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HATTORI, Masazumi
Hitotsubashi University

FUJITANI, Ryosuke
Hitotsubashi University

NAKAJIMA, Jouchi
Hitotsubashi University

YASUDA, Yukihiro
Hitotsubashi University

RIETI
Research Institute of Economy, Trade & Industry, IAA

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Real Effects of Corporate Cash Holdings: Evidence from Japan[1]

Masazumi Hattori
Hitotsubashi University

Ryosuke Fujitani
Hitotsubashi University

Jouchi Nakajima
Hitotsubashi University

Yukihiro Yasuda
Hitotsubashi University

Abstract

This study analyzes the real effects of cash holdings of Japanese companies. We quantitatively investigate whether differences in cash holdings immediately before a specific sample period after 2000 lead to differences in corporate behavior over the medium term. Specifically, we first investigate the period immediately after the Lehman shock in 2008 and analyze capital expenditures as real effects. The results clearly show that companies with high cash holdings immediately before the crisis make more capital investments in the post-crisis period than companies with low cash holdings. We also find that the difference is larger for tangible fixed assets than it is for intangible fixed assets. These results are similar to a preceding study in the UK that reported that differences in cash holdings create differences in companies' competitive advantage after the crisis. However, unlike in the UK, we also find that the real effects of cash holdings are almost equally apparent, regardless of the sample period chosen after 2000. Japanese companies experienced a domestic banking crisis in the late 1990s. It can be pointed out that the experience of the crisis motivated them to increase their tendency to hold cash, and that differences in the resulting cash holdings have led to differences in the real effects in Japan.

Keywords: corporate investment, corporate cash holdings, financial crisis, credit constraints, firm-bank relationship

JEL classification: D25, E22, G30, G31, G32

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1 Introduction

There is vast room for a more detailed empirical analysis of the real effects of corporate cash holdings. More precisely, the impact of differences in cash holdings between firms on corporate behavior and performance, such as the growth rates of capital investment, sales and profits, remains a topic for further investigation.

It is commonly known that Japanese firms accumulate a great amount of cash on their balance sheets. Sher (2014) and Kim et al. (2023) show that Japanese firms increased their cash reserves in the middle of the 2000's. In comparison with US firms, *Wall Street Journal* (2022) reports that "[t]he total cash held by firms in the MSCI Japan is equal to approximately 17% of their market capitalization-versus 5% for the MSCI USA." This observation is consistent with Sher's (2014) finding that the median cash-to-assets ratio of Japanese firms is four percentage points higher than that of US firms. Against this background, there are opinions criticizing the accumulation of cash and other equivalents by firms in Japan: Firms should allocate their abundant cash reserves to capital investment and increase their growth and profitability, or use seemingly excessive cash reserves for wage payments and shareholder payoffs. Although the debate about introducing a tax on corporate cash holdings is heating, there is one missing viewpoint: Have corporate cash holdings had any real effect on the economy?

This study analyzes the impact of liquidity holdings on corporate behavior and performance. The analytical approach is as follows: We first pay attention to corporate cash holdings immediately before the global financial crisis in 2007-8 and subsequent corporate behavior and performance. The results of the analysis using an economic crisis as a natural experiment are expected to reveal some general results. In other words, an economic crisis can be regarded in many ways as an exogenous shock starting in the year prior to the crisis. Therefore, by controlling for the conditions of various firms in the years just before the crisis, we can estimate in detail the impact of differences in cash holdings among firms before the crisis on corporate behavior while appropriately avoiding endogeneity problems.

Another reason for focusing on the post-crisis period is based on the idea that if there is a tangible effect of firms' cash holdings, it will be more clearly observed after the greater shock of the economic crisis. Focusing on firms in Japan that have long been noted to have an increase in the liquidity ratio on their balance sheets, we analyze whether substantial phenomena can be observed in firms with more liquidity compared to others that take advantage of investment opportunities after an economic crisis, increase sales, and, consequently, increase market share.

We investigate whether the results of the quantitative analysis for the period immediately after the GFC were distinctively different from those in other sample periods. Our finding is quite different from that of a previous study that employs similar methodologies to analyze the real effects of corporate cash holdings. Joseph et al. (2022) report a substantial impact of corporate cash holdings immediately before the GFC on capital investments and market share in the sample period. Our analysis of a comparable sample period highlights this point too. However, while Joseph et al. (2022) find that the significance of the impact of corporate cash holdings is distinctive in the period in question and that such impacts do not exist in other sample periods, we find that differential impacts exist almost equally in the sample period after 2000. We discuss the historical reason why this was the case for Japanese firms in the 2000s, unlike firms in the UK.

The analytical approach used in this study is described in detail below. After dividing each company's balance sheet liquidity ratio into groups with high and low liquidity ratios just before a certain sample year, such as the year of an economic crisis, we first confirm the differences in corporate behavior and business performance. We construct panel corporate financial data and estimate the impact of differences in liquidity holdings on corporate behavior during this period using panel data regressions. Next, we examine the explanatory power of differences in balance sheet composition in terms of cash holdings just before a certain year on differences in corporate performance (sales growth) and corporate behavior (business fixed investment growth rate) over an extended period after the year. This verification uses local projection method. The local projection proposed by Jorda (2005) is a method for analyzing the dynamic

effects of economic variables and has been used in many empirical corporate finance studies in recent years. This method estimates the impact of explanatory variables on the dependent variable at each point in time. By employing this method, we can include many explanatory variables and measure their nonlinear effects by simply adding nonlinear terms to the equation. When conducting complex empirical analyses, it is essential to include various dummy variables and cross-terms that capture regime changes to obtain robust results; this method is highly flexible, as shown in IMF (2020) and World Bank (2020). Recently, it is used to estimate the economic impact of the coronavirus pandemic (Jinjarak et al. (2020)).

By applying local projection to comprehensive panel data of Japanese companies, this study quantitatively examines the above problems and obtains highly robust conclusions. The liquidity ratio of each firm immediately before a certain year is used as the explanatory variable of interest. Other variables that characterize each firm, such as asset size, leverage ratio and industry dummy, are included as explanatory variables to verify the effect of the liquidity ratio. We primarily use capital investment as the dependent variable to identify the real effects of differences in liquidity conditions.

The remainder of this paper is organized as follows. Section 2 provides an overview of the previous studies. Section 3 describes the data use in the analysis. Section 4 explains the estimation methodologies of the panel data regression and local projection. Section 5 presents the estimation results. Section 6 extends the main analysis using local projection that focuses on bank-firm relationships. Session 7 concludes.

2 Literature review

In Japan, a substantial increase in firms' liquidity holdings has been observed since the late 1990s. Chronologically, this trend began after the domestic banking crisis of the late 1990s. The GFS accelerated this, and at the same time, a substantial increase in corporate liquidity holdings has become a phenomenon observed not only in Japan, but also in many major advanced economies, such as the United States, in recent

years. These have garnered worldwide attention as subjects of academic research.

Bates, Kahle and Stulz (2009) show that U.S. companies' cash and deposit holdings more than doubled from the early 1980s to the mid-2000s, reaching approximately 25% of their total assets. Ferreira and Vilela (2004) focus on companies in continental European countries whose cash and deposit holdings accounted for approximately 15% of total assets in the early 2000s. Brufman et al. (2013) analyze the trends of listed manufacturing companies in Germany, France, Italy, Japan, and the UK during the sample period from 1997 to 2011. They found that declining capital investment and increasing corporate savings were a common phenomena. Gruber and Kamin (2015) note that the tendency of firms in major countries to hold cash and deposits became more pronounced after the 2007-2009 global recession, particularly in expanding ICT companies. In recent years, Fahlenbrach et al. (2021) analyze the impact of the coronavirus pandemic on corporate financing from the perspective of differences in liquidity holdings.

