our baseline findings are robust to a more comprehensive set of firm characteristics.

6.2 Placebo analysis: Resona bank recapitalization

In this section, I conduct a placebo test by estimating equation 2 using a placebo treatment indicator. The placebo treatment indicator is constructed based on the third recapitalization episode in June 2003, when the Japanese government nationalized Resona Bank by injecting approximately 2 trillion yen through preferred and common shares. The third recapitalization's nature differs from the previous two recapitalizations. This recapitalization was prompted when the auditing corporation responsible for Resona Bank informed the insti-

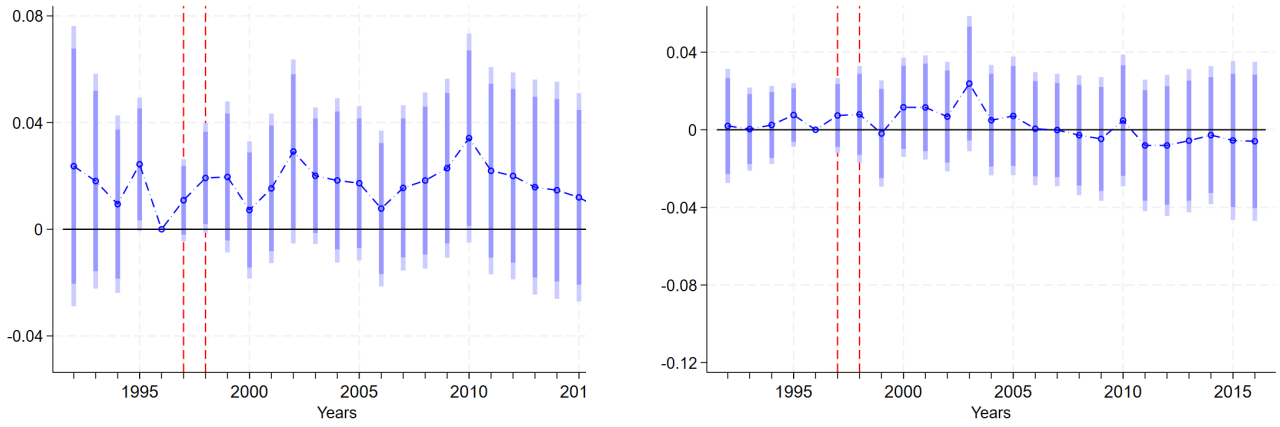
tution in May 2003 that it would only allow deferred tax assets for three years, instead of five, which had been the prevailing auditing guideline for major banks. This resulted in Resona Bank's capital adequacy ratio for the fiscal year ending March 2003 falling below the domestic bank's standard of 4%. The announcement came as a surprise to the public, given that Resona Bank had just been established as a result of the merger of four banks in March of the same year. I utilize this round of recapitalization for constructing a placebo treatment indicator as Giannetti and Simonov (2013) demonstrated that, unlike the prior two recapitalizations, it did not lead the bailed-out bank to extend loans to borrower firms. Consequently, we should not anticipate any long-term effects of this bailout on borrower firms' financing policies.

To conduct a placebo test, I define a new treatment indicator, T_i^{placebo}, which equals 1 for firms that borrowed from Resona Bank in the year preceding its 2002 recapitalization. This criterion is met by approximately 61% of the zombie firms in the sample.[15] I then re-estimate regression equation 2, substituting T_i^{placebo} for the original treatment variable T_i. This placebo test aims to examine whether the effects observed in our main analysis are attributable to the 1997-1998 bailouts or if they might be capturing other unrelated factors. Figure 7 presents the results of this placebo analysis.

Panel (a) in Figure 7 displays the outcomes for zombie firms with the long-term debt-to-asset ratio as the dependent variable. The result differs from our baseline findings in Figure 4, showing no significant increase in this ratio. Panel (b) similarly shows no clear decreasing trend in the cash-to-asset ratio, in contrast to our initial results. These findings are consistent with Giannetti and Simonov (2013), who found that the 2003 recapitalization did not significantly increase lending from bailed-out banks to borrower firms. The absence of significant effects in these placebo regressions suggests that the effects observed in our main analysis are associated with the conditions surrounding the first two bank bailouts, which were effective in stimulating bank lending during the financial crisis. This placebo test provides additional support for the causal interpretation of our main results, indicating

[15] Specifically, out of 14,120 firm-year observations classified as zombie, 8,601 have $T_i^{\text{placebo}} = 1$.

Figure 7: Placebo test:
Effects using pre-2003 Resona bank borrowers as treatment group

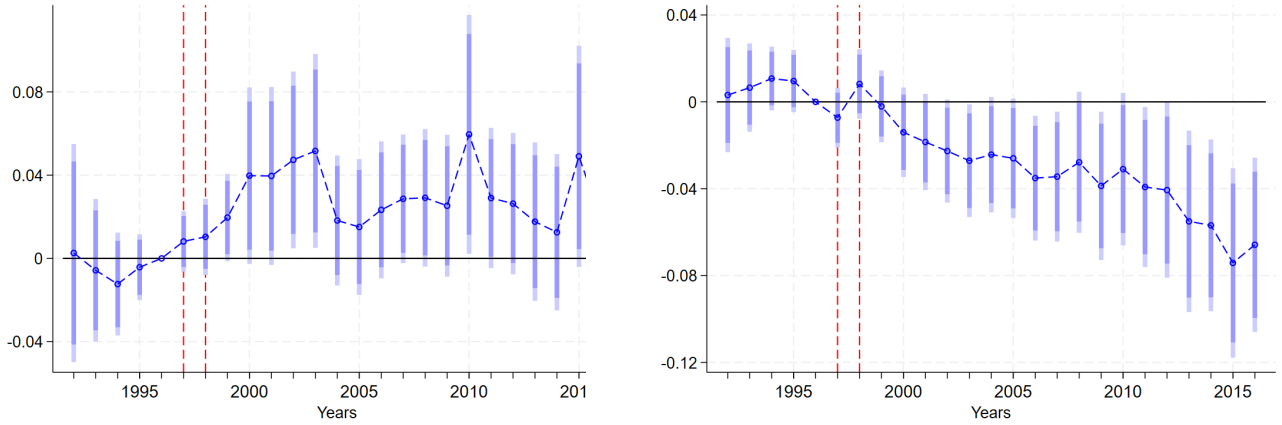


(a) Long-term debt/TA for zombie firms

(b) Cash/TA for zombie firms

Notes. The figure shows $\widehat{\beta}_t$ for $t = 1992 \ldots 2016$ using equation 2 when the placebo treatment indicator is used. The dependent variable is long-term financial debt over total assets in Panel (a) and cash over total assets in Panel (b). The base year is 1996. Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets and log of the number of employees). The first two recapitalizations occurred in 1997 and in 1998, followed by the third in 2002. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years.

