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Tomohito Honda, Hitotsubashi University

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The Research Center for Economic and Social Risks
Institute of Economic Research
Hitotsubashi University

2-1 Naka, Kunitachi, Tokyo, 186-8603 JAPAN
http://risk.ier.hit-u.ac.jp/

The Effects of Credit Lines on Cash Holdings and Capital Investment: Evidence from Japan

Tomohito Honda*

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Abstract

This study examines how credit lines affect corporate cash holdings and capital investment, using hand-collected data on credit lines for publicly traded Japanese firms for 2006–2017. Although theoretical research has explained the effects of credit lines in terms of the extensive margin, previous empirical studies have investigated the impacts of credit lines focusing on the intensive margin. Against this background, the present study concentrates on the extensive margin of the effects of credit lines and compares firms that have access to credit lines with those that do not. The empirical results are as follows: (1) firms with credit lines hold lower cash reserves than those without; (2) firms with credit lines undertake more capital investment than firms without; and (3) once firms gain access to credit lines, their cash holdings decrease and their capital investment increases.

These empirical findings are consistent with the predictions of the theoretical literature and suggest that credit lines improve firms' financial flexibility and enable firms to use cash holdings held for precautionary reasons for investment instead.

Keywords: Credit lines, Cash holdings, Corporate investment, Financial constraints

JEL classification: G31, G32

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*Center for Spatial Information Science, at the University of Tokyo. Email: thshhonda@gmail.com.

1. Introduction

How do credit lines affect the corporate activities of firms in Japan? This study investigates the effect of credit lines on the corporate activities of Japanese-listed firms, such as their cash holdings and capital investment. A credit line is a preset borrowing limit that enables a firm to borrow from a bank up to the agreed amount under conditions set out in the credit line agreement. While the credit line provides the firm with access to credit whenever it requires liquidity, it needs to pay a commitment fee to the bank. Credit lines are a popular form of bank loan in the United States. Cagle (1956), for example, reports that about 56% of banks provided firms with credit lines. Furthermore, the Federal Reserve's *Survey of Terms of Business Lending* suggests that between 1997 and 2017, credit line loans, or "loans under commitment," accounted for more than 70% of all commercial and industrial loans. In contrast to their counterparts in the United States, firms in Japan did not have access to credit lines until 1999 because of legal restrictions.[1] However, in 1999, the "Act on Specified Commitment Line Contracts" came into force, allowing Japanese firms access to credit lines.

Credit lines provide firms with flexible access to liquidity, and as long as firms have access, credit lines are alternative funds for cash in firms' liquidity management. A number of empirical studies have examined what kind of firms use credit lines as well as the link between credit lines and corporate activities. For example, analyzing the determinants of credit lines, Sufi (2009) finds that firms with larger cash flows are more likely to have credit lines; at the same time, firms that have credit lines are less likely to depend on cash holdings than those without. Similarly, surveying liquidity management of firms in the United States and Europe during the Global Financial Crisis of 2008–2011, Campello et al. (2011, 2012) find a negative association between credit lines and cash holdings. These studies suggest that there is a strong link between credit lines and cash holdings in corporate liquidity management. Meanwhile, other studies have focused on the impact of credit lines, and especially the drawdown of credit lines, on investment. Berrospide and Meisenzahl (2015), for example, investigate the effect of credit lines on capital investment around the time of the collapse of Lehman Brothers in 2008 and find a stronger correlation between drawdowns of credit lines and capital investments during the crisis than in normal times. Further, in a study on 17 European countries, Guney et al. (2017) find that credit lines positively affect research and development (R&D) expenditure.

While there are numerous empirical studies such as these that have investigated the effects of credit lines on cash holdings and capital investment, most have focused on drawdowns or the borrowing limit. In other words, when examining the effect of credit lines, they assume that firms have access to credit lines. In contrast, theoretical studies examine the relationship between credit lines and firms' activities from the perspective of the extensive margin; that is, they do not presume that firms are endowed with credit lines. Boot et al. (1987), for example, conduct a comparison of the impact on

[1] For details, see Section 2.

firms' capital expenditure between credit lines and spot loans. Meanwhile, Bolton et al. (2010) analyze how introducing credit lines change firms' activities, including cash holdings and capital expenditure. Therefore, theoretical research implies that having access to credit lines also influences firms' activities.

As described above, most previous studies suggest that credit lines affect corporate cash holdings and investments; however, these studies focus on firms in Western countries. In contrast, reflecting the fact that credit lines remain a relatively new type of bank loan in Japan, and given the difficulty of collecting data on credit lines, the number of studies on credit lines in Japan can be counted on one hand.[2] Moreover, most of these studies examine the effect of credit lines on stock prices. Therefore, the issue of whether and how credit lines affect firms' cash holdings and capital investment in the case of Japanese firms remains unclear.

Against this background, this study focuses on the extensive margin to examine the effect of credit lines on firms' activities and investigates how credit lines affect corporate cash holdings and capital investment using hand-collected data on credit lines for Japanese listed firms for the period 2006–2017. To do so, this paper compares firms that have access to credit lines with those that do not. In addition, it employs propensity score matching, fixed effect estimation, and subsample analysis taking reverse causality into account as a robustness check to see if the baseline results hold. The findings indicate that credit lines are negatively related to cash holdings and have a positive impact on capital investment, suggesting that having access to credit lines help firms lower their cash reserves and undertake more capital investment. In other words, firms with credit lines redeploy precautionary cash holdings and use them for capital investment instead.

This study contributes to the literature on credit lines in two respects. First, this study focuses on the extensive rather than the intensive margin when examining the effect of credit lines and finds that whether firms have access to credit lines does affect their cash holdings and capital investment. Although extant studies highlight that not all firms have access to credit lines, they pay little attention to the question whether firms do. In contrast, this study explicitly focuses on the effect that having access to credit lines has on cash holdings and capital investment.

Second, this study examines the interplay between credit lines, cash holdings, and capital investment. While existing studies examine the relationships between credit lines on the one hand and cash holdings or capital investment on the other separately, they do not say anything about the interaction of these variables. In contrast, the present study examines the relationship between credit lines and cash holdings as well as capital investment, providing a better understanding of how firms manage their liquidity and use it for their activities.

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[2] Examples are the studies by Kaneko and Watanabe (2005) and Tomita and Inoue (2014), which examine the effect of credit lines on the stock price, while Xu and Liu (2013) investigate the relationship between bank deposit-taking and providing credit lines, and Sasaki et al. (2016) conduct a survey on the liquidity management of Japanese listed firms.

The remainder of this study is organized as follows. Section 2 provides an overview of the use of credit lines in Japan. Section 3 then reviews related studies and presents the hypotheses examined in this study. Next, Section 4 describes the data and empirical strategy, while Section 5 presents the empirical results. Finally, Section 6 concludes.

2. Overview of the Use of Credit Lines in Japan

Credit lines are bank loans that differ from other bank loans in two respects. First, a credit line is a credit facility that allows firms to borrow from a bank up to a prearranged amount based on conditions set out in the credit line agreement. Firms can access the credit line extended to them if and when they need funds.[3] Second, firms need to pay banks a commitment fee regardless of whether they have an outstanding balance on their credit line. Given that firms can access such credit lines at any time, credit lines are generally regarded as an alternatively to cash in terms of maintaining liquidity.