Previous studies have discussed the reasons for firms' increasing cash and deposits from two broad perspectives. The first focuses on cash and deposit holdings as precautionary motives. The key point is that companies are limited in their ability to borrow from outside finance sources and often need to raise more capital when an investment opportunity arises. This gives companies an incentive to hold cash and deposits as readily available, highly liquid assets to secure future investment opportunities. Holding cash and deposits involves opportunity costs, and the firm's profitability will temporarily decrease because the return from highly liquid assets tends to be lower than that from less liquid assets. However, if a company does not hold highly liquid assets, it may not be able to make highly profitable investments.

Many empirical studies have pointed out that companies hold cash and deposits for precautionary motives. For example, Opler et al. (1999) analyze U.S. companies from the 1970s to the 90s and found that the cash holdings increased as growth opportunities and risks increased and decreased as external funding became easier. Kim et al. (1998) use data from U.S. companies to show similar results, noting that the opportunity cost of holding cash and deposits is related to the trade-off between borrowing costs. Almeida,

Campello and Weisbach (2004) show that an increase in cash flow leads to an increase in cash and deposits only for companies with borrowing constraints. This proves that the simultaneous existence of borrowing constraints and growth opportunities is a crucial factor in firms holding cash and deposits on a preliminary motivation basis.

The second perspective focuses on the holding cash and deposits associated with agency costs. Here, agency costs are expenses incurred when corporate stakeholders cannot closely monitor the actions of managers who are agents or properly evaluate and judge the results of their efforts. In the presence of agency costs, even if they lower corporate value, managers do not return surplus funds to shareholders as dividends but have an incentive to hold cash to increase their discretion and benefits. Since Jensen and Meckling's (1976) pioneering work, the free cash flow hypothesis has been argued, resulting in the conclusion that management holding cash, which is challenging to discipline from the outside, can lead to inefficient investment by managers pursuing personal gains.[2]

The results of the empirical analyses are mixed, and there is no consensus on whether agency costs increase the observed corporate cash holdings. Dittmar et al. (2003) conduct an international comparison using corporate data from 45 countries as of 1998 and find higher ratios of cash and deposits to total assets held by companies in countries where shareholder rights are less protected. Kalcheva and Lins (2007) use corporate data from 31 countries to show that the greater the control of a company by a group of managers and their families, the higher the ratio of cash and deposits. However, empirical analyses of U.S. companies have not shown a tendency for higher cash and deposit ratios in companies whose shareholder rights are not protected (Opler, Pinkowitz, Stulz and Williamson (1999)). Dittmar and Mahrt-

[2] From the perspective of opportunity cost, Bates et al. (2009) examine the yield of Treasury bills (T-bills) as a proxy variable for opportunity cost at U.S. companies. They found a negative relationship between the level of cash holdings and the T-Bill yield. Hori et al. (2010) demonstrate that long-term and short-term spreads, i.e., the difference between long-term government bond yields and collateralized overnight call rates, are negatively related to corporate cash holdings in Japan.

Smith (2007) use data from U.S. manufacturing companies to show that firms with less entrenchment from external disciplines, such as acquisitions–that is, companies with better governance–have greater value in cash and deposits.

When comparing firms in major countries, the ratio of cash and deposits to total assets in Japanese firms tended to be notably higher in the past. Pinkowitz and Williamson (2001) argue that in the late 1970s and the early 1980s, when the influence of banks was strong in Japan, the level of cash holdings was high, and the strength of banks' monopoly power was a factor that increased borrowers' cash holdings. They also report low levels of cash holdings among large firms' affiliates, which is consistent with the positive relationship between the strength of banks' monopoly power and high levels of cash holdings. Hori et al. (2010) examine the relationship between business relationships with banks and cash holdings. They report that an increase in bank borrowing increased firms' cash holdings in the manufacturing industry during the early 1980s. Furthermore, during the same period, the main bank's shareholding ratio had a negative impact on cash holdings, and the main bank may have relaxed its funding constraints. However, since the latter half of the 1980s, bank borrowing or the shareholding ratio of the main bank has had no significant impact, suggesting that corporate business relationships with banks have changed. Other studies focusing on the relationship with the financial health of main banks include Sasaki and Suzuki (2019). Luo and Hachiya (2005) also show that Japanese firms that do not protect their shareholder rights tend to hold more cash and deposits.

Other recent studies include Hori et al. (2010) and Shinada and Ando (2013). Hori et al. (2010) use data from companies listed on the First Section of the Tokyo Stock Exchange from 1981 to 2005 and find that companies with high growth potential (high market value ratio) tend to hold cash and deposits. However, an analysis of the monetary easing period since 2000 reveals that this relationship has disappeared. At the same time, the degree of fluctuation in business performance (standard deviation of the price-earnings ratio) has a positive impact and has become highly explanatory. Niimi (2011) examines the

preliminary motives of Japanese companies from 2000 to 2009. The results show that the volatility of business performance at the individual firm level positively affects cash holdings. Additionally, firms with financial constraints (firms with relatively low dividend payout ratios) have been unable to flexibly raise their cash holdings in response to increases in earnings volatility at the individual level. Shinada and Ando (2013) report empirical results showing that a decline in the ease of bank borrowing increased cash holdings during the domestic banking crisis in the late 1990s and the Lehman crisis (2008-2010).

Because of the substantial increase in firms' cash holdings in other major countries in recent years, the cash and deposits held by Japanese firms is not necessarily remarkably high in international comparisons. Kato et al. (2017) note that companies with enhanced corporate governance in recent years tend to experience a decline in cash holdings and an increase in dividend payout ratios, leading to improved performance. However, cash holdings of Japanese firms continued to increase significantly in the 2000s, especially since the GFC, both in monetary terms and as a ratio to total assets. Therefore, investigating the determinants of Japanese firms' cash holdings is becoming increasingly important.

From the perspective of verifying the real effects of firms' liquidity holdings, Joseph et al. (2022) are most closely related to our study. This study uses local projection approach to examine the impact of corporate liquidity holdings on capital investment after the GFC. In another study examining the financial crisis, Arslan et al. (2006) report that cash holdings may have supported investment during the financial crisis of 2001-2002, finding a low sensitivity to cash flows in cash-rich firms.

3 Data

Our primary sample consists of firms that filed annual financial reports (*Yuka-Shoken-Hokokusho*) from 2000 to 2019. The sample includes both public and quasi-private firms required to disclose their

annual financial reporting under the Financial Instruments and Exchange Act (French et al., 2020; 2021).[3] We obtained financial data on these firms and the stock price data of public firms from QUICK Astra Manager, a database that includes quarterly and annual financial reporting data, as well as daily stock market data. To form our primary dataset, we exclude firms in the financial industry (Nikkei Medium Classification Industry Code 47-52) and those with accounting periods that are not 12 months in duration. We also limit our observations to firms with non-missing data for the variables of interest. Using this approach, we ensure that our sample is comparable to previous research and that we have a comprehensive set of data to analyze corporate cash holdings in Japan.

4 Estimations

4.1 Panel data regression (for full sample for comparison)

To estimate the general sensitivity of corporate investments to cash holdings, we do estimation of the following equation (Model (1)):

$$investment_{i,t} = \beta_1 \, cash_{it-1} + \boldsymbol{\Gamma} \cdot \boldsymbol{w_{it-1}} + \varepsilon_{it}, \qquad (1)$$

where the dependent variable $investment_{i,t}$ is one of the variables regarding corporate investment activities of firm i in year t. It indicates capital expenditure reported in annual financial reporting, which includes investments in both tangible and intangible assets (*Capex*), research and development expenditures (*R&D*), purchases of stocks in subsidiaries and affiliates (*M&A*), and total investment, which aggregates all three investment variables (*Total*). These variables are scaled by the sum of tangible and intangible assets in year t. The independent variable of our interest is corporate cash holdings ($cash_{it-1}$) which is the sum of cash and short-term securities of firm i in year t-1 scaled by the sum of tangible and intangible assets in year t-1.[4]

[3] We adopt the term 'quasi-private firms' in line with the terminology used by Badertscher et al. (2019).
[4] If we use total assets as the denominator of cash holdings, as used in Hori et al. (2006), the main findings do not change.