Figure 8: Results from Propensity Score Matching DiD estimator



(a) Long-term debt/TA for zombie firms

(b) Cash/TA for zombie firms

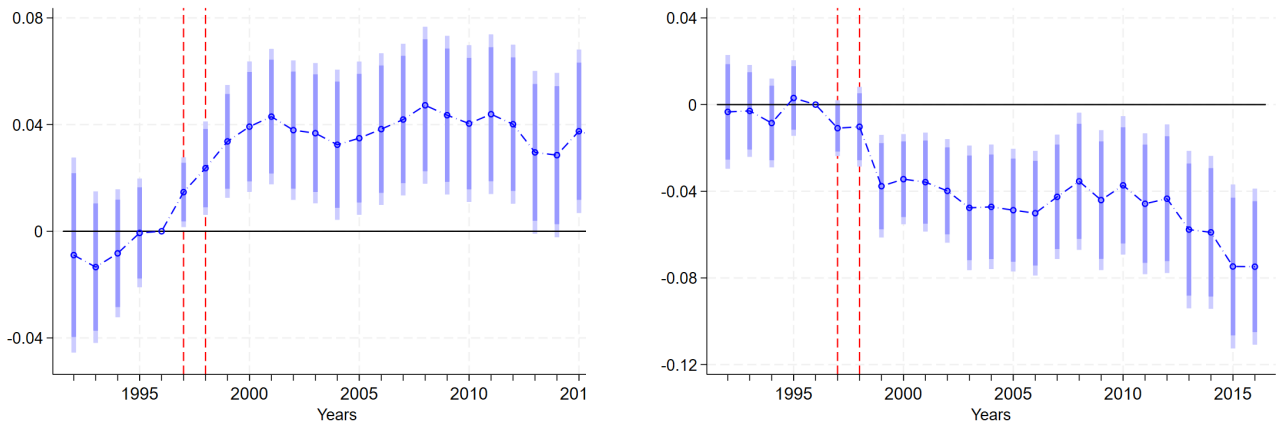
Notes. The figure shows $\widehat{\beta}_t$ for $t = 1992 \ldots 2016$ using equation 2 weighted by the propensity scores when the dependent variable is long-term financial debt over total assets (TA) in Panel (a) and cash over total assets (TA) in Panel (b). The base year is 1995. Specifications include firm fixed effects, industry-by-year fixed effects, and log of total assets, and log of the number of employees. The propensity score is calculated based on the outcome variables (debt to asset and cash to asset ratios), the log of total assets, and the log of the number of employees between 1992 and 1996. The bank bailouts occurred in 1997 and in 1998. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years.

a distinct impact of the 1997-1998 bailouts on corporate financing behavior.

6.3 Propensity score matching difference-in-differences

For further robustness checks, I employ the propensity score matching difference-in-differences (PSM DiD) estimator. The combination of a difference-in-differences model with propensity score matching facilitates enhanced comparability between the treated (borrower zombie firms) and untreated (non-borrower zombie firms) groups by providing more flexibility in the functional form. The propensity scores are derived from the debt-to-asset and cash-to-asset ratios, the logarithm of total assets, and the logarithm of the number of employees from 1992 to 1996. The estimation employs the kernel matching method, followed by an estimation of the propensity score-weighted version of equation 2, as described by Heckman et al. (1997). The results, depicted in Figure 8, demonstrate the significant effects of the bank bailouts for zombie firms, aligning with the baseline results.

Figure 9: Alternative treatment group definition: firms exposed to both bailouts vs. never treated



(a) Long-term debt/TA for zombie firms

(b) Cash/TA for zombie firms

Notes. The figure shows the estimated coefficients on the interaction term between the treatment indicator and the year fixed effect for different quartiles, $\widehat{\beta}_t$ for $t = 1992 \ldots 2016$, using equation 2 when the dependent variable is long-term financial debt over total assets in Panel (a) and cash over total assets in Panel (b). The base year is 1996. The sample is restricted to firms that are affected by both first and second rounds of recapitalization in 1997 and 19998 (treatment group) and firms that were never affected (control group). Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets and log of the number of employees). The bank bailout occurred in 1997 and in 1998. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years.

6.4 Alternative treatment group definition: twice-treated vs. never-treated Firms

The sample in the baseline analysis is categorized into four groups: 1) firms never impacted by recapitalization, 2) firms impacted only by the 1997 recapitalization, 3) firms affected solely by the 1998 recapitalization, and 4) firms affected by both recapitalizations. In the primary analysis, groups 1 and 2 formed the control group, while groups 3 and 4 constituted the treatment group. The distribution of the 70,846 observations across these groups is as follows: 13,187 (18.61%) in Group 1, 2,094 (2.96%) in Group 2, 1,171 (1.65%) in Group 3, and 54,394 (76.78%) in Group 4. For the subset of 14,120 zombie firm observations, the distribution adjusts to 26.42% in Group 1, 1.56% in Group 2, 1.40% in Group 3, and 70.62% in Group 4. This section examines whether modifying these control and treatment

definitions affects the baseline outcomes.

In this alternative analysis, I redefine the control group as only Group 1 (never treated firms) and the treatment group as only Group 4 (firms affected by both recapitalizations), excluding firms impacted by only one recapitalization round. Using this refined sample of zombie firms, I re-estimate equation 2. Figure 9 presents the results, showing a slight intensification in the debt-to-asset ratio effect and similar effects on the cash-to-asset ratio compared to baseline findings. The overall outcomes remain consistent with the baseline results for zombie firms, suggesting that this alternative definition does not substantially alter our primary conclusions.

To further assess robustness under this alternative definition, I conducted additional analyses examining underlying mechanisms, persistence of bank relationships, and other checks. These results, largely corroborating our main findings, are detailed in Appendix 8.4.