As mentioned, while credit lines are widely used in the United States, they only account for a relatively small share of bank loans in Japan. The reason is that until 1999, Japanese banks were prohibited from offering credit lines by the "Interest Rate Restriction Act" and the "Act Regulating the Receipt of Contributions and Receipt of Deposits and Interest Rates." Article 3 of the former act and Article 5, Paragraph (4) of the latter act state that fees should be deemed to be regarded as interest.

Of course, although banks charge both interest and commitment fees when they provide firms with credit lines, in Japan, it often becomes a problem when a commitment fee is included in the interest rate.

Consider the simple case of a firm that has a 100 million yen credit line. Further, for simplicity, assumed that the interest rate on drawdowns is 0%, while the commitment rate is 10%; that is, the commitment fee is equal to 10 million yen (=100 million yen*0.1). Suppose now that the outstanding credit line balance is 10 million yen. In this case, the interest rate (= (interest rate on drawdown + commitment fee)/outstanding credit line balance) is 100%, which exceeds the maximum allowable interest rate of 15% set in the "Interest Rate Restriction Act" and the 20% set in the "Act Regulating the Receipt of Contributions and Receipt of Deposits and Interest Rates." Therefore, it can happen that the interest rate including the commitment fee exceeds the maximum allowable interest rate defined in these acts, in which case banks may be charged with violation of the acts.

Due to this legal issue, credit lines were not widely available in Japan. However, in 1999, the "Act on Specified Commitment Line Contracts" came into force, which does not regard commitment fees as interest when credit lines are provided to large and/or listed firms. The act has subsequently been

[3] Needless to say, firms must honor the terms stipulated in the credit line agreement. If firms violate these terms, they may be denied access to further credit.

changed twice, and more and more firms can now access credit lines.[4]

(Insert Figure 1)

Figure 1 presents the number of credit line agreements and the total amount of contracted credit lines in Japan. A survey of such credit lines began in 2001, when the number of credit line agreements was 1,358. This number steadily increased until 2005 and then stagnated at around 10,000 before starting to fall from the middle of 2008. The number bottomed out around 2010/11 and began to rise again, reaching 12,015 in December 2017. Meanwhile, the total amount of contracted credit lines rose throughout most of the observation period and reached 35 trillion yen in December 2017 (ca. US$ 309 billion at the exchange rate at the time[5]), showing that credit lines have been more widely used over the last 20 years.

3. Literature Review and Hypotheses

Previous studies on credit lines have tended to focus on the following two related issues. The first is firms' liquidity management, including the use of cash holdings and credit lines. The second is the question of how credit lines potentially affect corporate activities. This section starts with presenting a review of studies examining the relationship between credit lines and cash holdings. This is followed by a brief overview of research exploring how credit lines affect corporate activities.

3.1 Credit Lines and Cash Holdings

Several studies have focused on the connection between credit lines and cash holdings. The previous empirical and theoretical studies conclude that credit lines serve as an alternative for cash in terms of providing firms with liquidity. The first study to focus on both credit lines and cash holdings when examining how U.S. firms manage their liquidity is that by Sufi (2009). He finds that that credit lines act as a substitute for liquidity only for firms with high cash flow, while firms that are unable to access credit lines are more likely to depend on cash in their liquidity management. Meanwhile, although the primary purpose of Demiroglu et al.'s (2012) study is to examine how bank lending standards affect the availability of credit lines, they also examine the extent to which credit lines are a substitute for cash and find that firms with credit lines hold less cash. Further, using a data set that combines Standard and Poor's COMPUSTAT and Security and Exchange Commission regulatory filings, Berrospide and

[4] For example, commitment fees are not regarded as interest in the case of credit lines to medium-sized firms (with paid-in capital of more than 300 million yen) or subsidiaries of large or publicly listed. In principle, small firms cannot access such credit lines. However, unless the interest rate exceeds the maximum allowable rate, even small firm can have access to credit lines, and Uesigi et al. (2021) find that some small firms do indeed have access to credit lines.

[5] Converted at the yen-dollar exchange rate on December 29, 2017, of about 113 yen/dollar, retrieved from the BOJ Time-Series Data Search (https://www.stat-search.boj.or.jp/ssi/cgi-bin/famecgi2?cgi=$nme_a000_en&lstSelection=FM08).

Meisenzahl (2015) examine the impact of credit lines for firms in the United States during 2006–2009. They find a negative relationship between cash holdings and credit lines, which, moreover, is more significant for financially constrained firms. Taking a theoretical approach, Bolton et al. (2011) propose a model of dynamic investment, financing, and risk management for financially constrained firms and show that credit lines lower the marginal value of cash and cause firms to hoard less cash even when faced with financial constraints.

Another strand in the literature consists of survey-based studies, which similarly find that credit lines act as a substitute for cash in firms' liquidity management. Lins et al. (2010), for example, conduct a survey to investigate whether and why firms from 29 countries use credit lines and cash for liquidity management, and find that about 41% of responding firms consider credit lines as a cash substitute. Campello et al. (2011, 2012) conduct surveys to investigate how firms in the U.S. and Europe managed their liquidity including credit lines and cash holdings during the financial crisis of 2008. They find a negative correlation between the use of credit lines – in terms of access, size of facility, and drawdown activity – and firms' cash holdings, and that this negative correlation became more pronounced following the financial crisis.

In sum, the theoretical and empirical evidence of studies and surveys on credit lines suggests that firms with credit lines tend to have lower cash holdings, implying that firms regard credit lines as a substitute for cash. Therefore, the first hypothesis regarding the relationship between credit lines and cash holdings for the empirical analysis on Japan is as follows.

Hypothesis 1: In comparison to firms that do not have credit lines, firms with credit lines hold lower cash reserves.

3.2 Credit Lines and Investment

Turning to the literature investigating the link between credit lines and corporate activities, studies unanimously show that credit lines either mitigate underinvestment problems or boost corporate activities such as capital investment and R&D.

For instance, Boot et al. (1987) develop a theoretical model to explain the economic rationale behind the use of credit lines. The model compares spot loans with loan commitments (credit lines). In states in which the riskless rate is high, the spot interest rate is also high and leads to distortions in firms' investment activities. In contrast to spot loans, even in the same situation, the interest rate on credit lines remains relatively low and is less likely to cause distortions in firms' actions because the interest rate on credit lines was already set before firms make their investment decision. In other words, Boot et al. (1987) suggest that credit lines can mitigate underinvestment and credit rationing caused by high-interest rates during a tightening of credit to a greater extent than spot loans. Bolton et al. (2011) propose a tractable and operational model that shows that the presence of external financing

costs influences a firm's optimal investment, financing, and risk management. Their simulation indicates that even when firms run out of cash, firms with a credit line invest substantially more than those without.

These theoretical considerations are further supported by survey-based research and empirical studies. For instance, investigating the relationship between credit lines and capital investment as well as cash during the financial crisis of 2008, Campello et al. (2011, 2012) and Berrospide and Meisenzahl (2015) show that credit lines for firms that are not cash-strapped are associated with greater capital investment; moreover, this relationship was amplified during the crisis period, suggesting that credit lines eased the negative impact of the financial crisis on corporate activities. Finally, a study focusing on R&D expenditure rather than capital investment is that by Guney et al. (2017). Using data for listed firms in 17 European countries for 2004–2013, they find that the use of credit lines has a positive impact on R&D expenditures.

Based on these studies on the link between credit lines and corporate activities, it is likely that for Japanese firms, too, the use of credit lines is associated with more investment. Therefore, the following hypothesis for the empirical analysis below is posited.

