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HOSONO, Kaoru
RIETI

TAKIZAWA, Miho
Gakushuin University

YAMANOUCHI, Kenta
Kagawa University

RIETI
Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
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Kaoru Hosono†
Miho Takizawa‡
Kenta Yamanouchi§

Abstract
We analyze the effects of financial constraints on markups. Using a firm-level dataset from Japan, we first find that financially constrained firms decreased markups and this effect was heightened during the Global Financial Crisis. Second, we find that financially constrained firms decreased inventories and tangible capital investment. These results are consistent with the liquidity management hypothesis that posits that financially constrained firms lower prices to shed inventories, but not with the customer market hypothesis that predicts that constrained firms raise prices to invest less in the customer base and decrease their market shares. Third, although the extent to which the dispersion in markups due to financial constraints results in aggregate TFP losses through inefficient resource allocation is economically small, the magnitude almost doubled during the Global Financial Crisis. Our results indicate that financial constraints matter for product market competition as well as investment.

Keywords: Markup, Financial constraint, Resource misallocation
JEL classification: D24, E44, G31

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† Gakushuin University and RIETI. Email: kaoru.hosono@gakushuin.ac.jp
‡ Gakushuin University. Email: miho.takizawa@gakushuin.ac.jp
§ Kagawa University. Email: yamanouchi.kenta@kagawa-u.ac.jp

Financial Constraints and Markup

1. Introduction

How do firms charge prices? This question is crucial for the aggregate economy because it is closely related to the inflation dynamics and has the implication for the monetary policy. While the marginal cost, which depends on input prices and productivity, is important as a determinant of the price, the markup, i.e., the price relative to the marginal cost, also matters in an imperfectly competitive market. Markups have significant impacts on the aggregate economy because differences in markups across firms affect resource allocation and hence aggregate productivity.[1] Moreover, markups are likely to be closely related to business dynamism; recent studies relate the increasing markups observed in the U.S. and other developed economies to declining business dynamism that is represented by high market concentration, low job reallocation, low entry and exit rates, and low labor share, among others (Autor et al., 2020; Akcigit and Ates, 2021).

Due to such potential importance of markups in the aggregate economy, vast literature focus on aggregate dynamics of markups in response to business cycles and monetary policy shocks based on sticky price models. Besides, there is growing literature on the determinants of firm-level heterogeneity in markups including export status (e.g., De Loecker and Warzynski, 2012) and firm age (Hosono, Takizawa, and Yamanouchi, 2020).[2] Furthermore, some theoretical studies examine the effects of financial constraints on markups, focusing on two opposing channels. The customer market theory pioneered by Phelps and Winter (1970) and Bils (1989), on the one hand, posits that cutting prices today increases future customer base and hence that a low markup is a form of investment. According to this theory, financially constrained firms are likely to set higher markup (i.e., invest less in the customer base) to compensate for the liquidity shortage while unconstrained firms are more aggressive to charge a lower markup and take a larger market share. On the other hand, the liquidity management hypothesis posits that financially constrained firms cut prices to shed their inventory and obtain cash especially when the external financing is difficult (Kim, 2020). These theoretical studies, although with opposing predictions, indicate that financial constraints can matter for the product market competition as well as for investment that exhaustive studies examine.[3]

Despite such theoretical interests in the relationship between financial constraints and

[1] See Nekarda and Ramey (2020) and Peters (2020) for the recent studies on the cyclical behavior of markups and the relationship between heterogeneous markups and misallocation of resources, respectively.
[2] For other related studies on markups, Hosono, Takizawa, and Yamanouchi (2022) study the effects of foreign direct investment status on parent firms' markups in Japan while De Loecker et al. (2016) show that trade liberalization raised average markups in India.
[3] See Almeida and Campello (2007) as a recent study on financial frictions and investment.

markup, few studies empirically examine it. As related studies, some examine the effect of financial constraints on the price, and yield mixed results: Chevalier and Scharfstein (1996), Gilchrist et al. (2017), Antoun de Almeida (2015) find positive effects while Kim (2021) find negative effects and Lenzu, Rivers, and Tielens (2021) find short-run negative and long-run positive effects. However, the effects of financial constraints on prices can differ from those on markups because input prices and hence marginal costs are likely to change in the same direction as output prices over business cycles and across firms.

To fill the void in the literature, we examine the following three questions. First, do firms with tighter financial constraints charge higher or lower markup than firms with looser constraints? Second, is the difference between firms with tighter and looser financial constraints, if any, widened during a financial crisis? Firms are likely to face a liquidity squeeze during a financial crisis, which hit financial constrained firms harder than unconstrained firms. Therefore, if financial constraints matter for markup, the difference in markup between financially constrained and unconstrained firms will widen during a financial crisis. Third, do the difference between financially constrained firms and unconstrained firms in markup, if any, narrow in response to monetary easing shocks? This is likely to happen if monetary easing relaxes financial constraints.

To answer these questions, we use a firm-level dataset from Japan that covers firms with 50 or more employees and with paid-up capital of over 30 million yen in manufacturing and nonmanufacturing industries. Using this dataset, we measure a change in the firm-level markup as the change in the ratio of variable costs to sales after controlling for industry-year and firm fixed effects as well as firm characteristics. To obtain a proxy of the firm's financial constraint, we use the ratio of the firm's liquid asset excluding inventories to total assets. Furthermore, we construct other proxies for financial constraints by combining the firm-level dataset with a database that contains information on the banks that the firm transacts with. Using this database, we identify the firm's main bank with the bank that the firm considers most important and hence is listed first. Then, we use the firm's main bank's balance sheet conditions as other proxies for financial constraints. As for monetary shocks, we use high-frequency data from financial markets to capture the conventional and unconventional monetary policy shocks consistently. Using these data, we examine whether the markup tends to be higher or lower for financially constrained firms than for unconstrained firms and whether the difference in markups between constrained and unconstrained firms widened during the Global Financial Crisis period or shrank in response to the monetary easing shocks.

After controlling for the possible endogeneity of the firm liquidity, we first find that firms with less liquid assets decreased markup while the bank health did not have a significant effect on markup. Second, we find that the effect of firm liquidity on markup was heightened during the

Global Financial Crisis. Third, we find that firms with less liquid assets decreased inventories and tangible capital investment. These results are consistent with the liquidity management hypothesis but not with the customer market hypothesis. Fourth, we did not obtain evidence that monetary policy shocks had a significant impact on the relationship between financial constraints and markup. Fifth, although the extent to which the dispersion in markups due to financial constraints results in aggregate TFP losses through inefficient resource allocation are economically small, the magnitude almost doubled during the Global Financial Crisis.

This study is closely related to two strands of literature. The first relevant strand is the studies on the role of financial constraints in markup. Previous studies focus on three channels: underinvestment in the customer market, a rise in financial costs, and the liquidity management by the sales of inventories. First, Gottfries (1990), Chevalier and Scharfstein (1996), and Gilchrist et al. (2017) extend the customer market theory by incorporating financial constraints and posit that firms that face liquidity constraints invest less in the customer market than unconstrained firms. This theory predicts that the output price of the constrained firms will be higher than that of unconstrained firms. Chevalier and Scharfstein (1996), Gilchrist et al. (2017), Antoun de Almeida (2015), and Montero and Urutasun (2021) provide empirical evidence supporting this customer-market hypothesis. Chevalier and Scharfstein (1996) show that during regional and macroeconomic recessions, more financially constrained supermarket chains raised their prices relative to less financially constrained chains in the U.S. Gilchrist et al. (2017) use a U.S. firm-level dataset to show that liquidity constrained firms increased prices in 2008 while their unconstrained counterparts cut prices. Antoun de Almeida (2015) examine sector-level price data from Euro area countries and corroborates Gilchrist et al. (2017)'s empirical results. Montero and Urutasun (2021), using a Spanish firm-level data, find that sector-level markups increased during the Global Financial Crisis for sectors with higher pre-crisis debt burden ratios. In addition to the customer-market hypothesis, the cost-push hypothesis developed by Christiano, Eichenbaum, and Tranbandt (2015) also predicts that financially constrained firm will set a relatively high price. They develop a DSGE model incorporating financial frictions and show that the rise in the cost of working capital played critical roles in accounting for the small drop in inflation that occurred during the Great Recession.

In contrast with the customer-market and cost-push hypotheses, the liquidity-management hypothesis predicts that financially constrained firms tend to set a lower price than unconstrained firms. Kim (2021) elaborates the liquidity management hypothesis and posits that liquidity constrained firms reduce prices to liquidate inventory and generate additional cashflow from the product market. He provides supportive evidence from the U.S. after the Lehman Brothers failure. Lenzu, Rivers, and Tielens (2021) use datasets covering manufacturing firms in Belgium and find that liquidity-constrained firms set a lower price in the short run after the

European sovereign debt crisis although they set a higher price eventually in the long run.

The second relevant literature is the studies on the effects of monetary policy shocks on markups. Nekarda and Ramey (2020) show that markup increases in response to expansionary monetary shocks based on the U.S. aggregate data and point out that such procyclicality of markup is not reconcilable with sticky price New Keynesian models. Meier and Reinelt (2020) show that dispersion in markups across firms increase in response to monetary policy tightening shocks using quarterly balance-sheet data of publicly listed U.S. firms from Compustat.

Our contribution to the literature is threefold. First, these preceding studies examine the role of financial constraints in prices while we examine their effects on markups.[4] This distinction is important because input prices may change in response to a credit supply shock. Suppose, for example, that a small firm purchases intermediate goods from another small firm and that both the supplier and customer are hard hit by a credit supply shock. If the supplier increases (or decreases) its price, it means that the customer faces a higher (or lower) input price. Without controlling for this input price change, we overestimate the effect of the customer-market (or liquidity-management) channel by just looking at the output price change. By investigating the change in markups, we can lessen this bias. It is now well known that estimating markups from data on sales suffers from identification and estimation problems (Bond et al., 2021). Considering these problems, we do not estimate the *level* of markup but focus on its *change* using the change in the ratio of variable costs in revenue controlling for industry-year and firm fixed effects as well as firm characteristics. Thus, we do not need to estimate the elasticity of inputs in production function, which is the core element for the estimation of the level of markup. Our maintained assumption that is necessary to estimate the change in markup is that the elasticity of inputs in production function is constant within an industry-year and a firm (after controlling for some observable firm characteristics variables).[5] By controlling for industry-year and firm fixed effects as well as firm characteristics, we focus on how markup changes over time within a firm and an industry-year in response to the shock to financial constraints.

Second, none of the preceding studies examines the role of the interaction of monetary policy shocks and financial constraints in markup. Give that monetary policy is likely to affect financial constraints (e.g., Bernanke, Gertler, and Gilchrist, 1999), considering the role of monetary policy in markup is a natural extension. We use high-frequency financial market data to identify monetary policy shocks. This method is useful both for clear identification of the shocks and for covering the non-conventional monetary policy such as Quantitative Easing (QE) and Quantitative and Qualitative Easing (QQE).