We also add a vector of control variables $\boldsymbol{w_{it-1}}$ to control for possible covariates in the determinants of cash holdings. This includes Tobin's q (q_{it-1}), firm size ($size_{it-1}$), operating cash flows ($cashflow_{it-1}$), and financial leverage (lev_{it-1}). For the estimation using quasi-private firms, we use sales growth (sg_{it-1}) to capture corporate investment opportunities instead of Tobin's q, which requires stock market data. We also include firm- and year-fixed effects to control for firm-level time invariant and macroeconomic factors, respectively. Panel A of Table 1 provides the definitions of all variables. Following the standard procedure in the literature, we winsorize all continuous variables at the 1% and 99% levels to mitigate the influence of outliers. We cluster standard errors at the firm level and present the significance of the two-tailed tests.

Coefficient β_1 captures the sensitivity of corporate investments to cash holdings. The positive value of this coefficient β_1 suggests that corporate cash holdings enhance corporate investment in the following periods.

To estimate the sensitivity of corporate investments to cash holdings before and after the GFC, we add interaction terms to Equation (1) as follows (Model (2)):

$$investment_{i,t} = \gamma_1\, cash_{it-1} + \gamma_2\, cash_{it-1} \times 1(after\ GFC)_t + \boldsymbol{\Gamma \cdot w_{it-1}} + \varepsilon_{it}, \qquad (2)$$

where the added dummy variable $1(after\ GFC)_t$ takes one if the observation drops in the years after 2009, when the effects of the Global Financial Crisis are reflected in financial data in Japan. We use two separate definitions for the dummy variables: long term and short term. For the long-term definition, we include one dummy variable ($1(2009\text{-}2019)_t$) to represent the period after the GFC. For the short-term definition, we divide the periods into three terms:$1(2009\text{-}2011)_t$, $1(2012\text{-}2015)_t$, and $1(2016\text{-}2019)_t$ to elaborate on the sensitivity of investment to cash holdings within the post-GFC periods. The control variables $\boldsymbol{w_{it-1}}$ are as we described in Model (1).

Given that the coefficient γ_1 on cash holdings captures the sensitivity of investment to cash holdings, coefficient(s) γ_2 on the interaction term(s) indicates how sensitivity changes after the GFC. If the

economic shock of the GFC enhanced the importance of cash holdings, the coefficient would be positive.

4.2 Local projection

To estimate the impact of cash holdings on investment in the year just before the crisis, following Joseph et al. (2022), we estimate the following linear local projection:

$$\Delta assets_{i,t+k} = \beta_{1k}\, relative\text{-}cash_{i,t-1} + \boldsymbol{\Gamma_k} \cdot \boldsymbol{w_{i,t-1}} + e_{i,t+k}, \quad k=1,\ldots,H \tag{3}$$

where the dependent variable $\Delta assets_{i,t+k}$ is the log difference of fixed assets between the crisis year t and year $t+k$, the $relative\text{-}cash_{i,t-1}$ is the firm's cash holding in year $t-1$, i.e., a previous year of the crisis, measured by a share of its total assets and standardized in z-scores, relative to the cash holdings of firms within the same industry. We use Nikkei's medium-grouping method to obtain 32 industries. Joseph et al. (2022) use year t=2007 as the GFC year for the baseline time point of this estimation, whereas the current analysis sets year t=2008 because the influence of the GFC on the Japanese economy was relatively later than that on the United States and major advanced economies in Europe. 2008 is called the year of the Lehman shock in Japan.

To avoid the endogeneity problem of the cash holdings variable, we control for various explanatory variables, denoted by $\boldsymbol{w_{i,t-1}}$, which include the log of the firm's total assets, financial leverage measured by total liabilities over total assets, ROA measured by profit over total assets, and changes in fixed assets from 2006 to 2007 and 2007 to 2008. It also includes dummy variables for mature firms: one corresponds to a firm whose age is between 10 and 20 years and the other to a firm whose age is higher than 20 years. Industry dummy variables are also included.

To highlight the impact of cash holdings on business performance after the crisis, we also estimate the regression by setting the baseline year t as a year other than the crisis. This estimation addresses that the estimate obtained from Equation (3) with t=2008 is unique and significantly different from that with

the other baseline year.

To avoid the excess influence of outliers, we drop the samples with an upper and lower one percent of the change in fixed assets from the baseline year and cash holdings over assets. After applying this restriction, the final sample includes 4,264 firm-year observations. Before estimating the impact of cash holdings, we examined the characteristics of our sample firms. Following Joseph et al. (2022), we define two groups based on cash holdings in 2008. One comprises *high relative cash firms*, which correspond to those in the top quartile of the z-score for cash holdings, and the other comprises *low relative cash firms*, which correspond to those in the bottom quartile.

Table 5 reports the means of selected variables in the sample of high and low relative cash firms and their differences. The difference of the cash holdings over total assets is clearly different with a statistical significance at the 1% level. The high relative cash firms are somewhat smaller in size (total assets), have fewer fixed assets (over total assets) and yield a good performance (profit over total assets). A key observation in this comparison of the two groups is the difference in growth rates of investment over two years before the crisis is not statistically significant at the 10% level. Because the investment activity essentially has a certain inertia for several years, it is important to check how the investment activity before the crisis differs between two groups, which could affect the post-crisis investment. The finding here indicates that the pre-crisis investment activity is less likely to affect the difference between high and low cash holding groups, and therefore we can appropriately estimate the impact of the cash holdings on the post-crisis investment using the local projection (3).

5 Estimation results

5.1 Panel data regression

Panel B of Table 1 shows the descriptive statistics for the variables used in the panel regressions for public firms. The mean values for investment activities are 0.181 for capital expenditure, 0.071 for R&D

expenditure, and 0.018 for M&A expenditure. It is worth noting that both R&D and M&A expenditures are truncated at zero. The mean value of cash holdings is 2.402 and the data distribution is right-skewed, with a substantial standard deviation of 7.061. This skewness can be attributed to the fact that the variable's denominator is the sum of tangible and intangible operating assets. When we substitute the denominator with total assets, the variable's standard deviation increases further, suggesting that this is not due to data manipulation errors. Panel B presents the descriptive statistics for both public and quasi-private firms. The statistics of the variables of interest are comparable to those in Panel C.

Table 2 reports the results of panel regressions by using only public firms. Column 1 uses the capital expenditures as dependent variable. The coefficient on cash holdings is positively significant, suggesting that cash holdings enhance corporate investment activities. The coefficient of 0.0036 suggests that if the cash-to-operating asset ratio increases by 10 percentage points, capital expenditure to operating asset ratio rises by 0.04 percentage points. Note that the sign of coefficients on control variables in the regression seems sensible.

Column 2 tests the sensitivity of R&D expenditure to cash holdings. Again, the coefficient on cash holdings is positive and significant. Column 3 estimates the sensitivity of M&A expenditures and suggests a positive coefficient. The signs of the coefficients for all the control variables other than firm size and operating cash flow in the regression also seem sensible. Column 4 estimates the sensitivity of the total corporate investment. A coefficient of 0.0095 suggests that if the cash-to-operating assets ratio increases by 10 percentage points, the capital expenditure to operating assets ratio rises by 0.1 percentage points. These results suggest that cash holdings enhance firm investments.

Table 3 reports the results of Model (2). Column 1 estimates how the sensitivity of capital expenditure to cash holdings varies before and post GFC. The coefficient on the single term is positively significant, suggesting that cash holdings enhance capital expenditure even before GFC. The coefficient rises to 0.0064, which approximately doubles 0.0036 derived from general sample. The coefficient of

0.0064 suggests that if the cash-to-operating asset ratio increases by 10 percentage points, capital expenditure to operating asset ratio rises by 0.06 percentage points. The coefficient of -0.0034 on the interaction term suggests that the sensitivity of capital expenditure to cash holdings weakened after GFC. The sensitivity drops to 0.0030 from 0.0064 before GFC. We observe the same patterns when using as dependent variables R&D expenditures and total investment. In terms of M&A expenditure, we do not find statistically significant results.