Hypothesis 2: Firms with credit lines tend to undertake more capital investment than those without.

4. Data and Empirical Strategy

This section starts with a description of the data used in the analysis. In particular, since the information on credit lines was compiled by the author, the data compilation process is explained in detail. The section closes with details on the empirical strategy employed.

4.1 Data

Two databases were used to compile firm-level information on publicly traded Japanese firms for the analysis. First, the Nikkei NEEDS Financial QUEST (henceforth, Nikkei NEEDS), provided by Nikkei Incorporated, was employed to obtain corporate financial information. The sample used for this study consists of non-financial listed firms and spans from 2006 to 2017. There are a total of 45,777 firm-year observations for 4,719 firms. Second, a database called "eol," provided by PRONEXUS Incorporated, was used to gather credit line information. As the Nikkei NEEDS does not include credit line information for 2006–2013,[6] the credit line data was collected manually by the author. The procedure is as follows. First, keywords such as "commitment line," "commitment," "loan commitment," and "overdraft" were used to search the "eol" to obtain documents containing one or more of the keywords. Second, the documents were examined to determine whether a firm has credit

[6] Nikkei NEEDS provides information on corporate credit lines from March 2013.

lines.

Using this procedure, 7,061 firm-year observations for 1,207 firms with credit lines were identified for the period 2006–2017. Next, financial information and credit line information were combined based on securities codes set by the Securities Identification Code Committee. Matching observations in this manner resulted in 35,312 firm-year observations for 3,965 firms.

(Insert Table 1)

Table 1 provides definitions of the variables constructed based on the data obtained as described and used for the analysis. Observations where at least one of the variables was missing were dropped. Further, to eliminate the effect of outliers, the variables, except for *Credit Line* and *Cash Flow Volatility*, were winsorized at the 1st and the 99th percentiles. As a result, the final sample consists of 34,652 firm-year observations for 3,737 firms.

4.2 Empirical Strategy

To investigate the effect of credit lines on cash holdings and capital investment, conventional specifications used in previous studies are adopted. Concretely, in the baseline estimation, the following specification is estimated:

$$Cash_{it} = Const + \beta_1 Credit\ Line_{it} + \beta_2 Size_{it} + \beta_3 Cash\ Flow_{it} + \beta_4 MB_{it} + \beta_5 Leverage_{it} + \beta_6 Tangibility_{it} + \beta_7 Cash\ Flow\ Volatility_{it} + \theta_t + \gamma_i + \varepsilon_{it} \ldots (1)$$

where θ_t, γ_i are time and industry fixed effects, respectively, and ε_{it} is the error term (errors are clustered at the firm level). The most important variable in Eq. (1) is *Credit Line*, which represents whether a firm has credit lines. If Hypothesis 1 is correct, the coefficient should be negative. The expected signs of the other explanatory variables are as follows. *Size* is expected to have a negative coefficient because larger firms are less likely to hold cash for precautionary reasons due to lower information asymmetry than in the case of smaller firms. The expected sign on *Cash Flow* is ambiguous. On the one hand, as highlighted by Almeida et al. (2004) and Acharya et al. (2007), liquidity-constrained firms tend to save more cash out of their cash flow than unconstrained firms, suggesting that the sign should be positive. On the other hand, Riddick and Whited (2009) find that firms that face positively serially correlated productivity shocks allocate some of their liquid assets to investments instead of saving because their capital becomes more productive, suggesting that the sign should be negative.

Next, the sign on *MB* (the market value of assets/total assets), used as a proxy for growth opportunities, is expected to be positive. Based on the financial hierarchy model developed by Myers

and Majluf (1984), firms with more growth investment opportunities suffer from more information asymmetry and thus tend to rely on cash to minimize the cost of forgoing investment. Therefore, *Leverage* is expected to have a negative coefficient: firms can use debt as a substitute for cash, and more highly leveraged firms are likely to hold less cash. Further, *Tangibility* is also expected to have a negative coefficient since firms can use tangible assets as collateral, and firms with more tangible assets are likely to have easier access to loans and hence need to hold less cash. Finally, the coefficient on *Cash Flow Volatility* is expected to be positive since firms with more volatile cash flow tend to hold cash for precautionary reasons (Opler et al. 1999, Han and Qiu 2007, Bates et al. 2009).

Next, to investigate Hypothesis 2 regarding the effect of credit lines on capital investment, the following regression model is employed:

$$Capex_{it} = Const + \gamma_1 Credit\ Line_{it} + \gamma_2 Cash_{it} + \gamma_3 Size_{it} + \gamma_4 Cash\ Flow_{it} + \gamma_5 MB_{it} + \gamma_6 Leverage_{it} + \gamma_7 Tangibility_{it} + \theta_t + \gamma_i + \varepsilon_{it} \ldots (2)$$

As seen in Section 3.2, the literature suggests that credit lines boost capital investment. Therefore, if Hypothesis 2 is correct, the coefficient on $Credit\ Line$ should be positive. The expected signs of the other explanatory variables are as follows. The coefficient on *Cash* is expected to be negative since firms either choose to hold cash reserves or to use them as a source of funding for capital investment (Campello et al. 2011, 2012). Next, the coefficient on *Size* is expected to be positive since information asymmetry is likely to be less pronounced for larger firms. The coefficient on *Cash Flow* is expected to be positive since, based on Fazzari et al. (1988), financially constrained firms should tend to depend more on internal than external liquidity. The coefficient on *MB* is expected to be positive since firms with more growth opportunities are more likely to undertake more investment. Next, firms with a higher leverage are more likely to suffer from a debt overhang, so that the coefficient on *Leverage* is expected to be negative. Finally, the coefficient on *Tangibility* is expected to be positive since tangible assets can be used as collateral, and firms with more tangible assets have easier access to external financing.

In addition to the baseline estimations for the whole sample, a number of additional estimations using widely used criteria to identify (potentially) financially constrained firms are conducted. Specifically, based on each of the criteria, two groups of firms – (potentially) constrained and unconstrained firms – are identified, Eqs. (1) and (2) are estimated for each group, and the difference in the effect of credit lines between the two groups is examined. The criteria for distinguishing (potentially) financially constrained and unconstrained firms are firms' size and payout ratio, and whether they have access to the corporate bond or commercial paper (CP) market. The procedure is as follows.

- *Firm size*: Firms are sorted each year based on their assets and firms in the bottom three deciles are classified as financially constrained and those in the top three deciles as unconstrained. Smaller firms are likely to be more financially opaque and hence face greater difficulties in accessing external funds.

- *Payout ratio*: Firms are ranked each year based on their payout ratio and firms in the bottom three deciles are classified as financially constrained and those in the top three deciles as unconstrained. As noted by Almeida et al. (2004), financially constrained firms tend to have a lower payout ratio than financially unconstrained firms.

- *Access to the bond or CP market*: Firms are classified as financially constrained if they do not have outstanding bond or CP balances and as unconstrained if they have outstanding bond or CP balances or both. Firms with access to the bond or CP market are less financially opaque and likely to be regarded as higher quality by outsiders, so that it is easier for them to obtain external funding.[7]

Previous studies suggest that credit lines are more important for financially constrained firms than for unconstrained ones. For example, while for financially constrained firms cash holdings are related to their cash flow, Sufi (2009) finds that no such link is found when financially constrained firms have access to credit lines, indicating that even if firms are financially constrained, they need to hold less cash if they have access to credit lines. Meanwhile, Berrospide and Meisenzahl (2015) show that during the 2008 financial crisis the correlation between credit lines and cash holdings or capital investment was larger for smaller firms. Finally, focusing on firms in Europe, Guney et al. (2017) find that the impact of credit lines on R&D expenditure is more pronounced for small firms than large firms. Therefore, in the analysis below, the coefficient on *Credit Line* is expected to be larger and/or more statistically significant for financially constrained firms than unconstrained firms.

