Zombies on the Brink: Evidence from Japan on the Reversal of Monetary Policy Effectiveness*

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April 23, 2025

Abstract

How does unconventional monetary policy affect corporate capital structure and investment decisions? We study the transmission channel of quantitative easing and its potential diminishing returns on investment from a corporate finance perspective. Using a rich bank-firm matched data of Japanese firms with information on corporate debt and investment, we study how firms adjust their capital structure in response to the changes in term premia. Investment responds positively to a reduction in the term premium on average. However, there is a significant degree of cross-sectional variation in firm response: healthier firms increase capital spending and cash holdings, while financially vulnerable firms take advantage of lower long-term yields to refinance with increasing investment.

JEL Classification Numbers: E2, E5, G3

Keywords: Transmission of unconventional monetary policy, Quantitative easing, Reversal rate, Zombie firms, Corporate balance sheet, Term premium, Corporate investment

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1 Introduction

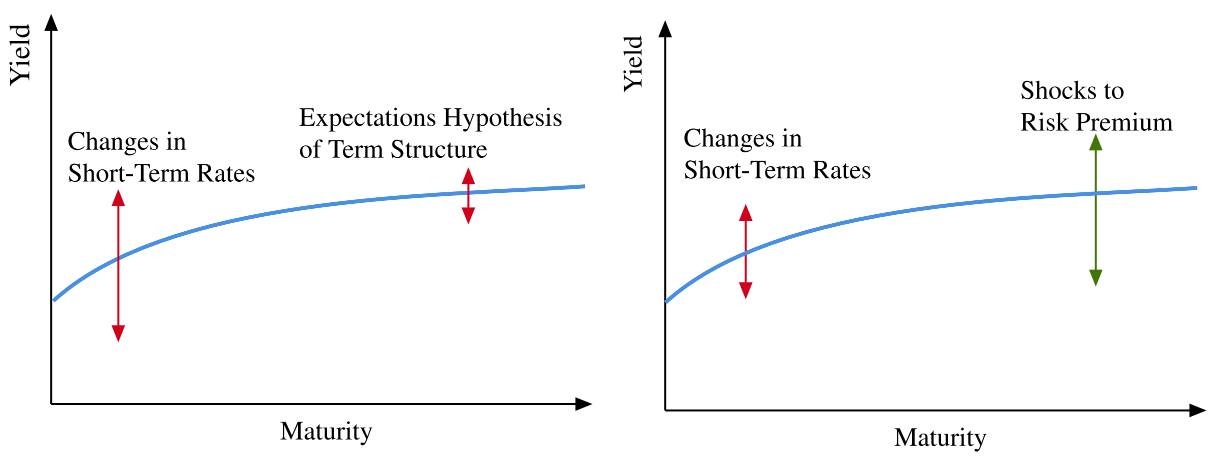
The investment channel of conventional monetary policy is relatively well-understood: a reduction in the nominal interest rate reduces the real interest rate and the user cost of capital, which results in an increase in firm investment. However, our understanding is still evolving when it comes to how unconventional monetary policy affects firms' investment decisions. Does an increase in the size of asset purchases by the central bank lead to an increase in corporate investment? Or, is there a limit as to how much unconventional monetary policy can affect the real economy? In this paper, we propose a corporate finance perspective to assess the effectiveness and the potential limits of unconventional monetary policy by assessing the impact of the change in term premia on firms' corporate structure and investment decisions.

The effectiveness and the transmission channel of unconventional monetary policy have taken a center stage of policy discussions since the outbreak of the COVID-19. Indeed, the COVID-19 pandemic has triggered a global economic crisis of unprecedented magnitude. In the face of this significant challenge, central banks around the globe have taken swift and aggressive measures. With interest rates already close to the effective lower bound and traditional transmission mechanisms impaired, many advanced and some emerging economies have resorted to unconventional monetary policy, particularly quantitative easing (IMF (2020)). While the nearly global surge in inflation in the second half of 2021 led to a sharp reversal of the monetary policy stance, questions remain as to whether pre-pandemic pattern of low inflation and stagnant growth will reinsert itself, prompting central banks to consider the role of unconventional policies under their monetary policy frameworks should they be called to stimulate the economy once again.

How does quantitative easing affect firm's corporate structure and investment decision? One can begin answering this question by first understanding what quantitative easing implies for interest rates and the term structure, relative to conventional monetary policy. In the absence of other factors that affect long-term rates, the change in short-term policy rates stemming from conventional monetary policy affects long-term rates in line with the expectations hypothesis: the yield of long-term bonds should be equal to the current and future expected short-term rates (Figure 1, left panel). In contrast, by design, quantitative easing brings down the long-term rates more than what is predicted by the expectations hypothesis with large-scale asset purchases (Figure 1, right panel). As a result, the term premium—the difference between the long-term bond yield and the expected return of the short-term bonds—is reduced and the yield curve flattens.

The change in the yield curve induced by unconventional monetary policy may have a different impact on firm's capital structure than by conventional monetary policy. For instance, firms can take advantage of the flatter yield curve in several ways. On the one hand, firms can take advantage of the reduced real cost of capital by taking on new investment projects. This channel is analogous to the investment channel of conventional monetary policy. On the other hand, however, if the term premium is squeezed to a certain level, firms can make a risk-free return by taking advantage of the low long-term rates and refinance their debt by replacing short-term debt with long-term debt. The return from refinancing will be the difference between the yield of long-term debt and that of short-term debt. A squeeze in the term premium will increase such return and if the return from the refinancing operation becomes larger than the return from investment, firms will take advantage of the flatter yield curve by refinancing, instead of investing.

Figure 1: Expectations Hypothesis of Term Structure and Term Premium



In this paper, we conduct an empirical analysis to observe if indeed firms respond to the changes in term premia and, if so, how. We use a bank-firm matched dataset of the Japanese firms and study how Japanese firms reacted to the changes in the term premium. The dataset includes rich information on corporate debt structure and capital spending. To control for potential impact of term premium on banks' credit supply, we introduce bank-firm and bank-time fixed effects.

There are several merits in focusing on Japan's experience. First, Japan has a long history of unconventional monetary policy. Unlike other major central banks that adopted quantitative easing in the aftermath of the Global Financial Crisis (GFC), the Bank of Japan introduced its first quantitative easing program in early 2000s. This is beneficial for the empirical analysis as it allows us to study a longer time series. Second, we can test cross-sectional variation in the impact of monetary policy based on cross-sectional variation of firm characteristics, making use of the prevalence of unproductive and insolvent firms (the so-called "zombie firms," Caballero et al. (2008)) in Japan, and shed light on some aspects of the ongoing debate about the extent to which COVID-19—and the associated policy support—may generate zombies (Gagnon (2020)) and how the existence of such firms with low debt capacity may have a bearing on the effectiveness of monetary policy (Lubik and Schwartzman (2020)).

Our findings show an overall positive association between monetary easing and firm investment. However, we document that this investment channel is muted for highly-indebted firms with low interest coverage ratio. Instead, these firms seem to respond to monetary easing by refinancing—they reduce their current liabilities while increasing non-current liabilities. In other words, a reduction in term premia does not necessarily translate into higher investment for both healthy and weak firms: the latter have lower investment compared to healthier firms. Firms also seem to increase their cash holdings and share buybacks. Both healthy and unhealthy firms decrease their total debt by shedding off short-term debt, where a positive net issuance of long-term debt is not large enough to offset the decrease in short-term debt. Financially vulnerable firms decrease their (short-term) debt more so than healthy firms and continue to survive benefiting from the low interest rates despite their low productivity and profits. We are not able to find a "reversal rate" of the term premium where monetary easing starts having a contractionary effect.

Our study builds on an important literature that studies the impact of unconventional monetary policy on the yield curve and term premium. Hanson and Stein (2015) and Swanson (2021) highlight the impact of large-scale asset purchases on the long-end maturity of Treasury bonds through a lowering of the term premium. Recent studies also highlight the impact of monetary policy on long-term rates and the term structure.[1]

In addition, we contribute to the rapidly-growing literature that looks at the potential side-effects of prolonged monetary easing in a low-for-long environment. Brunnermeier and Koby (2018) look at the reversal interest rate where accommodative monetary policy reverses and becomes contractionary as banks start lending less rather than more. Claessens et al. (2018) study the impact of prolonged low interest rates on bank profitability. Studies that are closest to our paper are Cloyne et al. (2018) and Acharya and Plantin (2019) that examine how low interest rates can incentivize firms to lower investment. Banerjee and Hofmann (2018) provide cross-country evidence that low interest rates have resulted in a deterioration of corporate balance sheets and generated more zombie firms.

Finally, we also contribute to the literature documenting that investment behavior closely relates to corporate balance sheet health and exploiting cross-sectional variation in corporate balance sheets to gauge the effectiveness of monetary policy. The first strand shows that debt overhang limits investment, for instance, Caballero et al. (2008) and Kalemli-Ozcan et al. (2018). The second strand links this relationship with the responsiveness to monetary policy actions. For example, Acharya et al. (2019) document zombie lending by banks that remained weakly capitalized even after the ECB outright monetary transactions program and show that firms receiving loans used these funds not to undertake real economic activity, such as employment and investment, but to build cash reserves. Other studies argue that the firm-level response also depends on size (Gertler and Gilchrist (1994)), age (Cloyne et al. 2018), and liquidity (Jeenas (2023)).

The paper is organized as follows. In Section 2, we provide some background summarizing unconventional monetary policy in Japan as well as policy interventions of non-monetary type that affect firm financing patterns, we then motivate our empirical exercise by describing a potential tradeoff between refinancing and investment when the term premium is compressed. In Section 3, we describe the data and the identification strategy. Section 4 presents the empirical findings. Section 5 concludes.

[1]The quantitative impact of monetary policy actions on the yield curve and the channels through which monetary policy actions influence term premia are still being debated. See, for instance, Abrahams et al. (2016), Crump et al. (2016), Gertler and Karadi (2015), Hanson and Stein (2015), Nakamura and Steinsson (2018), and Ramey (2016).

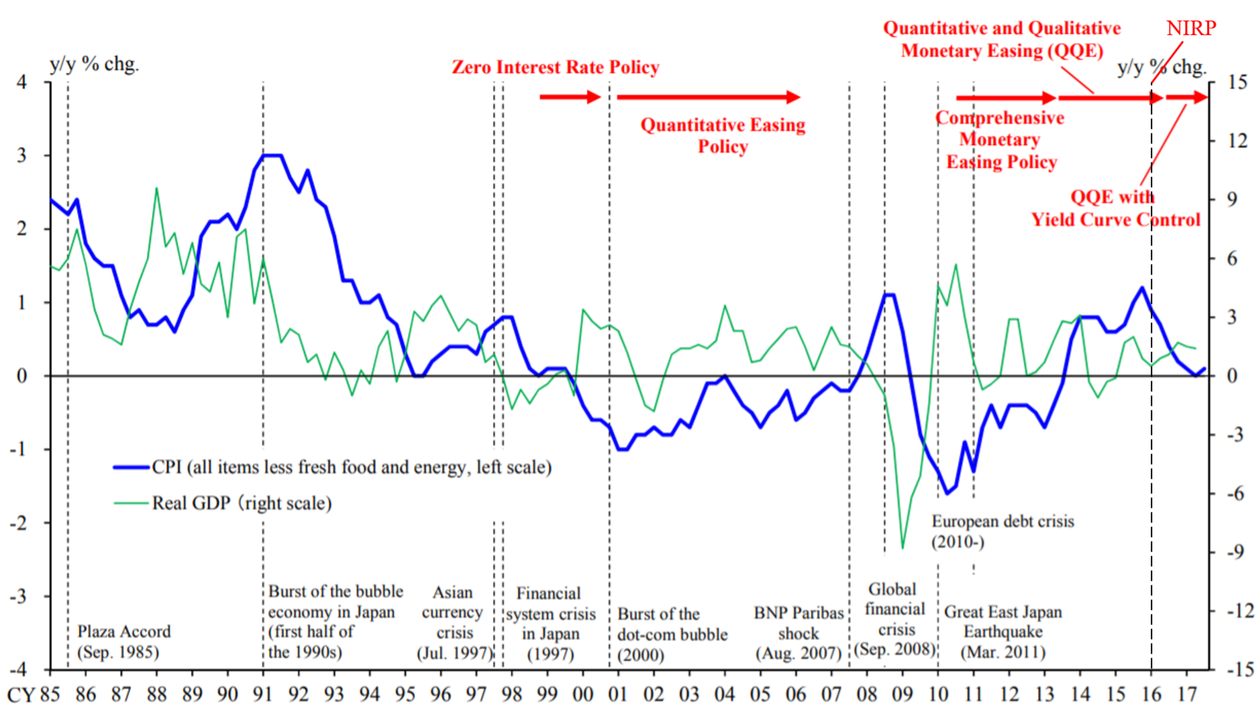
2 Background

In this section, we start by sketching a summary of Japan's monetary policy history with a focus on the Bank of Japan (BoJ)'s introduction of unconventional monetary policy in 2001. In the ensuing subsection, we provide background on cross-sectional variation of corporate balance sheet health in Japan focusing on zombie firms. Here, we explain the institutional background of the credit guarantee scheme in Japan.

2.1 Japan's Experience with Unconventional Monetary Policy

At its inception, unconventional monetary policy in Japan was a tool which only constituted a large-scale asset purchase program. Since the GFC, various forms of unconventional policy tools were introduced, including negative interest rate policy, yield curve control, and forward guidance (Figure 2).[2]

Figure 2: Japan's Long History of Monetary Easing



Note: The CPI figures are adjusted for changes in the consumption tax rate.
Source: Ministry of Internal Affairs and Communications; Cabinet Office.

[2] Westelius (2020) documents various unconventional monetary policies introduced by the BoJ in the past two decades.