To elaborate on the decrease in sensitivity, Columns 5-8 separate the post-GFC periods into three terms. Again, the coefficients on the single terms are positive and all except for M&A expenditures are statistically significant. The interaction term between cash and the dummy variable indicating the periods immediately after the GFC (*cash* × 1(*2009-2011*)) indicates no statistically significant difference before and after the GFC. Instead, the sensitivity of investment to cash holdings dropped in the recent span from 2016 to 2019 as the coefficients of its interactions (*cash* × 1(*2016-2019*)) were negatively significant. These results suggest that corporate investment sensitivity to cash holdings does not change immediately after the GFC, while it may decline in the recent period to some extent.

Table 4 presents the results of the same tests by using both public and quasi-private firms. For brevity, we show only the results of the regressions in which the dependent variable is total investment (*Total*). Column 1 tests the sensitivity of corporate investments to the cash holdings of both public and quasi-private firms. The coefficient of cash shows that the cash-to-operating assets ratio increases by 10 percentage points, the capital expenditure to operating assets ratio rises by 0.02 percentage points, and the effect is statistically significant. Column 2 examines how the sensitivity of corporate investment to cash holdings changed after the GFC. Contrary to previous results using only public firms, the coefficient of the interaction term is positively significant, suggesting that sensitivity increased after the GFC. To detect the timing when sensitivity changed, Column 3 includes three separate terms for the post-GFC periods. The coefficients of the interactions suggest that the increase in sensitivity did not occur immediately after the

GFC but rather after 2012. These findings indicate that the conclusions drawn from the public firms remain consistent when the sample is expanded to include quasi-private firms.

5.2 Local projection

Figure 1 plots the estimated coefficient β_{lk} for $k=1,\ldots,8,$ in the baseline regression (3). Clearly, the estimate indicates that the relative cash holdings prior to the crisis have a sizable effect on the investment after the crisis. The coefficients are statistically significant from one to five years ahead, increasing from 0.02 in the first year up to 0.07 in the fifth year. This result suggests that within an industry, a firm which held cash, or its equivalents one-standard deviation more than the industry average increased the investment by two percent more than the average in the first year and even seven percent more in the fifth year. To check a robustness of the result, we replace the relative cash holdings with the ratio of cash holdings relative to total assets. Figure 2 plots the estimated coefficient β_{lk}, which shows the same pattern of statistical significance and increasingly enhanced impact on the investment.

We assess the kinds of assets invested after the crisis that yield differences in the local projection results associated with the z-score variable of relative cash holdings. We replace the dependent variable, $\Delta assets_{i,t+k}$, in equation (3) by the log difference of (a) tangible assets and (b) intangible assets from the baseline year 2008. Figure 3 shows the estimation results. Notably, the coefficient of relative cash holdings on tangible assets differs significantly from that in 2010, two years after the crisis. By contrast, intangible assets did not yield such a significant difference up to 2014, six years after the crisis, while the difference became relevant after 2015. These results imply that relatively high-cash firms invest more in tangible assets than low-cash firms in the earlier post-crisis period. Subsequently, six years after the crisis, high-cash firms invest more in their intangible assets than low-cash firms.

To address whether high-cash firms increased their market share after the crisis by investing more than low-cash firms, we estimate local projection (3) by replacing the dependent variable with a cumulative

difference in the ratio of sales to total assets since the baseline year 2008, following Joseph et al. (2022). Figure 4 plots the coefficients of the z-score variable for relative cash holdings. In the first year of the post-crisis period, the coefficient is significantly negative. This result presumably reflects that while sales dropped due to the economic downturn in the crisis, the total assets of the relatively higher-cash firms were larger because they could invest right after the crisis with cash or lose fewer assets. The trajectory of the coefficients turned upward after 2009, and they are significantly positive after 2011, which indicates that relatively higher-cash firms increase their market share in their industry by increasing their sales significantly more than lower-cash firms.

Joseph et al. (2022) show that the impact of relative cash holdings on investment arose only after the global financial crisis in the UK. They examine the local projection with the baseline year in 2001, which corresponds to the economic downturn triggered by the dot-com bubble, and find that there is no statistically significant difference in investment after the baseline year between high- and low-cash firms, concluding that the financial crisis is a unique event in the sense that pre-crisis cash holdings were relevant in explaining heterogeneity in investment and changing market share in the post-crisis period.

We examine such an exercise with local projection (3) by altering the baseline year to 2001 in the same way as in Joseph et al. (2022). Figure 5 plots the coefficients of z-score variable of relative cash holdings measured in 2000 on the investment ($\Delta assets_{i,t+k}$). Surprisingly, the coefficients increase and become significantly positive after the baseline year, which is significantly different from the results of the previous study. To check its robustness, we also examined other baseline years, 2003 and 2013. The figure shows that the results were almost the same as those for the baseline year 2008. A key background of these findings could be that Japanese firms experienced a large-scale domestic banking crisis in the late 1990s, which severely propagated across Japan and damaged a wide range of industries. During the crisis, Japanese firms experienced considerable difficulty obtaining bank credit. Shinada and Ando (2013) report that a decline in the ease of bank borrowing during the domestic banking crisis increased corporate cash holdings.

The unique experience of Japanese firms would have led to a significant real impact of corporate cash holdings not only after the global financial crisis but also in other periods in our sample period from 2000.

6 Extension focusing on bank and firm relationship

We investigate how firms' relationships with banks affect the impact of cash holdings on investments. To evaluate this quantitatively, we employed the same local projection method framework as in the previous section. To measure the relationship between a firm and a bank, we employ the Nikkei Cges, which contains survey data related to the corporate governance of Japanese firms. The database also provides data on the existence of main bank of each firm, indicating whether the firm has main bank or not. Moreover, it includes data on whether the firm borrowed loans from the bank and whether the bank is a stockholder of the firm. We define firms with *weak bank relationship* as those without a main bank. Firms that answered that they have a main bank are labeled as having *strong bank relationship*. We estimate the local projection (3) by splitting the sample into firms with strong and weak bank relationships.

Figure 6 plots the estimated coefficient β_{lk} for the firms with strong and weak bank relationships. Interestingly, the coefficients are significantly positive from the first year after the crisis for the firms with strong bank relationships. In contrast, the coefficients are not statistically significant up to the third year after the crisis and turn out to be significantly positive afterwards. It is somewhat counterintuitive because it could be natural to consider that the cash holdings for firms with weak bank relationships are more important than those for firms with strong bank relationships as the latter can rely on banks during the economic downturn even if they do not have enough cash.

We consider that the difference in the estimation result arises because, in the firm group with strong bank relationships, the high-cash firms could borrow money for current business operations and investment from the bank more swiftly and easily than the low-cash firms during the post-crisis period, which leads to more substantial investment activity in the high-cash firms, as shown in Figure 6. In the firm

group with weak bank relationships, even firms with rich cash could not invest due to higher uncertainty immediately after the crisis but eventually had the advantage of additional room for investing.

To assess the background of the results, we replace the dependent variable with investments in tangible and intangible assets, as in the exercise described above. Figure 7 shows the results, which indicate that the difference observed above is mainly attributable to tangible assets, supporting our conjecture of explaining the counterintuitive result. For investment in intangible assets, the shapes of the coefficients are similar for the firm group with respect to the bank relationships, which supports the previous result.