[4] Montero and Urtasun (2021) are exceptional in that they examine markups at the sector level, but not at the firm level.

[5] We relaxed this assumption in the robustness checks and confirmed that the main results held even allowing for the variable input elasticity.

Third, unlike Gilchrist et al. (2017) or Kim (2021) that focus on the Global Financial Crisis, we use a long-period (mainly from 2006 to 2017) firm-level panel dataset to examine the effects of business cycles and monetary policy shocks as well as the financial crisis on the relationship between financial constraints and markup.

The remainder of the study is structured as follows. Section 2 describes our data and our estimation methodology. Section 3 then provides the estimation results. We check the robustness of our main results and obtain further implications in Section 4. Section 5 summarizes the results and concludes.

2. Data and methodology

In this section, we explain the data and the methodology for the empirical analysis. We use a firm-bank matched dataset to analyze the effects of financial constraints on markup. As for a firm-level dataset, we use the Basic Survey of Japanese Business Structure and Activities (BSJBSA), which are conducted by the Ministry of Economy, Trade and Industry (METI). This survey covers enterprises in Japan with more than 50 employees and with paid-up capital of over 30 million yen. The BSJBSA covers firms both in manufacturing and nonmanufacturing industries. Our sample period is from 2006 to 2017. The information that we use from the BSJBSA are firms' financial statements (i.e., sales, cost of goods sold, selling and general and administrative expenses, assets, debts, and wage bill), the import or export statement and the research and development (R&D) expense, the firm age, and firms' industry classification. While we explain the details of the measurement method below, Table 1 provides the list of variables we use for estimation and Table 2 shows summary statistics.

2.1 Markup

We define markups (μ) as the price (P) to marginal cost (c), $\mu = P/c$. If we multiply the numerator and the denominator by total output (Q), we obtain markups as follows:

$$\mu = \frac{PQ}{cQ} \tag{1}$$

Assuming that the marginal cost is equal to the average cost, we can calculate the markup by replacing cQ with the total cost. This approach to measure markups is called the accounting approach (De Loecker, Eeckhout and Unger, 2020). We need to impose strong restrictions on firm-level cost structures to follow this approach. As De Loecker, Eeckhout and Unger (2020) pointed out, this approach requires constant returns to scale in production, the absence of economies of scale, and no fixed cost. Another approach to measure markups is the production approach developed by De Loecker and Warzynski (2012). Following the production approach, the markup is derived from the output elasticity of a variable input divided by revenue share of that input. In terms of logarithms, the markup can be expressed as

$$\ln(\mu) = \ln\left(\frac{PQ}{P_M M}\right) + \ln\left(\frac{\partial Q}{\partial M}\frac{M}{Q}\right). \tag{2}$$

Here, M and P_M are the quantity and price of the variable input, respectively. This approach does not require strong assumptions about the cost structure, but it does require the estimation of the production function. It is now well known that estimating markups from data on revenue suffers from identification and estimation problems (Bond et al., 2021).[6]

Considering these problems, we employ a mixture of accounting and production approach to avoid estimating the level of markup but focus on the variation in the logarithm of markups using the variation in the logarithm of the ratio of variable costs in revenue. Our maintained assumption that is necessary to estimate the variation in markup is that the elasticity of production with respect to a variable input in production function is constant within a firm and industry-year. By controlling for a firm- and industry-year-level fixed effects, we focus on how markup changes over time within a firm in a given industry and year in response to a shock to financial constraints. Specifically, we use cost of goods sold (COGS) to measure the variable cost and use its ratio to total sales as a proxy of markup in the baseline specification following De Loecker, Eeckhout and Unger (2020). We further use the operating expenses (OPEX) and wage bill as measures of variable costs and use their ratios to total sales as alternative measures of markup.[7] These measures are used by Traina (2018) and Keller and Yeaple (2020), respectively. We trimmed 1% tails of the distribution of the markup measures to lessen the effects of outliers.

2.2 Financial constraints

As proxies of financial constraints, we measure the liquid asset-to-total asset ratio by subtracting inventory from liquid assets and then dividing by total assets.[8] Although the ratio of cashflow to total assets is often used as a proxy of financial constraints (e.g., Antoun de Almeida,

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[6] Nishioka and Tanaka (2019) also point out that to estimate the production function, detailed output and input data are required, and the estimated value of the markup varies depending on the estimation method of the production function. Kasahara and Sugita (2020) propose nonparametric identification of markup from revenue data.

[7] However, it should be noted that the variation of the ratio of sales to wage bill may reflect idiosyncratic distortions of the labor market.

[8] We subtract the inventory from liquid assets as the numerator of the proxy of financial constraints because the liquidity of the inventory is relatively low. Our measure of liquid assets consists mainly of cash, deposits, accounts receivable, securities, and advance payments. The data on cash and deposits are not available from the BSJBSA.

2015), we use the cashflow ratio as a control variable rather than a proxy for financial constraints because it is likely to be affected by the markup through profits and hence to suffer from an endogeneity problem. Figure 1 depicts the mean and median values of our liquidity measure. It shows that about 50% of total assets are liquid assets other than inventory on average and that the liquidity measure fell sharply in 2008 during the Global Financial Crisis.

We also use the balance sheet variables of the firm's main bank. For linking the firm's main bank information to the firm's financial statement, we use the TSR Enterprise Information File (TSR Kigyo Joho file) provided by the Tokyo Shoko Research, Ltd (TSR). The file provides information on the banks that firms transact with from 2006 to 2017. We define a firm's main bank as the financial institution placed first in the bank list in the TSR Enterprise Information File, where financial institutions are listed in a descending order according to loan amounts outstanding. To get the bank financial data, we use the Nikkei NEEDS Financial Quest. We construct a firm-bank-matched dataset for Japanese firms, combining three data sources: the BSJBSA, the TSR Enterprise Information File and the Nikkei NEEDS Financial Quest.[9] The matched sample covers the period from 2006 to 2017. As the bank's balance sheet variables, we use the ratio of total non-performing loans (i.e., risk-monitored loans) to total loans and capital adequacy ratio. The capital adequacy ratio for internationally active banks is total capital to risk-weighted assets following the Basel standard and that for domestic banks total capital to risk-unweighted assets following the domestic standard.

2.3 Monetary policy shocks

In order to see the different impact of monetary policy on markups between financially constrained firms and unconstrained firms, we construct two monetary shock variables, both of which are based on high-frequency data from financial markets.[10] The first variable is based on changes in short-term interest rate (STIR) futures within a 30-minute window around monetary policy announcements.[11] This variable is constructed following Nakamura, Sudo, and Sugisaki (2021), who show that monetary shocks that they construct are closely correlated with key financial variables such as exchange rates, stock market returns, and long-term interest rates. Specifically, we set the 30-minute window that starts 10 minutes before the announcement and ends 20 minutes after it. We use three-month Euroyen futures rates for the contracts that start one-, two-, three-, and four-quarters ahead. Using these four futures rates, we conduct the principal

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9 We merge the BSJBSA and the TSR Enterprise Information File using telephone numbers and postal codes. We use bank codes to merge the TSR Enterprise Information File and the Nikkei NEEDS Financial Quest.

10 For the use of high-frequency data to construct monetary policy shocks in the U.S., see Nakamura and Steinsson (2018), Gertler and Kaladi (2015), Gorodnichenko and Weber (2016).

11 We obtained tick-level data including Euroyen futures prices for the period from April 28, 2003 to April 30, 2021 from Tokyo Financial Exchange Inc.

component analysis and use the first principal as the monetary policy shock. These procedures to obtain policy shocks for each announcement are exactly the same as those of Nakamura, Sudo, and Sugisaki (2021).[12] After excluding unscheduled meetings, we have 225 announcement-level shocks that covers the period from April 2003 to April 2021. Then, we aggregate announcement-level shocks into a fiscal year (FY)-level by summing the announcement-level shocks within the FY.[13] Eventually, we have Euroyen futures-based policy shocks, $MP1$, from FY 2003 to FY 2020.

The second policy shock variable is based on broader financial variables including long-term interest rates (LTIR). Specifically, we use the following seven financial market variables: (1) three-month Euroyen Tibor futures rate, (2) yen interest swap rates of one-, two-, five-, 10-, and 30-years, and (3) three-month Euroyen Tibor spot rate.[14] Following Nakashima, Shibamoto, and Takahashi (2020), we set the one-day window that starts at the end of the day previous to the Monetary Policy Meeting and ends at the end of the Meeting's day. We exclude unscheduled meetings following Nakashima, Shibamoto, and Takahashi (2020). Using the seven variables, we conduct the principal component analysis and use the first principal as the monetary policy shock. We have 319 announcement-level shocks from January 1998 to April 2021. Aggregating these announcement-level shocks into FY by summing them up them within the FY, we have alternative policy shocks, $MP2$, from FY 1998 to FY 2020. A higher $MP1$ or $MP2$ indicates monetary tightening shock. Figure 2 plots $MP1$ and $MP2$ over the period from FY2006 to FY2020 that we use for estimation, showing that these two are positively correlated with each other with the correlation coefficient of 0.780.

In addition to $MP1$ or $MP2$, we use 10-year government bond rate to consider the possibility that the as long-run interest rates are lower, firms can more easily access external financing even when they have scarce liquidity.

2.4 Estimation methodology

In this subsection, we explain the method to estimate the effects of financial constraint on markups. Specifically, we estimate the following baseline equation:

$$\ln \mu_{it} = \alpha_1 Liquid\ Asset_{it} + \boldsymbol{Bank_{bt}\alpha_2} + \alpha_3 Liquid\ Asset_{it} * Crisis_t$$

[12] Following Nakamura, Sudo, and Sugisaki (2021), we regard the time at which the Monetary Policy Meeting ends as the announcement time, and adjust the definition of the window when a meeting ends during lunch time.

[13] Fiscal year starts on April 1 and ends March 31 of the next year.

[14] In addition to these seven variables, Nakashima, Shibamoto, and Takahashi (2020) use (4) yen-U.S. dollar and yen-AUS dollar spot exchange rates, (5) TOPIX and Nikkei JASDAQ indexes, and (6) banks' reserve deposits. We do not use these variables because they may be regarded as responses to policy shocks rather than policy shocks themselves. The data source is the Nikkei Financial Quest database. The data for yen interest rate swap rates before October 2006 were kindly provided by Shibamoto as they were not available at the Nikkei Financial Quest database.

$$+Liquid\ Asset_{it} * \boldsymbol{MP_t}\boldsymbol{\alpha_4} + \boldsymbol{x_{it}}\boldsymbol{\beta} + \delta_i + \delta_b + \delta_{st} + u_{it}, \tag{3}$$

where $\ln \mu_{it}$, $Liquid\ Asset_{it}$, $\boldsymbol{Bank_{bt}}$, $Crisis_t$, $\boldsymbol{MP_t}$, and $\boldsymbol{x_{it}}$ denote the logarithm of a markup indicator, the ratio of liquid assets to total assets, the main bank's ratio of total non-performing loans (i.e., risk-monitored loans) to total loans and its capital adequacy ratio, global financial crisis dummy for 2008 and 2009, monetary policy variables that consist of 10-year government bond rate and either $MP1$ or $MP2$, and control variables. The control variables include the ratio of cashflow to total assets, sales growth rate, the logarithm of total assets, the logarithm of firm age, R&D dummy, exporter dummy, and importer dummy. The dummies δ_i, δ_b, and δ_{st} denote firm fixed effects, bank fixed effects, and industry-year fixed effects.