Quantitative Easing Policy (QEP) Japan has had a long history with quantitative easing, dating back to March 2001, when the BoJ implemented the QEP as a response to address strong deflationary pressures following a collapse in real estate and stock prices. The QEP consisted of three pillars: (i) to change the main operating target for money market operations from the uncollateralized overnight call rate to the outstanding current account balances (CABs) held by financial institutions at the BoJ, and provide ample liquidity to realize a CAB target substantially in excess of the required reserves, (ii) to make the commitment that the above ample liquidity provision would continue to stay in place until the consumer price index (excluding perishables) registers stably at zero percent or an increase year on year, and (iii) to increase the amount of outright purchases of long-term Japanese government bonds (JGBs), up to a ceiling of the outstanding balance of banknotes issued, should the BoJ consider such an increase to be necessary for providing liquidity smoothly. Initially, the transition of the QEP started with a CAB of ¥5 trillion, compared to the required reserve level of ¥4 trillion. By January 2004, the amount was progressively raised to ¥35 trillion (described in McCauley and Ueda (2009), Berkmen et al. (2012), Dell'Ariccia et al. (2018)). Around November 2005, core CPI inflation turned positive and deflationary concerns subsided. As a result, the BoJ decided to exit the QEP, announcing on March 9, 2006 that the objective of the QEP had been fulfilled. The operating target of money market operations was switched back to the uncollateralized overnight call rate, which was kept at zero percent.

Initial Reaction to the Global Financial Crisis (2009–10) Faced with the GFC against the backdrop of persistent deflation and a policy rate at the lower bound, the BoJ expanded its policy toolkit to include outright purchases of corporate bonds and commercial papers, expansion of outright purchases of JGBs, fixed rate fund supply operations, and a fund provisioning measure to support growth. In October 2010, the BoJ introduced a more aggressive monetary easing called the "comprehensive monetary easing" (CME) policy, which comprised of three elements: (i) a "virtually zero interest rate" policy, (ii) a commitment to maintain zero interest rates until the BoJ judges that price stability is in sight on the basis of its "medium- to long-term understanding of price stability," and (iii) a new asset purchase program, covering corporate bonds, commercial paper, exchange-traded funds (ETFs), and real estate investment trusts (REITs), in addition to government securities, in an effort to reduce term and risk premia. Following the Great East Earthquake in 2011, the BoJ doubled the size of the asset purchase program to ¥10 trillion. As a result, the BoJ's balance sheet, which was already large at about 20 percent of GDP, expanded to roughly 30 percent of GDP.

Abenomics and Quantitative and Qualitative Easing (QQE) In 2012, the new government of Prime Minister Shinzo Abe launched an ambitious economic revitalization plan, often referred to as "Abenomics." Accordingly, in January 2013, the BoJ announced a new monetary policy framework where a 2-percent inflation target, measured as the year-on-year rate of change in the headline consumer price index (CPI), became the price stability mandate. The objective was to pull Japan out of deflation that had afflicted the country for two decades.

On April 4, 2013, the BoJ introduced the QQE and entered a new phase of monetary easing both in terms of quantity and quality, by doubling the monetary base and purchasing of assets including JGBs, ETFs, and REITs. A similar trend was reflected in the reserve balances held at the BoJ by banks. From 2009 onward, long-term bonds held by the BoJ increased exponentially while the holdings of these securities by the banks decreased.

Negative Interest Rate Policy On January 29, 2016, the BoJ decided to implement QQE with a negative interest rate on excess reserve, by introducing a three-tier system where a negative interest rate of minus 0.1 percent was charged to current accounts that financial institutions hold at the Bank. The other two segments of the outstanding balance of a financial institution's current account at the BoJ would be subject to a positive interest rate (applied to the basic balance) and zero interest rate (applied to the macro add-on balance).

Yield Curve Control In September 2016, the BoJ introduced a new framework of "QQE with yield curve control" which consisted of two new components in addition to QQE: (1) "yield curve control" in which the BoJ would control short-term and long-term interest rates and (2) inflation-overshooting commitment in which the BoJ commits itself to expanding the monetary base until the year-on-year rate of increase in the observed CPI exceeds the price stability target of 2 percent and stays above the target in a stable manner.[3]

Forward Guidance The term forward guidance was first introduced in the BoJ's policy statement on July 31, 2018: *"Forward guidance for policy rates. The Bank intends to maintain the current extremely low levels of short- and long-term interest rates for an extended period of time, taking into account uncertainties regarding economic activity and prices including the effects of the consumption tax hike scheduled to take place in October 2019."*[4]

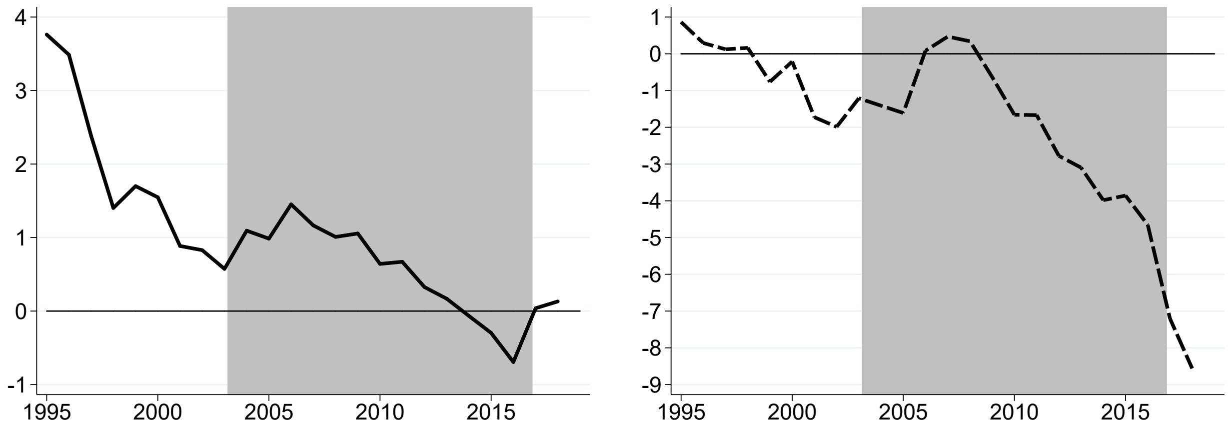
Unconventional monetary policy and benchmarks for financing costs Using the methodology by Kim and Wright (2005), we estimate the term premia for Japan and find that the term premium broadly declined since the mid-1990s (Figure 3). To be sure, the term premium is determined by a multitude of factors (risk preference shocks, global risk factor, external factors, etc) other than monetary policy. However, from the perspective of firms, the term premium, regardless of the driver, is key in the capital structure decision as will be shown in the model section. In addition, we estimate the shadow rate of the policy rate (an indicator that can be informative of monetary policy stance in the presence of the zero-lower bound on nominal interest rates and unconventional policy interventions) using the methodology by Wu and Xia (2016) and see that it declined steadily since the GFC and reached minus 9 percent in 2016. These patterns are broadly consistent with the timing of specific unconventional monetary policy actions. For instance, the end of QEP in 2006 is detectable as a short-lived increase in both the term premium and the shadow rate. Continued and accelerated decline of both indicators after the GFC coincides with the expansion of the policy toolkit and the introduction of QQE.[5]

[3] IMF (2018a), IMF (2018b) discuss the sustainability of the unconventional monetary policy and the yield curve control and potential side-effects of prolonged monetary easing in a low-for-long environment.

[4] For more details on the statement, see https://www.boj.or.jp/en/announcements/release_2018/k180731a.pdf.

[5] Previous studies on Japan mostly confirm that unconventional monetary policy has a significant effect on financial market indicators. The results on the portfolio rebalancing effect of the asset purchase program introduced in the early 2000s are somewhat mixed (Ugai (2007)). For instance, Oda and Ueda (2007) find that the effects of QEP on long-term interest rates (10-year JGBs) were statistically insignificant. In contrast, Kimura and Small (2006) report that the credit spread of high-grade corporate bonds narrowed. For the monetary easing that happened in 2009–10, Lam (2011) and Ueda (2012) find statistically significant impact of unconventional monetary policy on various financial market indicators.

Figure 3: Estimates of the Term Premium and Shadow Rates in Japan



(A) Term Premium (%) **(B)** Shadow Rate (%)

Note: Term-premium estimates use Kim and Wright (2005) methodology. Shadow rate are calculated using Wu and Xia (2016). The shaded areas correspond to the period covered in our sample.
Source: Authors' calculations.

2.2 "Zombie" Firms in Japan

In the seminal papers of Hoshi (2006) and Caballero et al. (2008), the prevalence of the so-called "zombie firms" is well-documented, which resulted in low investment, employment growth, and productivity growth. The continued financing or "evergreening" of loans to insolvent small and medium-sized enterprises (SMEs) by the banks was encouraged by the government and delayed restructuring process of the firms with weak balance sheets. Restructuring efforts continued to be delayed, as documented by Lam and Shin (2012), who show that a great number of Japanese SMEs still faced structural challenges of high leverage and low profitability after the GFC.

An important factor behind the prevalence of zombie firms is Japan's generous public credit guarantee scheme, standing at about 7.2 percent of GDP in 2010. The credit guarantee scheme was introduced first in 1950. For the majority of Japanese firms, except for a few cash-rich firms, loans from banks based on a long-term bank-firm relationship have been the key source of financing (Fukuda (2001)). During the GFC, loans extended by main banks were again the first resort for most Japanese SMEs (Ono and Uesugi (2014)). Credit guarantees have been widely used, with nearly a third of SMEs (about 1.5 million companies) receiving credit guarantees. The system features little risk sharing with extensive loss coverage.[6]

2.3 Investment vs. Financial Restructuring under Aggressive QE

QE flattens the yield curve by lowering long-term yields more than what is expected by the "expectations hypothesis of term structure." Because QE eases financial conditions by reducing the term premium embedded in longer-term rates, policymakers must confront the issue of whether reductions in term premia are as effective in stimulating real activity as reductions in the path of short-term rates. Indeed, a long-standing literature presumes short- and long-term assets to be imperfect substitutes (Tobin (1961), Tobin (1963); Modigliani and Sutch (1966) and Modigliani and Sutch (1967)).

We consider one possible mechanism by which QE may suffer from diminishing marginal returns and have limited impact on capital spending. Specifically, we focus on potential changes to corporations' incentive to pursue capital spending plans when they are facing falling long-term rates that are declining due to monetary actions that work primarily by weighing on the term premium, rather than due to a change in the expected future path of short-term rates.[7]

As discussed in Stein (2012), for a financially constrained firm that finances capital expenditures with debt at the margin, the hurdle rates are the rate on long-term bonds and the expected average rate on a sequence of short-term debt issues. By lowering the term premium embedded in long-term rates, central banks can thus ease the financial constraint for some firms. These firms go on to borrow at the long-term rate to fund new investment projects, while others may not have capacity to take on additional debt and/or projects that would clear the hurdle rate no matter how low it is (e.g., zombies). The latter set of firms may still benefit from a flattening of the yield curve and replace short-term debt with long-term debt. In other words, the response to monetary policy actions that lower the term premium could

[6]Until 2005, guarantee fees were fixed with no link to risk and a 100-percent guarantee was provided without screening' firms' business potential (Yamori (2015)). In 2005, the coverage of guarantees was reduced to 80 percent. Such reform efforts were short-lived, however, as the government re-introduced a 100-percent guarantee scheme after the GFC and the Great East Earthquake in 2011. In April 2018, reform efforts were revived to increase risk-sharing and the coverage was lowered to 80 percent of loans (see Colacelli and Hong (2019) for details). However, the guarantee level was revised up again to 100 percent in response to the COVID-19 pandemic.

[7]Kiley (2014) predicts a differential reaction of spending to changes in term premium versus changes in the future path of short rates.

differ across firms.

Further, as additional rounds of QE further depress the term premium, the willingness of even those firms with healthy balance sheets and profit opportunities to issue long-term debt to fund new projects may diminish. As we have seen (including in the case of Japan), ongoing QE programs eventually alter the supply and demand balance so substantially that the term premium becomes negative. In such an environment, a firm can still benefit from the relatively cheap long-term debt, but the hurdle rate for new investment projects will not fall with the term premium. Instead, the firm now faces an opportunity cost of the expected average short-term rate because it can simply use the proceeds from the new long-term debt to either purchase short-term debt securities or pay down its short-term debt. Consequently, the hurdle rate for investment spending is given by the expected path of short rates even if the central bank reduces long-term rates further by depressing term premia.

To illustrate this point, we consider a simple model motivated by Greenwood et al. (2010) looking at the maturity structure of corporate debt. The model has three periods indexed by $t = 0, 1, 2$. There is a firm that raises k dollars in order to finance its long-term investment. Firm raises a fraction f in default-free long-term debt and $(1 - f)$ in short-term debt. There is a pre-determined 'target' capital structure of the firm so that the firm's optimal level of long-term debt is z. We assume that any deviations from this target leads to quadratic costs defined as $(\theta k(f - z)^2)/2$, where θ is a measure of firm's balance sheet strength. When θ is equal to zero, the firm is perfectly financially unconstrained and indifferent between any maturity structure options. A higher value of θ would imply a weaker balance sheet. The short-term interest rate from $t = 0$ to $t = 1$, r_1, is known at time 0. The short-term rate from time $t = 1$ to $t = 2$, denoted r_2 is random at time $t = 0$, with mean $E(r_2)$ and variance $Var(r_2)$. The default-free long-term bond pays one unit of wealth at time 2 and is traded at price P at time 0.

The firm's objective function is to minimize the sum of expected interest costs and the costs associated with financial constraints. The firm chooses optimal f, f^*, that minimizes:

$$\min \left[k \left((1 - f)(1 + r_1)(1 + E(r_2)) + \frac{f}{P} + \theta \frac{(f - z)^2}{2} \right) \right]$$

The optimal f^* is determined as follows:

$$f^*(P) = z - \frac{P^{-1} - (1 + r_1)(1 + E(r_2))}{\theta}$$

Now suppose the central bank introduces QE. Due to aggressive purchases of long-term bonds by the central bank, the price of the long-term bond increases and leads the term $P^{-1} - (1 + r_1)(1 + E(r_2))$ to decline. Then, it is optimal for firms to increase their long-term debt. In a rough way, this term can be interpreted as the term premium: the difference between the return of the long-term bond and the return of the short-term bonds following the expectations hypotheses. It is straightforward from this equation that a decline in the 'term premium' leads firms to increase issuance of long-term bonds.