4.3 Summary Statistics

This subsection describes the characteristics of the variables used in the empirical analysis. Table 2 presents the summary statistics for the sample. The average of *Credit Line* is 0.195, indicating that about 20% of the observations for 2006–2017 have credit lines. This figure contrasts with a corresponding figure of 80% in Sufi's (2009) sample consisting of listed firms in the United States for 1996–2006. This difference suggests that credit lines are less widely used in Japan than in the United States.

[7] Most studies on cash holdings focus on whether firms have a bond or CP rating to determine whether a firm is financially constrained. However, the dataset used for this study does not contain information on such ratings, so that outstanding bond or CP balances are used instead.

(Insert Table 2)

Next, Table 3 shows sample statistics for the same variables when dividing the sample into firms with credit lines and those without as well as the difference between them. The average of *Cash* for firms with credit lines is 0.144, while it is 0.184 for firms without, and the difference between them is approximately −0.040, suggesting that firms with credit lines tend to hold less cash. The average of *Capex* is 0.042 for firms with credit lines and 0.039 for firms without, so that the difference is about 0.003, implying that firms with credit lines tend to undertake more capital investment. The difference in *Size* between the two groups is 102,982 million yen, meaning that larger firms are more likely to have access to credit lines than smaller ones. The average of *Cash Flow* for both firms with and without credit lines is 0.039. Therefore, while Sufi (2009) finds that firms with a higher cash flow are more likely to have access to credit lines, this does not appear to be the case in the sample of Japanese firms used here. The average of *MB* for firms with credit lines is lower than that of firms without, suggesting that firms with more investment opportunities rely more on internal liquidity than on external financing due to the information asymmetry problem. Meanwhile, the average *Leverage* of firms with credit lines is higher than that of firms without, meaning that firms that depend on external financing are more likely to have credit lines. Next, the average of *Tangibility* for firms with credit lines is higher than that for firms without, suggesting that, since tangible assets can be used as collateral, firms with more tangible assets have greater access to credit lines. Finally, the average of *Cash Flow Volatility* is lower for firms with credit lines than for those without, implying that firms with more volatile cash flow are less likely to have access to credit lines, presumably because such firms are regarded as high risk by banks that supply credit lines.

(Insert Table 3)

The next section starts by presenting the baseline estimations for cash holdings and capital investment. Then, in order to examine the robustness of the baseline results, alternative approaches such as propensity score matching, controlling for firm fixed effects, and a subsample analysis for firms that newly arranged credit lines are employed.

5. Results

5.1 Baseline Results

The baseline results for cash holdings are reported in Table 4. Column (1) presents the results for the entire sample. The coefficient on *Credit Line*, the variable of key interest, takes a value of −0.005 and is significant at the 10% level. Given that the average of *Cash* is 0.195, this result indicates that firms

with credit lines hold 2.56% (0.005/0.195) less cash than firms without. The coefficient on *Size* is significant and negative, as expected. Next, the coefficient on *Cash Flow* is also, as expected, positive and significant, suggesting that firms tend to hold cash reserves for precautionary purposes, in line with the arguments by Almeida et al. (2004) and Acharya et al. (2007). Further, the coefficient on *MB* is also positive and significant, which is consistent with the financial hierarchy model. The coefficient on *Leverage* is negative and significant, as expected, suggesting that debt is used as an alternative for cash. Finally, the coefficient on *Tangibility* is negative and significant, while that on *Cash Flow Volatility* is positive and significant, both as expected.

(Insert Table 4)

To investigate how the impact of credit lines on corporate cash holdings varies across firms with different financial constraints, Table 4 also presents various subsample analyses, where firms are divided in terms of their size (measured in terms of assets), their payout ratio, and whether they have access to the bond or CP market. Starting with firm size, Column (2) presents the result for small (financially constrained) firms, while Column (3) shows the result for large (financially unconstrained) firms. Interestingly, the coefficient on *Credit Line* for small firms is negative and significant at the 1% level but is insignificant for large firms. Moreover, in Column (2), the coefficient is −0.018, which is larger than the coefficient in Column (1). Turning to firms' payout ratio, the coefficient on *Credit Line* for both firms with a low and a high payout ratio is negative but not significant. Finally, Columns (6) and (7) present the results for firms that do and do not have access to the bond or CP market. Similar to the results in Columns (2) and (3), the coefficient on *Credit Line* for firms without access to the bond or CP market (i.e., firms that are more likely to be financially constrained) is negative and significant and somewhat larger than that in Column (1).

Next, Table 5 presents the results for capital investment. Column (1) reports the result for all firms. The coefficient on *Credit Line* takes a value of 0.003 and is significant at the 1% level. Given that the average of *Capex* is 0.040, this implies that the level of capital investment of firms with credit lines is 7.5% (0.003/0.040) higher than that of firms without credit lines. Meanwhile, the coefficient on *Cash* is negative and weakly significant, indicating that firms choose to either hold cash or spend their cash for capital investment. Further, the coefficients on *Cash Flow* and *MB* are both positive. The latter implies that firms with more growth opportunities undertake more capital investment. Next, the coefficient on *Leverage* is positive and significant. One possible explanation is that high leverage means that firms have better access to debt. Finally, the coefficient on *Tangibility* is positive, indicating that the more tangible assets firms have, the more inclined they are to undertake capital investment since tangible assets make it easier to obtain bank loans.

Columns (2)–(7) present the estimation results for capital investment for the same subsamples as

in Table 4. Columns (2) and (3) show that the coefficient on *Credit Line* is not statistically significant for both small and large firms when firms are classified in terms of their assets. In Columns (4) and (5), the coefficient on *Credit Line* is positive and significant for firms with a low payout ratio, while it is insignificant for firms with a high payout ratio. Similarly, Columns (6) and (7) show that the coefficient on *Credit Line* is positive and significant for firms without access to the bond or CP market, while it is insignificant for firms with access.

To summarize the results in Tables 4 and 5, firms with credit lines tend to hold lower cash reserves and invest more than those without, implying that credit lines enable firms to use precautionary cash holdings for investment. Moreover, the impact of credit lines on cash holdings and capital investment is more pronounced for financially constrained firms.

5.2 Propensity Score Matching Approach

Section 5.1 compared firms with and without credit lines to investigate how credit lines affect corporate cash holdings and capital investment. However, the analysis may suffer from sample selection problems. As mentioned by Sufi (2009), firms that have high cash flows tend to have easier access to credit lines. Therefore, to check the robustness of the results, this section employs propensity score matching to take potential sample selection bias due to differential access to credit lines into account.[8] The first step of the propensity score matching approach here consists of a probit model estimation in which the dependent variable is *Credit Line*, while lagged values of the variables in Eq. (1) are used as independent variables. In the second step, firms with and without credit lines are compared.