7 Conclusion

This study analyzes the real effects of cash holdings of Japanese companies. We quantitatively investigate whether differences in cash holdings immediately before a specific sample period after 2000 can lead to differences in corporate behavior over the medium term. The results show that companies with high cash holdings immediately before a certain sample period make more capital investments in the subsequent sample years than those with low cash holdings. It is also found that the difference is more significant for tangible fixed assets than for intangible fixed assets. These results are similar to a preceding study in the UK, which reports that differences in cash holdings create differences in companies' competitive advantage after the GFC. However, unlike in the UK, we also find that the real effects of cash holdings exist almost equally, regardless of the sample period chosen after 2000. Japanese companies experienced a domestic banking crisis in the late 1990s. The experience preceding the GFC would have already motivated them to increase cash holdings, and the difference in the resulting degree of ample liquidity would have made a significant difference in corporate performance, as measured by capital investment growth rates, throughout our sample period from 2000. An extended sample period from the 1990s is desirable to verify this conjecture. However, consistency in financial reporting standards, that is,

individual or consolidated basis, must be carefully treated, as the consolidated basis has been mandatory since 2000 in Japan. This will be a subject of future research.

References

Almeida, H., Campello, M., & Weisbach, M. S. (2004). The cash flow sensitivity of cash. *Journal of Finance*, *59*(4), 1777-1804.

Arslan, Ö., Florackis, C., & Ozkan, A. (2006). The role of cash holdings in reducing investment–cash flow sensitivity: Evidence from a financial crisis period in an emerging market. *Emerging Markets Review*, *7*(4), 320-338.

Badertscher, B. A., Katz, S. P., Rego, S. O., & Wilson, R. J. (2019). Conforming tax avoidance and capital market pressure. *Accounting Review*, *94*(6), 1-30.

Bates, T. W., Kahle, K. M., & Stulz, R. M. (2009). Why do US firms hold so much more cash than they used to?. *Journal of Finance*, *64*(5), 1985-2021.

Brufman, L., Martinez, L., & Artica, R. P. (2013). What are the causes of the growing trend of excess savings of the corporate sector in developed countries? an empirical analysis of three hypotheses. *World Bank Policy Research Working Paper*, (6571).

Campello, M., Giambona, E., Graham, J. R., & Harvey, C. R. (2011). Liquidity management and corporate investment during a financial crisis. *Review of Financial Studies*, *24*(6), 1944-1979.

Campello, M., Giambona, E., Graham, J. R., & Harvey, C. R. (2012). Access to liquidity and corporate investment in Europe during the financial crisis. *Review of Finance*, *16*(2), 323-346.

Campello, M., Graham, J. R., & Harvey, C. R. (2010). The real effects of financial constraints: Evidence from a financial crisis. *Journal of Financial Economics*, *97*(3), 470-487.

Chang, C. C., & Yang, H. (2022). The role of cash holdings during financial crises. *Pacific-Basin Finance Journal*, *72*, 101733.

Dittmar, A., & Mahrt-Smith, J. (2007). Corporate governance and the value of cash holdings. *Journal of Financial Economics*, *83*(3), 599-634.

Dittmar, A., Mahrt-Smith, J., & Servaes, H. (2003). International corporate governance and corporate cash holdings. *Journal of Financial and Quantitative analysis*, *38*(1), 111-133.

Fahlenbrach, R., Rageth, K., & Stulz, R. M. (2021). How valuable is financial flexibility when revenue stops? Evidence from the COVID-19 crisis. *Review of Financial Studies*, *34*(11), 5474-5521.

Fazzari, S., Hubbard, R. G., & Petersen, B. C. (1988). Financing constraints and corporate investment. *Brookings Papers on Economic Activity*, *1988*(1), 141-206.

Fazzari, S. M., & Petersen, B. C. (1993). Working capital and fixed investment: new evidence on financing constraints. *RAND Journal of Economics*, *24* (3), 328-342.

Ferreira, M. A., & Vilela, A. S. (2004). Why do firms hold cash? Evidence from EMU countries. *European Financial Management*, *10*(2), 295-319.

French, J. J., Fujitani, R., & Yasuda, Y. (2020). Under pressure: listing status and disinvestment in Japan. *Finance Research Letters*, *34*, 101264.

French, J. J., Fujitani, R., & Yasuda, Y. (2021). Does stock market listing impact investment in Japan?. *Journal of the Japanese and International Economies*, *59*, 101093.

Gruber, J. W., & Kamin, S. B. (2015). The corporate saving glut in the aftermath of the global financial crisis. *FRB International Finance Discussion Paper*, (1150).

Hori, K., Saito, M., & Ando, K. (2006). What caused fixed investment to stagnate during the 1990s in Japan? Evidence from panel data of listed companies. *The Japanese Economic Review*, *57*(2), 283-306.

Hori, K., Ando, K., & Saito, M. (2010). Empirical analysis on corporate cash holdings in Japan: a panel data analysis using listed firms' financial data, *Gendai Finance*, 27, 3-24. (in Japanese)

Jensen, M., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, *3*(4), 305-360.

Jordà, Ò. (2005). Estimation and inference of impulse responses by local projections. *American Economic Review*, *95*(1), 161-182.

Joseph, A., Kneer, C., Van Horen, N., & Saleheen, J. (2022). All you need is cash: Corporate cash holdings and investment after the financial crisis. *CEPR Discussion Paper*, DP14199.

Kalcheva, I., & Lins, K. V. (2007). International evidence on cash holdings and expected managerial agency problems. *Review of Financial Studies*, *20*(4), 1087-1112.

Kato, K., Li, M., & Skinner, D. J. (2017). Is Japan really a "buy"? The corporate governance, cash holdings and economic performance of Japanese companies. *Journal of Business Finance & Accounting*, *44*(3-4), 480-523.

Kim, C. S., Mauer, D. C., & Sherman, A. E. (1998). The determinants of corporate liquidity: Theory and evidence. *Journal of Financial and Quantitative Analysis*, *33*(3), 335-359.

Kim, S., Murphy, P. L., & Xu, R. (2023). Drivers of Corporate Cash Holdings in Japan. *IMF Selected Issues Paper*, SIP/2023/029.

Luo, Q., & Hachiya, T. (2005). Corporate governance, cash holdings, and firm value: evidence from Japan. *Review of Pacific Basin Financial Markets and Policies*, *8*(04), 613-636.

Opler, T., Pinkowitz, L., Stulz, R., & Williamson, R. (1999). The determinants and implications of corporate cash holdings. *Journal of Financial Economics*, *52*(1), 3-46.

Pinkowitz, L., Stulz, R. M., & Williamson, R. (2013). Is there a US high cash holdings puzzle after the financial crisis?. *Fisher College of Business working paper*, 2013-03-07.

Pinkowitz, L., & Williamson, R. (2001). Bank power and cash holdings: Evidence from Japan. *Review of Financial Studies*, 14(4), 1059-1082.

Sasaki, T., & Suzuki, K. (2019). Bank health and cash holdings: Evidence from a bank-centered financial market. *Pacific-Basin Finance Journal* 57, 101195.

Sher, G. (2014). Cashing in for Growth: Corporate Cash Holdings as an Opportunity for Investment in Japan. *IMF Working Papers*, *2014*(221).

Shinada, N., & Ando, K. (2013). Changes in cash and deposit holdings of Japanese companies and their factors. *Shoken Analyst Journal*, 6, 6-16. (in Japanese)

Wall Street Journal (WSJ). (2022). Japan Inc. Finally Shows Shareholders the Money. July 14, 2022.

Tables and figures

Figure 1. Impact of cash holdings on investment ($\Delta assets_{i,t+k}$): the baseline result of linear local projection

The cash holdings variable is the share of cash holdings over total assets and is standardized in z-scores relative to the cash holdings of firms within the same industry. The solid line indicates the estimated coefficients of the relative cash holdings. Dashed lines indicate 90 percent confidence intervals.