In fact, the expected return from issuing a long-term bond is $\frac{f}{P} - \theta\frac{(f-z)^2}{2}$, which is the yield minus the cost of deviating from the optimal capital structure, z. On the other hand, issuance of a short-term bond generates $(1 - f)(1 + r_1)(1 + E(r_2))$. Put differently, if the following inequality holds, it is more profitable for firms to engage in capital restructuring by reducing short-term debt and increasing long-term debt:

$$\frac{f}{P} - \theta\frac{(f - z)^2}{2} \geq (1 - f)(1 + r_1)(1 + E(r_2))$$

Re-arranging the terms delivers a threshold for $E(r_2)$ as follows:

$$E(r_2) \leq \frac{1}{(1 - f)(1 + r_1)}\left(\frac{f}{P} - \theta\frac{(f - z)^2}{2}\right)$$

The intuition is that if the expected return of the short-term debt in the second period is smaller than the threshold value on the right-hand side, the firm is better off increasing the share of long-term debt rather than short-term debt. With a larger value of θ (financially vulnerable firms), the threshold value decreases and the inequality is more likely to bind. If P increases with a higher demand for long-term bonds, for instance, QE, the threshold value also decreases, making it more binding.

In what follows, we take these insights to the Japanese data to explore how firms respond to changes in the term premium by choosing between investment and financial restructuring.

3 Data and Methodology

In this section, we provide details on the data used in this paper before describing some stylized facts for Japanese firms and explaining the empirical model.

3.1 Data Source and Coverage

Our empirical analysis uses two main data sources.

The first dataset is from Nikkei NEEDS FinancialQUEST (FINQUEST). This loan-level dataset reports the total short-term and long-term loans made by each financial institution to both listed and non-listed firms, at an annual frequency for the period from 2004 to 2015. The dataset covers all Japanese financial institutions, including city, trust, regional, and mutual banks, as well as insurance companies and holding companies. All loans are deflated using local currency deflators from the OECD Structural Analysis Database (STAN) and converted to 2005 U.S. dollars using end-of-year 2005 US dollar / national currency exchange rates.

Importantly for our analysis, the FINQUEST dataset features multiple banking relationships for the same firm. In fact, the average firm has banking relationships with about 17 banks in our sample, with less than 1 percent of firms having less than 3 banking relationships. Hence, the data allow us to compare the financing and investment decisions of the same firm that borrows from different banks, whose lending decisions may also be affected by the movement in the term premium. We use the matched bank-firm observations to shut down credit supply effects in a nonparametric way by including bank-firm and bank-time fixed effects in the specification.[8]

The second dataset is from ORBIS, which is provided by Bureau van Dijk (BvD) and covers information on the financial accounts of private and public firms. For our analysis, we select the sample of Japanese firms out of this cross-country database, over the period between 2004 and 2015. We use the historical database to combine firm-level information across annual vintages starting from 2004. We keep unconsolidated accounts only. We drop observations with missing total assets, operating revenue,

[8]Exploiting the richness of the data from the lender side, the same dataset has been used by Amiti and Weinstein (2018) to study the impact of supply-side financial shocks on firm investment by shutting down the credit demand effects.

and employment. We exclude firms with negative total assets, operating revenue, and employment at any year. We exclude from our analysis firms with missing industry information or firms in SIC divisions for finance and public administration. We also drop government-owned firms. The firm-level variables of interest are defined and calculated as follows. The interest coverage ratio (ICR) is the ratio between the firm's earnings before interest and taxes (EBIT) and interest expenses. Size is measured as the log of total assets. Age is defined as the number of years since the year of incorporation of the company. Return on assets (ROA) is measured as the firm's net income to total asset ratio. Leverage is measured with the equity multiplier defined as the ratio between the firm's total assets to total equity. Following Gal (2013) and Kalemli-Ozcan et al. (2015), all nominal variables recorded in US dollars in the original dataset are converted to local currency. They are then deflated using local currency deflators from the OECD Structural Analysis Database (STAN) and converted to 2005 US dollars using end-of-year 2005 US dollar / national currency exchange rates. All firm-level variables are winsorized by (2-digit SIC) industries at the 1-percent level so that extreme values that are below the 1st percentile or above the 99th percentile within each industry's distribution are excluded.

We merge the two sources together based on the firm name reported in both datasets. There is no standardized procedure to link each firm in FINQUEST with the corresponding entry in ORBIS. Therefore, we use a probabilistic record linking algorithm implemented by the *reclink2* program (as used in Wasi and Flaaen (2015)) to match the firm name in FINQUEST to the firm name in ORBIS. The matching rate between FINQUEST and ORBIS is relatively high at 79 percent. Compared to the full FINQUEST data featuring 169,004 loans from 2,772 firms (after dropping duplicates), the dataset merged with ORBIS using the firm name matches includes 128,811 loans from 2,179 firms.

Finally, we also draw from the World Bank World Development Indicators to obtain aggregate information on macroeconomic variables including real GDP growth, unemployment rate, and inflation. As shown earlier in Figure 3, we estimate the term premia for Japan using interest rate data from the IMF's International Financial Statistics and applying the methodology by Kim and Wright (2005).

3.2 Summary Statistics and Stylized Facts

We start with some summary statistics and stylized facts to guide the analysis. We use not only the full sample of firms, including those that enter or exit the sample in various years, but also a balanced sample to ensure that firm entry and exit patterns do not drive the findings. Similarly, the empirical exercise in Section 4.1 uses the full sample but a robustness check with the balanced sample is provided in Section 4.2.

Table 1 presents simple summary statistics on the variables of interest, splitting the sample by high or low ICR, following a commonly applied indicator to identify zombie firms (see, for instance, Caballero et al. (2008)). Firms are mapped to high or low ICR bins based on whether each firm's average ICR over the sample period is above or below the median of distribution of the average ICR across firms. The first rows for each variable report the averages, and the second rows in parentheses report the standard deviations for each group.

On average, low-ICR firms are smaller and younger than high-ICR firms. Firms in the low ICR group are less profitable, with an average ROA of 0.002 compared to 0.047 for high-ICR firms, and more levered, with an average leverage ratio equal to 5.38 compared to 2.77 for high-ICR firms. In terms of the maturity structure of debt, a larger share of the average firm's debt consists of long-term debt and there is no statistically significant difference between low-ICR and high-ICR firms in terms of the share of long-term debt in total debt. On the asset side of the balance sheet, financially healthier firms have more cash and lower tangible fixed assets as a share of total assets. They also have lower share capital but the difference in this case is not statistically significant.

Table 2 reports the industry composition of zombie firms, which we identify based on their operating characteristics that suggest persistent financial vulnerabilities. Specifically, in a given year, we define a firm as a zombie if it had an ICR less than one for the last three consecutive years and is more than ten years old.[9] We choose to measure zombies based on their ICR because doing so allows us to capture subsidized credit or government guarantees to SMEs as possible channels that can keep these financially

[9] Fukuda and Nakamura (2011) defines a zombie firm by creating a proxy for receiving subsidized credit (as in Caballero et al. (2008)) plus two other criteria related to profitability and ever-greening.

Table 1: Summary Statistics

Variable	Low ICR	High ICR	Test statistic
Interest coverage ratio (ICR)	-2.46	53.29	-13.91
	(21.65)	(130.53)	
Size	16.90	18.21	-15.20
	(2.22)	(1.77)	
Age	44.75	49.83	-4.79
	(24.77)	(24.73)	
Return on assets (ROA)	0.20	4.72	-18.08
	(5.53)	(6.14)	
Leverage	5.38	2.77	11.03
	(7.30)	(2.78)	
Long-term debt / Total debt	56.05	57.15	-0.52
	(35.78)	(36.93)	
Short-term debt / Total debt	43.95	42.85	0.52
	(35.78)	(36.93)	
Cash / Assets	19.35	23.02	-2.10
	(18.53)	(20.77)	
Share capital / Assets	20.14	22.11	-1.13
	(21.11)	(21.59)	
Tangible fixed assets / Assets	28.67	24.67	2.11
	(18.61)	(13.86)	

Note: Summary statistics of the main variables based on the full sample of firms from 2004 to 2015. The first rows for each variable report the averages, and the second rows in parentheses report the standard deviations for each group. Firms are mapped to high or low interest coverage ratio (ICR) bins based on whether a firm's average ICR over the sample period is above or below the median of distribution of average ICR across all firms. All variables are winsorized by SIC divisions at the 1 percent level. The test statistic in the last column is for the low-ICR mean minus the high-ICR mean for the corresponding variable. It displays the t-test score for ICR, size, age, ROA, and leverage and the z-test score for the rest of the variables (since the latter are proportions).
Source: FINQUEST and ORBIS Databases; authors' calculations.

vulnerable firms alive. A similar approach has been used to study productivity (Adalet McGowan et al. (2018)) or disinflationary effect of zombie firms (Acharya et al. (2020)). Restricting zombies to older firms is intended to rule out young start-ups that may not be generating earnings just yet and, hence, be difficult to separate from actual zombies just based on their profitability measures.

Under this definition, about 16 percent of firms are identified as zombies across all industries. Zombie firms are quite evenly distributed across industries, with each 2-digit SIC industry having a sizeable share of zombie firms (the larger share for agriculture, forestry, and fishing and mining should be taken with a grain of salt given the very small number of firms our sample has in these industries).

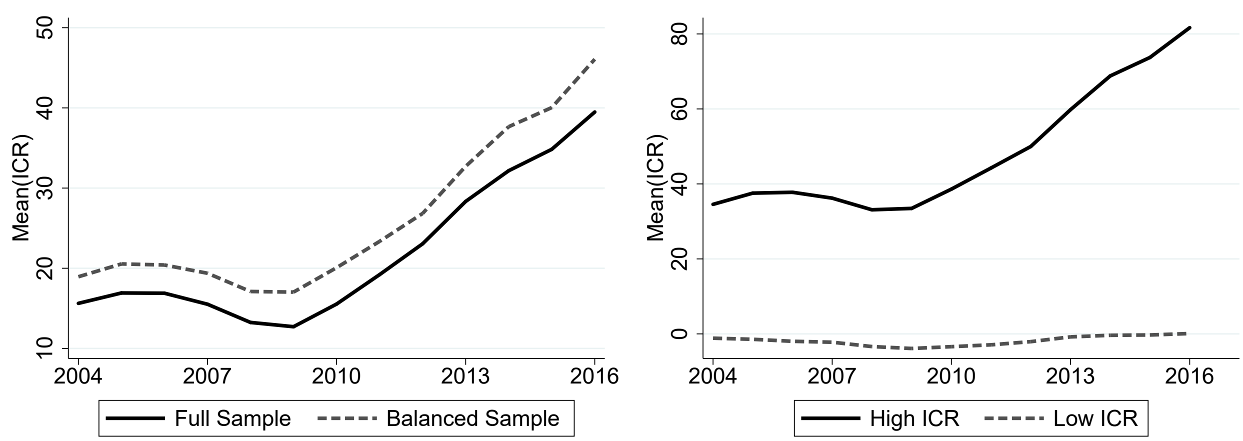
Table 2: Industry Composition of Zombie Firms

Industry (SIC Division)	Total No. Firms	Zombie Share (ICR $<$ 1)	Average ICR	Average Leverage
Agriculture, Forestry, And Fishing	6	0.22	7.89	5.05
Mining	6	0.26	13.54	5.63
Construction	234	0.16	18.32	6.34
Manufacturing	1,022	0.16	22.65	6.85
Transp, Comm, Electric, Gas & Sanitary	128	0.16	23.64	7.65
Wholesale Trade	207	0.15	31.73	6.21
Retail Trade	203	0.18	19.06	7.12
Services	373	0.15	27.22	4.87
Total	2,179	0.16	22.86	6.17

Note: Summary statistics of the main variables based on the full sample of firms from 2004 to 2015. The first rows for each variable report the averages, and the second rows in parentheses report the standard deviations for each group. Firms are mapped to high or low interest coverage ratio (ICR) bins based on whether a firm's average ICR over the sample period is above or below the median of distribution of average ICR across all firms. All variables are winsorized by SIC divisions at the 1 percent level. The test statistic in the last column is for the low-ICR mean minus the high-ICR mean for the corresponding variable. It displays the t-test score for ICR, size, age, ROA, and leverage and the z-test score for the rest of the variables (since the latter are proportions).
Source: FINQUEST and ORBIS Databases; authors' calculations.

Next, we document several stylized facts about the evolution of key items in firm balance sheets.

Figure 4: Rising Interest Coverage Ratio

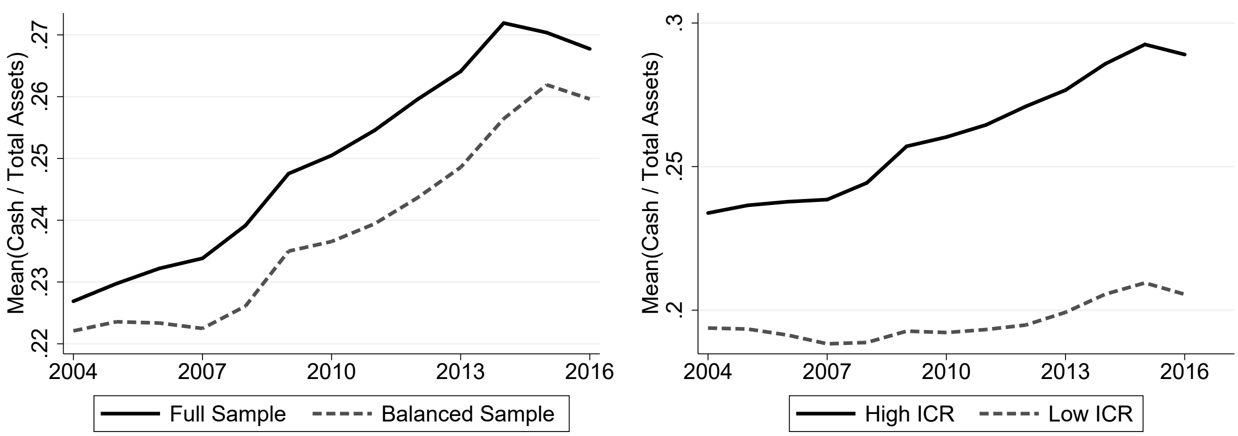


(A) $\text{Mean}_t(\text{ICR}_{it})$ **(B)** High vs. Low ICR (Balanced Sample)

Note: This figure plots the evolution of the Interest Coverage Ratio (ICR) over the sample period from 2004 to 2016. Panel A displays the mean ICR across firms for each year, comparing both the full sample and a balanced sample. Panel B decomposes the balanced sample into firms with high or low ICR and plots the mean cash to total assets ratio separately for the two groups. Firms are categorized into high or low ICR groups based on whether their average ICR over the sample period is above or below the median across all firms.
Source: ORBIS Database.