Table 6 presents the estimation results for cash holdings using the propensity score matching approach. Column (1) shows the result for all firms in the sample, which indicates that firms with credit lines have lower cash holdings than firms without. Furthermore, the results remain essentially unchanged when the number of matched observations is increased from 1 to 3 or 5. Columns (2) and (3) show the results for small and large firms, respectively. Column (2) indicates that small firms with credit lines have 0.013–0.016 percentage point lower cash holdings than firms without credit lines, while Column (3) shows that in the case of large firms, the difference is 0.003 percentage points. Next, Columns (4) and (5) show the results when firms are grouped in terms of their payout ratios. Among firms with a low payout ratio, the difference between firms with and without credit lines is insignificant. In contrast, in the group of firms with a high payout ratio, firms with credit lines have 0.06–0.08 percentage point lower cash holdings than firms without. Finally, Columns (6) and (7) present the results when the sample is split based on whether firms have access to the bond or CP market. Among firms with access, firms with credit lines have 0.005–0.007 percentage point lower cash holdings than

[8] For details on propensity score matching, see Rosenbaum and Rubin (1983)

firms without credit lines.

(Insert Table 6)

Next, Table 7 presents the corresponding results for capital investment. The results are similar to those in Table 5. Specifically, Column (1) shows that firms with credit lines undertake 0.002−0.003 percentage points more capital investment than firms without. Among financially constrained firms, such as those with a low payout ratio and those without access to the bond or CP market, the capital investment of firms with credit lines is 0.003-0.005 percentage points larger than that of those without credit lines. In contrast, for financially unconstrained firms, the results provide no evidence that firms with credit lines invest more than those without.

(Insert Table 7)

Overall, the propensity matching approach addressing potential sample selection bias due to differential access to credit lines confirms that firms with credit lines have lower cash reserves and undertake more capital investment than those without, which is consistent with the hypotheses presented earlier. Furthermore, the impact of credit lines is more significant for financially constrained firms than for unconstrained.

5.3 Firm Fixed Effects

The analysis so far has shown that firms with credit lines tend to have lower cash holdings and invest more than firms without credit lines. To further check the robustness of the findings so far, this section conducts estimations taking firm fixed effects into account since cash holdings and capital investment may be affected by unobserved firm characteristics. The advantage of controlling for firm fixed effects is discussed by Becker and Ivashina (2014). To eliminate unobservable firm fixed effect, the independent variables are transformed from $X_{i,t}$ to $\ddot{X}_{i,t} = (X_{i,t} - \bar{X}_i)$, where $\bar{X}_i$ is the firm-level average. If firms have access to credit lines throughout ($Credit\ Line_{i,t} = 1, \forall\ t$), the average of *Credit Line* is equal to 1, and transformed $\ddot{Credit\ Line}_{i,t}$ is 0, $\forall\ t$. Similarly, if firms do not have access to credit lines, the average and transformed *Credit Line* is equal to 0. Therefore, in the firm fixed effects estimation, the coefficient on *Credit Line* reflects the effect of gaining access to credit lines. Table 8 shows the results of the firm fixed effects estimation for cash holdings, which are similar to those in Tables 4 and 6. Column (1), for instance, shows that the coefficient on *Credit Line* is negative. In Columns (2) and (3), the coefficient on *Credit Line* is negative for small firms while it is insignificant for large firms. Meanwhile, Columns (4) and (5) show that the coefficient on *Credit Line* is negative for firms with a high payout and insignificant for those with a low payout Finally, while the coefficient

on *Credit Line* in Columns (6) and (7) is negative for both firms with and without access to the bond or CP market, it is somewhat larger and more statistically significant for those without access.

(Insert Table 8)

Next, Table 9 shows the results of the fixed firm effects estimation for capital investment. In Column (1), the coefficient on *Credit Line* is positive and significant. On the other hand, in Columns (2) and (3), the coefficient on *Credit Line* is insignificant for both small and large firms. Meanwhile, in Columns (4) and (5), the coefficient on *Credit Line* is positive and significant for firms with a low payout ratio and insignificant for firms with a high payout ratio. Finally, in Columns (6) and (7), the coefficient on *Credit Line* is also positive and significant for firms without access to the bond or CP market but insignificant for firms with access. Therefore, the results in Table 9 are in line with those in Tables 5 and 7.

(Insert Table 9)

Overall, the regression results controlling for fixed effects indicate that the baseline results remain essentially unchanged when unobservable firm characteristics are taken into account. That is, as before, firms with credit lines hold lower cash reserves and undertake more capital investment.

5.4 Subsample Analysis

Finally, as a further robustness check, a subsample analysis is conducted focusing on firms that newly arranged credit lines during the observation period from 2006 to 2017. The baseline analysis compared firms with credit lines to those without. However, the analysis could potential suffer from endogeneity due to reverse causality: it could be the case that firms with lower cash holdings and more investment are more likely to arrange credit lines, giving rise to the correlations observed in the baseline analysis.

To address this issue, the following categorical variable is constructed. *NONE* equals 0 when a firm does not have credit lines. *New* equals 1 if a firm starts using credit lines, that is, if *Credit Line* in the present period is 1 and in the previous period is 0. *Continue* equals 2 if a firm continues to have credit lines, that is, if *Credit Line* in the present period is 1 and in the previous period is also 1. *Nonrenewal* equals 3 if a firm does not renew its credit lines, that is, if *Credit Line* in the present period is 0 and in the previous period is 1.

Table 10 reports the average cash holdings and capital investment of firms (observations) falling into the categories defined by these variables. Specifically, Column (A) shows the average cash holdings (*Cash*) and investment (*Capex*) of firms that did not have credit lines in the period when the observation was made. Similarly, column (B) shows these values for firms that newly arranged credit

lines during the period of observation. Looking at the value for *Cash*, the average is 0.176 for firms without credit lines, which falls to 0.158 for firms that have newly arranged credit lines. The difference is 0.018. In addition, if firms firm continue to have credit lines (Column (C)), *Cash* further decreases to 0.150. On the other hand, if firms do not renew their credit lines (Column (D)), the average of *Cash* increases again to 0.179, and the difference is not statistically significant. Turning to *Capex*, whereas the average for firms without credit lines when the observation was made (Column (A)) is 0.043, it is 0.047 in the period in which a firm starts to have credit lines (Column (B)), suggesting that firms increase their capital investment after arranging credit lines. This difference is statistically significant, and the significant difference in *Capex* remains when firms continue to have credit lines (Column (C)). In contrast, when firms cancel their credit lines, the average of *Capex* returns to the level when firms do not have credit lines (Column (D)).

(Insert Table 10)

Next, the link between, on the one hand, credit lines and cash holdings and, on the other hand, capital investment based on Eqs. (1) and (2) including the categorical variable and controlling for industry or firm fixed effects is estimated. The results are shown in Table 11. Columns (1) and (2) for *Cash* indicate that the coefficients on *New* and *Continue* are negative, implying that firms' level of cash holdings decreases from the period in which they start to have credit lines. On the other hand, the coefficient on *Nonrenewal* is not statistically significant. Turning to the results for *Capex*, the coefficient on *New* in Column (3) is positive, while in Column (4), the coefficient on *Continue* is positive. The coefficient of *Nonrenewal* is statistically insignificant.

(Insert Table 11)

To summarize, the results in Tables 10 and 11 suggest that after gaining access to credit lines, firms decrease their cash holdings and increase their capital investment. In other words, the negative relationship between credit lines and cash holdings and the positive relationship between credit lines and capital investment found in the baseline analysis is not caused by firms that already had lower cash reserves and undertook more capital investment but rather the result of credit lines. Credit lines improve firms' financial flexibility and boost activities such as investment because they enable firms to access bank loans whenever they need funds.