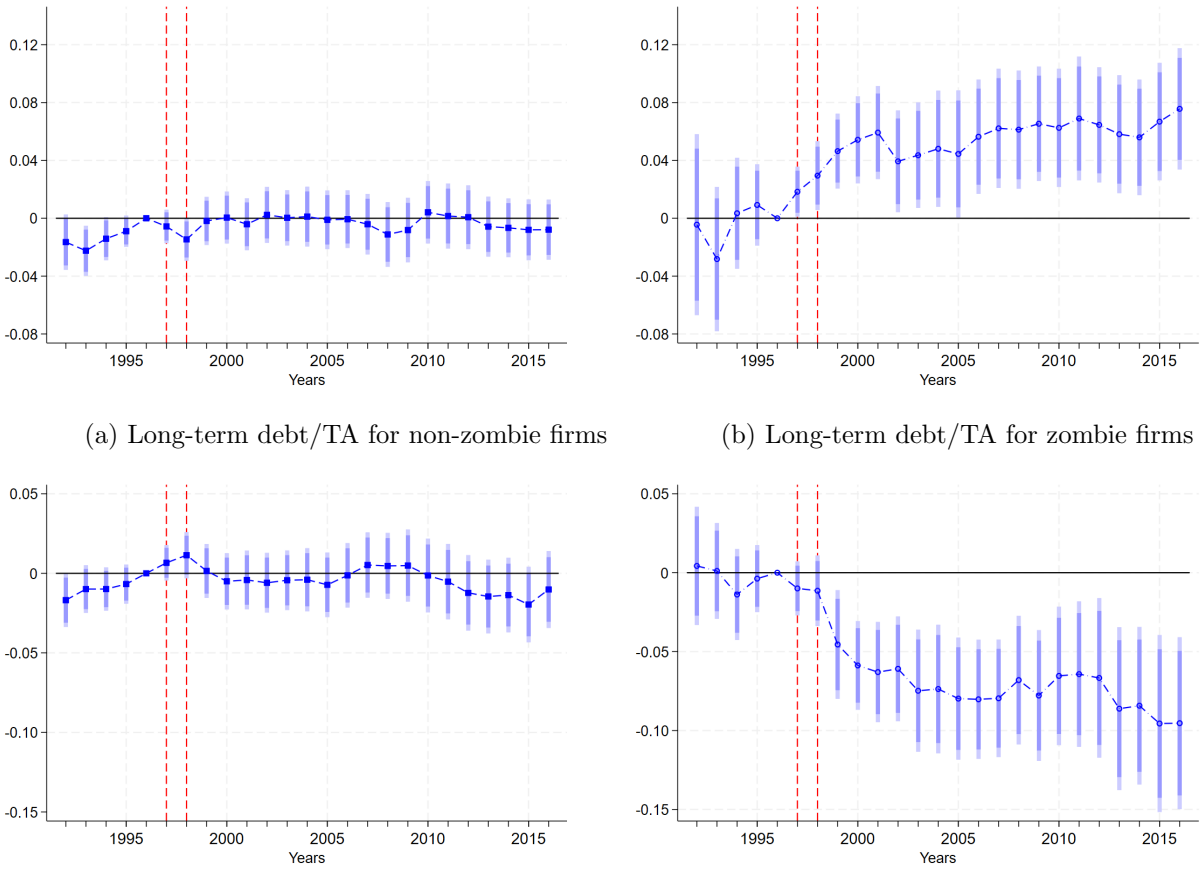
6.5 Robustness to bank merger activity

The late 1990s and early 2000s marked a significant consolidation phase in the Japanese banking sector, characterized by numerous mergers and acquisitions. This period was defined by efforts to stabilize the financial system in the wake of the late 1990s financial crisis. The mergers were primarily motivated by the need to create more resilient institutions capable of managing the increasing non-performing loans that threatened the banking industry's stability. These consolidations reshaped the banking landscape, potentially altering firms' banking relationships, which is crucial for understanding changes in their financing policies.

Ideally, to isolate the effects of bank bailouts on firms' financing decisions, examining a subset of firms whose main banks were not involved in any mergers would provide a clearer picture. However, this approach proves unfeasible as the number of firms unaffected by bank mergers is exceedingly small, rendering such an analysis impractical. While not all banks underwent mergers, the widespread consolidation in the sector affected the vast majority of firms in our sample.

To address this challenge, I conducted two complementary analyses. First, I introduced a 'merger exposure measure' for each firm, representing the proportion of borrowing from

Figure 10: Long-term debt and cash ratios of firms highly exposed to bank mergers



(a) Long-term debt/TA for non-zombie firms

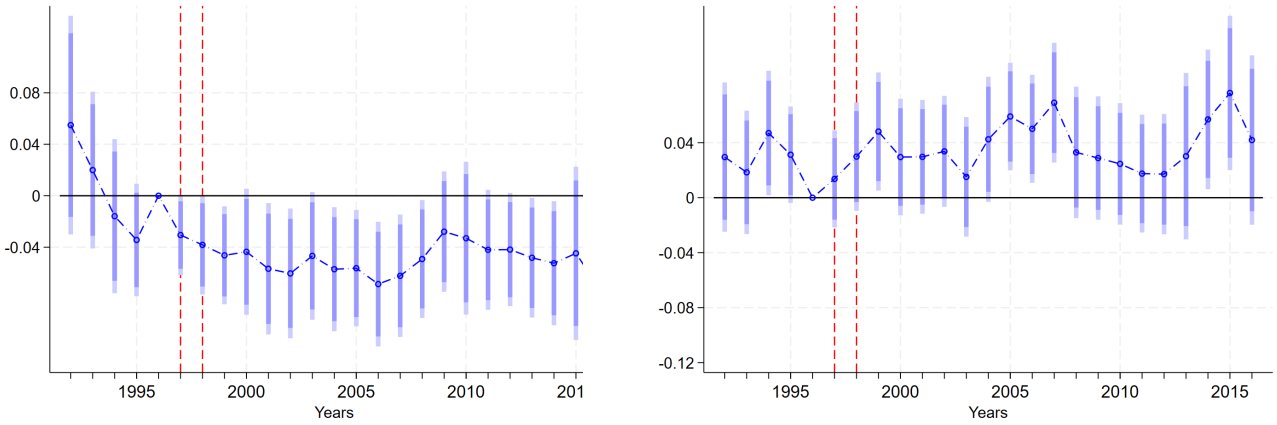
(b) Long-term debt/TA for zombie firms

(c) Cash/TA for non-zombie firms

(d) Cash/TA for zombie firms

Notes. The figure shows the coefficients on the interaction term between the treatment indicator and the year fixed effect, $\widehat{\beta}_t$ for $t = 1992 \ldots 2016$, using equation 2, when the dependent variable is long-term financial debt over total assets (TA) in Panel (a) and cash over total assets (TA) in Panel (b). The sample is restricted to firms with high exposure to bank mergers. The base year is 1996. Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets and log of employees). The bank bailout occurred in 1997 and in 1998. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years

Figure 11: Long-term debt and cash ratios of firms that had relationship with non-bailed-out banks that later merged with bailed-out banks



(a) Long-term debt/TA for zombie firms

(b) Cash/TA for non-zombie firms

Notes. The figure shows $\widehat{\beta}_t$ for $t = 1992 \ldots 2016$ using equation 2 when the treatment indicator is defined as firms that had relationship with non-bailed-out banks that later merged with bailed-out banks. The dependent variable is long-term financial debt over total assets in Panel (a) and cash over total assets in Panel (b). The base year is 1996. Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets and log of the number of employees). The first two recapitalizations occurred in 1997 and in 1998, followed by the third in 2003. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years.

banks that later merged, relative to total borrowing between 1994 and 1996. By focusing on firms with a merger exposure ratio above 90%, the analysis aims to determine if the changes in financial policies are driven primarily by bailouts, regardless of the firms' high exposure to bank mergers. Out of 47,272 firms that are identified as having high exposure to mergers, 10,921 were classified as zombie firms, with 7,839 of them being in the treated group, while out of 36,351 non-zombie firms that have high exposure to mergers, 30,013 are in the treatment group. I re-estimated equation 2 for these specific groups. Figure 10 illustrates the results, showing that non-zombie firms, despite high merger exposure, did not exhibit significant changes in their debt-to-asset and cash-to-asset ratios. In contrast, zombie firms demonstrated substantial shifts, consistent with the baseline analysis.

For the second analysis, I constructed a new treatment indicator to examine the effects of mergers involving bailed-out banks on firms that were not initially affected by the bailouts.

This indicator identifies firms that initially had loan relationships with non-bailed-out banks, which subsequently merged with bailed-out banks. Crucially, this analysis excluded the original treatment group to focus solely on the effects of these mergers. I defined treated firms as those whose primary lenders merged with bailed-out banks, where the bailed-out banks comprised more than 50% of the resulting merged bank. Given that very few firms had relationships with banks that would never merge, using a strict definition of non-merging banks for the control group would result in an insufficiently small sample. This approach resulted in a sample of 15,281 year-firm observations, corresponding to the baseline control group.Of these, 3,951 were classified as zombie firms, and 2,960 met the new treatment criteria..

I then re-estimated equation 2 for zombie firms using this new treatment indicator. Figure 11 presents the results, revealing that mergers with bailed-out banks do not appear to cause any meaningful changes in debt-to-asset and cash-to-asset ratios that are consistent with the patterns observed in the baseline analysis. This contrasts markedly with the substantial effects observed in our baseline results for firms directly exposed to bailouts.