Figure 4 shows how ICR has evolved over the sample period. Panel A plots the mean ICR across firms for each given year, for both the full sample and the balanced sample. The average ICR was flat in the early part of the sample period but has been increasing in the aftermath of the GFC. The time trend for the full sample closely match the trend for the balanced sample, so the increase in the average ICR is not explained by low-ICR firms exiting the sample. Panel B decomposes this aggregate trend by splitting the balanced sample into firms with high ICR and low ICR. Firms are grouped into high or low ICR bins based on whether a firm's average ICR over the sample period is above or below the median across all firms. The decomposition shows that firms in the high-ICR group are the main drivers of the increasing ICR after the crisis. On the other hand, firms in the low ICR group has had a flat trend in ICR over the entire sample period. This speaks to the persistence of the state of being a zombie firm.

Figure 5: Buildup of Cash

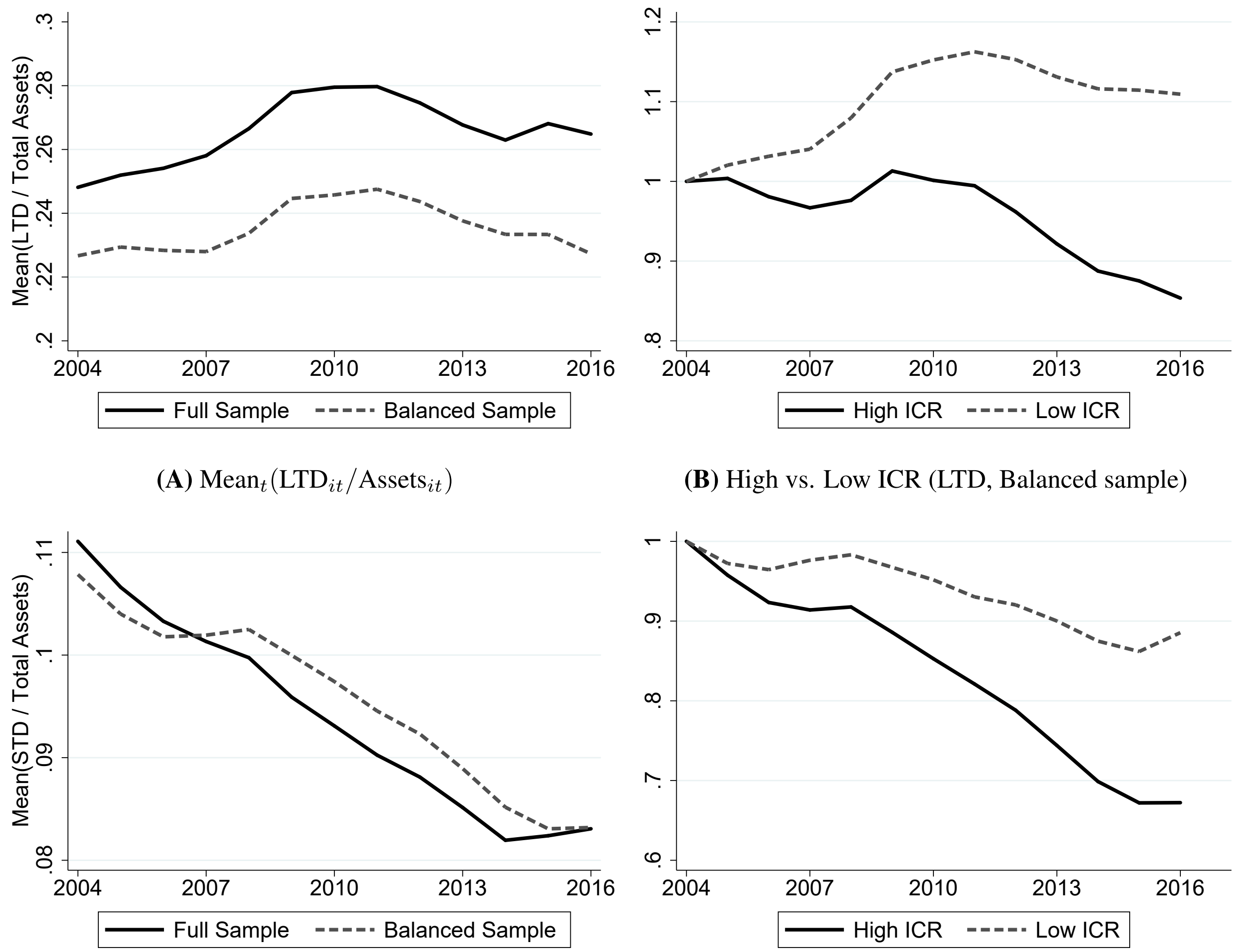


(A) $\text{Mean}_t(\text{Cash}_{it}/\text{Assets}_{it})$ **(B)** High vs. Low ICR (Balanced Sample)

Note: This figure plots the evolution of cash to total assets over the sample period from 2004 to 2016. Panel A displays the mean cash to total assets ratio across firms for each year, comparing both the full sample and a balanced sample. Panel B decomposes the balanced sample into firms with high or low Interest Coverage Ratio (ICR) and plots the mean cash to total assets ratio separately for the two groups. Firms are categorized into high or low ICR groups based on whether their average ICR over the sample period is above or below the median across all firms.
Source: ORBIS Database.

Figure 5 demonstrates that firms' cash holdings have increased over time. Panel A plots the average cash to total assets ratio for each year for the full sample and the balanced sample. In both samples, the trend clearly shows that firms have consistently increased their cash holdings since 2004. Panel B repeats the exercise for high-ICR and low-ICR groups in the balanced sample. The figure shows that the buildup of cash holdings is largely driven by financially healthier firms in the high-ICR group.

Figure 6: Reduction of Debt and Extension of Maturity



(A) $\text{Mean}_t(\text{LTD}_{it}/\text{Assets}_{it})$

(B) High vs. Low ICR (LTD, Balanced sample)

(C) $\text{Mean}_t(\text{STD}_{it}/\text{Assets}_{it})$

(D) High vs. Low ICR (STD, Balanced sample)

Note: This figure plots the evolution of long-term debt to total assets and short-term debt to total assets over the sample period from 2004 to 2016. Panel A displays the mean long-term debt to total assets ratio across firms for each year, comparing both the full sample and a balanced sample. Panel B decomposes the balanced sample into firms with high or low Interest Coverage Ratio (ICR) and plots the mean long-term debt to total assets ratio separately for the two groups. Panels C and D repeat panel A and B for short-term debt to total assets. Firms are categorized into high or low ICR groups based on whether their average ICR over the sample period is above or below the median across all firms.
Source: ORBIS Database.

Figure 6 shows that the buildup of cash coincided with some decline in debt relative to assets, particularly for short-term debt. Panel A plots the average long-term debt to total assets ratio for each year for the full sample and the balanced sample. There is a buildup in long-term debt following the crisis and a relatively slower reduction in subsequent years. Panel B plots the average long-term debt to total assets ratio for the balanced sample after splitting into high-ICR and low-ICR groups. To better visualize the relative changes over time, we normalize the series to equal one in the first year of the sample period. The figure clearly shows that financially vulnerable firms in the low-ICR group have built up long-term debt since the GFC and have not returned to the pre-crisis level. By contrast, financially healthier firms in the high-ICR group have significantly reduced their long-term debt over this same period.

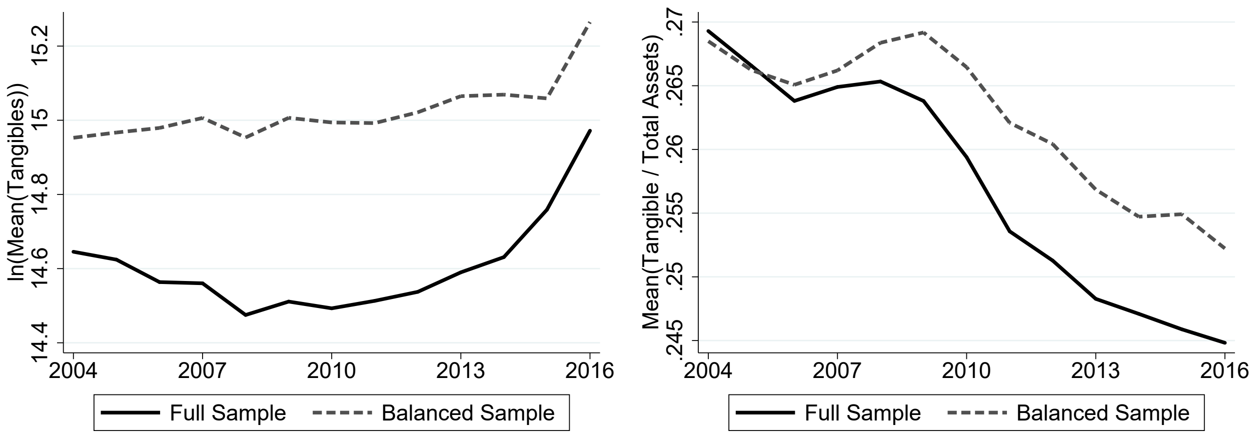
Panel C of Figure 6 plots the average short-term debt to total assets ratio for each year for the full sample and the balanced sample. We observe a strong decrease in short-term debt throughout the sample period. Taken together with the trend in Panel A, this points to some extension of maturity: the average firm seems to keep its long-term debt steady while significantly reducing its short-term debt.

Panel D of Figure 6 plots the average short-term debt to total assets ratio for the balanced sample in high-ICR and low-ICR groups. Similarly to Panel B, to better visualize the relative changes over time, we normalize the series to equal one in the first year of the sample period. Financially healthier firms in the high-ICR group have reduced their short-term debt faster than financially vulnerable firms in the low-ICR group. Compared to the patterns in Panel B, however, firms' reduction of short-term debt has been much faster than their reduction of long-term debt.

Next, we explore a typical firm's capital spending decisions by looking at the evolution of tangible assets. Panel A of Figure 7 plots the average tangible fixed asset for each year for the full sample and the balanced sample. In both samples, the trend shows a drop in capital during the crisis and a subsequent recovery. Panel B plots the average tangible fixed assets to total assets ratio for each year for the full sample and the balanced sample. In both samples, the trend clearly shows that firms have been consistently decreasing their capital as a share of total assets after the crisis.

The stylized facts so far have shown that firms decreased their debt and increased their cash during this extended period of monetary easing. However, this increased liquidity is not necessarily matched by a comparable increase in investment. Next, we turn to regression analysis to understand which patterns survive once we control for a host of other factors.

Figure 7: Falling Capital as a Share of Total Assets



(A) $\ln(\text{Mean}_t(\text{Tangibles}_{it}))$ **(B)** $\text{Mean}_t(\text{Tangibles}_{it}/\text{Assets}_{it})$

Note: This figure plots the evolution of tangible fixed assets over the sample period from 2004 to 2016. Panel A displays the mean tangible fixed assets across firms for each year, comparing both the full sample and a balanced sample. Panel B decomposes the balanced sample into firms with high or low Interest Coverage Ratio (ICR) and plots the mean tangible fixed assets to total assets separately for the two groups. Firms are categorized into high or low ICR groups based on whether their average ICR over the sample period is above or below the median across all firms.
Source: ORBIS Database.

3.3 Empirical Model

In this section, we describe the empirical model and identification strategy to study the link between firm balance sheets and unconventional monetary policy, as captured by movements in the term premium. To characterize the dynamic responses to changes in the term premium, we first examine the liability side of the balance sheet and run the following Jorda (2005)-style local projections:

$$\Delta Y_{i,j,t,t+h} = \alpha^h_{i,j} + \beta^h_1 TP_t + \theta^h_1 X_{i,t} + \theta^h_2 Z_t + \varepsilon^h_{i,j,t} \tag{1}$$

$$\Delta Y_{i,j,t,t+h} = \alpha^h_{i,j} + \beta^h_2(\overline{ICR}_i \times TP_t) + \theta^h_1 X_{i,t} + \theta^h_2(\overline{ICR}_i \times Z_t) + \gamma^h_{s,t} + \delta^h_{j,t} + \varepsilon^h_{i,j,t} \tag{2}$$

for firm i, bank j, year t, and (2-digit) industry-region s, where $h = 1, \ldots, 5$ indexes the horizons of the projection. The dependent variable $\Delta Y_{i,j,t,t+h}$ is the subsequent cumulative growth at horizon h for the following balance sheet variables: debt (total, long-term or LT, and short-term or ST), cash, share capital, and investment. $\overline{ICR}_i$ is the firm's average interest coverage ratio over the sample period and TP_t is the term premium.

$X_{i,t}$ is a vector of controls for firm characteristics and their interactions with TP_t. The firm characteristics include the lagged dependent variable $\Delta Y_{i,j,t-1,t}$, leverage, size, return on assets, and age. We further interact these firm characteristics with TP_t to account for possible interaction effects between the firm-level controls and the term premium. Z_t is a vector of aggregate controls to capture macroeconomic developments including real GDP growth, unemployment rate, and CPI inflation. $\alpha^h_{i,j}$ are bank-firm fixed effects, $\delta^h_{j,t}$ are bank-year fixed effects, and $\gamma^h_{s,t}$ are sector-region-year fixed effects.

The specification in equation (1) is linear with respect to the term premium TP_t. Thus, the coefficient of interest β^h_1 captures the aggregate impact of QE for each projection horizon. We cannot include time fixed effects in this instance given that the variable of interest, TP_t, only varies by time.