While we first estimate the above equation by OLS, we also perform instrumental variable (IV) estimation because the liquid asset is potentially endogenous. On the one hand, firms may increase their liquid assets because raising the markup allows them to temporarily increase earnings. To capture this earnings channel, we have controlled for the ratio of cashflow to total assets. On the other hand, the fire sales hypothesis posits that firms will lower markups to secure their liquidity. If this attempt is successful, firms can increase the liquid assets by reducing markups. To deal with this type of reverse causality, we conduct IV estimation with the following first stage regression:

$$\begin{aligned} LiquidAsset_{it} = \alpha_1' Liquid\ Asset_{it-1} + \boldsymbol{Bank_{bt}}\boldsymbol{\alpha_2'} + \alpha_3' Liquid\ Asset_{it-1} * Crisis_t \\ + Liquid\ Asset_{it-1} * \boldsymbol{MP_t}\boldsymbol{\alpha_4'} + \boldsymbol{x_{it}}\boldsymbol{\beta'} + \delta_i' + \delta_{st}' + u_{it}'. \end{aligned} \tag{4}$$

In the IV estimation, we instrument the liquid asset ratio and its interaction terms with lagged liquid asset ratio and the corresponding interaction terms of the lagged variables. Lagged variables are valid instruments if the error terms are not serially correlated. We therefore added the various types of fixed effects and explanatory variables to exclude the possibility of serial correlation. Standard errors are clustered by firm and bank-year in both OLS and IV estimations.

3. Estimation results

In this section, we provide the results of empirical analyses explained in the previous section to estimate the effects of financial constraints on markups. We begin by the results of OLS estimation, and then, go on to the estimation results from IV to deal with the endogeneity. We further show the estimation results from using markups measured by alternative methods and investment rates as the dependent variables.

3.1 Estimation results from OLS

We first estimate Equation (3) by OLS. Table 3 shows the results. In column (1), only the liquid asset ratio is used as an explanatory variable, and firm fixed effects, bank fixed effects, and industry-year fixed effects are taken into account. The coefficient on the liquid asset ratio is positive and statistically significant. Firms tend to raise their markups when they have more liquidity. Conversely, firms that face tight liquidity constraints charge relatively low markups. This result is consistent with the fire sale hypothesis rather than the customer base hypothesis.

In column (2), we add the following explanatory variables as control variables: cashflow ratio, sales growth rate, logarithm of total assets, logarithm of firm age, R&D dummy, exporter dummy, and importer dummy. The coefficient on the liquid asset ratio, however, remains almost unchanged, and positive and statistically significant. Among the control variables, the coefficients on cashflow ratio, total assets, and R&D dummy are positive and significant. In column (3), We add as explanatory variables the bank variables: the ratio of non-performing loans and the capital adequacy ratio of the main banks. The coefficients on these variables are, however, not statistically significant. The main bank's financial health does not significantly affect the markups. To examine if the effects of financial constraints on markups were larger during the Global Financial Crisis, we add the interaction term of the liquidity ratio with the Global Financial Crisis dummy as an explanatory variable in column (4). The coefficient is positive and statistically significant, indicating that the impact of liquidity on markups was particularly large during the Global Financial Crisis. This result is also consistent with the fire sale hypothesis because securing liquidity was more important for firms during the crisis than usual times. Finally, in columns (5) and (6), we add the interaction terms between monetary policy shocks and the liquidity ratio to the explanatory variable. The columns show that neither of the coefficients is statistically significant. The results indicate that the impact of liquidity on markups is not significantly dependent on the monetary policy shocks.

3.2 Estimation results from IV

As explained in the previous section, we conduct IV estimation using the ratio of liquid assets in the previous period as the instrumental variable. In cases where the interaction terms of liquid assets are included in the explanatory variables, the interaction terms are constructed by the lagged liquid assets and used as the instrumental variables. As in the OLS estimation, we take into account firm fixed effects, bank fixed effects, and industry-year fixed effects. In addition, we add the control variables, main bank variables, the interaction term between the financial crisis dummy and the liquid asset ratio, and the interaction terms between monetary policy shocks and the liquid asset ratio to the explanatory variables.

Table 4 shows the results of the IV estimation. It shows that all coefficients on the liquid asset ratio are positive and statistically significant. Furthermore, the coefficients on the liquid asset ratio in Table 4 from IV are larger than those in Table 3 from OLS. This indicates that if firms face exogenous liquidity constraints, markups drop significantly, resulting in an increase in liquid assets. The interaction term between the Global Financial Crisis dummy and liquid assets also remains positive and statistically significant. The results for the other explanatory variables are also qualitatively unchanged from the OLS estimation results.

3.3 Alternative markup measures

In this subsection, we confirm the robustness of the previous results by using alternative markup measures. First, we use OPEX instead of COGS to calculate a markup measure and use it as the dependent variable in Equation (3). Column (1) of Table 5 shows the result estimated by OLS, while column (2) shows the result of the IV estimation using the liquid asset ratio of the previous period and its interaction terms as instruments. In both columns, the coefficients on the liquid asset ratio and its interaction terms with the Global Financial Crisis dummy are positive and statistically significant, although the coefficient on the liquid asset ratio is larger in column (2) than in column (1). In addition, the coefficients on the interaction terms of liquid assets with long-term interest are positive and statistically significant. While the coefficients on long-term interest rates are not significant in the case of the COGS-based markup in Table 3, the results here from the OPEX-based markup weakly suggest that the liquidity is more important as the determinant of markups when the interest rate is higher and borrowing is more costly.

The results also hold when the ratio of sales to wage bill is used as the markup indicator as columns (3) and (4) in Table 5 show. Column (3) shows the results of OLS and (4) shows the results of IV. The coefficients on the liquid asset ratio and its interaction terms with the Global Financial Crisis dummy are again positive and significant. The coefficients on the interaction terms of liquid assets with long-term interest are also positive and statistically significant in columns (3) and (4). In columns (3) and (4), the coefficients on the interaction terms of liquid assets and the monetary policy shock ($MP1$) are positive and statistically significant. Given that the ratio of sales to wage bill is likely to depend on the distortions of the labor market, the monetary policy may affect them. In sum, while we obtained some additional implications from these analyses, the baseline results from the COGS-based markup measure are robust to the alternative markup indicators.

3.4 Investment

In this subsection, we examine the effects of liquid assets on investment in tangible fixed assets and that in inventory. Previous studies found that financial constraints reduce investment in physical capital.[15] Moreover, the liquidity management hypothesis posits that financially constrained firms cut markups to shed their inventory, suggesting a positive correlation between inventory and liquid assets other than inventory.

Specifically, we estimate Equation (3) with the dependent variable replaced with the log difference of tangible fixed assets and that of inventory using OLS and IV. Column (1) of Table 6 shows the result for tangible fixed assets from the OLS estimation. It shows that the coefficient of the liquid asset ratio is negative and statistically significant. We interpret this negative coefficient as arising from the endogenous nature of liquid assets; firms make investment in tangible assets at least partly from their liquid assets. In column (2), however, IV estimation shows a different result: the coefficient on liquid assets is positive and statistically significant. This suggests that an exogenous increase in liquid assets promotes investment in tangible asset. These results are consistent with previous studies. Furthermore, it shows that the lagged liquidity ratio works as a valid IV.

We obtain similar results for inventory investment as shown in columns (3) and (4) of Table 6. The coefficient of the liquid asset ratio in column (3), estimated using OLS, is negative, but the coefficient of the liquid asset ratio in column (4), estimated using IV, is positive. The OLS estimation result suggests that firms can secure their liquidity by reducing their inventories while the IV estimation results indicate that firms that face an exogenous negative shock to liquid assets reduce their inventories. These results are consistent with the hypothesis on the liquidity management through inventory.

4. Robustness checks and Further analysis

In this section, we show the results of three types of additional analyses. First, we check the robustness of our main results by adding more control variables. Then, we proceed with the estimation by subsamples. Finally, we estimate the impacts of the liquid assets on markups by year to derive the macroeconomic implications.

4.1 Robustness checks

The purpose of this subsection is to check the robustness of our results obtained so far by adding some control variables. We first estimate the Equation (3) with cashflow volatility because Kim (2021) shows that controlling for the cashflow volatility can completely change the estimation results. Another set of the control variables includes the production factors: logs of tangible fixed assets, employment, and intermediates. Controlling for these variables allows the elasticity of production with respect to the variable input can be variable and depend on production factors. Both estimations results show that our main results do not change

[15] See Almeida and Campello (2007) and references therein.

qualitatively.[16]

We first add the cashflow volatility to the explanatory variables. Kim (2021) shows that the positive effect of liquid assets on prices that Gilchrist et al. (2017) found for the U.S. firms during the Global Financial Crisis loses its significance once the cashflow volatility is controlled for. We examine whether this is the case for our sample. Specifically, we add the standard deviation of the cashflow ratio for the previous five or ten years. We use the three alternative markup measures and investment in tangible fixed assets and inventory as the dependent variable of Equation (3) and estimate them by IV. Panels A and B of Table 7 show the results from adding the five- and ten-year volatility, respectively. The volatility measures take positive and significant coefficients for some specifications. Importantly, the positive coefficients of the liquidity ratio remain significant for all the markup measures and both types of investment. Thus, our results are robust to controlling for the cashflow volatility.

We have so far assumed that the elasticity of production with respect to the variable input is constant within a firm and industry-year. While we have imposed this assumption to simplify the analyses, we can relax it by controlling for the production factors. Specifically, we estimate Equation (3) with additional explanatory variables of the production factors: logs of tangible fixed assets, employment, and intermediates.[17] Table 8 presents the estimation results from using the COGS-based markups in columns (1) and (2), the OPEX-based markups in columns (3) and (4), and the wage bill-based markups in (5) and (6), respectively. Columns (1), (3), (5) report the estimation results by OLS while columns (2), (4), and (4) show results by IV. Table 8 shows that the coefficients on the liquid assets are all positive and statistically significant except for column (6). In addition, the coefficients on the interaction terms with Global Financial Crisis dummy are also significantly positive for IV estimations. While some coefficients on the production factors are statistically significant, the main results do not change qualitatively. In sum, our baseline results are robust to the alternative specifications of the production function.