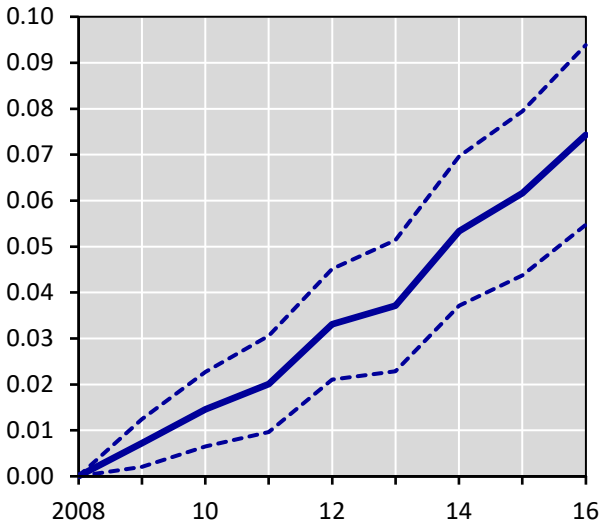


Figure 2. Impact of cash holdings on investment ($\Delta assets_{i,t+k}$): the robustness check

The cash holding variable is the ratio of cash holdings to total assets. The solid line indicates the estimated coefficient on the ratio of cash holdings to total assets. Dashed lines indicate 90 percent confidence intervals.

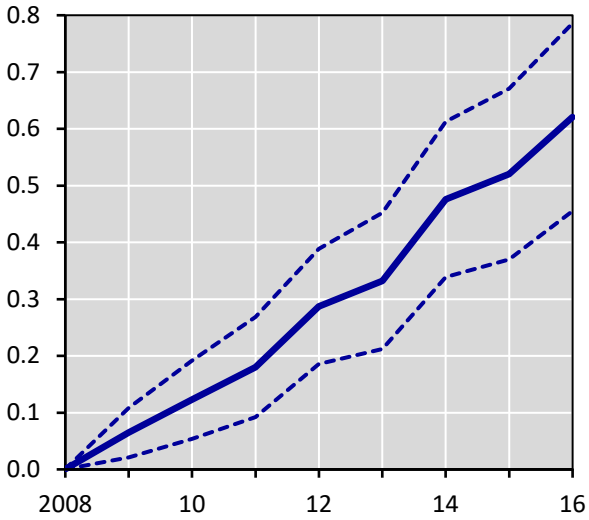


Figure 3. Impact of cash holdings on investment ($\Delta assets_{i,t+k}$): (a) tangible assets and (b) intangible

The cash holdings variable is the share of cash holdings over total assets and is standardized in z-scores relative to the cash holdings of firms within the same industry. The solid line indicates the estimated coefficient on the ratio of cash holdings to total assets. Dashed lines indicate 90 percent confidence intervals.

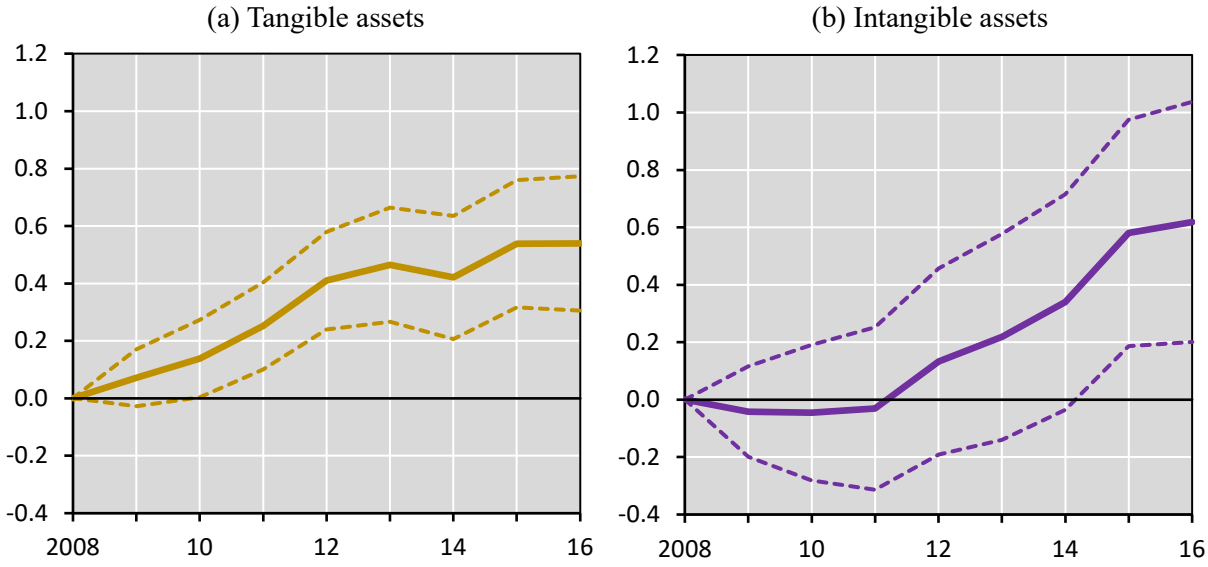


Figure 4. Impact of cash holdings on sales over total assets: the cumulative difference since the baseline year 2008

The cash holdings variable is the share of cash holdings over total assets and is standardized in z-scores relative to the cash holdings of firms within the same industry. The solid line indicates the estimated coefficient on the ratio of cash holdings to total assets. Dashed lines indicate 90 percent confidence intervals.

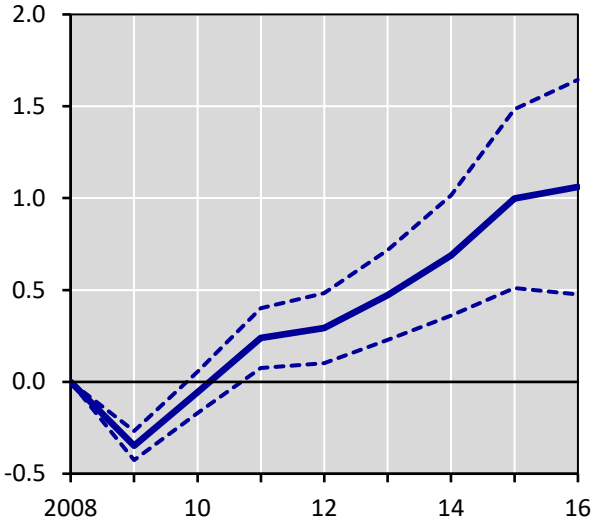


Figure 5. Impact of cash holdings on investment ($\Delta assets_{i,t+k}$): local projections with the different baseline years

The cash holdings variable is the share of cash holdings over total assets and is standardized in z-scores relative to the cash holdings of firms within the same industry. The solid line indicates the estimated coefficients of the relative cash holdings. Dashed lines indicate 90 percent confidence intervals.