Equation (2) captures the differential effect of QE by interacting the term premium with the firm's average interest coverage ratio $\overline{ICR}_i$. The coefficient of interest is β^h_2, which measures how the firm's responsiveness to QE depends on the level of the firm's financial vulnerability. We use $\overline{ICR}_i$ as a cross-sectional measure to identify firms that are more or less exposed to the dynamics described in Section 2. $\overline{ICR}_i$ is scaled to have unit variance so that the coefficients report the impulse response to a one standard deviation change. The aggregate controls are absorbed by the bank-year fixed effects. We also control for $\overline{ICR}_i \times Z_t$ to account for any possible interactions between the firm's financial vulnerability and macroeconomic factors.

In estimating equations (1) and (2), we measure the cumulative change in debt (total, long-term, or short-term) $\Delta Y_{i,j,t,t+h}$ over year t to t+h for firm i and bank j as

$$\Delta Y_{i,j,t,t+h} = \frac{Y_{i,j,t+h} - Y_{i,j,t}}{0.5 \times Y_{i,j,t+h} + 0.5 \times Y_{i,j,t}} \tag{3}$$

where $Y_{i,j,t}$ and $Y_{i,j,t+h}$ are the values of debt at year t and $t+h$, respectively. The cumulative changes calculated with this method have been used widely given its advantage of being symmetric and bounded by -200 percent (exit) and 200 percent (entry) while also being equal to zero for bank-firm relationships that do not exhibit variation over time (Haltiwanger et al. (2013); Berton et al. (2018)).

Standard errors are two-way clustered by bank and year to account for correlation within banks and within years. For our baseline specifications, we estimate the equations on the full sample of firms that enter or exit from the sample in various years, and hence are closer to the full coverage of Japanese firms. We confirm the robustness of the results to using the balanced sample later.

Our identification strategy exploits the granular nature of the bank-firm matched data. By saturating the empirical specification with bank-firm, bank-year, and sector-region-year fixed effects as well as including a battery of controls for firm characteristics and time-varying macroeconomic indicators, we can isolate the response of firm liabilities to changes in the term premium as induced by monetary policy actions.

Turning to the asset side of the balance sheet, we conduct the analysis at the firm level. Specifically, we consider the following firm-level specifications:

$$\Delta Y_{i,t,t+h} = \alpha_i^h + \beta_1^h TP_t + \theta_1^h X_{i,t} + \theta_2^h Z_t + \varepsilon_{i,t}^h \tag{1$'$}$$

$$\Delta Y_{i,t,t+h} = \alpha_i^h + \beta_2^h (\overline{ICR}_i \times TP_t) + \theta_1^h X_{i,t} + \theta_2^h (\overline{ICR}_i \times Z_t) + \gamma_{s,t}^h + \delta_t^h + \varepsilon_{i,t}^h \tag{2$'$}$$

for firm i, year t, and (2-digit) industry-region s, where $h = 1, \ldots, 5$ indexes the horizons of the projection. The dependent variable $\Delta Y_{i,t,t+h}$ is the subsequent cumulative growth at horizon h for the following balance sheet variables: cash holdings, share capital, and tangible fixed assets (a proxy for investment).

As before, $\overline{ICR}_i$ is the firm's average interest coverage ratio over the sample period and TP_t is the term premium. Also as before, $X_{i,t}$ is a vector of controls for firm characteristics and their interactions with TP_t. The firm characteristics include the lagged dependent variable $\Delta Y_{i,t-1,t}$, leverage, size, return on assets, and age. We further interact these firm characteristics with TP_t to account for possible interaction effects between the firm-level controls and the term premium. Z_t is a vector of aggregate controls in macroeconomic variables including real GDP growth, unemployment rate, and inflation.

α_i^h are firm fixed effects and $\gamma_{s,t}^h$ are sector-region-year fixed effects. So, our identification strategy again relies on saturating the specifications with as many fixed effects and controls as we can. Standard errors two-way clustered by firm and year to account for correlation within firms and within years.

4 Results

4.1 Main Findings

In this section, we present the empirical results from the specifications laid out in Section 3.

4.1.1 Restructuring Towards More Long-Term Debt

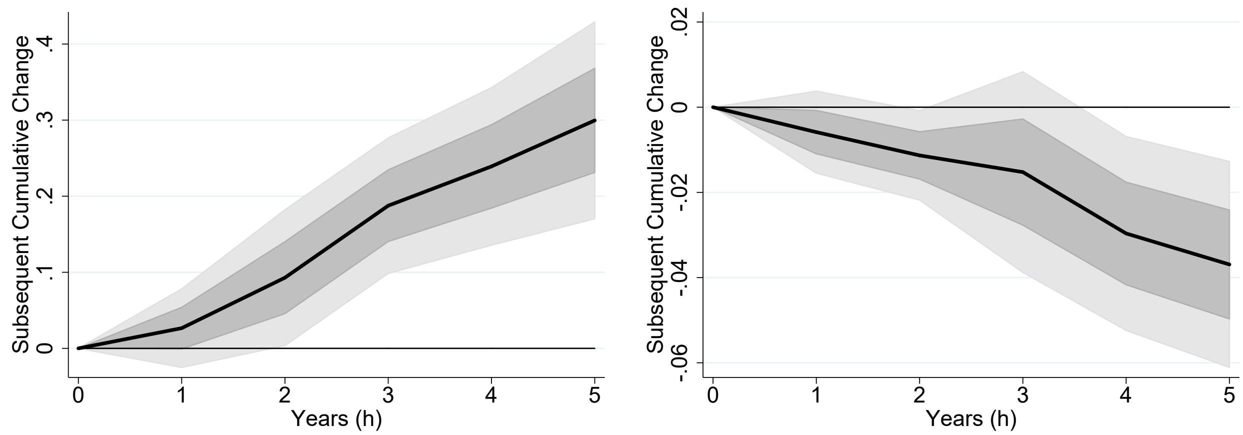
Figure 8 explores the relationship between total debt and monetary policy changes. Panel A estimates the average effect of a change in the term premium. Total debt increases following monetary contraction (an increase in the term premium). A one percentage point increase in the term premium leads to a 2.7 percent higher total debt upon impact, further increasing to 9.3 percent after two years and cumulating up to a 30 percent response by year 5.

This may seem counterintuitive if one interprets it as credit becoming *less* available with monetary easing. An alternative interpretation would be that the accommodative impact of monetary policy works on the intensive rather than the extensive margin. In other words, the level of outstanding debt may decline but financial conditions are relaxed as credit becomes cheaper and firms are able to refinance in favorable terms and retire more expensive debt. This seems to be the case in Japan, where a large-scale corporate deleveraging has taken coincided with the periods of monetary easing.

Panel B estimates the differential effect to a decrease in the term premium depending on where the firm is located in the $\overline{ICR_i}$ distribution. Firms with lower ICR seem to be reducing debt significantly more than the average firm. Recall that, to make the coefficients easily interpretable, we rescale $\overline{ICR_i}$ over the entire sample into units of standard deviations relative to the sample mean. Hence, Panel B indicates that more financially vulnerable firms with a one standard deviation lower $\overline{ICR_i}$ relative to the average firm further reduce their total debt by 0.6 percent immediately following a one percentage point drop in the term premium. The response cumulates up to a 3.7 percent decrease in total debt by the end of the projection horizon.

One way to assess the economic significance of the estimated interaction coefficients in Panel B is to compare them with the average effect of monetary easing in Panel A. For example, comparing the

Figure 8: Dynamic Response of Total Debt



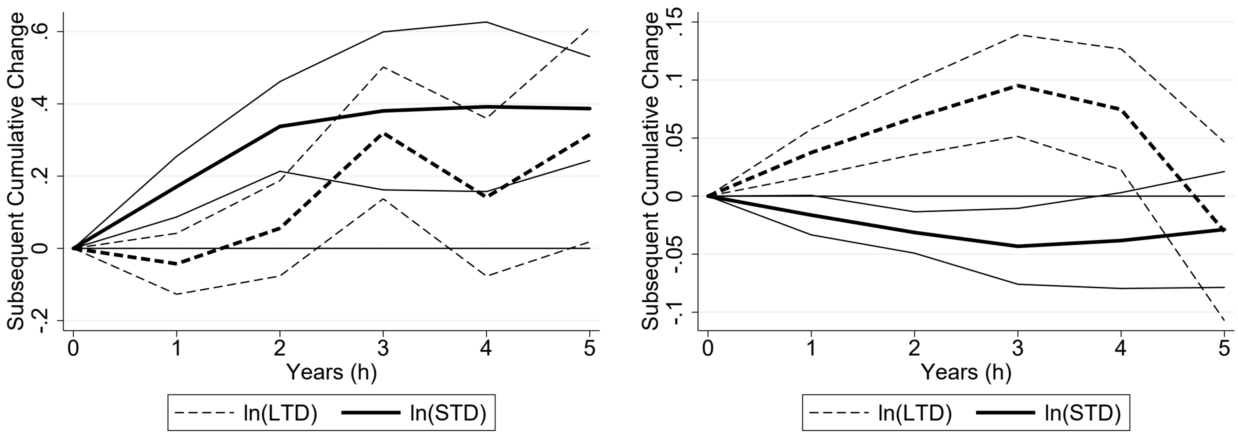
(A) β_1^h from equation (1) **(B)** β_2^h from equation (2)

Note: Firm-level responses to a 1 percentage point increase in the term premium (contractionary). The plots show the coefficients β_1^h and β_2^h of a local projection model estimated at the bank-firm level using equation (1) and (2), over different horizons of $h = 1, \ldots, 5$. The dependent variable is the cumulative change in the firm's total debt as calculated by equation (3). We rescale $\overline{ICR}_i$ over the entire sample into units of standard deviations relative to the sample mean. Standard errors are two-way clustered by bank and year. Lightly shaded areas plot the 95 percent confidence interval; darker shaded areas plot the 85 percent confidence interval.
Source: FINQUEST and ORBIS Databases, authors' estimates.

point estimates of β_1^5 and β_2^5 suggests that, for five years after impact, a firm with an $\overline{ICR}_i$ one standard deviation lower than the average has a response to monetary easing that is 12.3 percent larger than the response of the average firm.

To explore how firms react to the refinancing motive as aggressive QE pushes down the term premium, we decompose the firms' total debt into a sum of short-term debt and long-term debt. Figure 9 presents the results. Panel A shows that firms reduce both components of their debt after monetary easing. On average, firms decrease their short-term debt and long-term debt by 38.7 percent and 31.5 percent, respectively, after three years following a one percentage point decrease in the term premium. Panel B demonstrates the heterogeneity in this response. Less healthy firms are more likely to react to the refinancing motive reinforced by prolonged monetary easing. Financially vulnerable firms with a one standard deviation lower $\overline{ICR}_i$ further decrease their short-term debt by 1.6 percent immediately following a one percentage point drop in the term premium. The response reaches its peak after three years with a 4.3 percent decrease in short-term debt. The same financially vulnerable firms also further decrease their long-term debt by 3.8 percent immediately following a one percentage point drop in the

Figure 9: Long-Term Debt vs. Short-Term Debt



(A) β_1^h from equation (1) **(B)** β_2^h from equation (2)

Note: Firm-level responses to a 1 percentage point increase in the term premium (contractionary). The plots show the coefficients β_1^h and β_2^h of a local projection model estimated at the bank-firm level using equation (1) and (2), over different horizons of $h = 1, \ldots, 5$. The dependent variable is the cumulative change in the firm's short-term debt (STD; dashed line) and long-term debt (LTD; solid line) as calculated by equation (3). We rescale $\overline{ICR}_i$ over the entire sample into units of standard deviations relative to the sample mean. Standard errors are two-way clustered by bank and year. The thinner lines around the point estimates plot the 95 percent confidence interval.
Source: FINQUEST and ORBIS Databases, authors' estimates.

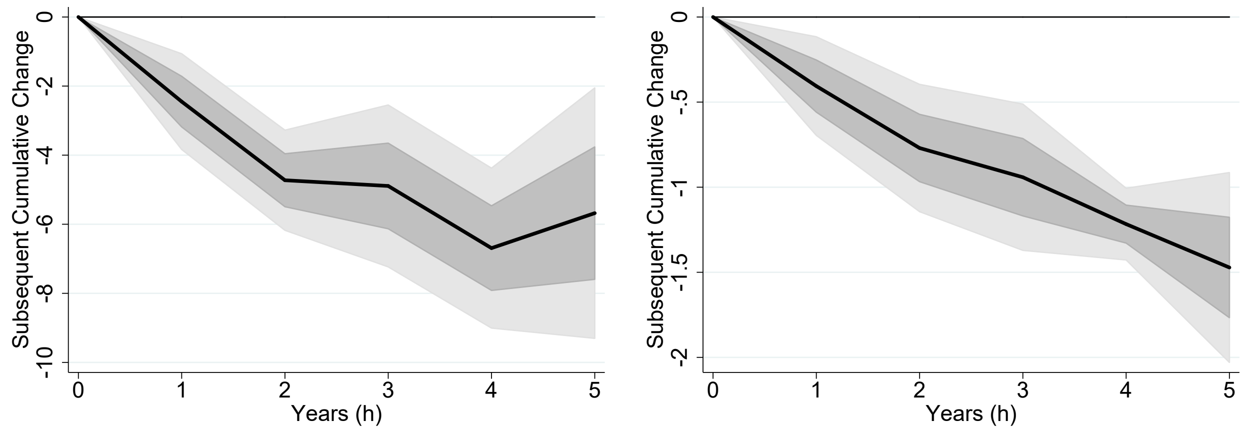
term premium, cumulating up to a 9.5 percent decrease in long-term debt at its peak in year 3.

Relative to the average effect, a firm with an $\overline{ICR}_i$ one standard deviation lower than the average firm has a 11.1 percent larger response in short-term debt, while the response in long-term debt is 30.1 percent lower than the response of the average firm. Taking the two sets of estimates together, the results suggest that less healthy firms with lower $\overline{ICR}_i$ are engaging in capital restructuring by increasing their mix of long-term debt relative to short-term debt.

4.1.2 Hoarding Cash and Buying Back Shares

The results so far show that firms reduce their debt following rounds of aggressive monetary easing, with particularly large reductions for financially vulnerable firms, but they also replace more expensive short-term debt with cheaper long-term debt. The next question to ask is how firms use the financial room created by these refinancing operations. A natural way to proceed is to examine the average and differential effect of monetary policy on the asset side of the balance sheet. For this, we estimate equations (1′) and (2′) at the firm level.