4.2 Subsample estimation

In this subsection, we present the results from subsamples divided by firm size or industry to examine if our baseline results are driven by some specific sectors in terms of size or industry. For each subsample, we estimate Equation (3) for the three types of the markup indicators and investment in tangible fixed assets and inventory using IV.

[16] We also included other variables such as interaction terms of the liquidity assets with the bank-level variables or interaction terms of the exporter and importer dummies with real effective exchange rate into the set of explanatory variables. In all cases, the main results qualitatively held.

[17] In this estimation, intermediates are measured by subtracting the wage bill from OPEX. While this term is expenditure to intermediate and can be affected by changes in material prices, the industry-level effects are absorbed into the industry-year fixed effect in the regression analysis.

4.2.1 Size

First, we divide the firms in our sample into large and small firms depending on whether their total assets are larger or smaller than the median value for each year. Panels A and B of Table 9 show the estimation results for small and large firms, respectively. For the markup indicators shown in columns (1)–(3), the coefficients of the liquid asset ratio are positive and significant both for large and small firms. Moreover, the coefficients of the interaction terms between the liquid asset ratio and the Global Financial Crisis dummy are positive and significant both for large and small firms. These results show that our baseline results hold both for large and small firms. Comparing the coefficients of the liquid asset ratio for large and small firms, we find that for the COGS-based markup indicator, which is our preferred measure because COGS can be regarded as variable costs, the coefficient for small firms is larger than that for large firms (0.0997 vs. 0.0636), suggesting that small firms' markup is more sensitive to financial constraints. However, the other two markup measures show that large firms' markups are more sensitive to the liquid asset ratio. For the investment in tangible fixed assets and inventory, shown in columns (4)–(5), the coefficients of the liquid asset ratio are positive and significant with the coefficients for small firms slightly larger than those for large firms.

4.2.2 Industry

Next, we divide the firms in our sample into manufacturing, commerce, and other industries. Panel A of Table 10 show the results for manufacturing firms. Columns (1)–(3) show that the liquid assets have significant and positive effects on the three markup measures and that their magnitudes are larger for manufacturing firms than for all firms. For example, the effect of the liquid asset ratio on the COGS-based markup indicator for manufacturing firms is almost twice as high as that for all firms (0.135 vs. 0.0687). Such a large sensitivity may reflect a relatively high demand elasticities for manufacturing goods.[18] Columns (4) and (5) show that the effects of the liquid asset ratio on investment in tangible fixed assets and inventory are also positive and significant for manufacturing firms with almost the same magnitudes as for all firms.

Panels B and C of Table 10 show the results for commerce and other industries, respectively. Columns (1)–(3) show that while the positive effects of the liquid asset on markups are weaker for firms in commerce industries, those for other industries are quantitatively almost the same as those for all firms. Columns (4) and (5) show that the effects of the liquid asset on investment in tangible fixed assets and inventory are also positive and significant for firms in commerce and other industries with almost the same magnitudes as for all firms.

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[18] Kim (2021) empirically shows that the firms that face high demand elasticity are more likely to decrease their output prices when they face a negative credit supply shock.

4.2.3 Manufacturing

The previous analysis shows that the quantitative effects of the liquid assets are heterogeneous and dependent on the industry characteristics. We delve deeper into the difference across products within manufacturing industry. Specifically, we classify the industries into three groups by the degree of product differentiation according to Rauch (1999). The results are reported in Table 11. Panels A, B, and C show the estimation results using the subsamples of homogeneous, refence priced, and differentiated products, respectively. The dependent variable in the columns (1) is the ratio of sales to COGS, and the coefficients on the liquid assets are positive and statistically significant in all panels. In addition, the coefficient for the reference priced products is smaller than homogeneous products and the coefficient for the differentiated products is the smallest. The order of the coefficients is consistent with the previous analysis and Kim (2021). These results support the idea that the effects of the liquidity on markups are larger for the firms facing higher demand elasticities.

4.3 Aggregate implications

We have so far shown robust evidence that firms set different markups depending on how much liquid assets they have. In turn, a dispersion in markups results in misallocation of resources and lowers aggregate productivity (Peters, 2020). In this subsection, we conduct a back-of-the-envelope calculation to show to what extent differences in the liquid asset ratio among firms lower aggregate productivity. Using Hsieh and Klenow (2009)'s framework, Chen and Irarrazabal (2015) show that under some conditions including a joint log-normal distribution of firm-level productivity and one plus distortion, the aggregate TFP losses can be expressed as

$$\ln(TFP_t^e/TFP_t) = \frac{\sigma}{2} V_t(\ln \mu_{it}), \tag{5}$$

where TFP_t^e and TFP_t denote the efficient TFP and actual TFP in year t, respectively, so that the left-hand side approximately indicates the percentage of aggregate productivity losses. In the right-hand side, σ denotes the elasticity of substitution between firm-level outputs, and $V_t(\ln \mu_{it})$ denotes the variance of the logarithm of markup in year t, To obtain $V_t(\ln \mu_{it})$ we extend Equation (3) by allowing for time-variant coefficients of the liquidity ratio as

$$\ln \mu_{it} = \sum_{t=2007}^{2017} \alpha_{1t} Liquid\ Asset_{it} + \boldsymbol{Bank_{bt}\alpha_2} + \boldsymbol{x_{it}\beta} + \delta_i + \delta_b + \delta_{st} + u_{it}. \tag{6}$$

First, we estimate Equation (6) by IV and obtain the year-by-year estimates of the liquid asset ratio, $\hat{\alpha}_{1t}$. Then, to focus on the variation in markups arising solely from the difference in the liquid asset ratio, we assume that the control variables are common across firms and years. Therefore, the markup of firm i in year t can be expressed as

$$\ln(\mu_{it}) = \ln(\mu) + \hat{\alpha}_{1t} Liquid\ Asset_{it}. \tag{7}$$

Using Equation (7) we obtain $V_t(\ln \mu_{it})$. Setting $\sigma = 3$ following Hsieh and Klenow (2009), we obtain the percentage of TFP losses, $100 * (TFP_t^e / TFP_t - 1)$, due to the difference in markups that different firms' liquid asset ratios cause.

Figure 3 shows the percentage of TFP losses. It indicates that the TFP losses are economically small. They range from 0.03% to 0.04% for most of the sample period, and 0.035% on average. However, the TFP losses almost doubled in year 2008 from the previous year (from 0.026% to 0.054%). As Figure 4 shows, such a hike during the Global Financial Crisis is mainly due to the rise in the coefficient of the liquid asset ratio, $\hat{\alpha}_{1t}$, rather than the rise in the variance of the liquid asset ratio.

5. Conclusion

We have analyzed the effects of financial constraints on markups. Using a firm-level panel dataset from Japan over the period 2006-2017, we find that financially constrained firms decreased markup and that this effect was heightened during the Global Financial Crisis. We also find that financially constrained firms decreased investment in fixed capital and inventories. These results are consistent with the liquidity management hypothesis that posits financially constrained firms set relatively low prices to shed inventories, but not with the customer market hypothesis that predicts unconstrained firms lower prices to invest in the customer base and increase their market shares. Third, we did not obtain strong evidence that bank health shocks and monetary policy shocks had a significant impact on the relationship between financial constraints and markup. These results are robust to the measures of markups and observed for subsamples divided by size and industry. Fourth, although the extent to which the dispersion in markups due to financial constraints results in aggregate TFP losses through inefficient resource allocation are economically small for most of the sample period, the magnitude almost doubled during the Global Financial Crisis.

Our results indicate that financial constraints matter for product market competition as well as investment and have some policy implications. First, public credit guarantees and other financial supports that governments often provide during a financial crisis are likely to enhance resource allocation and aggregate productivity through the product market competition as well as to increase investment and aggregate demand. Second, as financially constrained firms set low markups, competing firms are also likely to be forced to set relatively low markups although competing firms themselves are not financially constrained. Such spillover effects may cause an economy-wide deflation during a financial crisis because the effects of financial constraints on markups are large during a crisis. Although such a spillover effect and its macroeconomic consequences are beyond the scope of this study, they are interesting paths for future work.

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Table 1. List of variables

Category	Variables	Description
Markup	ln(mu_cogs)	ln(Sales/Cost of goods sold), 1% tails trimmed
	ln(mu_opex)	ln(Sales/Operating expenses), 1% tails trimmed
	ln(mu_wagebill)	ln(Sales/Wage bill), 1% tails trimmed
Investment	dln(tangible)	ln(Tangible fixed assets(t)/Tangible fixed assets(t-1)), 1% tails trimmed
	dln(inventory)	ln(Inventory(t)/Inventory(t-1)), 1% tails trimmed
Financial constraints	Liquid assets	(Liquid assets-inventory)/Total assets
	Nonperfoming loan ratio	Total Risk-Monitored Loans/Total loans
	Equity ratio	Capital-adequacy ratio
Control variables	Cashflow	(Operating profits+depreciation)/Total assets
	Import dummy	Dummy that takes value one if firms import, and zero otherwise
	Export dummy	Dummy that takes value one if firms export, and zero otherwise
	R&D dummy	Dummy that takes value one 1 if firms perform R&D
	Firm age	ln(Survey year - Established year)
	Total assets	ln(Total assets)
	Sales growth	ln(Sales(t)/Sales(t-1))
Financial crisis dummy	Crisis	Dummy that takes value one if the survey year=2008 or 2009, and zero otherwise
Monetary policy shock	MP1	First principal component of three-month Euroyen futures rates
	MP2	First principal component of broad financial market variables including long-term interest rates

Source: Authors' compilation, using Basic Survey of Japanese Business Structure and Activities (METI), TSR Enterprise Information File (TSR), Nikkei Financial Quest, and data from Tokyo Financial Exchange Inc.

Table 2. Summary Statistics

Variables	N	mean	min	p25	median	p75	max
Firm level							
mu_cogs	222,965	1.49	0.94	1.14	1.24	1.43	15.72
mu_opex	223,078	1.03	0.78	1.01	1.02	1.05	1.33
mu_wagebill	224,753	9.28	1.32	3.91	6.41	10.95	83.43
tangible rate	201,663	1.02	0.33	0.94	0.98	1.04	3.99
inventory rate	177,031	1.14	0.10	0.89	1.01	1.16	49.63
Liquid assets	209,012	0.50	0	0.34	0.48	0.65	1.04
Cashflow	203,864	0.05	-8.55	0.02	0.05	0.08	121.88
Sales growth	208,193	0.00	-5.70	-0.06	0.01	0.07	3.96
Total assets	229,195	13,279	0	1,498	3,161	7,443	15,149,263
Firm age	229,208	41.41	0	26	42	56	301
R&D dummy	229,208	0.27	0	0	0	1	1
Exporter dummy	229,208	0.21	0	0	0	0	1
Importer dummy	229,208	0.21	0	0	0	0	1
Bank level							
Nonperfoming loan ratio	2,356	0.05	0.00	0.03	0.05	0.07	0.23
Equity ratio	2,356	0.12	0.02	0.10	0.11	0.13	0.37
Number of transaction firms	2,356	97.29	1	3	8	49	4,599

Notes: In this table, we do not take logarithm of the variables. Markup indicators and investment rates are trimmed 1% tails.