6. Conclusion

Credit lines are a form of bank loan that help firms access external financing whenever liquidity is needed. As such, credit lines represent an important alternative to cash as a source of liquidity. Previous

studies have examined the effect of credit lines on firms' cash management and capital investment, with empirical and theoretical findings suggesting that credit lines are associated with lower cash reserves and more capital investment. However, although numerous empirical studies have investigated the effect of credit lines on cash holdings and capital investment, most have focused on drawdowns or the size of the credit line facility. In other words, they have focused not on the extensive margin but the intensive margin of the effect of credit lines. In contrast to these empirical studies, theoretical studies have examined the relationship between credit lines and firms' activities in terms of the extensive margin.

Further, while most extant studies suggest that credit lines affect corporate cash holdings and investment, these studies concentrated on firms in Western countries. In contrast, there are only a handful of studies on credit lines in Japan, reflecting the fact that credit lines are a relatively recent phenomenon in Japan as well as the difficulty of collecting data on credit lines. Most of these studies have examined the effect of credit lines on stock prices. Therefore, the issue of whether and how credit lines affect Japanese firms' cash holdings and capital investment remained unclear.

Against this background, this study investigated the impact of credit lines on corporate cash holdings and capital investment using hand-collected data on credit lines for publicly listed Japanese firms spanning the period 2006–2017. The following empirical results were obtained: (1) relative to firms that do not have credit lines, those with credit lines hold lower cash reserves and undertake more capital investment; (2) using propensity score matching and firm fixed effects as robustness checks confirmed these results; and (3) subsample analyses focusing on firms that had newly arranged credit lines – conducted as a further robustness check – indicated that firms decreased their cash holdings and increased their capital investment after gaining access to credit lines.

In summary, the findings suggest that credit lines improve firms' financial flexibility; that is, credit lines enable firms to redeploy cash holdings held for precautionary purposes and use them for capital investment instead. Moreover, these findings for listed firms in Japan are in line with results of the empirical studies focusing on the United States and other countries mentioned at the outset.

Finally, it is worth pointing out various avenues for future research. The present study examined the effect of credit lines on cash holdings and capital investment of listed firms. However, access to credit lines might actually be more important for private firms, which are more likely to be financially constrained than publicly traded firms since the latter have a wider range of options to obtain financing (such as through the issuance of equity, corporate bonds, or CP). It would therefore be interesting to also examine the effect on private firms. Another topic for future research would be to examine the role of overdrafts, which are similar to credit lines. However, although overdrafts also provide firms with contingent access to funds, unlike credit lines they require firms to maintain deposits. Another avenue for research therefore would be to examine whether and how overdrafts affect firms' cash holdings, investment, etc., and how these effects differ from those of credit lines.

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Figure 1 Number and total volume of credit lines in Japan, 2001–2017

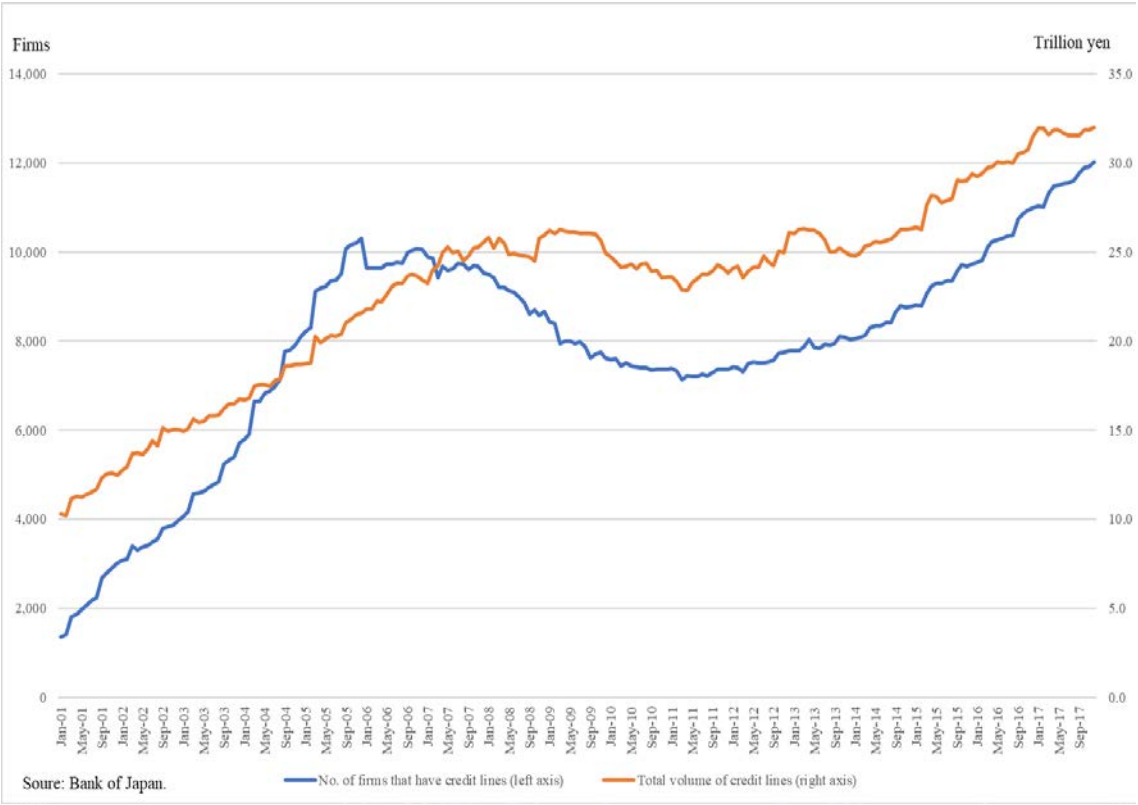

Table 1 Definition of variables

Variable	Definition
Credit Line	A dummy that takes 1 if a firm has a credit line and 0 otherwise
Cash	Sum of cash and deposits/Total assets
Capex	Capital expenditure/Total assets
Size	Log (Total assets)
Cash Flow	EBITDA/Total assets
MB	Market value of assets/Total assets
Leverage	Total liabilities/Total assets
Tangibility	Tangible assets/Total assets
Cash Flow Volatility	Ratio of the average of the standard deviation of *Cash Flow* over the observation period to the average of total assets over the observation period

Table 2 Summary statistics

Variable	N	Mean	S.d.	Min	Median	Max
Credit Line	34,652	0.195	0.397	0.000	0.000	1.000
Cash	34,652	0.176	0.135	0.008	0.140	0.734
Capex	34,652	0.040	0.039	0.000	0.029	0.232
Size	34,652	175,524	629,369	47	33,699	18,400,000
Cash Flow	34,652	0.039	0.086	-0.783	0.041	0.263
MB	34,652	0.653	0.761	0.033	0.423	7.219
Leverage	34,652	0.503	0.206	0.074	0.508	0.976
Tangibility	34,652	0.282	0.185	0.005	0.263	0.810
Cash Flow Volatility	34,652	0.052	0.068	0.000	0.035	1.108

The table shows summary statistics for the sample used in the analysis. Definitions of the variables are provided in Table 1. *Size* is measured in million yen.