Figure 10: Cash Holdings



(A) β_1^h from equation (1′) **(B)** β_2^h from equation (2′)

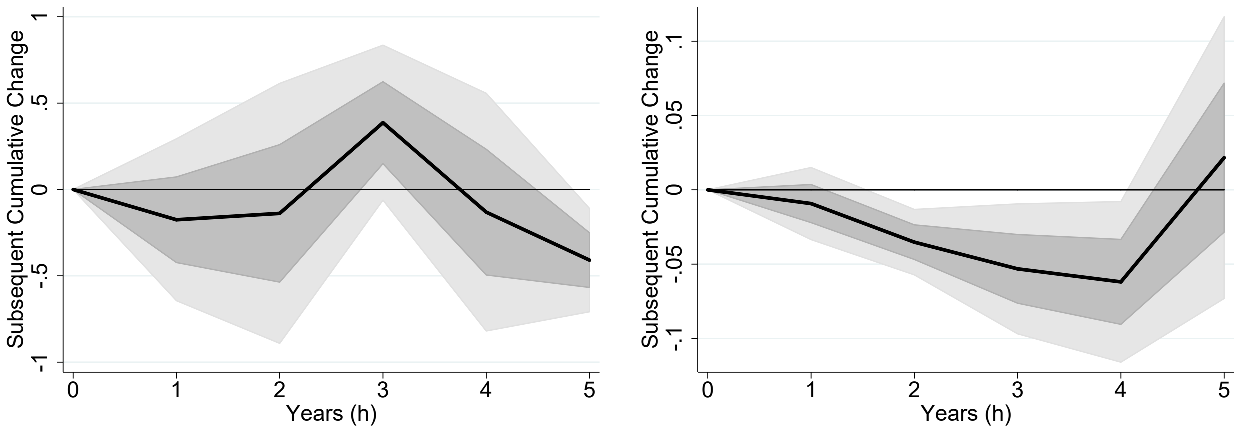
Note: Firm-level responses to a 1 percentage point increase in the term premium (contractionary). The plots show the coefficients β_1^h and β_2^h of a local projection model estimated at the firm level using equation (1′) and (2′), over different horizons of $h = 1, \ldots, 5$. The dependent variable is the subsequent cumulative change in the firm's cash and cash equivalents as a share of total assets (in percent). We rescale $\overline{ICR}_i$ over the entire sample into units of standard deviations relative to the sample mean. Standard errors are two-way clustered by firm and year. Lightly shaded areas plot the 95 percent confidence interval; darker shaded areas plot the 85 percent confidence interval.
Source: ORBIS Database, authors' estimates.

We first look at cash holdings. Figure 10 shows the firm-level response in the cash to total asset ratio (in percent). Panel A shows that firms build up more cash holdings following monetary easing. On average, firms increase their cash to total asset ratio by 2.5 percentage point immediately following a one percentage point decrease in the term premium. By the end of the projection horizon, the response cumulates to a 5.7 percentage point increase.

The results in Panel B not only confirm a rise in corporate cash holdings but also suggest that this broad trend is mainly driven by firms with high interest coverage ratio. Financially healthier firms with a one standard deviation higher $\overline{ICR}_i$ further increase their cash to total assets ratio by 0.4 percentage points immediately following a one percentage point drop in the term premium, cumulating up to a 1.5 percentage point increase in the cash to total assets after five years. To put these estimates into perspective, a firm with an $\overline{ICR}_i$ one standard deviation lower than the average firm has a response to monetary easing that is 26.3 percent larger than the response of the average firm.

Next, we explore share buybacks. Figure 11 shows the firm-level response in the share capital to total asset ratio. Panel A shows that, on average, firms' share capital to total asset ratio remains mostly

Figure 11: Share Capital



(A) β_1^h from equation (1′) **(B)** β_2^h from equation (2′)

Note: Firm-level responses to a 1 percentage point increase in the term premium (contractionary). The plots show the coefficients β_1^h and β_2^h of a local projection model estimated at the firm level using equation (1′) and (2′), over different horizons of $h = 1, \ldots, 5$. The dependent variable is the subsequent cumulative change in the firm's share capital as a share of total assets (in percent). We rescale $\overline{ICR}_i$ over the entire sample into units of standard deviations relative to the sample mean. Standard errors are two-way clustered by firm and year. Lightly shaded areas plot the 95 percent confidence interval; darker shaded areas plot the 85 percent confidence interval.
Source: ORBIS Database, authors' estimates.

flat following a change in the term premium.

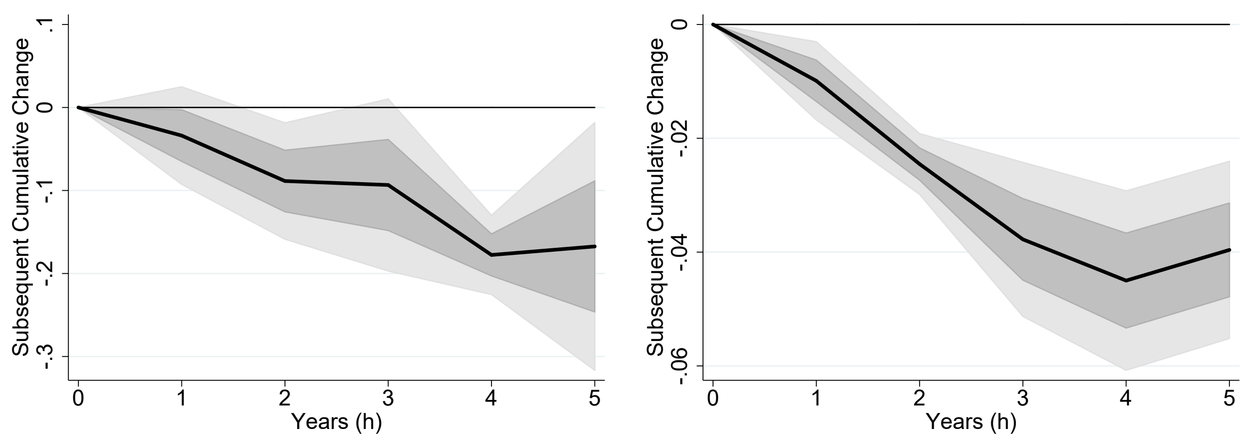
That said, Panel B shows that there is significant heterogeneity in the way firms treat their share capital. The results suggest that the same firms that are building up their cash holdings are also accumulating more share capital. Financially healthier firms with one standard deviation higher $\overline{ICR}_i$ further increase their share capital to total assets following a one percentage point drop in the term premium. The increase reaches its peak after four years with an increase in the share capital to total assets ratio by 0.06 percentage points. These findings are in line with firms buying back shares to reduce their cost of financing.

Taken together, firms seem to react to monetary easing by reducing their debt and extending its maturity while building up liquid assets (the latter applies primarily to healthier firms). Do these balance sheet changes on the asset side then mean that the financial room generated on the liability side translate to a comparable increase in capital spending? This is the question we turn to next.

4.1.3 Less Investment by Firms More Prone to Refinancing Incentives

Figure 12 presents the firm-level response in the level of tangible fixed assets. Overall, there is a weakly positive relationship between monetary easing and firm investment. Panel A shows that on average, firms' capital increase following a decrease in the term premium. A one percentage point drop in the term premium leads to a 3.4 percent immediate increase in tangible fixed assets and cumulates to a 16.7 percent increase by year 5.

Figure 12: Tangible Fixed Assets (Level)

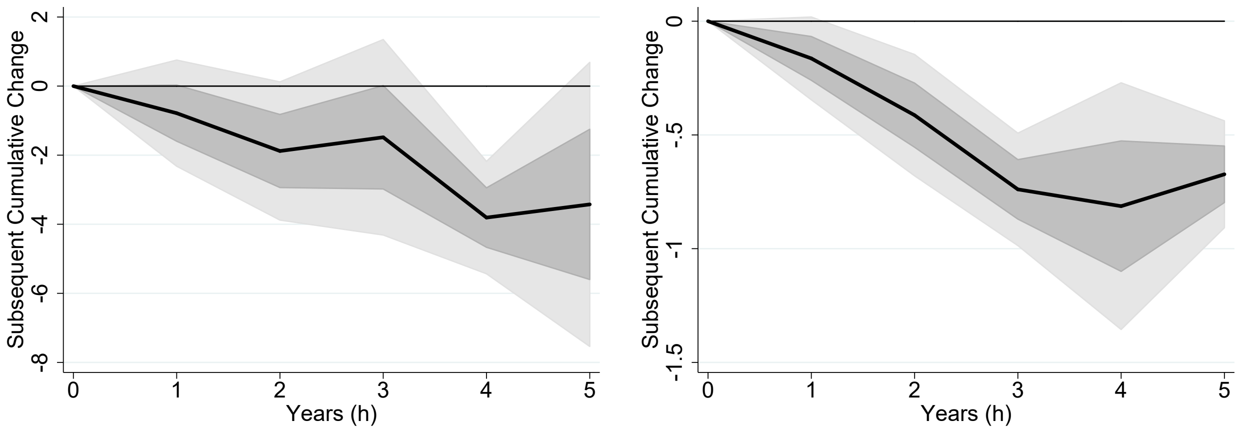


(A) β_1^h from equation (1′) **(B)** β_2^h from equation (2′)

Note: Firm-level responses to a 1 percentage point increase in the term premium (contractionary). The plots show the coefficients β_1^h and β_2^h of a local projection model estimated at the firm level using equation (1′) and (2′), over different horizons of $h = 1, \ldots, 5$. The dependent variable is the subsequent cumulative change in the firm's tangible fixed assets (in log). We rescale $\overline{ICR}_i$ over the entire sample into units of standard deviations relative to the sample mean. Standard errors are two-way clustered by firm and year. Lightly shaded areas plot the 95 percent confidence interval; darker shaded areas plot the 85 percent confidence interval.
Source: ORBIS Database, authors' estimates.

Panel B of Figure 12 suggests, however, that this investment channel of QE is less effective for less healthy firms. Financially vulnerable firms with one standard deviation lower $\overline{ICR}_i$ has approximately 1 percent lower tangible fixed assets immediately after a one percentage point drop in the term premium. By year 5, these financially vulnerable firms have 4 percent lower tangible fixed assets relative to the average firm. To put these estimates into perspective, a firm with an $\overline{ICR}_i$ one standard deviation lower than the average firm has a response to monetary easing that is 24 percent lower than the response of the average firm by year 5.

Figure 13: Tangible Fixed Assets (Percent of Total Assets)



(A) β_1^h from equation (1′) **(B)** β_2^h from equation (2′)

Note: Firm-level responses to a 1 percentage point increase in the term premium (contractionary). The plots show the coefficients β_1^h and β_2^h of a local projection model estimated at the firm level using equation (1′) and (2′), over different horizons of $h = 1, \ldots, 5$. The dependent variable is the subsequent cumulative change in the firm's tangible fixed assets as a share of total assets (in percent). We rescale $\overline{ICR}_i$ over the entire sample into units of standard deviations relative to the sample mean. Standard errors are two-way clustered by firm and year. Lightly shaded areas plot the 95 percent confidence interval; darker shaded areas plot the 85 percent confidence interval.
Source: ORBIS Database, authors' estimates.

One could think that those firms with more financial restructuring would be the ones increasing capital spending but we find the opposite: financially vulnerable firms take greater advantage—more so than their less vulnerable peers—of the accommodative financial conditions but tend to not expand their assets as much as the healthier firms do.

Scaling firm capital by total assets, rather than using the level of fixed assets, further reinforces this finding. Figure 13 shows the firm-level response in the tangible fixed assets ratio. Panel A shows that firm capital increases also as a share of total assets following monetary easing. On average, firms increase their tangibles to total asset ratio by 0.78 percentage points immediately following a one percentage point decrease in the term premium. The response cumulates up to a 3.43 percentage point increase in the tangibles to total assets ratio by the end of the projection horizon.

Panel B of Figure 13 supports the hypothesis that this increasing share of tangibles to total assets is more pronounced for healthier firms. Those with one standard deviation higher $\overline{ICR}_i$ further increase their tangibles to total assets by 0.16 percentage points immediately following a one percentage point drop in the term premium, eventually cumulating up to 0.67 percentage point increase by year 5. To put these estimates into perspective, a firm with an $\overline{ICR}_i$ one standard deviation higher than the average firm has a response to monetary easing that is 20 percent larger than the response of the average firm.

The overall message then appears to be that, although firms decrease their debt and increase their cash holdings following monetary easing, this increased liquidity is not necessarily accompanied by a comparable increase in investment (as captured by tangible fixed assets; in an exercise not reported for the sake of brevity, we look at intangible fixed effects and do not find any statistically significant effects). As a robustness check, we test if the finding holds when firms are categorized into bins based on the level of ICR, rather than the continuous ICR variable used in the previous regressions. For this exercise, we estimate the following empirical specification:

$$\Delta \ln(Tangibles)_{i,t,t+1} = \alpha_i^1 + \sum_{d=1}^{10} \beta_d^1 (TP_t \times \mathbf{1}[\overline{ICR}_i \text{ in decile } d]) + \theta^1 X_{i,t} + \varepsilon_{i,t}^1 \qquad (4)$$

where $\mathbf{1}[\overline{ICR}_i \text{ in decile } d]$ is an indicator variable that takes the value of 1 if the ICR is in decile $d = 1, \dots, 10$.