Source: Authors' compilation, using Basic Survey of Japanese Business Structure and Activities (METI), TSR Enterprise Information File (TSR), and Nikkei Financial Quest.

Table 3. OLS estimation

OLS	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	ln(mu_cogs)	ln(mu_cogs)	ln(mu_cogs)	ln(mu_cogs)	ln(mu_cogs)	ln(mu_cogs)
Liquid assets	0.0388	0.0354	0.0333	0.0333	0.0346	0.0344
	[0.00662]***	[0.00637]***	[0.00637]***	[0.00637]***	[0.00716]***	[0.00708]***
Liquid assets*Crisis			0.0136	0.0135	0.0137	0.0134
			[0.00455]***	[0.00455]***	[0.00434]***	[0.00448]***
Nonperfoming loan ratio				-0.00612	-0.00687	-0.00682
				[0.0501]	[0.0501]	[0.0501]
Equity ratio				-0.0145	-0.0145	-0.0147
				[0.0244]	[0.0244]	[0.0244]
Liquid assets*Interest					-0.00152	-0.00137
					[0.00405]	[0.00392]
Liquid assets*MP1					-0.00442	
					[0.00599]	
Liquid assets*MP2						-0.000122
						[0.000186]
Cashflow		0.0363	0.0362	0.0362	0.0362	0.0362
		[0.0160]**	[0.0160]**	[0.0160]**	[0.0160]**	[0.0160]**
Sales growth		0.00436	0.00429	0.00429	0.0043	0.0043
		[0.00291]	[0.00290]	[0.00290]	[0.00290]	[0.00290]
Total assets		0.0071	0.00732	0.00732	0.00729	0.00729
		[0.00267]***	[0.00267]***	[0.00267]***	[0.00266]***	[0.00266]***
Firm age		0.00491	0.00532	0.00535	0.00523	0.00524
		[0.00362]	[0.00360]	[0.00359]	[0.00362]	[0.00361]
R&D dummy		0.00337	0.00337	0.00338	0.00337	0.00337
		[0.00134]**	[0.00134]**	[0.00134]**	[0.00134]**	[0.00134]**
Export dummy		-0.000127	-0.000125	-0.00013	-0.000128	-0.000129
		[0.00131]	[0.00131]	[0.00131]	[0.00131]	[0.00131]
Import dummy		0.000277	0.000271	0.00027	0.000268	0.00027
		[0.00119]	[0.00119]	[0.00119]	[0.00119]	[0.00119]
Firm fixed effect	yes	yes	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes	yes	yes
N	201,084	180,796	180,796	180,796	180,796	180,796
Adjusted R-squared	0.0012	0.00733	0.00747	0.00746	0.00746	0.00745

Notes: Standard errors are in brackets. * p<0.1, ** p<0.05, *** p<0.01.

Source: Authors' estimation, using Basic Survey of Japanese Business Structure and Activities (METI), TSR Enterprise Information File (TSR), Nikkei Financial Quest, and data from Tokyo Financial Exchange Inc..

Table 4. IV estimation

IV	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	ln(mu_cogs)	ln(mu_cogs)	ln(mu_cogs)	ln(mu_cogs)	ln(mu_cogs)	ln(mu_cogs)
Liquid assets	0.0716	0.07	0.0686	0.0686	0.0687	0.0685
	[0.0126]***	[0.0123]***	[0.0123]***	[0.0123]***	[0.0129]***	[0.0128]***
Liquid assets*Crisis			0.0147	0.0146	0.0145	0.0146
			[0.00488]***	[0.00489]***	[0.00471]***	[0.00481]***
Nonperfoming loan ratio				0.00329	0.00343	0.00347
				[0.0630]	[0.0626]	[0.0626]
Equity ratio				-0.00826	-0.00811	-0.00822
				[0.0221]	[0.0221]	[0.0221]
Liquid assets*Interest					0.0000831	0.000256
					[0.00521]	[0.00509]
Liquid assets*MP1					-0.00161	
					[0.00640]	
Liquid assets*MP2						0.0000157
						[0.000192]
Cashflow		0.032	0.0319	0.0319	0.0319	0.0319
		[0.0143]**	[0.0143]**	[0.0143]**	[0.0143]**	[0.0143]**
Sales growth		0.00534	0.00522	0.00522	0.00521	0.00521
		[0.00234]**	[0.00233]**	[0.00233]**	[0.00233]**	[0.00233]**
Total assets		0.00877	0.00907	0.00907	0.00908	0.00908
		[0.00270]***	[0.00269]***	[0.00269]***	[0.00269]***	[0.00269]***
Firm age		0.00449	0.00513	0.00515	0.00518	0.00518
		[0.00403]	[0.00398]	[0.00398]	[0.00394]	[0.00394]
R&D dummy		0.00261	0.0026	0.0026	0.0026	0.0026
		[0.00137]*	[0.00137]*	[0.00137]*	[0.00137]*	[0.00137]*
Export dummy		0.000423	0.000428	0.000425	0.000424	0.000425
		[0.00124]	[0.00124]	[0.00124]	[0.00124]	[0.00124]
Import dummy		0.000381	0.000381	0.000381	0.000381	0.000381
		[0.00126]	[0.00126]	[0.00126]	[0.00126]	[0.00126]
Firm fixed effect	yes	yes	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes	yes	yes
N	161,152	159,101	159,101	159,101	159,101	159,101
Kleibergen-Paap rk Wald F statistic	1,165	1,209	610	610	296	296

Notes: Standard errors are in brackets. * p<0.1, ** p<0.05, *** p<0.01.

Source: Authors' estimation, using Basic Survey of Japanese Business Structure and Activities (METI), TSR Enterprise Information File (TSR), Nikkei Financial Quest, and data from Tokyo Financial Exchange Inc.

Table 5. Alternative markup indicators

	(1)	(2)	(3)	(4)
Dependent Variable	ln(mu_opex)	ln(mu_opex)	ln(mu_wagebill)	ln(mu_wagebill)
Method	OLS	IV	OLS	IV
Liquid assets	0.0613	0.0853	0.199	0.273
	[0.00283]***	[0.00483]***	[0.0178]***	[0.0313]***
Liquid assets*Crisis	0.0145	0.0115	0.0348	0.0339
	[0.00224]***	[0.00166]***	[0.0135]**	[0.0116]***
Nonperfoming loan ratio	0.0263	0.0147	-0.0141	0.123
	[0.0247]	[0.0295]	[0.168]	[0.191]
Equity ratio	0.00359	0.00308	-0.0698	-0.0947
	[0.0106]	[0.0103]	[0.0658]	[0.0641]
Liquid assets*Interest	0.00464	0.00679	0.0378	0.0331
	[0.00170]***	[0.00175]***	[0.0121]***	[0.0132]**
Liquid assets*MP1	0.00328	0.00313	0.0413	0.0347
	[0.00305]	[0.00211]	[0.0169]**	[0.0151]**
Cashflow	0.0569	0.051	0.0323	0.0269
	[0.0289]**	[0.0271]*	[0.0139]**	[0.0109]**
Sales growth	0.038	0.0393	0.245	0.252
	[0.00281]***	[0.00243]***	[0.00758]***	[0.00714]***
Total assets	0.0121	0.0128	0.15	0.145
	[0.00123]***	[0.00134]***	[0.00705]***	[0.00693]***
Firm age	0.00594	0.00575	-0.0581	-0.0615
	[0.00142]***	[0.00166]***	[0.0118]***	[0.0136]***
R&D dummy	-0.00095	-0.00128	-0.0209	-0.0189
	[0.000471]**	[0.000523]**	[0.00374]***	[0.00413]***
Export dummy	-0.000612	-0.00057	-0.00457	-0.00452
	[0.000662]	[0.000666]	[0.00469]	[0.00485]
Import dummy	0.000108	0.000572	-0.00734	-0.00446
	[0.000574]	[0.000612]	[0.00416]*	[0.00432]
Firm fixed effect	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes
N	180,592	158,867	181,936	160,081
Adjusted R-squared	0.121		0.0705	
Kleibergen-Paap rk Wald F statistic		305		307

Notes: Standard errors are in brackets. * p<0.1, ** p<0.05, *** p<0.01.

Source: Authors' estimation, using Basic Survey of Japanese Business Structure and Activities (METI), TSR Enterprise Information File (TSR), Nikkei Financial Quest, and data from Tokyo Financial Exchange Inc.

Table 6. Investment

	(1)	(2)	(3)	(4)
Dependent Variable	dln(tangible)	dln(tangible)	dln(inventory)	dln(inventory)
Method	OLS	IV	OLS	IV
Liquid assets	-0.241	0.833	-0.644	1.4
	[0.0130]***	[0.0450]***	[0.0306]***	[0.0757]***
Liquid assets*Crisis	0.00137	0.0131	0.0209	-0.00442
	[0.0124]	[0.0154]	[0.0238]	[0.0249]
Nonperfoming loan ratio	0.0445	0.0508	-0.705	0.0882
	[0.107]	[0.115]	[0.310]**	[0.224]
Equity ratio	0.0597	0.0822	0.131	0.123
	[0.0432]	[0.0452]*	[0.0963]	[0.0813]
Liquid assets*Interest	-0.0402	-0.0426	-0.0704	-0.0109
	[0.00787]***	[0.0112]***	[0.0226]***	[0.0238]
Liquid assets*MP1	-0.0365	-0.0396	-0.0675	-0.034
	[0.0173]**	[0.0214]*	[0.0418]	[0.0401]
Cashflow	0.053	0.0213	0.0932	0.0544
	[0.0311]*	[0.0143]	[0.0495]*	[0.0274]**
Sales growth	0.0816	0.0478	0.198	0.127
	[0.00516]***	[0.00542]***	[0.0121]***	[0.0105]***
Total assets	0.0991	0.0907	0.143	0.127
	[0.00629]***	[0.00567]***	[0.0100]***	[0.00910]***
Firm age	-0.0288	-0.0314	-0.0543	-0.0118
	[0.00707]***	[0.00870]***	[0.0232]**	[0.0154]
R&D dummy	-0.00025	-0.000116	0.00474	-0.00161
	[0.00224]	[0.00277]	[0.00495]	[0.00501]
Export dummy	-0.00777	-0.00789	-0.00855	-0.00647
	[0.00278]***	[0.00345]**	[0.00550]	[0.00583]
Import dummy	-0.00408	-0.000872	0.00301	0.0103
	[0.00245]*	[0.00287]	[0.00504]	[0.00516]**
Firm fixed effect	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes
N	180,179	158,677	171,489	155,226
Adjusted R-squared	0.0283		0.0275	
Kleibergen-Paap rk Wald F statistic		372		391

Notes: Standard errors are in brackets. * p<0.1, ** p<0.05, *** p<0.01.