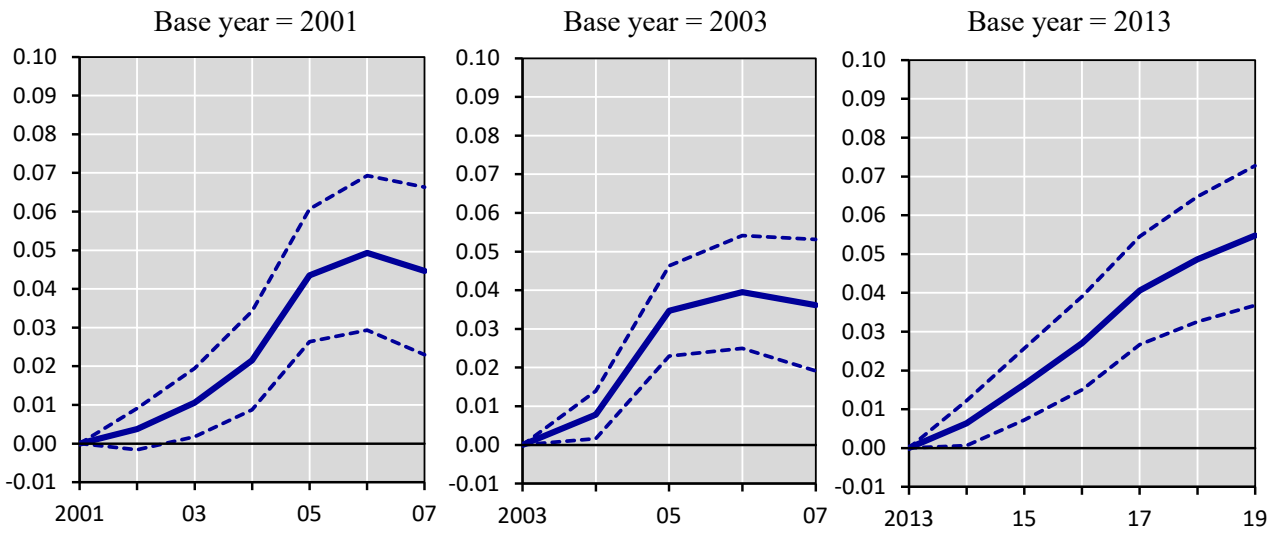
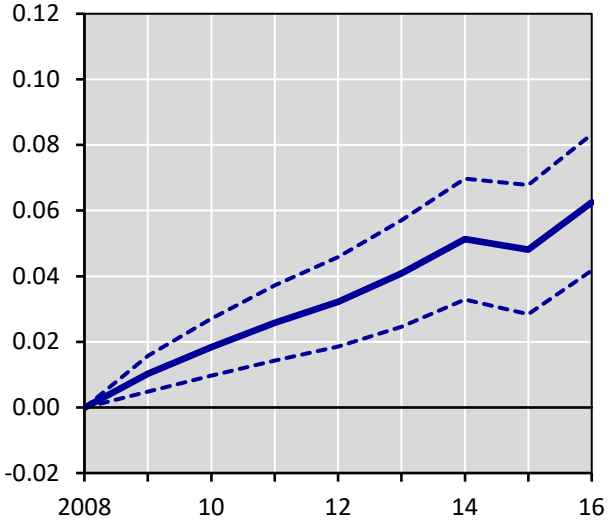


Figure 6. Impact of cash holdings on investment ($\Delta assets_{i,t+k}$): firms with strong and weak bank relationship

The cash holdings variable is the share of cash holdings over total assets and is standardized in z-scores relative to the cash holdings of firms within the same industry. The solid line indicates the estimated coefficients of the relative cash holdings. Dashed lines indicate 90 percent confidence intervals.

(i) Strong bank relationship



(ii) Weak bank relationship

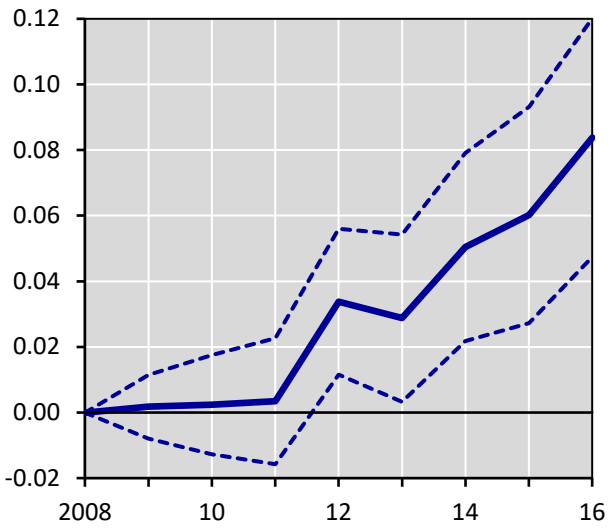
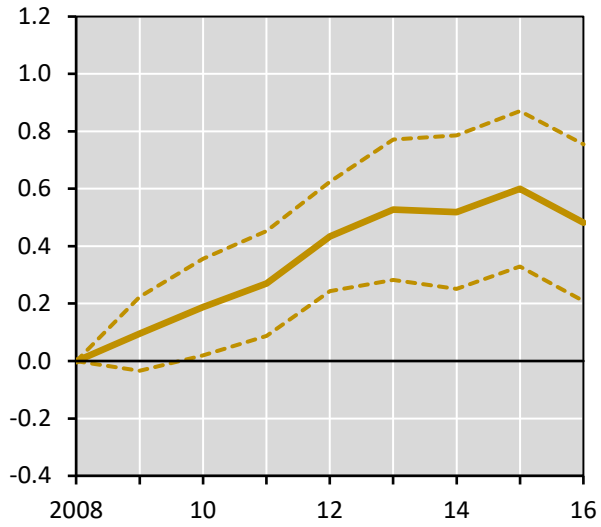


Figure 7. Impact of cash holdings on investment ($\Delta assets_{i,t+k}$): (a) tangible and (b) intangible assets for firms with strong and weak bank relationship

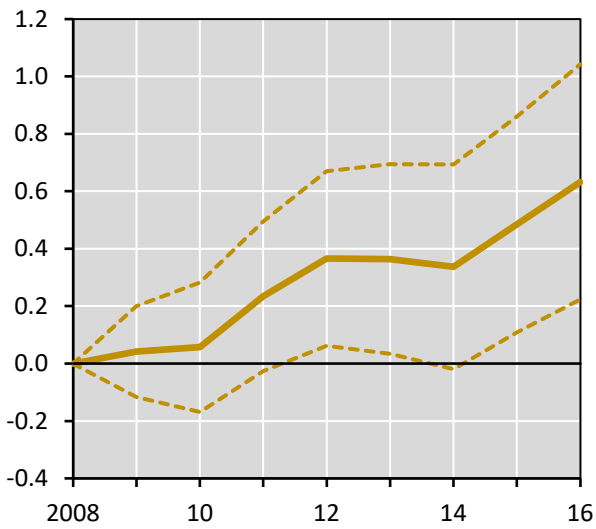
The cash holdings variable is the share of cash holdings over total assets and is standardized in z-scores relative to the cash holdings of firms within the same industry. The solid line indicates the estimated coefficients of the relative cash holdings. Dashed lines indicate 90 percent confidence intervals.

(a) Tangible assets

(i) Strong bank relationship

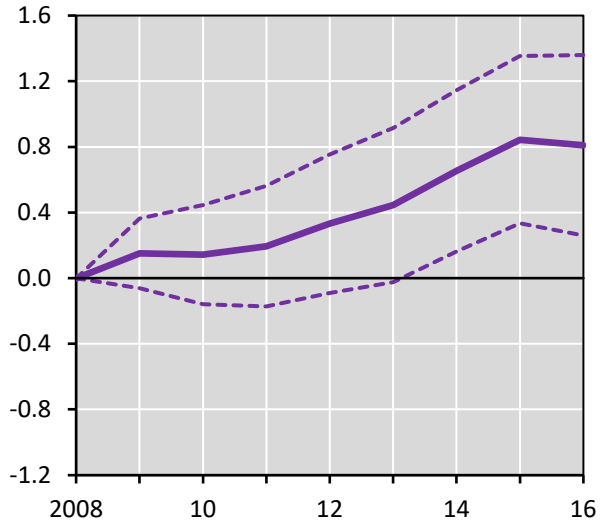


(ii) Weak bank relationship



(b) Intangible assets

(i) Strong bank relationship



(ii) Weak bank relationship

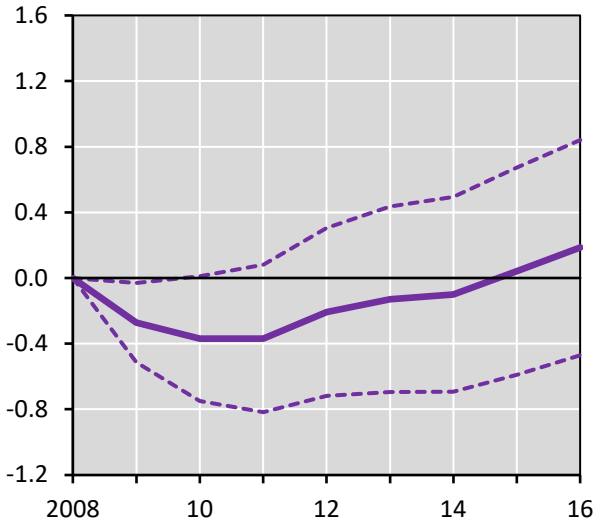


Table 1. Descriptive statistics (for panel regression)

Panel A: Variable definition

Variables	Definition
Capex	Capital expenditure scaled by lagged operating assets. Capital expenditure reported on annual financial reporting includes investment in tangible, intangible, and intangible assets. Operating assets are sum of tangible and intangible assets.
R&D	R&D expenditure scaled by lagged operating assets.
MA	Mergers and acquisition expenditure scaled by lagged operating assets.
Total	The sum of *Capex*, *R&D*, and *MA*.
q	The sum of total liability and market cap scaled by the sum of total liability and book value of shareholder's equity.
sg	The change in sales from the previous period scaled by lagged sales.
cash	The sum of cash and short-term investment scaled by operating assets.
size	Natural log of total assets.
cashflow	Cash inflow from operating activities scaled by lagged total assets.
lev	Total liability scaled by total assets.