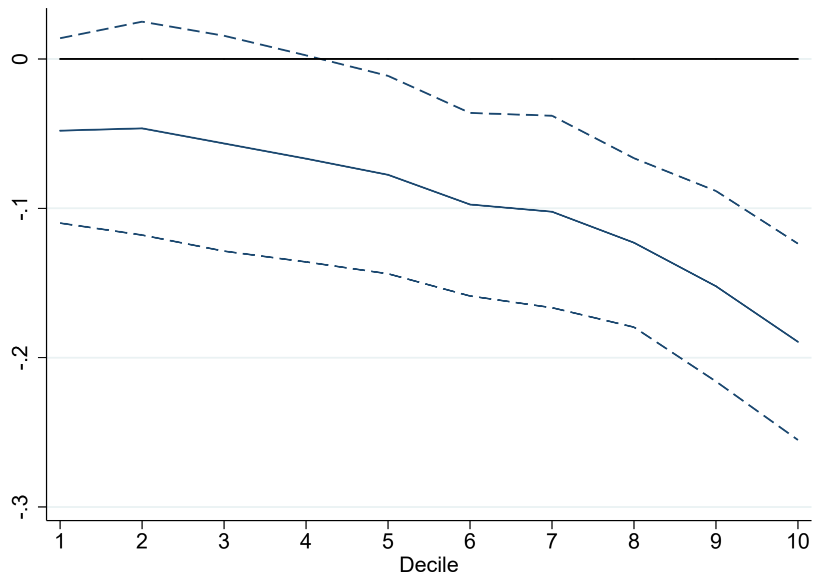
Firms with ICR above the median increase tangible investment when the term premium declines, as the coefficients become negative and significant starting with the 5th bin (Figure 14). The coefficient declines for the higher bins, implying that healthier firms respond more. Firms with ICR below the median (from bin 1 to bin 4), the coefficient is statistically insignificant, indicating that financially weak firms do not increase investment when there is a decline in the term premium.

4.2 Robustness

4.2.1 Results Using the Balanced Sample

First, we confirm the finding that financially vulnerable firms tend to refinance their debt by decreasing short-term debt and increasing long-term debt. We find that one percentage decline in the term premium combined with one standard deviation of decline in ICR results in a decrease of 5 percent in short-term debt and an increase of 8 percent in long-term debt (Figure A1). The size of the responses of long-term and short-term debt is comparable to the results in Section 4.1.

Figure 14: Tangible Investment by Deciles of Average ICR



Note: Firms are placed into ten bins based on their average ICR, the first bin with the lowest average ICR and the tenth bin with the highest average ICR. The coefficients reflect the change in tangible investment to a 1 percentage point increase in the term premium (contractionary). The plots shows the coefficient β_d^1 for each decile bin d using equation (4). Standard errors are two-way clustered by firm and year. Dashed lines plot the 85 percent confidence interval.
Source: ORBIS Database, authors' estimates.

As for the changes in cash holdings, firms build up their cash holdings following monetary easing consistent with our findings using the full sample (Figure A2, Panel A). The finding that financially healthier firms increase corporate cash holdings more so than financially weaker firms is also confirmed (Figure A2, Panel B).

Investment, measured by tangible assets, increases when the term premium declines in the balanced sample (Figure A3, Panel A). One percentage decline of the term premium leads to 18 percentage increase in investment. We also confirm that financially healthier firms increase investment more than financially weaker ones, with a negative and significant estimate for β_2^h (Figure A3, Panel B).

4.2.2 Results Using the Shadow Rate

We consider the shadow rate, using the methodology by Wu and Xia (2016), as an alternative measure of monetary easing. First, on refinancing of corporate debt, we confirm the finding that financially vulnerable firms tend to increase long-term debt and decrease short-term debt, although the magnitudes of these responses for both long-term debt and short-term debt are smaller relative to our findings in the previous section (Figure A4).

Using the shadow rate instead of the term premium, we confirm our findings on cash holdings (Figure A5), although the effect of monetary policy on cash holdings disappear after year 4. The overall impact is also smaller than the previous findings.

Finally, we confirm the findings on investment. Compared to the previous findings, the impact of the term premium on firm investment (Figure A6, Panel A) and the differential impact depending on corporate balance sheet health (Figure A6, Panel B) are weaker both in terms of the size and the duration of the impact, as the coefficients become statistically significant in year 5.

4.2.3 Results with Split Sample: Negative Term Premium vs. Positive Term Premium

In an additional exercise, we consider if it makes a difference depending on whether the term premium is positive or negative. The aim is to understand if the findings are different when the term premium drops to a certain level, for instance, whether the effect of QE is reversed.

We execute this exercise by splitting the interaction terms for ICR and TP into two: one multiplied by one if the term premium is positive and one multiplied by one if the term premium is negative. As reported in A1, we do not find any robust evidence that points to a "reversal rate" in the sense that the impact of further decline in the term premium on firm investment decidedly turns negative.

First, we find that the growth rate of long-term debt increases (decrease) following an increase (decrease) in the term premium, but only when the term premium is in the positive territory (Table A1, Panel A). The interaction with firm-level balance sheet, however, only appears when the term premium is in the negative territory. While this finding does not necessarily support the idea that zero is the threshold for such non-linearity, it does suggest that financially vulnerable firms will react by increasing the long-term bond with a sufficiently low value of term premium (below zero). For the short-term bond, we find that an increase (decrease) in the term premium leads to an increase (decrease) in the growth rate of short-term debt for both signs of the term premium (Table A1, Panel B). However, when introducing the interaction term with corporate balance sheet heath, the change of short-term debt declines with less healthy firms ($-0.137 + 0.072 = -0.065$) when the term premium is in the negative territory. For positive term premium, the interaction term weakens the change in short-term debt, but the total effect ($0.072 - 0.024 = 0.048$) remains still positive. On tangible assets, we find no evidence that supports a meaningful relationship between the sign of the term premium and tangible assets, hence, no evidence of a "reversal rate."

4.3 Summary of Findings

In summary, we find that the balance sheet adjustment in response to the changes in term premium differs substantially depending on the health of the firm (Table 3). For healthier firms, a decrease in the term premium leads to an increase in cash holdings and in investment accompanied by a decline in short-term debt (current liabilities). Less healthy firms engage instead in financial restructuring by adjusting the composition of debt away from short-term to long-term debt (non-current liabilities) but without increasing investment or other assets. We observe no significant changes related to the changes in the asset side of less healthy firms.

Table 3: Corporate Balance Sheet Adjustment to Lower Term Premium

High-ICR firms			
Assets		Liabilities	
Current Assets	++	Current Liabilities	−
Tangible Fixed Assets	+	Non-Current Liabilities	.
Intangible Fixed Assets	.	Equity	++
Low-ICR firms			
Assets		Liabilities	
Current Assets	.	Current Liabilities	−
Tangible Fixed Assets	.	Non-Current Liabilities	+
Intangible Fixed Assets	.	Equity	.

Note: This table summarizes how corporate balance sheets adjust in response to a lower term premium based on the findings of this paper, differentiating between firms with high and low interest coverage ratio (ICR). The table categorizes the balance sheet adjustments into assets and liabilities for each group. ++ denotes a relative large and significant increase, + denotes a moderate increase, and . denotes an insignificant response to a lower term premium.

5 Conclusion

While numerous central banks have resorted to quantitative easing to respond to economic shocks, the effectiveness of unconventional monetary policy on corporate balance sheets and firm investment decisions has not been well understood. This paper attempts to take a step in filling this gap based on the Japanese experience.

Our study shows that the change in the term premium affects firm's capital structure and corporate investment differentially depending on the health of the balance sheet. A couple of policy-relevant takeaways follow.

First, the finding that a lower term premium does not lead to an increase in corporate investment for financially weaker firms underlines the point that bankruptcy resolution and corporate restructuring efforts should accompany monetary easing to increase the effectiveness of monetary policy. While we do not find a direct evidence of the "reversal" effect of quantitative easing on investment, we can deduce that quantitative easing will have a diminishing effect on firm investment in an economy with a sufficiently large number of financially weak firms.

Second, even for financially healthier firms, we find strong evidence of the increase in corporate cash holdings to buy back shares. It is difficult to have a clear picture on the impact of quantitative easing on firm investment for healthier firms unless we understand the determinants of cash holdings and how cash holdings and investment are correlated, either negatively or positively. One possible explanation could be that low interest rate and low inflation which led to a decline in the opportunity cost of holding cash, thereby, leading to an increase in cash. However, while such explanation be well-suited for an increase in cash holdings by households, the drivers of corporate cash holdings are still not well-understood. This could be a fruitful avenue for future research.

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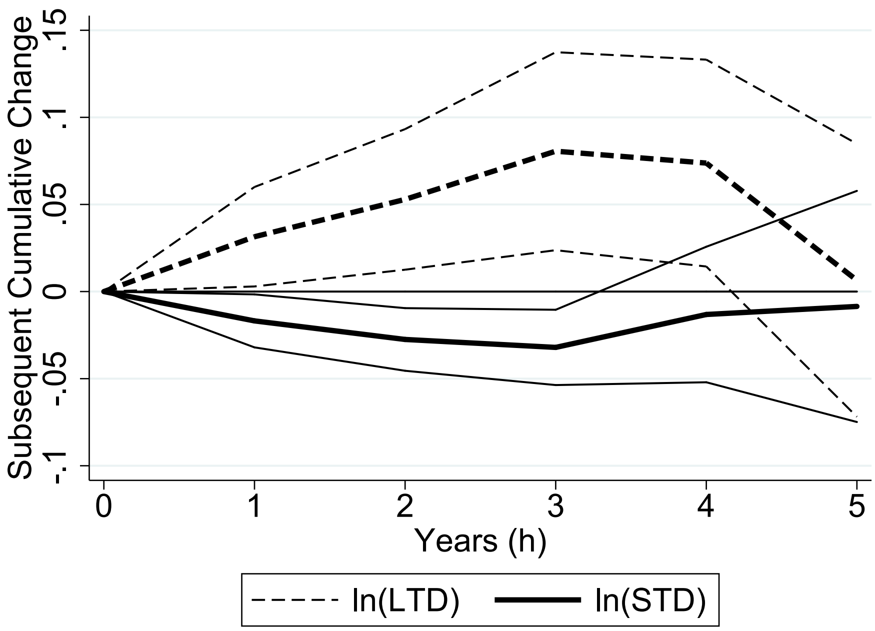
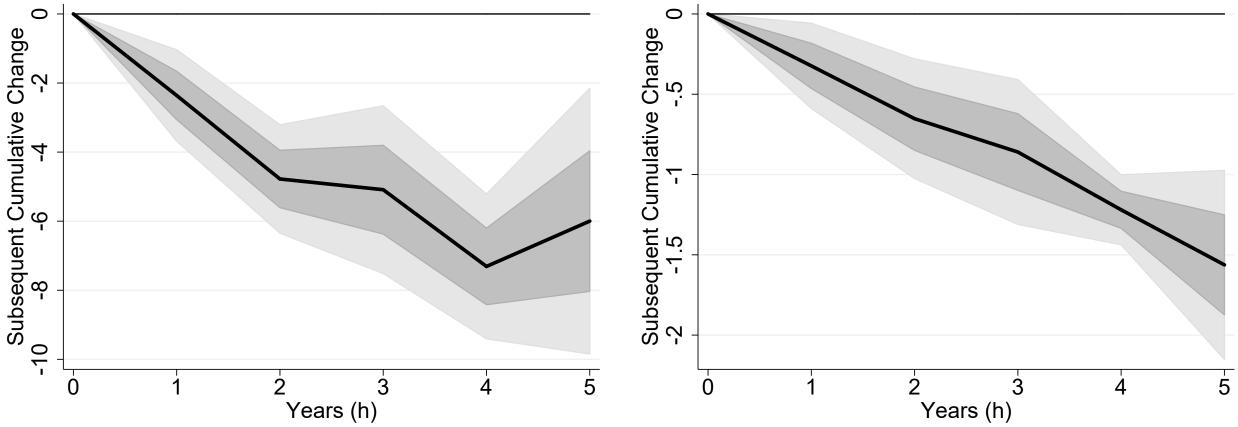
A Online Appendix

Figure A1: Long-Term Debt vs. Short-Term Debt (Balanced Sample)



Note: Firm-level responses to a 1 percentage point increase in the term premium (contractionary) using the balanced sample. The plots show the coefficient β_2^h of a local projection model estimated at the bank-firm level using equation (2), over different horizons of $h = 1, \ldots, 5$. This uses the balanced sample of firms. The dependent variable is the cumulative change in the firm's short-term debt (STD; dashed line) and long-term debt (LTD; solid line) as calculated by equation (3). We rescale $\overline{ICR}_i$ over the entire sample into units of standard deviations relative to the sample mean. Standard errors are two-way clustered by bank and year. The thinner lines around the point estimates plot the 95 percent confidence interval.
Source: FINQUEST and ORBIS Databases, authors' estimates.

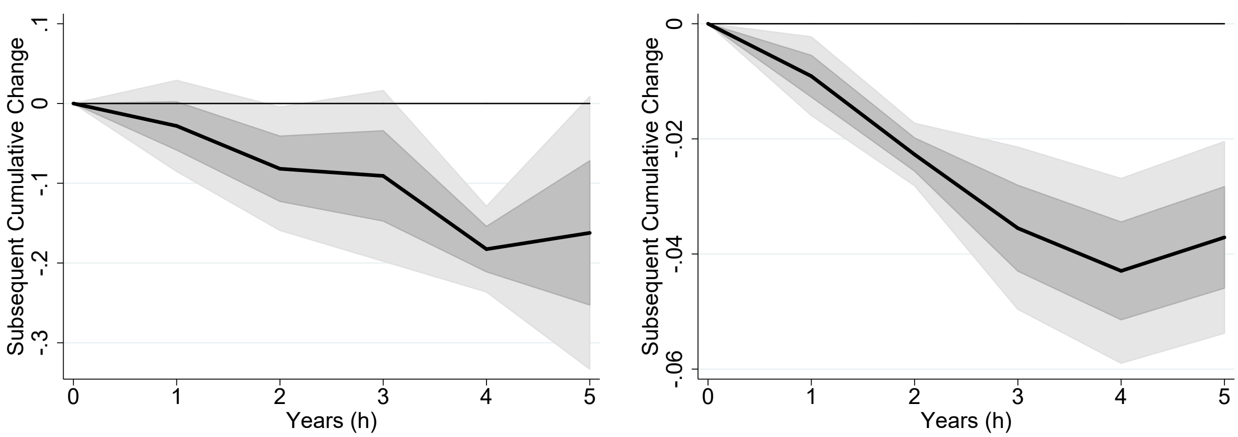
Figure A2: Cash Holdings (Balanced Sample)



(A) β_1^h from equation (1′) **(B)** β_2^h from equation (2′)

Note: Firm-level responses to a 1 percentage point increase in the term premium (contractionary) using the balanced sample. The plots show the coefficients β_1^h and β_2^h of a local projection model estimated at the firm level using equation (1′) and (2′), over different horizons of $h = 1, \ldots, 5$. The dependent variable is the subsequent cumulative change in the firm's cash and cash equivalents as a share of total assets (in percent). We rescale $\overline{ICR}_i$ over the entire sample into units of standard deviations relative to the sample mean. Standard errors are two-way clustered by firm and year. Lightly shaded areas plot the 95 percent confidence interval; darker shaded areas plot the 85 percent confidence interval.
Source: ORBIS Database, authors' estimates.