Collectively, these findings suggest that mergers involving bailed-out banks were not the primary driver of the financial policy changes observed in the baseline results. Rather, the observed effects appear to be predominantly attributable to the direct impact of bailouts on firms through their pre-existing relationships with bailed-out banks at the time of the bailouts. The lack of significant effects consistent with the baseline patterns from mergers with bailed-out banks underscores the importance of the immediate and direct bailout exposure in shaping firms' financial policies.

7 Conclusion

This study reveals the long-term impacts of bank bailouts on corporate financing policies, demonstrating persistent changes in firms' financial structures and strategies. The analysis shows a sustained increase in the long-term debt-to-asset ratio and a corresponding decrease in the cash-to-asset ratio for firms associated with bailed-out banks, indicating a lasting shift in their financing approaches post-bailout.

A key finding is the differential response between non-zombie and zombie firms. Non-zombie firms affected by the bailouts showed no significant changes in their cash-to-asset and long-term debt-to-asset ratios, nor in their retained earnings, suggesting minimal alterations to their capital structures. In contrast, zombie firms exhibited more pronounced effects, with notable increases in long-term debt ratios, decreases in cash ratios, and reductions in retained earnings, indicating substantial and persistent changes in their capital structures.

The study also found that zombie firms were more likely to maintain relationships with their main banks post-bailout. This aligns with previous research by Opler et al. (1999) and Kahle and Stulz (2013), which highlights precautionary motives as a significant factor in firms' cash reserve management. The sustained banking relationships may have mitigated uncertainties about securing future funding, potentially explaining the reduced cash ratios observed in affected firms.

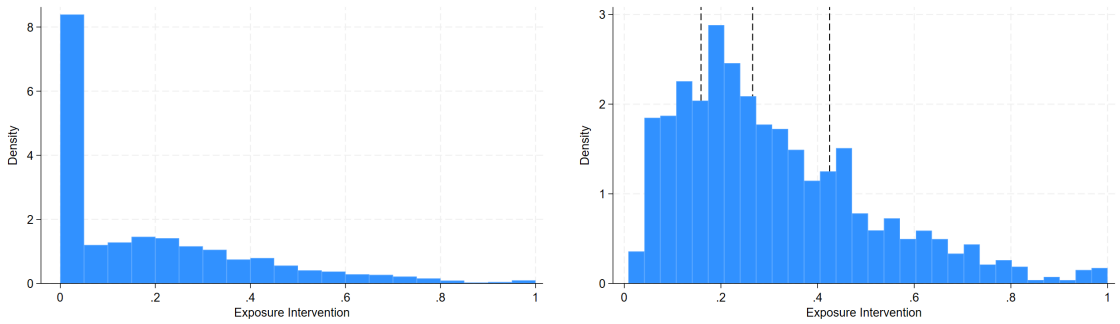
This paper underscores the critical importance of examining the long-term consequences of financial interventions such as bank bailouts. By revealing the persistent influence of these measures on corporate financing behavior, particularly among zombie firms, this study highlights a significant and often overlooked aspect of bailout policies. The findings suggest that while bailouts may provide short-term financial stability, they can lead to long-lasting distortions in resource allocation. Specifically, the prolonged support of zombie firms through sustained banking relationships and increased long-term debt may divert capital away from more productive enterprises. This misallocation of resources can potentially hamper economic efficiency and growth over extended periods. As such, this study contributes to a more comprehensive understanding of bailout policies, emphasizing the need for policymakers to consider not just immediate economic stabilization, but also the long-term implications for market dynamics and resource distribution.

8 Appendix

8.1 Distribution of firm exposure to the 1998 bank bailout

Figure 12 illustrates the distribution of Exposure Intervention$_i$, as defined in equation 1, based on the second episode of bank bailouts in fiscal year 1998. Panel (a) presents the histogram for the entire sample, including firms with zero exposure. Panel (b) focuses on the subset of firms with positive exposure values (Exposure Intervention$_i > 0$).

Figure 12: Distribution of firm exposure to the 1998 bank bailout



(a) Exposure Intervention$_i$ (b) Exposure Intervention$_i > 0$

Notes. This figure illustrates the distribution of Exposure Intervention$_i$, as defined in equation 1, based on the second episode of bank bailouts in fiscal year 1998. Panel (a) shows the histogram for the entire sample, including firms with zero exposure. Panel (b) presents the distribution for firms with positive exposure values (Exposure Intervention$_i > 0$). Vertical dotted lines in panel (b) indicate the 25th, 50th, and 75th percentiles of the positive exposure distribution.

An examination of the Exposure Intervention$_i$ distribution in Figure 12 provides rationale for the baseline treatment definition. Panel (b) reveals a left-skewed distribution, with over 75% of positive exposure values below 0.5. Setting a high threshold, such as 0.5, would exclude a substantial portion of exposed firms, potentially reducing statistical power. Conversely, a lower threshold like 0.2 would not differ significantly from a non-zero cutoff. Defining treatment as Exposure Intervention$_i > 0$ captures a broad spectrum of exposed firms while maintaining a clear distinction between treated and untreated groups. Notably, sensitivity analyses in Section 8.3 demonstrate that the main findings remain consistent across alternative threshold definitions, supporting the robustness of this baseline treatment definition.

8.2 Differential bailout effects on zombie firms using quartile analysis of treatment intensity

This section examines how the intensity of pre-existing connections with bailed-out banks influences the bailout's effects on zombie firms' corporate financing policies. To achieve this, I define T_i^q, which equals 1 if zombie firm i belongs to the q-th quartile of Exposure Intervention$_i^j >$ 0. The quartiles are defined as follows: $q = 1$ represents the bottom 25 percentile, indicating the weakest exposure to bailed-out banks among zombie firms with pre-existing relationships; $q = 4$ denotes the top 25 percentile, signifying the strongest exposure. To analyze these differential effects, I estimate the following model:

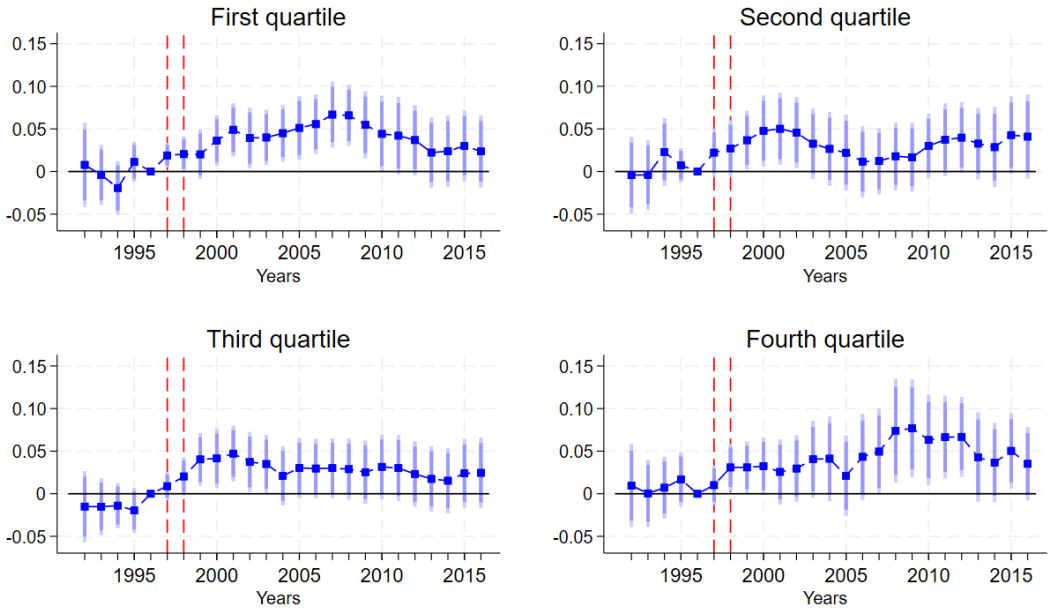
$$Y_t = \sum_{q=1}^{4} \sum_{t=1992}^{2016} \beta_t^q \left(\text{Year}_t \times T_i^q\right) + \psi \mathbf{X}_{i,t} + \text{Firm}_i + \text{Industry}_h \times \text{Year}_t + u_{i,t}, \tag{5}$$

where $\mathbf{X}_{i,t}$ includes the same control variables as in equation 2. If the bailout's effect increases with the strength of relationships with bailed-out banks, we expect the absolute values of β_t^q to be greater as q increases. Figure 13 presents the results for zombie firms.