Source: Authors' estimation, using Basic Survey of Japanese Business Structure and Activities (METI), TSR Enterprise Information File (TSR), Nikkei Financial Quest, and data from Tokyo Financial Exchange Inc.

Table 7. Cashflow volatility

A. Past 5 years	(1)	(2)	(3)	(4)	(5)
Dependent Variable	ln(mu_cogs)	ln(mu_opex)	ln(mu_wagebill)	dln(tangible)	dln(inventory)
Method	IV	IV	IV	IV	IV
Liquid assets	0.0689	0.084	0.277	0.852	1.437
	[0.0150]***	[0.00545]***	[0.0384]***	[0.0489]***	[0.0821]***
Liquid assets*Crisis	0.0129	0.0132	0.0235	0.00566	0.000119
	[0.00486]***	[0.00230]***	[0.0115]**	[0.0153]	[0.0305]
Liquid assets*Interest	0.00104	0.00977	0.0267	-0.0548	-0.0141
	[0.00546]	[0.00219]***	[0.0154]*	[0.0127]***	[0.0283]
Liquid assets*MP1	-0.000504	0.00345	0.0197	-0.078	-0.0347
	[0.00617]	[0.00251]	[0.0158]	[0.0214]***	[0.0445]
Cashflow	0.0232	0.0417	0.0219	0.0147	0.039
	[0.0115]**	[0.0293]	[0.00923]**	[0.0109]	[0.0226]*
Cashflow Volatility	0.000111	0.000125	-0.0000472	0.00197	-0.000104
	[0.0000839]	[0.0000441]***	[0.000443]	[0.000320]***	[0.000456]
Controls	yes	yes	yes	yes	yes
Firm fixed effect	yes	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes	yes
N	111,087	110,949	111,759	111,422	109,436
Kleibergen-Paap rk Wald F statistic	305	314	314	358	359

B. Past 10 years	(1)	(2)	(3)	(4)	(5)
Dependent Variable	ln(mu_cogs)	ln(mu_opex)	ln(mu_wagebill)	dln(tangible)	dln(inventory)
Method	IV	IV	IV	IV	IV
Liquid assets	0.0703	0.0978	0.34	0.866	1.454
	[0.0183]***	[0.00702]***	[0.0472]***	[0.0500]***	[0.0947]***
Liquid assets*Crisis	0.0187	0.0182	0.0179	0.00272	0.0382
	[0.00527]***	[0.00312]***	[0.0168]	[0.0195]	[0.0384]
Liquid assets*Interest	0.0126	0.0112	0.0279	-0.0508	-0.0337
	[0.00568]**	[0.00274]***	[0.0188]	[0.0141]***	[0.0316]
Liquid assets*MP1	0.00472	0.00567	0.0385	-0.0608	-0.0342
	[0.00742]	[0.00303]*	[0.0227]*	[0.0274]**	[0.0610]
Cashflow	0.0148	0.0294	0.0174	0.0107	0.0367
	[0.00728]**	[0.0241]	[0.00724]**	[0.00850]	[0.0244]
Cashflow Volatility	0.0000529	0.000244	-0.000425	0.00348	0.000997
	[0.000192]	[0.0000892]***	[0.000699]	[0.000511]***	[0.000779]
Controls	yes	yes	yes	yes	yes
Firm fixed effect	yes	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes	yes
N	72,805	72,651	73,181	73,085	72,230
Kleibergen-Paap rk Wald F statistic	296	301	307	329	366

Notes: Standard errors are in brackets. * p<0.1, ** p<0.05, *** p<0.01.

Source: Authors' estimation, using Basic Survey of Japanese Business Structure and Activities (METI), TSR Enterprise Information File (TSR), Nikkei Financial Quest, and data from Tokyo Financial Exchange Inc.

Table 8. Flexible production function

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	ln(mu_cogs)	ln(mu_cogs)	ln(mu_opex)	ln(mu_opex)	ln(mu_wagebill)	ln(mu_wagebill)
Method	OLS	IV	OLS	IV	OLS	IV
Liquid assets	0.0423	0.108	0.0617	0.0946	0.0686	-0.00605
	[0.00763]***	[0.0159]***	[0.00310]***	[0.00562]***	[0.0132]***	[0.0282]
Liquid assets*Crisis	-0.0318	0.0191	0.0291	0.0121	0.119	0.0142
	[0.0490]	[0.00450]***	[0.0244]	[0.00165]***	[0.125]	[0.00840]*
Nonperfoming loan ratio	-0.000281	-0.0258	0.0000138	0.0149	0.000296	0.231
	[0.000232]	[0.0612]	[0.000105]	[0.0292]	[0.000492]	[0.148]
Equity ratio	1.61	-0.0221	1.51	0.00152	2.81	0.0167
	[0.420]***	[0.0214]	[0.223]***	[0.0103]	[0.836]***	[0.0480]
Liquid assets*Interest	0.00289	0.00392	0.00533	0.00767	0.00718	0.00689
	[0.00420]	[0.00518]	[0.00169]***	[0.00177]***	[0.00754]	[0.00982]
Liquid assets*MP1	-0.00116	-0.000239	0.00335	0.00331	0.016	0.0146
	[0.00635]	[0.00646]	[0.00298]	[0.00216]	[0.0102]	[0.0110]
Cashflow	0.0536	0.0466	0.057	0.0505	0.0681	0.0608
	[0.0269]**	[0.0244]*	[0.0297]*	[0.0275]*	[0.0346]**	[0.0324]*
Sales growth	0.0351	0.0365	0.042	0.0435	0.00243	0.00871
	[0.00345]***	[0.00287]***	[0.00291]***	[0.00256]***	[0.00688]	[0.00653]
Total assets	0.0563	0.053	0.0219	0.0209	-0.104	-0.1
	[0.00433]***	[0.00440]***	[0.00166]***	[0.00171]***	[0.00676]***	[0.00726]***
Firm age	0.00577	0.00493	0.00655	0.00594	-0.0471	-0.0477
	[0.00345]*	[0.00380]	[0.00141]***	[0.00166]***	[0.00878]***	[0.00998]***
R&D dummy	0.00365	0.00265	-0.000778	-0.00113	-0.0183	-0.0157
	[0.00128]***	[0.00132]**	[0.000467]*	[0.000524]**	[0.00296]***	[0.00311]***
Export dummy	0.00134	0.00192	-0.000293	-0.000221	-0.0117	-0.0129
	[0.00130]	[0.00124]	[0.000667]	[0.000679]	[0.00363]***	[0.00379]***
Import dummy	0.00159	0.00188	0.000464	0.000973	-0.0145	-0.0134
	[0.00116]	[0.00121]	[0.000570]	[0.000605]	[0.00307]***	[0.00321]***
Tangible fixed assets	-0.00122	0.0033	-0.000117	0.00219	-0.00857	-0.0147
	[0.00133]	[0.00173]*	[0.000428]	[0.000516]***	[0.00229]***	[0.00312]***
Employment	0.0195	0.0221	-0.00709	-0.00779	-0.444	-0.439
	[0.00380]***	[0.00339]***	[0.000983]***	[0.00106]***	[0.0122]***	[0.0109]***
Intermediates	-0.0922	-0.0947	-0.011	-0.0119	0.724	0.73
	[0.00424]***	[0.00379]***	[0.00116]***	[0.00118]***	[0.00783]***	[0.00713]***
Firm fixed effect	yes	yes	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes	yes	yes
N	180,179	158,677	171,489	155,226	180,737	159,117
Adjusted R-squared	0.0283		0.0275		0.376	
Kleibergen-Paap rk Wald F statistic		372		391		236

Notes: Standard errors are in brackets. * p<0.1, ** p<0.05, *** p<0.01.

Source: Authors' estimation, using Basic Survey of Japanese Business Structure and Activities (METI), TSR Enterprise Information File (TSR), Nikkei Financial Quest, and data from Tokyo Financial Exchange Inc.

Table 9. Subsample Estimation: Size

A. Large firm	(1)	(2)	(3)	(4)	(5)
Dependent Variable	ln(mu_cogs)	ln(mu_opex)	ln(mu_wagebill)	dln(tangible)	dln(inventory)
Liquid assets	0.0636	0.0997	0.367	0.784	1.399
	[0.0135]***	[0.00657]***	[0.0474]***	[0.0499]***	[0.0939]***
Liquid assets*Crisis	0.0166	0.0148	0.0347	0.0265	0.0603
	[0.00468]***	[0.00270]***	[0.0162]**	[0.0183]	[0.0353]*
Liquid assets*Interest	0.00306	0.00865	0.0191	-0.0327	0.00311
	[0.00526]	[0.00233]***	[0.0171]	[0.0121]***	[0.0278]
Liquid assets*MP1	-0.0103	0.00371	0.0198	-0.0392	-0.0143
	[0.00661]	[0.00316]	[0.0181]	[0.0251]	[0.0591]
Cashflow	0.0289	0.0879	0.0254	0.0811	0.116
	[0.0171]*	[0.0378]**	[0.0144]*	[0.0248]***	[0.0305]***
Controls	yes	yes	yes	yes	yes
Firm fixed effect	yes	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes	yes
N	80,802	80,129	80,491	80,658	79,638
Kleibergen-Paap rk Wald F statistic	222	230	233	280	283

B. Small firm	(1)	(2)	(3)	(4)	(5)
Dependent Variable	ln(mu_cogs)	ln(mu_opex)	ln(mu_wagebill)	dln(tangible)	dln(inventory)
Liquid assets	0.0997	0.0834	0.126	1.014	1.588
	[0.0205]***	[0.00665]***	[0.0413]***	[0.0552]***	[0.0947]***
Liquid assets*Crisis	0.0154	0.0101	0.0421	0.0174	-0.0862
	[0.00643]**	[0.00219]***	[0.0160]***	[0.0165]	[0.0260]***
Liquid assets*Interest	-0.00451	0.00419	0.0529	-0.0855	-0.00947
	[0.00788]	[0.00253]*	[0.0163]***	[0.0146]***	[0.0252]
Liquid assets*MP1	0.00842	0.00313	0.0396	-0.0573	-0.0493
	[0.00958]	[0.00325]	[0.0201]**	[0.0273]**	[0.0477]
Cashflow	0.0363	0.0393	0.0284	0.00787	0.0394
	[0.0254]	[0.0283]	[0.0206]	[0.00800]	[0.0236]*
Controls	yes	yes	yes	yes	yes
Firm fixed effect	yes	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes	yes
N	77,060	77,500	78,328	76,771	74,371
Kleibergen-Paap rk Wald F statistic	274	275	273	325	382

Source: Authors' estimation, using Basic Survey of Japanese Business Structure and Activities (METI), TSR Enterprise Information File (TSR), Nikkei Financial Quest, and data from Tokyo Financial Exchange Inc.