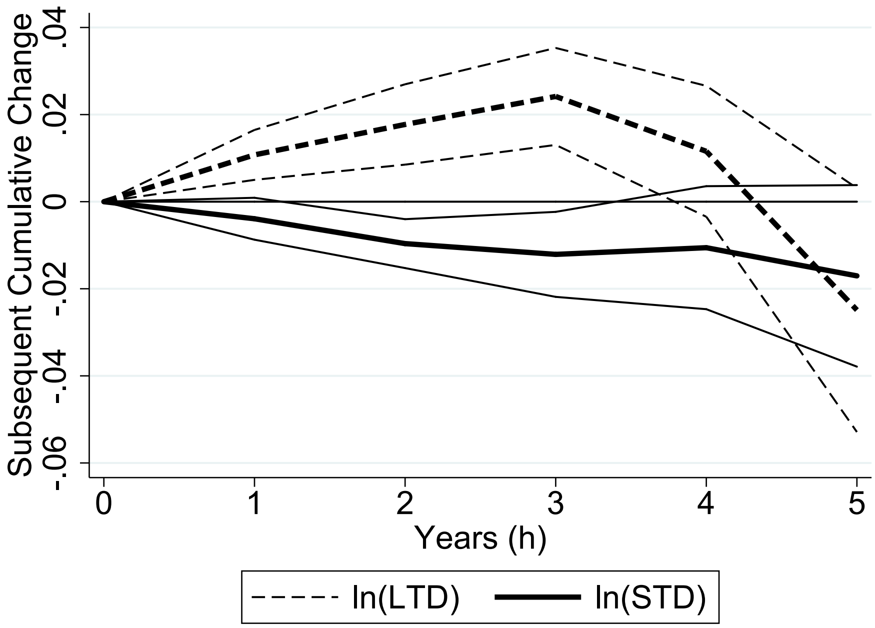
Figure A3: Tangible Fixed Assets (Balanced Sample)



(A) β_1^h from equation (1′) **(B)** β_2^h from equation (2′)

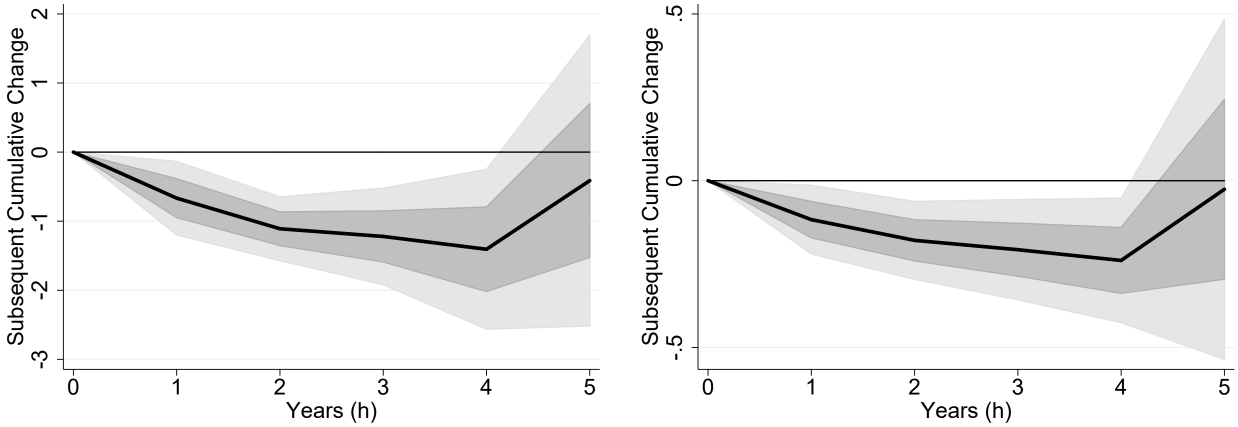
Note: Firm-level responses to a 1 percentage point increase in the term premium (contractionary) using the balanced sample. The plots show the coefficients β_1^h and β_2^h of a local projection model estimated at the firm level using equation (1′) and (2′), over different horizons of $h = 1, \ldots, 5$. The dependent variable is the subsequent cumulative change in the firm's tangible fixed assets (in log). We rescale $\overline{ICR}_i$ over the entire sample into units of standard deviations relative to the sample mean. Standard errors are two-way clustered by firm and year. Lightly shaded areas plot the 95 percent confidence interval; darker shaded areas plot the 85 percent confidence interval.
Source: ORBIS Database, authors' estimates.

Figure A4: Long-Term Debt vs. Short-Term Debt (Shadow Rate)



Note: Firm-level responses to a 1 percentage point increase in the shadow rate (contractionary) using the balanced sample. The plots show the coefficient β_2^h of a local projection model estimated at the bank-firm level using equation (2), over different horizons of $h = 1, \ldots, 5$. This uses the balanced sample of firms. The dependent variable is the cumulative change in the firm's short-term debt (STD; dashed line) and long-term debt (LTD; solid line) as calculated by equation (3). We rescale $\overline{ICR}_i$ over the entire sample into units of standard deviations relative to the sample mean. Standard errors are two-way clustered by bank and year. The thinner lines around the point estimates plot the 95 percent confidence interval.
Source: FINQUEST and ORBIS Databases, authors' estimates.

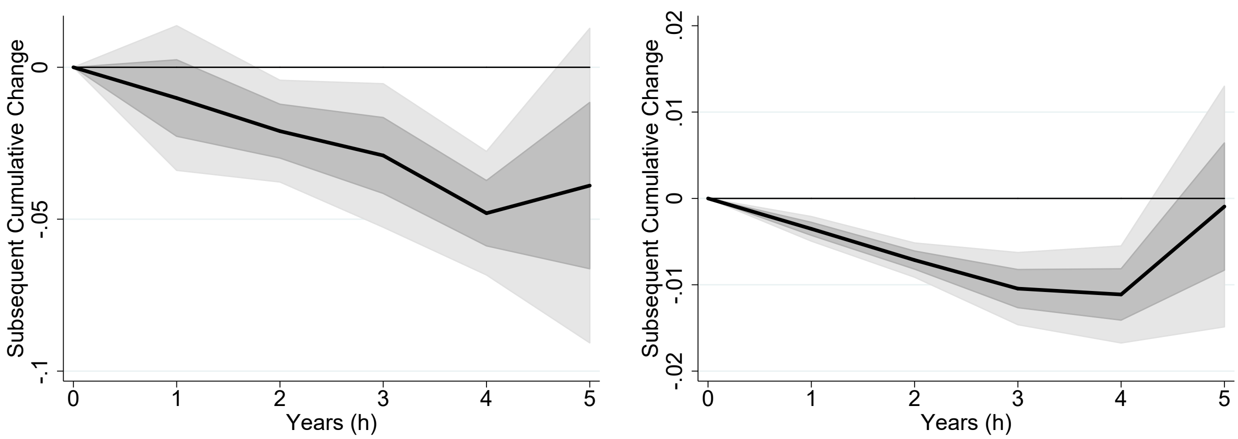
Figure A5: Cash Holdings (Shadow Rate)



(A) β_1^h from equation (1′) **(B)** β_2^h from equation (2′)

Note: Firm-level responses to a 1 percentage point increase in the shadow rate (contractionary) using the balanced sample. The plots show the coefficients β_1^h and β_2^h of a local projection model estimated at the firm level using equation (1′) and (2′), over different horizons of $h = 1, \ldots, 5$. The dependent variable is the subsequent cumulative change in the firm's cash and cash equivalents as a share of total assets (in percent). We rescale $\overline{ICR}_i$ over the entire sample into units of standard deviations relative to the sample mean. Standard errors are two-way clustered by firm and year. Lightly shaded areas plot the 95 percent confidence interval; darker shaded areas plot the 85 percent confidence interval.
Source: ORBIS Database, authors' estimates.

Figure A6: Tangible Fixed Assets (Shadow Rate)



(A) β_1^h from equation (1′) **(B)** β_2^h from equation (2′)

Note: Firm-level responses to a 1 percentage point increase in the shadow rate (contractionary) using the balanced sample. The plots show the coefficients β_1^h and β_2^h of a local projection model estimated at the firm level using equation (1′) and (2′), over different horizons of $h = 1, \ldots, 5$. The dependent variable is the subsequent cumulative change in the firm's tangible fixed assets (in log). We rescale $\overline{ICR}_i$ over the entire sample into units of standard deviations relative to the sample mean. Standard errors are two-way clustered by firm and year. Lightly shaded areas plot the 95 percent confidence interval; darker shaded areas plot the 85 percent confidence interval.
Source: FINQUEST and ORBIS Databases, authors' estimates.

Table A1: Sample Split by the Sign of the Term Premium

(A) Long-Term Debt

	$\Delta \ln(LTD_{i,j,t,t+1})$	$\Delta \ln(LTD_{i,j,t,t+1})$	$\Delta \ln(LTD_{i,j,t,t+1})$
$\mathbf{1}[TP_t \geq 0] \times \overline{ICR}_i \times TP_t$	0.016		0.009
	(0.020)		(0.019)
$\mathbf{1}[TP_t < 0] \times \overline{ICR}_i \times TP_t$	-0.131		-0.114
	(0.052)		(0.045)
$\mathbf{1}[TP_t \geq 0] \times TP_t$		0.049**	0.049**
		(0.009)	(0.009)
$\mathbf{1}[TP_t < 0] \times TP_t$		0.038	0.024
		(0.031)	(0.031)
Mean DV	-0.085	-0.085	-0.085
Bank-Firm FE	Y	Y	Y
Year FE	Y	N	N
Controls	Y	Y	Y
Cluster SE	Bank, Year	Bank, Year	Bank, Year
R^2	0.396	0.315	0.315
N	24,463	24,890	24,738

Note: This table reports estimates from an extension of equation (1) and (2) by splitting the sample by the sign of the term premium. The dependent variable is the log difference in long-term debt. The independent variables are interaction terms between indicator functions of the term premium's sign, the interest coverage ratio (ICR), and the term premium itself. Controls include leverage, size, and age groups. Standard errors in parentheses are clustered by bank and year. ** and * indicate statistical significance at the 1 and 5 percent, respectively.
Source: FINQUEST and ORBIS Databases; authors' calculations.

Table A1: Sample Split by the Sign of the Term Premium (Continued)

(B) Short-Term Debt

	$\Delta \ln(STD_{i,j,t,t+1})$	$\Delta \ln(STD_{i,j,t,t+1})$	$\Delta \ln(STD_{i,j,t,t+1})$
$\mathbf{1}[TP_t \geq 0] \times \overline{ICR}_i \times TP_t$	-0.025		-0.024
	(0.014)		(0.011)
$\mathbf{1}[TP_t < 0] \times \overline{ICR}_i \times TP_t$	-0.141**		-0.137**
	(0.028)		(0.025)
$\mathbf{1}[TP_t \geq 0] \times TP_t$		0.084**	0.082**
		(0.007)	(0.007)
$\mathbf{1}[TP_t < 0] \times TP_t$		0.083*	0.072*
		(0.027)	(0.027)
Mean DV	-0.028	-0.028	-0.028
Bank-Firm FE	Y	Y	Y
Year FE	Y	N	N
Controls	Y	Y	Y
Cluster SE	Bank, Year	Bank, Year	Bank, Year
R^2	0.349	0.250	0.251
N	18,471	18,820	18,728

Note: This table reports estimates from an extension of equation (1) and (2) by splitting the sample by the sign of the term premium. The dependent variable is the log difference in short-term debt. The independent variables are interaction terms between indicator functions of the term premium's sign, the interest coverage ratio (ICR), and the term premium itself. Controls include leverage, size, and age groups. Standard errors in parentheses are clustered by bank and year. ** and * indicate statistical significance at the 1 and 5 percent, respectively.
Source: FINQUEST and ORBIS Databases; authors' calculations.

Table A1: Sample Split by the Sign of the Term Premium (Continued)

(C) Tangible Fixed Assets

	$\Delta \ln(Tangible_{i,t,t+1})$	$\Delta \ln(Tangible_{i,t,t+1})$	$\Delta \ln(Tangible_{i,t,t+1})$
$\mathbf{1}[TP_t \geq 0] \times \overline{ICR}_i \times TP_t$	-0.005		-0.006
	(0.004)		(0.005)
$\mathbf{1}[TP_t < 0] \times \overline{ICR}_i \times TP_t$	0.004		0.001
	(0.008)		(0.010)
$\mathbf{1}[TP_t \geq 0] \times TP_t$		-0.027	-0.028
		(0.026)	(0.026)
$\mathbf{1}[TP_t < 0] \times TP_t$		0.030	0.029
		(0.068)	(0.068)
Mean DV	0.002	0.002	0.002
Firm FE	Y	Y	Y
Year FE	Y	N	N
Controls	Y	Y	Y
Cluster SE	Firm, Year	Firm, Year	Firm, Year
R^2	0.293	0.243	0.240
N	849,761	880,158	849,851

Note: This table reports estimates from an extension of equation ($1'$) and ($2'$) by splitting the sample by the sign of the term premium. The dependent variable is the log difference in tangible fixed assets. The independent variables are interaction terms between indicator functions of the term premium's sign, the interest coverage ratio (ICR), and the term premium itself. Controls include leverage, size, and age groups. Standard errors in parentheses are clustered by bank and year. ** and * indicate statistical significance at the 1 and 5 percent, respectively.
Source: FINQUEST and ORBIS Databases; authors' calculations.