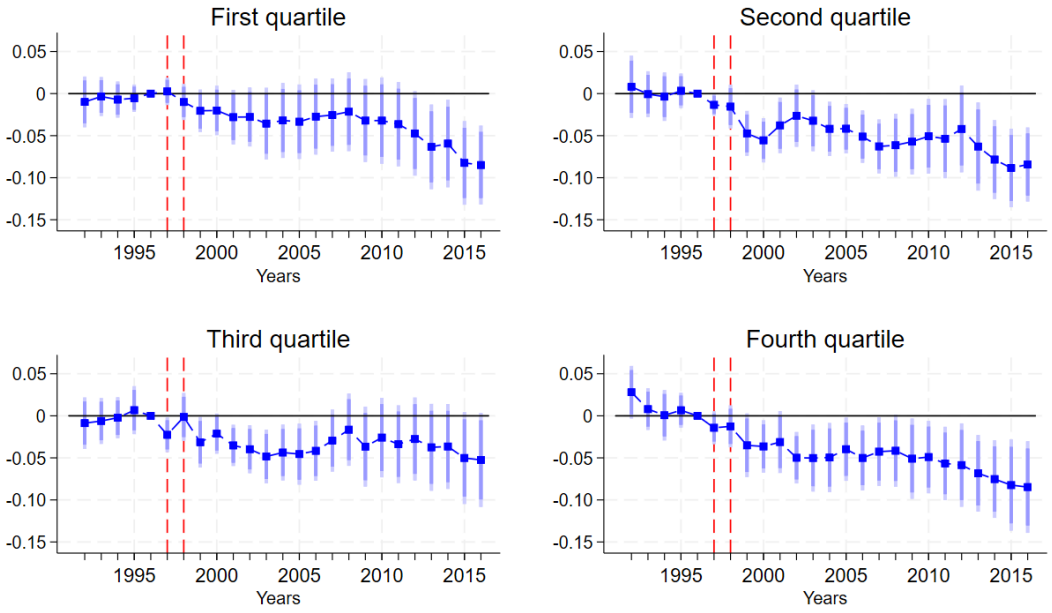
Panel (a) of Figure 13 illustrates the bailout's effects on the long-term debt-to-asset ratio for zombie firms across different quartiles of bailout exposure intensity. Notably, the effects are visible across all quartiles. However, the strength of the effect does not correlate strongly with the intensity of firms' connections to bailed-out banks. Zombie firms with the weakest exposure ($q = 1$) experienced almost as strong an increase in the debt-to-asset ratio as those with the strongest exposure ($q = 4$), although the latter group showed a slightly more intense increase. This suggests that for zombie firms, the bailout's effect on the debt-to-asset ratio does not linearly depend on the intensity of exposure to bailed-out banks.

Panel (b) of Figure 13 shows the treatment effects on the cash-to-asset ratio for zombie firms across different exposure quartiles. The bailout's effects on cash holdings are significant across all groups of zombie firms. The strength of the effect appears to be weakly correlated with the intensity of connections to bailed-out banks, although the third quartile exhibits a somewhat weaker response. Generally, the effects become stronger as the exposure to

Figure 13: Bailout effects on zombie firms by exposure intensity quartiles



(a) Long-term debt/TA for zombie firms



(b) Cash/TA for zombie firms

Notes. The figure shows the estimated coefficients on the interaction term between the treatment indicator and the year fixed effect for different quartiles of zombie firms, $\widehat{\beta_t^q}$ for $t = 1992 \ldots 2016$ and $q = \{1, 2, 3, 4\}$, using equation 5 when the dependent variable is long-term financial debt over total assets (TA) in Panel (a) and cash over total assets (TA) in Panel (b). The base year is 1996. Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets and log of the number of employees). The bank bailout occurred in 1997 and in 1998. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years.

bailed-out banks increases, but this relationship is not strictly linear.

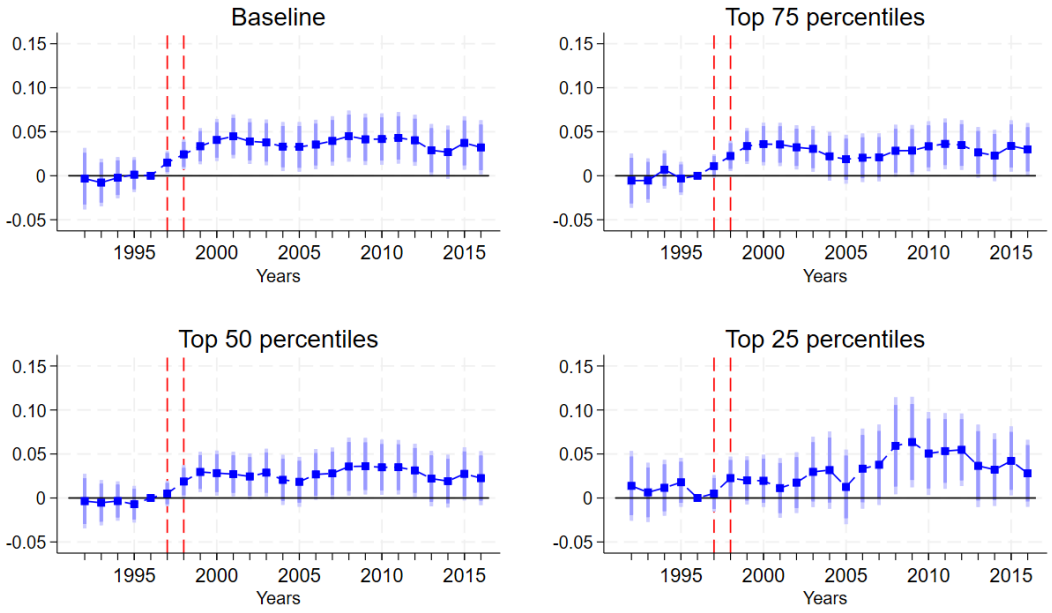
The U-shaped pattern observed in the debt-to-asset ratio response suggests complex underlying mechanisms. Several hypotheses might explain this pattern. For weakly connected zombie firms, it's possible that these firms viewed the bailout as an opportunity to secure additional funding, potentially approaching bailed-out banks more aggressively to increase their borrowing. Conversely, lending to strongly connected zombie firms might represent a form of 'evergreening', where banks extend additional credit to highly indebted borrowers to avoid recognizing losses on existing loans. The relatively weaker response from firms in the middle quartiles might reflect a balancing act by the bailed-out banks, attempting to manage their risk exposure while simultaneously supporting their most indebted clients and responding to new borrowers.