Table 10. Subsample Estimation: Industry

A. Manufacturing	(1)	(2)	(3)	(4)	(5)
Dependent Variable	ln(mu_cogs)	ln(mu_opex)	ln(mu_wagebill)	dln(tangible)	dln(inventory)
Liquid assets	0.135	0.126	0.325	0.9	1.303
	[0.0132]***	[0.00785]***	[0.0445]***	[0.0458]***	[0.0777]***
Liquid assets*Crisis	0.0231	0.025	0.0466	0.0241	0.00649
	[0.00425]***	[0.00326]***	[0.0164]***	[0.0177]	[0.0295]
Liquid assets*Interest	-0.00558	-0.00326	0.0204	-0.0609	-0.0923
	[0.00574]	[0.00470]	[0.0243]	[0.0278]**	[0.0479]*
Liquid assets*MP1	-0.0028	0.00729	0.0373	-0.0949	-0.0189
	[0.00565]	[0.00336]**	[0.0182]**	[0.0167]***	[0.0278]
Cashflow	0.023	0.0419	0.0217	0.0106	0.0504
	[0.0128]*	[0.0319]	[0.0110]**	[0.00986]	[0.0325]
Controls	yes	yes	yes	yes	yes
Firm fixed effect	yes	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes	yes
N	74,192	73,865	75,346	74,694	74,541
Kleibergen-Paap rk Wald F statistic	317	327	321	361	349

B. Commerce	(1)	(2)	(3)	(4)	(5)
Dependent Variable	ln(mu_cogs)	ln(mu_opex)	ln(mu_wagebill)	dln(tangible)	dln(inventory)
Liquid assets	-0.0273	0.0576	0.392	0.835	1.741
	[0.0158]*	[0.00566]***	[0.0553]***	[0.0619]***	[0.127]***
Liquid assets*Crisis	0.00586	0.00463	0.00408	0.0349	0.0224
	[0.00526]	[0.00178]***	[0.0161]	[0.0234]	[0.0384]
Liquid assets*Interest	-0.0142	0.00182	0.0385	-0.0458	0.13
	[0.00629]**	[0.00180]	[0.0199]*	[0.0328]	[0.0648]**
Liquid assets*MP1	0.00353	-0.00044	-0.033	-0.0258	-0.00564
	[0.00422]	[0.00160]	[0.0164]**	[0.0147]*	[0.0261]
Cashflow	0.0701	0.105	0.101	0.0868	0.0832
	[0.0191]***	[0.0187]***	[0.0280]***	[0.0267]***	[0.0431]*
Controls	yes	yes	yes	yes	yes
Firm fixed effect	yes	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes	yes
N	51,623	51,375	50,471	50,595	50,765
Kleibergen-Paap rk Wald F statistic	196	197	207	219	277

C. Other	(1)	(2)	(3)	(4)	(5)
Dependent Variable	ln(mu_cogs)	ln(mu_opex)	ln(mu_wagebill)	dln(tangible)	dln(inventory)
Liquid assets	0.0676	0.0532	0.0235	0.827	1.421
	[0.0373]*	[0.00894]***	[0.0637]	[0.0761]***	[0.127]***
Liquid assets*Crisis	0.0108	0.000905	0.0464	-0.0105	-0.058
	[0.0126]	[0.00328]	[0.0272]*	[0.0256]	[0.0484]
Liquid assets*Interest	0.00765	0.00769	0.0441	-0.0436	-0.0827
	[0.0133]	[0.00347]**	[0.0239]*	[0.0417]	[0.0733]
Liquid assets*MP1	-0.00573	0.0131	0.0825	-0.0422	0.0632
	[0.0137]	[0.00344]***	[0.0235]***	[0.0184]**	[0.0348]*
Cashflow	0.0571	0.0514	0.0166	0.026	0.0649
	[0.0288]**	[0.0256]**	[0.0159]	[0.0229]	[0.0424]
Controls	yes	yes	yes	yes	yes
Firm fixed effect	yes	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes	yes
N	32,590	32,940	33,574	32,682	29,238
Kleibergen-Paap rk Wald F statistic	154	156	158	207	258

Source: Authors' estimation, using Basic Survey of Japanese Business Structure and Activities (METI), TSR Enterprise Information File (TSR), Nikkei Financial Quest, and data from Tokyo Financial Exchange Inc.

Table 11. Subsample Estimation: Rauch classification

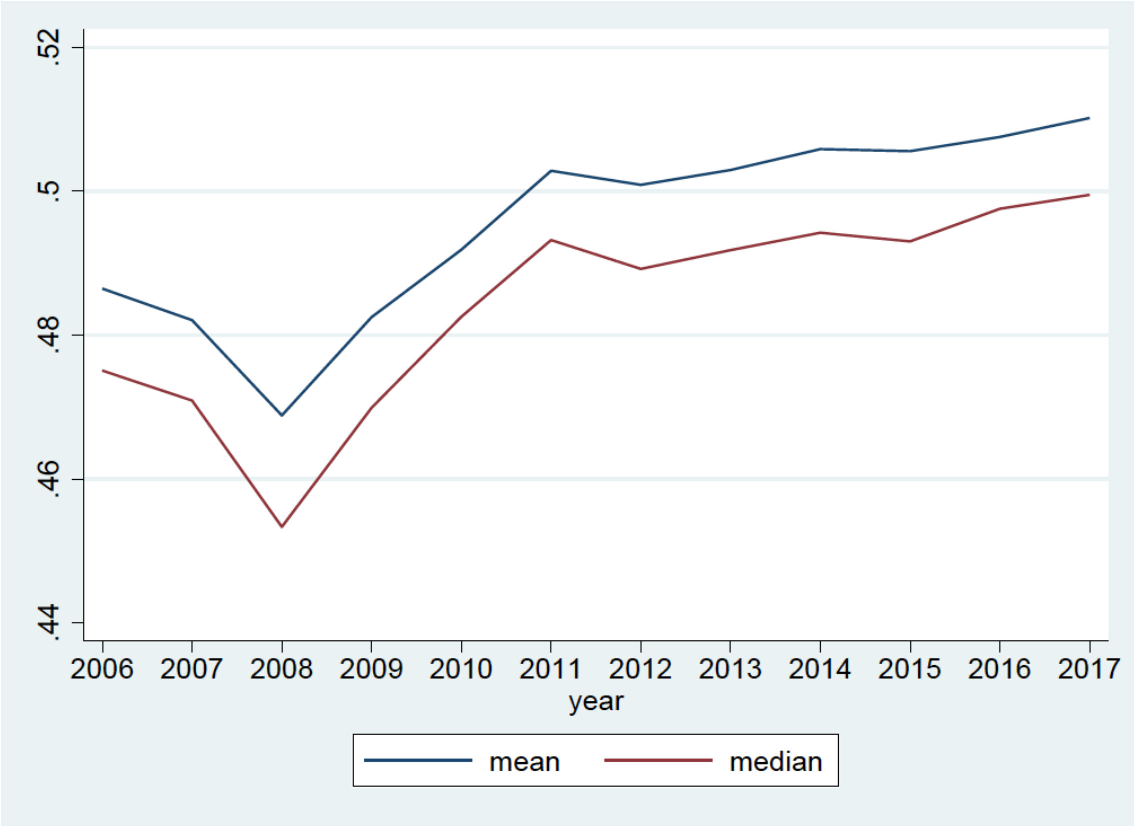
A. Homogeneous	(1)	(2)	(3)	(4)	(5)
Dependent Variable	ln(mu_cogs)	ln(mu_opex)	ln(mu_wagebill)	dln(tangible)	dln(inventory)
Liquid assets	0.181	0.14	0.692	0.871	1.172
	[0.0512]***	[0.0372]***	[0.203]***	[0.147]***	[0.235]***
Liquid assets*Crisis	0.0309	0.0251	-0.00236	0.0862	0.0336
	[0.0166]*	[0.0133]*	[0.0722]	[0.0608]	[0.0826]
Liquid assets*Interest	-0.0155	-0.0124	-0.0958	-0.198	-0.0841
	[0.0225]	[0.0188]	[0.0723]	[0.0937]**	[0.202]
Liquid assets*MP1	-0.00574	-0.00417	-0.0814	-0.0993	-0.00328
	[0.0167]	[0.0117]	[0.0668]	[0.0490]**	[0.0819]
Cashflow	0.393	0.402	0.161	0.126	0.495
	[0.0353]***	[0.0302]***	[0.140]	[0.0954]	[0.124]***
Controls	yes	yes	yes	yes	yes
Firm fixed effect	yes	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes	yes
N	4,582	4,607	4,590	4,603	4,581
Kleibergen-Paap rk Wald F statistic	64	63	66	55	66

B. Reference priced	(1)	(2)	(3)	(4)	(5)
Dependent Variable	ln(mu_cogs)	ln(mu_opex)	ln(mu_wagebill)	dln(tangible)	dln(inventory)
Liquid assets	0.158	0.122	0.215	1.083	1.273
	[0.0599]***	[0.0232]***	[0.150]	[0.169]***	[0.255]***
Liquid assets*Crisis	-0.0131	-0.00107	0.1	-0.0249	0.139
	[0.0112]	[0.0121]	[0.0792]	[0.0556]	[0.0959]
Liquid assets*Interest	-0.0294	-0.011	0.0401	-0.122	-0.29
	[0.0135]**	[0.0122]	[0.0920]	[0.110]	[0.175]*
Liquid assets*MP1	-0.0245	-0.00244	-0.024	-0.104	0.0135
	[0.0151]	[0.00757]	[0.0605]	[0.0584]*	[0.0895]
Cashflow	0.174	0.191	0.0228	0.0573	0.293
	[0.0633]***	[0.0685]***	[0.0703]	[0.0604]	[0.116]**
Controls	yes	yes	yes	yes	yes
Firm fixed effect	yes	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes	yes
N	4,794	4,800	4,830	4,801	4,794
Kleibergen-Paap rk Wald F statistic	43	44	49	42	69

C. Differentiated	(1)	(2)	(3)	(4)	(5)
Dependent Variable	ln(mu_cogs)	ln(mu_opex)	ln(mu_wagebill)	dln(tangible)	dln(inventory)
Liquid assets	0.134	0.128	0.31	0.902	1.33
	[0.0140]***	[0.00842]***	[0.0471]***	[0.0467]***	[0.0852]***
Liquid assets*Crisis	0.0251	0.0263	0.0466	0.023	-0.0112
	[0.00452]***	[0.00337]***	[0.0187]**	[0.0190]	[0.0348]
Liquid assets*Interest	-0.00239	-0.00144	0.025	-0.0473	-0.0749
	[0.00667]	[0.00545]	[0.0276]	[0.0296]	[0.0509]
Liquid assets*MP1	-0.00117	0.00827	0.0501	-0.0952	-0.0248
	[0.00623]	[0.00366]**	[0.0197]**	[0.0177]***	[0.0302]
Cashflow	0.021	0.0377	0.021	0.00878	0.0448
	[0.0117]*	[0.0292]	[0.0107]**	[0.00847]	[0.0288]
Controls	yes	yes	yes	yes	yes
Firm fixed effect	yes	yes	yes	yes	yes
Bank fixed effect	yes	yes	yes	yes	yes
Industry*year fixed effect	yes	yes	yes	yes	yes
N	64,660	64,301	65,770	65,137	65,014
Kleibergen-Paap rk Wald F statistic	290	300	289	349	328

Source: Authors' estimation, using Basic Survey of Japanese Business Structure and Activities (METI), TSR Enterprise Information File (TSR), Nikkei Financial Quest, and data from Tokyo Financial Exchange Inc.