Table 3 Summary statistics for firms with and without access to credit lines

	(A) Firms with Credit Lines (Obs. 6,771)			(B) Firms without Credit Lines (Obs. 27,881)			
Variable	Mean	S.d.	Median	Mean	S.d.	Median	Mean Comparison: Difference ((A)-(B))
Cash	0.144	0.101	0.121	0.184	0.140	0.146	−0.040***
Capex	0.042	0.039	0.032	0.039	0.039	0.028	0.003***
Size	258,383	756,897	60,136	155,401	592,553	28,896	102,982***
Cash Flow	0.039	0.066	0.039	0.039	0.090	0.042	0.001
MB	0.538	0.559	0.385	0.682	0.800	0.436	−0.144***
Leverage	0.552	0.180	0.561	0.492	0.210	0.493	0.060***
Tangibility	0.297	0.177	0.280	0.278	0.187	0.259	0.019***
Cash Flow Volatility	0.044	0.045	0.033	0.054	0.072	0.035	−0.010***

This table reports the average, the standard deviation, and the median of the variables employed in the analysis for firms with and without access to credit lines. Definitions of the variables are provided in Table 1. *Size* is measured in million yen. The columns under (A) show statistics for firms that have access to credit lines, while the columns under (B) show statistics for firms that do not have access to credit lines. *** denotes statistical significance at the 1% level.

Table 4 Estimation results for cash holdings

	(A) All firms	(B) Size		(C) Payout ratio		(D) Access to Bond/CP market	
		Small	Large	Low Payout	High Payout	No Access	Access
Dependent Variable: *Cash*	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Credit Line	−0.005*	−0.018***	−0.000	−0.002	−0.006	−0.008**	−0.002
	(0.003)	(0.007)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)
Size	−0.020***	−0.036***	−0.011***	−0.017***	−0.019***	−0.023***	−0.018***
	(0.001)	(0.005)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Cash Flow	0.083***	0.100***	0.025	0.044***	0.343***	0.095***	0.080***
	(0.016)	(0.019)	(0.031)	(0.017)	(0.064)	(0.019)	(0.021)
MB	0.031***	0.022***	0.038***	0.030***	0.023***	0.030***	0.030***
	(0.002)	(0.003)	(0.006)	(0.003)	(0.005)	(0.003)	(0.004)
Leverage	−0.143***	−0.177***	−0.099***	−0.153***	−0.134***	−0.169***	−0.086***
	(0.008)	(0.013)	(0.013)	(0.009)	(0.012)	(0.009)	(0.013)
Tangibility	−0.232***	−0.291***	−0.163***	−0.241***	−0.217***	−0.254***	−0.191***
	(0.007)	(0.014)	(0.011)	(0.008)	(0.011)	(0.009)	(0.009)
Cash Flow Volatility	0.092***	−0.012	0.346***	0.023	0.301***	0.094***	0.084**
	(0.030)	(0.027)	(0.051)	(0.028)	(0.060)	(0.034)	(0.040)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,652	10,402	13,856	15,012	11,448	24,026	10,626
R^2	0.504	0.502	0.360	0.516	0.511	0.497	0.465

This table shows the estimation results for cash holdings. The dependent variable is *Cash*. (A) shows the results for the full sample. (B)-(D) show the results when two groups are distinguished in terms of different criteria representing whether firms are likely to be financially constrained. The criteria are firms' size (in terms of assets), their payout ratio, and whether firms have access to the corporate bond or commercial paper (CP) market. Definitions of the variables are provided in Table 1. All estimations include a constant as well as year and industry fixed effects. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table 5 Estimation results for capital investment

	(A) All firms	(B) Size		(C) Payout ratio		(D) Access to Bond/CP market	
		Small	Large	Low Payout	High Payout	No Access	Access
Dependent Variable: *Capex*	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Credit Line	0.003***	0.003	0.000	0.004***	0.000	0.003**	0.002
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Cash	−0.007*	−0.019***	0.002	−0.005	−0.016***	−0.009**	0.018**
	(0.004)	(0.006)	(0.006)	(0.005)	(0.006)	(0.004)	(0.008)
Size	0.000	−0.001	0.001	0.001*	0.000	0.000	0.001***
	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Cash Flow	0.008*	−0.004	0.062***	−0.007	0.100***	0.008	0.006
	(0.005)	(0.006)	(0.011)	(0.005)	(0.016)	(0.005)	(0.010)
MB	0.010***	0.007***	0.007***	0.009***	0.006***	0.009***	0.012***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
Leverage	0.005**	0.008**	0.003	0.001	0.013***	0.005**	0.006
	(0.002)	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.004)
Tangibility	0.083***	0.073***	0.100***	0.077***	0.085***	0.091***	0.073***
	(0.003)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,652	10,402	13,856	15,012	11,448	24,026	10,626
R^2	0.188	0.120	0.292	0.156	0.219	0.207	0.159

This table shows the estimation results for capital investment. The dependent variable is *Capex*. (A) shows the results for the full sample. (B)-(D) show the results when two groups are distinguished in terms of different criteria representing whether firms are likely to be financially constrained. The criteria are firms' size (in terms of assets), their payout ratio, and whether firms have access to the corporate bond or commercial paper (CP) market. Definitions of the variables are provided in Table 1. All estimations include a constant as well as year and industry fixed effects. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table 6 Estimation results for cash holdings using propensity matching

Dependent variable: *Cash*	No. of matched observations: 1	No. of matched observations: 3	No. of matched observations: 5
(A) (1) All firms	−0.006**	−0.007***	−0.006***
	(0.002)	(0.002)	(0.002)
(B) Size			
(2) Small	−0.013*	−0.013**	−0.016***
	(0.007)	(0.006)	(0.006)
(3) Large	−0.003	−0.003	−0.003
	(0.002)	(0.002)	(0.002)
(C) Payout ratio			
(4) Low Payout	−0.005	−0.001	−0.001
	(0.004)	(0.003)	(0.003)
(5) High Payout	−0.008**	−0.007	−0.006**
	(0.004)	(0.003)	(0.003)
(D) Access to Bond/CP market			
(6) No Access	−0.005	−0.007***	−0.007***
	(0.003)	(0.002)	(0.002)
(7) Access	−0.001	−0.000	−0.001
	(0.003)	(0.002)	(0.002)

This table shows the average effect of credit lines on cash holdings using the propensity score matching approach. The dependent variable is *Cash*. (A) shows the results for the full sample. (B)-(D) show the results when two groups are distinguished in terms of different criteria representing whether firms are likely to be financially constrained. The criteria are firms' size (in terms of assets), their payout ratio, and whether firms have access to the corporate bond or commercial paper (CP) market. Definitions of the variables are provided in Table 1. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table 7 Estimation results for capital investment using propensity matching

Dependent variable: *Capex*	No. of matched observations: 1	No. of matched observations: 3	No. of matched observations: 5
(A) (1) All firms	0.003***	0.002***	0.002***
	(0.001)	(0.001)	(0.001)
(B) Size			
(2) Small	0.001	0.002	0.003
	(0.002)	(0.002)	(0.002)
(3) Large	0.001	0.000	0.000
	(0.001)	(0.001)	(0.001)
(C) Payout ratio			
(4) Low Payout	0.004***	0.004***	0.005***
	(0.001)	(0.001)	(0.001)
(5) High Payout	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)
(D) Access to Bond/CP market			
(6) No Access	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)
(7) Access	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)