These findings suggest that for zombie firms, while the bailout had significant effects across all levels of exposure, the intensity of these effects doesn't always correspond directly to the strength of pre-existing relationships with bailed-out banks.

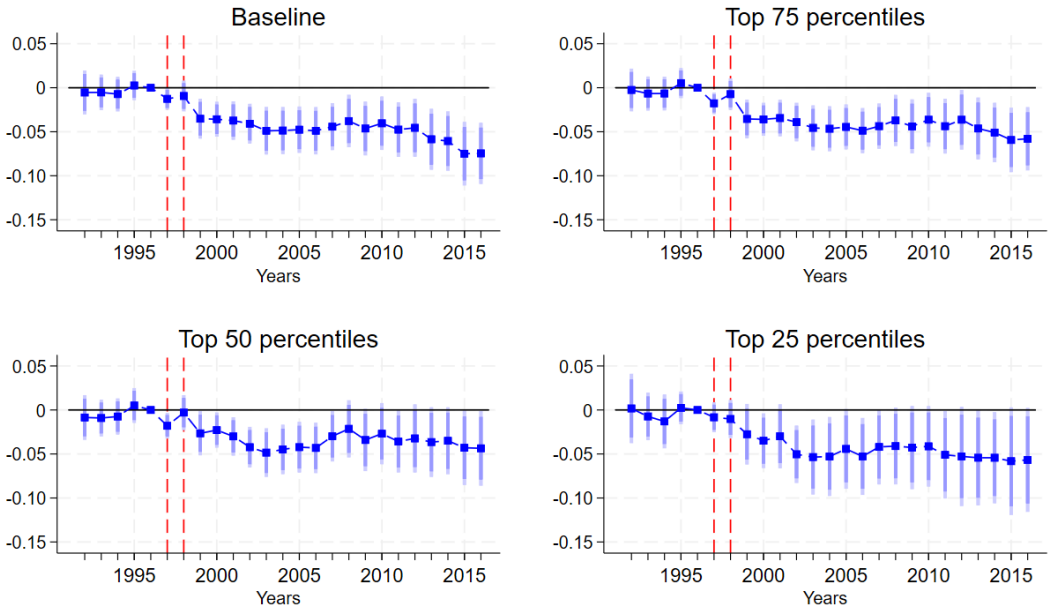
8.3 Sensitivity analysis using varying exposure thresholds

This section examines the robustness of our main findings by employing different thresholds of firms' exposure to bailed-out banks to define our treatment groups. I construct four versions of the treatment indicator T_i, each based on varying levels of Exposure Intervention$_i$, which is defined in Section 3 and quantifies each firm's level of connection to banks that received bailouts. I define the four treatment indicators as follows: The baseline case, used in the main analysis, sets $T_i = 1$ if Exposure Intervention$_i > 0$. The second case, representing the top 75 percentiles, sets $T_i = 1$ if Exposure Intervention$_i$ exceeds the 25th percentile of positive Exposure Intervention$_i$. The third case uses the median, setting $T_i = 1$ if Exposure Intervention$_i$ is above the median of positive Exposure Intervention$_i$. The fourth case, representing the top 25 percentiles, sets $T_i = 1$ if Exposure Intervention$_i$ surpasses the 75th percentile of positive Exposure Intervention$_i$.

Figure 14: Sensitivity of bailout effects to varying exposure levels



(a) Long-term debt/TA for zombie firms



(b) Cash/TA for zombie firms

Notes. The figure shows the estimated coefficients on the interaction term between the treatment indicators and the year fixed effect for different quartiles of zombie firms, $\widehat{\beta}_t$ for $t = 1992 \ldots 2016$, using equation 2 when the dependent variable is long-term financial debt over total assets (TA) in Panel (a) and cash over total assets (TA) in Panel (b). The treatment indicators are based on varying thresholds of Exposure Intervention$_i$: baseline (> 0), top 75 percentiles ($>$ 25th percentile), median ($>$ 50th percentile), and top 25 percentiles ($>$ 75th percentile). The base year is 1996. Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets and log of the number of employees). The bank bailout occurred in 1997 and in 1998. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years.

For each of these definitions, I re-estimate the main specification:

$$Y_{i,t} = \sum_{t=1992}^{2016} \beta_t \left(\text{Year}_t \times T_i\right) + \psi \mathbf{X}_{i,t} + \text{Firm}_i + \text{Industry}_h \times \text{Year}_t + u_{i,t},$$

where all variables are defined as in equation 2, but T_i varies according to the four definitions above.

Figure 14 presents the results of this analysis for both the long-term debt-to-asset ratio and the cash-to-asset ratio for zombie firms. As evident from Figure 14, the results remain consistently similar across all four definitions of the treatment indicator. The long-term debt-to-asset ratio (Panel a) exhibits a persistent increase following the bailouts, regardless of how the treatment group is defined. Similarly, the cash-to-asset ratio (Panel b) demonstrates a consistent decrease across all treatment definitions.

The stability of these results across varying thresholds of exposure to bailed-out banks reinforces the robustness of my main findings. It suggests that the observed effects of bank bailouts on corporate financing policies are not sensitive to the specific cut-off point used to define treatment.

8.4 Mechanism and robustness with alternative treatment definitions

In this section, I replicate the analyses conducted in Section 5 using alternative definitions of treatment and control groups. I conduct robustness checks with two different treatment group definitions. The first alternative, referred to as "double treatment," consists of firms affected by both the 1997 and 1998 rounds of recapitalization (twice-treated), while the control group comprises firms never impacted by recapitalization (never-treated), as explained in Section 6.4. The second alternative, termed "above-median treatment," includes firms whose exposure to the second recapitalization exceeds the median of positive Exposure Intervention_i.[16] Using these alternative definitions, I re-examine the responses of retained earnings-to-asset ratio, the probability of maintaining relationships with key lenders, and

[16] This corresponds to the third case of treatment with varying exposure thresholds in Section 8.3.

the probabilities of eventual delisting from the stock exchange and of eventual bankruptcy.

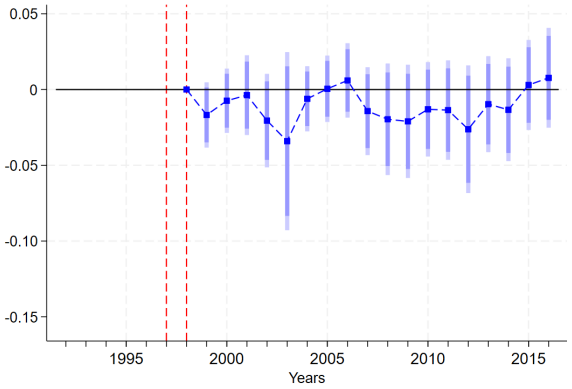
Figure 15 presents the results for the retained earnings-to-asset ratio under these alternative treatment definitions. Panels (a) and (b) show the responses for non-zombie and zombie firms with double treatment, while panels (c) and (d) display the responses for non-zombie and zombie firms with above-median treatment, respectively. Consistent with the main analysis, a decrease in this ratio is observed only for zombie firms under both alternative treatment definitions.