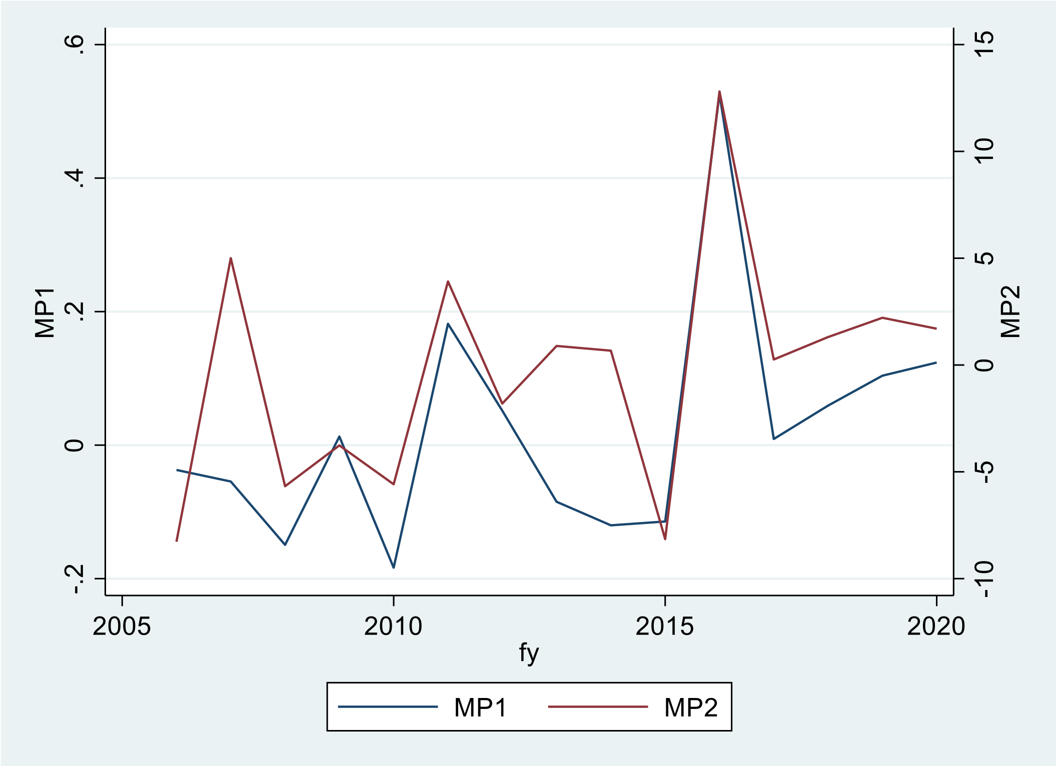
Figure 1. Liquid asset ratio



Note. The liquid asset ratio is the ratio of liquid assets other than inventory to total assets.

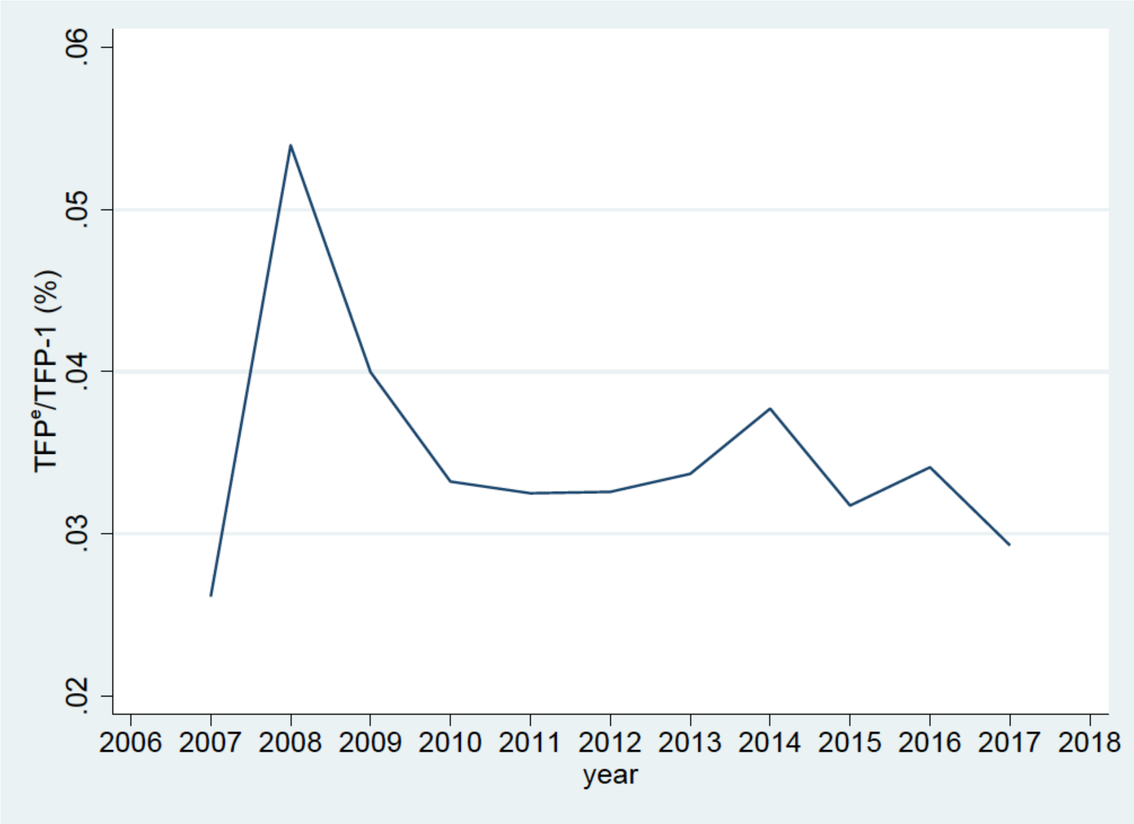
Source: Authors' calculation, using the Basic Survey of Japanese Business Structure and Activities (METI) and TSR Enterprise Information File (TSR).

Figure 2. Monetary policy shocks



Source: Authors' estimation, using Nikkei Financial Quest and data from Tokyo Financial Exchange Inc.

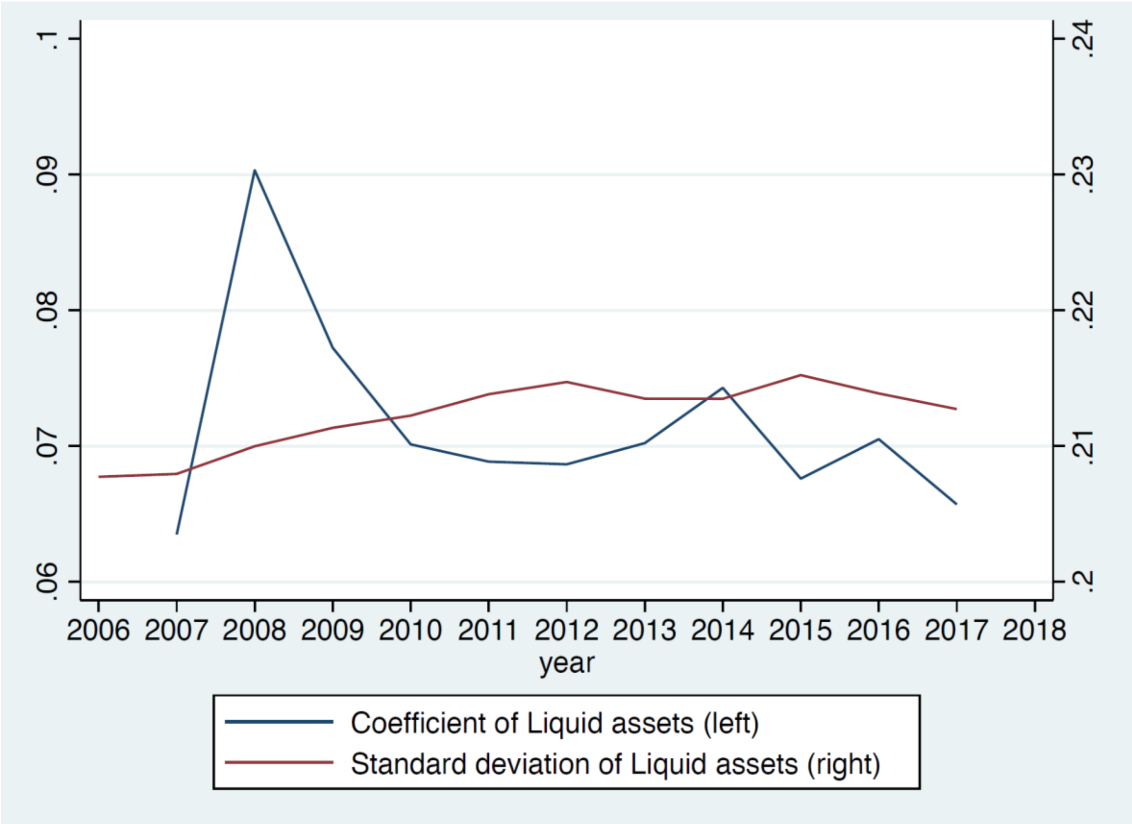
Figure 3. Aggregate TFP Losses as a percentage of efficient aggregate TFP



Note. The figure shows the TFP loss, calculated by exponentiating logarithm of the ratio of efficient TFP and actual TFP, subtracting one, and multiplying 100 to express the value as percentage.

Source: Authors' estimation, using Basic Survey of Japanese Business Structure and Activities (METI), TSR Enterprise Information File (TSR), Nikkei Financial Quest, and data from Tokyo Financial Exchange Inc.

Figure 4. Year-by-year coefficient of the liquid asset ratio and the standard deviation of the ratio



Source: Authors' estimation, using Basic Survey of Japanese Business Structure and Activities (METI), TSR Enterprise Information File (TSR), Nikkei Financial Quest, and data from Tokyo Financial Exchange Inc.