Panel B: Public firms

	mean	sd	1st quartile	median	3rd quartile
Capex	0.1805	0.2651	0.0445	0.1041	0.2033
R&D	0.0714	0.2022	0	0.0084	0.0584
MA	0.0175	0.0826	0	0	0
Total	0.3047	0.5648	0.0689	0.1551	0.3066
q	1.3554	1.3108	0.7418	0.9788	1.3885
cash	2.4016	7.0610	0.2324	0.5525	1.4004
size	10.3989	1.6753	9.2542	10.2347	11.3677
cashflow	0.0522	0.0743	0.0215	0.0551	0.0900
lev	0.5087	0.2441	0.3395	0.5104	0.6711

Panel C: Public and quasi-private firms

	mean	sd	1st quartile	median	3rd quartile
Capex	0.1730	0.2733	0.0320	0.0929	0.1933
R&D	0.0666	0.2028	0	0.0024	0.0483
MA	0.0152	0.0774	0	0	0
Total	0.2900	0.5703	0.0498	0.1372	0.2883
sg	0.0569	0.2117	-0.0342	0.0262	0.1015
cash	2.5284	7.4368	0.2113	0.5281	1.4122
size	10.1929	1.7832	9.0110	10.0737	11.2446
cashflow	0.0506	0.0760	0.0168	0.0525	0.0886
lev	0.5207	0.2566	0.3429	0.5240	0.6940

Table 2. General sensitivity of corporate investment to cash holdings

	Capex	*R&D*	*MA*	*Total*
	(1)	(2)	(3)	(4)
q	0.0249***	0.0063***	-0.0007	0.0376***
	(0.0026)	(0.0017)	(0.0007)	(0.0050)
cash	**0.0036****	**0.0012****	**0.0003****	**0.0095****
	(0.0015)	**(0.0005)**	**(0.0001)**	**(0.0038)**
size	-0.0792***	-0.0192***	0.0020	-0.1311***
	(0.0062)	(0.0035)	(0.0019)	(0.0117)
cashflow	0.1273***	-0.0081	-0.0083	0.0747
	(0.0288)	(0.0126)	(0.0084)	(0.0529)
lev	-0.1803***	-0.0445***	-0.0588***	-0.3909***
	(0.0196)	(0.0113)	(0.0058)	(0.0405)
Observations	66,678	66,678	66,678	66,678
Year	yes	yes	yes	yes
Firm	yes	yes	yes	yes
clustered by	firm	firm	firm	firm
Adj. R^2	0.395	0.809	0.162	0.533

Standard errors clustered by firm are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Table 3. Sensitivity of investment to cash holdings

	Capex (1)	*R&D* (2)	*MA* (3)	*Total* (4)	*Capex* (5)	*R&D* (6)	*MA* (7)	*Total* (8)
q	0.0237***	0.0057***	-0.0006	0.0345***	0.0239***	0.0058***	-0.0007	0.0350***
	(0.0025)	(0.0017)	(0.0007)	(0.0049)	(0.0026)	(0.0017)	(0.0007)	(0.0050)
cash	0.0064***	0.0026***	0.0002	0.0168***	0.0065***	0.0026***	0.0002	0.0171***
	(0.0010)	(0.0007)	(0.0002)	(0.0023)	(0.0009)	(0.0007)	(0.0002)	(0.0022)
cash×1(2009-2019)	**-0.0034****	**-0.0016****	**0.0001**	**-0.0090*****				
	(0.0014)	**(0.0008)**	**(0.0002)**	**(0.0033)**				
cash×1(2009-2011)					**-0.0029**	**-0.0014***	**-0.0001**	**-0.0081***
					(0.0023)	**(0.0007)**	**(0.0002)**	**(0.0045)**
cash×1(2012-2015)					-0.0022	-0.0011	0.0003	-0.0064*
					(0.0015)	(0.0009)	(0.0003)	(0.0037)
cash×1(2016-2019)					-0.0042**	-0.0020***	0.0001	-0.0107**
					(0.0017)	(0.0008)	(0.0002)	(0.0042)
size	-0.0773***	-0.0183***	0.0019	-0.1262***	-0.0765***	-0.0179***	0.0020	-0.1244***
	(0.0061)	(0.0036)	(0.0019)	(0.0112)	(0.0061)	(0.0036)	(0.0019)	(0.0111)
cashflow	0.1235***	-0.0099	-0.0082	0.0646	0.1234***	-0.0100	-0.0080	0.0644
	(0.0286)	(0.0125)	(0.0084)	(0.0522)	(0.0282)	(0.0126)	(0.0085)	(0.0516)
lev	-0.1725***	-0.0407***	-0.0590***	-0.3702***	-0.1710***	-0.0400***	-0.0589***	-0.3669***
	(0.0184)	(0.0111)	(0.0058)	(0.0373)	(0.0180)	(0.0110)	(0.0058)	(0.0366)
Observations	66,678	66,678	66,678	66,678	66,678	66,678	66,678	66,678
Year	yes	yes	Yes	yes	yes	yes	yes	yes
Firm	yes	yes	Yes	yes	yes	yes	yes	yes
clustered by	firm	firm	Firm	firm	firm	firm	firm	firm
Adj. R^2	0.397	0.810	0.162	0.537	0.398	0.811	0.162	0.538

Standard errors clustered by firm are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Table 4. Panel regression of public and quasi-private firms

	Total		
	(1)	(2)	(3)
sg	0.2447***	0.2506***	0.2498***
	(0.0199)	(0.0198)	(0.0197)
cash	**0.0023*** **	0.0014***	0.0014***
	(0.0009)	(0.0005)	(0.0005)
cash×1(2009-2019)		**0.0039** **	
		(0.0018)	
cash×1(2009-2011)			**0.0014**
			(0.0017)
cash×1(2012-2015)			0.0037*
			(0.0022)
cash×1(2006-2019)			0.0048
			(0.0033)
size	-0.0077	-0.0103	-0.0108
	(0.0088)	(0.0086)	(0.0087)
cashflow	0.3189***	0.3238***	0.3257***
	(0.0551)	(0.0543)	(0.0542)
lev	-0.4149***	-0.4095***	-0.4103***
	(0.0330)	(0.0326)	(0.0325)
Observations	80,210	80,210	80,210
Year	yes	Yes	yes
Firm	yes	Yes	yes
clustered by	firm	Firm	firm
Adj. R^2	0.469	0.472	0.473

Standard errors clustered by firm are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Table 5. Characteristics of high and low cash firms

The figures in the table show the means of the selected variables for 2007. For definitions of high- and low-cash firms, see the main text. A hypothetical test was conducted for the difference in variables between the two groups using two-sided t-test. *** indicates a statistical significance at the 1% level.

Variable	High relative cash	Low relative cash	Difference
Cash holdings over total assets	0.38	0.08	0.30***
Total assets (million JPY)	82.4	232.4	-150.0***
Age (the ratio of firms under 10 years old)	0.09	0.11	-0.02
Fixed assets over total assets	0.31	0.58	-0.27***
Profits over total assets	0.054	0.035	0.020***
Investment (average annual growth rates from 2005 to 2007)	-0.021	-0.023	0.003