To further explore the underlying mechanism of these changes, I re-estimate the probability of firms maintaining relationships with their three most significant lenders from the pre-bailout period (1992-1996) using both alternative treatment definitions. Figure 16 presents these results. The findings are consistent with the earlier conclusions: zombie firms under both alternative treatment definitions exhibit a higher likelihood of maintaining key banking relationships compared to their untreated counterparts. In contrast, non-zombie firms show a smaller difference between treated and untreated groups in maintaining these relationships.

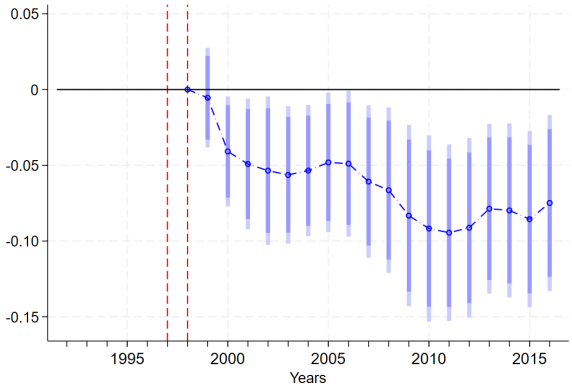
I also re-estimated the impact of bailout exposure on firm delisting and bankruptcy probabilities using the alternative definitions of the treatment group. The results are largely consistent with those obtained using the baseline treatment indicator. For both alternative definitions of treatment, I find no statistically significant effect on the probability of delisting, mirroring the null results observed in the main analysis. Regarding bankruptcy probability, the results show a positive effect similar to the baseline findings, although the effect is not statistically significant under these alternative specifications.

In conclusion, these additional analyses using alternative definitions of treatment and control groups consistently support the main findings of this study. The results underscore the persistent impact of bank bailouts on corporate financing policies, particularly for zombie firms, across varying definitions of treatment intensity. The consistency observed across different methodological approaches and sample definitions reinforces the robustness of the conclusions regarding the long-term effects of bank bailouts on corporate financing behavior.

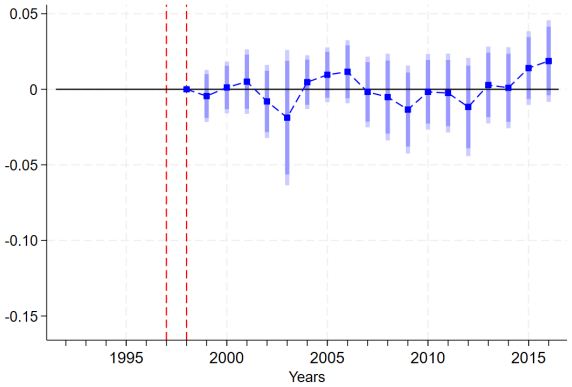
Figure 15: Retained earnings responses under alternative definitions of treatment



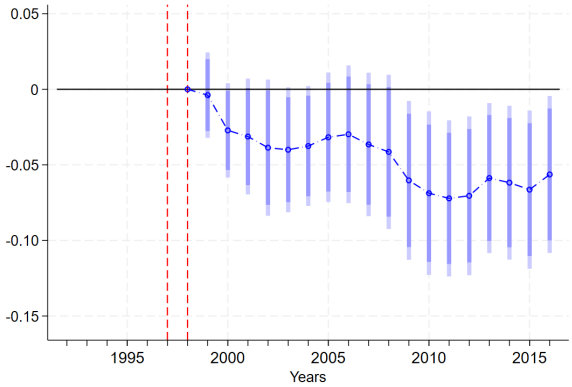
(a) Retained earnings/TA for non-zombie firms: double treatment



(b) Retained earnings/TA for zombie firms: double treatment



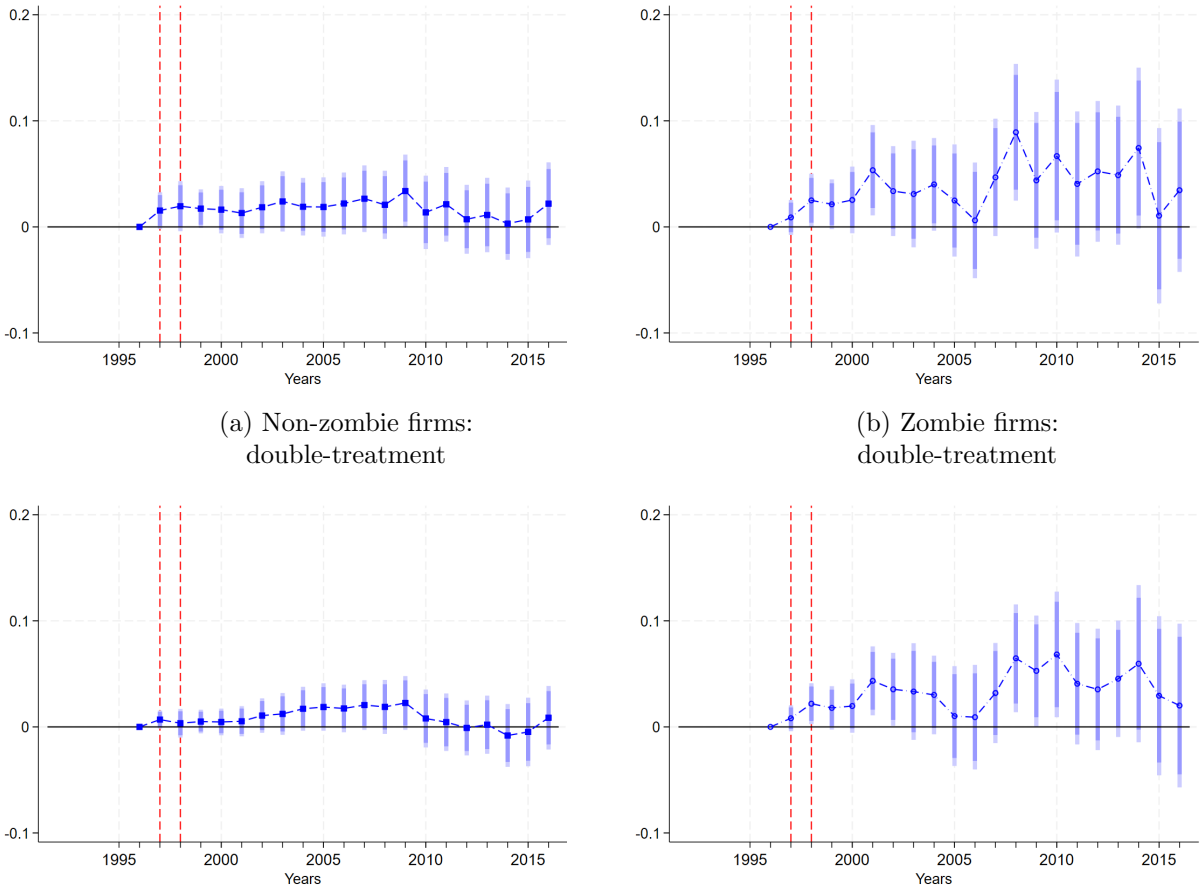
(c) Retained earnings/TA for non-zombie firms: above-median treatment



(d) Retained earnings/TA for zombie firms: above-median treatment

Notes. The figure shows the coefficients on the interaction term between the treatment indicator and the year fixed effect, $\widehat{\beta}_t$ for $t = 1992 \ldots 2016$, using equation 2, where the dependent variable is retained earnings over total assets for non-zombie firms (panels a and c) and zombie firms (panels b and d). The base year is 1996. Panels (a) and (b) use firms affected by both the first and second rounds of recapitalization in 1997 and 1998 (double-treatment) as the treatment group. Panels (c) and (d) use firms whose exposure intensities to bailouts exceed the median of positive intensities (above-median treatment). Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets and log of employees). The bank bailouts occurred in 1997 and 1998. The dark shaded area represents 90% firm-cluster-robust confidence intervals, and the lightly shaded area represents 95% intervals. All years shown are fiscal years.