This table shows the average effect of credit lines on capital investment using the propensity score matching approach. The dependent variable is *Capex*. (A) shows the results for the full sample. (B)-(D) show the results when two groups are distinguished in terms of different criteria representing whether firms are likely to be financially constrained. The criteria are firms' size (in terms of assets), their payout ratio, and whether firms have access to the corporate bond or commercial paper (CP) market. Definitions of the variables are provided in Table 1. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table 8 Results for cash holdings controlling for firm fixed effects

	(A) All firms	(B) Size		(C) Payout ratio		(D) Access to Bond/CP market	
		Small	Large	Low Payout	High Payout	No Access	Access
Dependent Variable: *Cash*	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Credit Line	−0.007***	−0.013**	−0.001	−0.004	−0.009***	−0.006**	−0.005*
	(0.002)	(0.006)	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)
Size	−0.014***	−0.006	−0.011**	−0.014***	−0.018	−0.015***	−0.012**
	(0.004)	(0.007)	(0.005)	(0.005)	(0.011)	(0.005)	(0.006)
Cash Flow	0.038***	0.034**	0.002	0.030**	0.126***	0.029**	0.076***
	(0.011)	(0.016)	(0.018)	(0.013)	(0.047)	(0.013)	(0.019)
MB	0.013***	0.012***	0.019***	0.013***	0.013***	0.013***	0.009**
	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.002)	(0.004)
Leverage	−0.128***	−0.151***	−0.060***	−0.140***	−0.100***	−0.142***	−0.065***
	(0.011)	(0.019)	(0.015)	(0.016)	(0.028)	(0.014)	(0.018)
Tangibility	−0.316***	−0.357***	−0.294***	−0.293***	−0.393***	−0.362***	−0.253***
	(0.015)	(0.027)	(0.021)	(0.020)	(0.026)	(0.020)	(0.021)
Cash Flow Volatility	0.445***	0.426***	0.357***	0.449***	0.439***	0.478***	0.368***
	(0.037)	(0.056)	(0.056)	(0.049)	(0.108)	(0.048)	(0.064)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,652	10,402	13,856	15,012	11,448	24,026	10,626
R^2	0.204	0.191	0.213	0.195	0.186	0.204	0.187

This table shows the estimation results for cash holdings. The dependent variable is *Cash*. (A) shows the results for the full sample. (B)-(D) show the results when two groups are distinguished in terms of different criteria representing whether firms are likely to be financially constrained. The criteria are firms' size (in terms of assets), their payout ratio, and whether firms have access to the corporate bond or commercial paper (CP) market. Definitions of the variables are provided in Table 1. All estimations include a constant as well as year and firm fixed effects. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table 9 Results for capital investment controlling for firm fixed effects

	(A) All firms	(B) Size		(C) Payout ratio		(D) Access to Bond/CP market	
		Small	Large	Low Payout	High Payout	No Access	Access
Dependent Variable: *Capex*	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Credit Line	0.003***	0.001	0.002	0.004***	0.000	0.003**	0.002
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)
Cash	−0.021***	−0.026***	−0.020***	−0.022***	−0.017***	−0.019***	−0.020*
	(0.004)	(0.006)	(0.006)	(0.006)	(0.007)	(0.004)	(0.011)
Size	0.006***	0.008***	0.007***	0.004**	0.006**	0.006***	0.009***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Cash Flow	0.000	−0.014**	0.032***	−0.014***	0.057***	0.002	−0.009
	(0.004)	(0.006)	(0.007)	(0.005)	(0.015)	(0.005)	(0.009)
MB	0.003***	0.002**	0.005***	0.002**	−0.000	0.002**	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Leverage	−0.006*	−0.014**	−0.005	−0.014***	0.025***	−0.002	−0.005
	(0.004)	(0.006)	(0.006)	(0.005)	(0.007)	(0.004)	(0.008)
Tangibility	0.137***	0.136***	0.154***	0.100***	0.213***	0.153***	0.135***
	(0.007)	(0.012)	(0.011)	(0.010)	(0.014)	(0.010)	(0.012)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,652	10,402	13,856	15,012	11,448	24,026	10,626
R^2	0.089	0.085	0.125	0.070	0.127	0.099	0.087

This table shows the estimation results for capital investment. The dependent variable is *Capex*. (A) shows the results for the full sample. (B)-(D) show the results when two groups are distinguished in terms of different criteria representing whether firms are likely to be financially constrained. The criteria are firms' size (in terms of assets), their payout ratio, and whether firms have access to the corporate bond or commercial paper (CP) market. Definitions of the variables are provided in Table 1. All estimations include a constant as well as year and firm fixed effects. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table 10 Average of cash holdings and capital investment of firms that newly arranged credit lines

	(A) Periods when firms did not have credit lines (Obs.: 3,180)	(B) Periods when firms arranged credit lines (Obs.: 647)	(C) Periods when firms continued to have access to credit lines (Obs.: 2,568)	(D) Periods when firms did not renew credit lines (Obs.: 331)
Cash	0.176	0.158	0.150	0.179
Capex	0.043	0.047	0.046	0.041
Difference in *Cash* from (A)		−0.018***	−0.025***	0.004
Difference in *Capex* from (A)		0.004**	0.003***	−0.002

This table reports the average of *Cash* and *Capex* for firms that newly arranged credit lines during 2006-2017 for the following the periods: (A) periods when firm did not have credit lines; (B) periods when firms newly arranged credit lines; (C) periods when firm continued to have access to credit lines; and (D) periods when firms did not renew credit lines. Definitions of the variables are provided in Table 1. *** and ** denote statistical significance at the 1% and 5% level, respectively.

Table 11 Estimation results for firms that newly arranged credit lines

	(A) Dependent variable: *Cash*		(B) Dependent variable: *Capex*	
	(1)	(2)	(3)	(4)
New	−0.009**	−0.006*	0.004**	0.002
	(0.003)	(0.003)	(0.002)	(0.002)
Continue	−0.013***	−0.007**	0.002	0.003**
	(0.005)	(0.003)	(0.002)	(0.001)
Nonrenewal	-0.002	-0.001	−0.002	−0.003
	(0.005)	(0.004)	(0.002)	(0.002)
Cash			−0.002	−0.027***
			(0.010)	(0.009)
Size	−0.017***	−0.023***	−0.000	0.002
	(0.001)	(0.007)	(0.001)	(0.003)
Cash Flow	0.056*	0.019	0.008	0.009
	(0.031)	(0.026)	(0.012)	(0.008)
MB	0.035***	0.014***	0.013***	0.004**
	(0.004)	(0.004)	(0.002)	(0.002)
Leverage	−0.105***	−0.143***	0.012**	−0.006
	(0.016)	(0.025)	(0.005)	(0.007)
Tangibility	−0.207***	−0.290***	0.090***	0.124***
	(0.014)	(0.031)	(0.008)	(0.015)
Cash Flow Volatility	0.107			
	(0.077)			
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes		Yes	
Firm FE		Yes		Yes
Observations	6,726	6,726	6,726	6,726
R^2	0.484	0.223	0.210	0.090

This table shows the estimation results for cash holdings and capital investment for firms that newly arranged credit lines during 2006-2017. The dependent variable in (A) is *Cash*, while the dependent variable in (B) is *Capex*. The categorical variable employed in the analysis is as follows: *New* is equal to 1 if a firm newly contracted credit lines, *Continue* is equal to 2 if a firm continued to have credit lines, *Nonrenewal* is equal to 3 if a firm did not renew credit lines, and *None* is equal to 0 and the base category. Definition of the variables are provided in Table 1. All estimations include a constant as well as year and industry or firm fixed effects. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, 10% level, respectively.