Figure 16: Probability of retaining banking relationships with alternative definitions of treatment



(a) Non-zombie firms: double-treatment

(b) Zombie firms: double-treatment

(c) Non-zombie firms: above-median treatment

(d) Zombie firms: above-median treatment

Notes. The figure shows the coefficients on the interaction term between the treatment indicator and the year fixed effect, $\widehat{\beta}_t$ for $t = 1997 \ldots 2016$, using equation 3. The dependent variable is an indicator for whether a firm maintains at least one of its top 3 banks from the pre-bailout period (1992-1996) for non-zombie firms (panels a and c) and zombie firms (panels b and d). Panels (a) and (b) use firms affected by both the first and second rounds of recapitalization in 1997 and 1998 (double-treatment) as the treatment group. Panels (c) and (d) use firms whose exposure intensities to bailouts exceed the median of positive intensities (above-median treatment). The 'top 3 banks' are defined as the three financial institutions from which a firm had the largest outstanding debt balances. The base year is 1996. Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets and log of employees). The bank bailout occurred in 1997 and in 1998. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years.

Table 4: Impact of bailout exposure on firm delisting and bankruptcy probabilities using alternative definitions of the treatment groups

	Treatment Definition: Double			
	Unlisted		Bankruptcy	
	(1)	(2)	(3)	(4)
	Linear Prob. Model	Probit Model	Linear Prob. Model	Probit Model
T_i (Treatment)	-0.007	-0.006	0.012	0.022
	(0.039)	(0.038)	(0.008)	(0.016)
Number of obs.	1045	1045	1045	1045
R^2	0.078	0.057	0.078	0.281

	Treatment Definition: Above-median			
	Unlisted		Bankruptcy	
	(5)	(6)	(7)	(8)
	Linear Prob. Model	Probit Model	Linear Prob. Model	Probit Model
T_i (Treatment)	-0.009	-0.009	0.012	0.015
	(0.028)	(0.028)	(0.008)	(0.010)
Number of obs.	1138	1138	1138	1138
R^2	0.081	0.058	0.074	0.284

Notes. This table presents the marginal effects of injection exposure on firm outcomes by 2017. Columns (1), (2), (5), and (6) show the probability of delisting using linear probability and probit models. Columns (3), (4), (7), and (8) show the probability of bankruptcy using linear probability and probit models. Columns (1)-(4) use the double treatment definition, while columns (5)-(8) use the above-median treatment definition. All models include industry fixed effects and the following control variables from 1998 to 2000: zombie index, log of market capitalization, investment, interest coverage ratio, financial debt over total assets, and cash over total assets. Robust standard errors are in parentheses. The R^2 for probit models is a pseudo-R^2. All years shown are fiscal years.

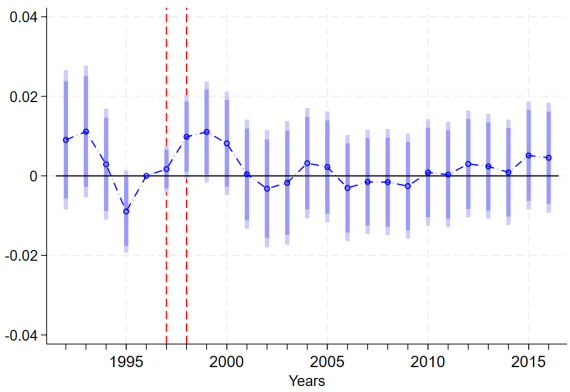
8.5 Response of other relevant variables

I extended the analysis to examine the effects of bailouts on zombie firms' corporate bond-to-asset ratio, investment, and labor productivity (defined as the log of operating profits per employee). These variables provide additional insights into the firms' financial and operational responses to the bailouts beyond the debt and cash ratios examined in the main analysis. For this analysis, I re-estimated equation 2 using each of these variables as the dependent variable. The control variables in $\mathbf{X}_{i,t}$ remained consistent with the main analysis, except when investment was the dependent variable, where I included three lags of investment as additional controls.

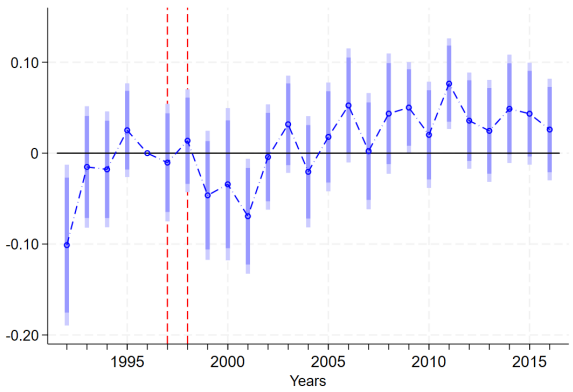
Figure 17 presents the results: Panel (a) shows the response of the bond-to-asset ratio, Panel (b) displays investment response, and Panel (c) illustrates changes in labor productivity. While some statistically significant responses are observed, the patterns are inconsistent, and the timing of these responses does not align clearly with the bailout events.

Given the lack of clear and consistent patterns in these variables that correspond with the timing of the bailouts, it is difficult to conclude that the bailouts caused significant changes in bond issuance, investment behavior, or labor productivity for zombie firms. These findings suggest that the primary effects of the bailouts on zombie firms were concentrated in their debt and cash management strategies, rather than broader operational changes.

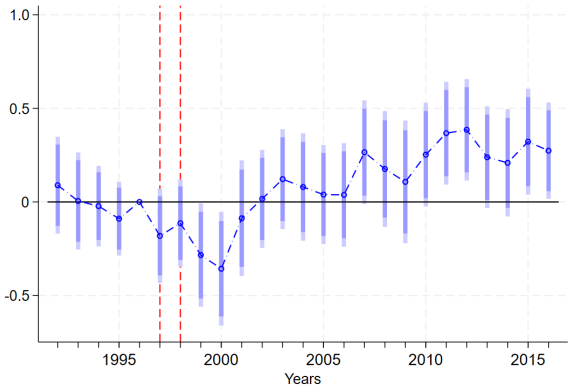
Figure 17: Responses of other variables for non-zombie and zombie firms



(a) Bond/TA for zombie firms



(b) Investment for zombie firms



(c) Labor productivity zombie firms

Notes. The figure shows the coefficients on the interaction term between the treatment indicator and the year fixed effect, $\widehat{\beta}_t$ for $t = 1992 \ldots 2016$, using equation 2. The dependent variables are: outstanding bonds over total assets in Panel (a), investment in Panel (b), and labor productivity (defined as the log of operating profits per employee) in Panel (c). The base year is 1996. Specifications include firm fixed effects, industry-by-year fixed effects, and firm-level covariates (log of total assets and log of employees). For the investment regression, three lags of investment are also included as controls. The bank bailouts occurred in 1997 and in 1998. The dark shaded area represents 90%, and the lightly shaded area 95% firm-cluster-robust confidence intervals, respectively. All years shown are fiscal years.

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