論　　文

Cash Holdings: Evidence from Firm-Level Big Data in Japan*

By Kaoru HOSONO, Daisuke MIYAKAWA and Miho TAKIZAWA**

Abstract

To investigate the status of Japanese firms' cash holdings, first, we document how the distribution of firms' cash holding has been evolving over the last two decades. Our descriptive analyses using Japanese firm-level "big data" accounting for at most 400 thousand firms over the period of 1994-2016 suggest that Japanese firms on average have increased its size-adjusted cash holding since the late 2000s. This trend has been accompanied by increasing dispersion of the size-adjusted cash holding among firms. Second, we document how firms have increased their cash holdings. The results of our panel estimation show that the sensitivity of the change in cash holdings with respect to the change in cash inflow becomes substantially larger since the late 2000s. Such a sensitivity is also found to be larger for firms holding smaller account receivables and/or inventory as well as for firms with smaller number of customer or transacting with customer showing worse creditworthiness. These results suggest firms' heterogeneous motivations to hold cash, i.e., firms' recent tendency to hold larger cash is found for the firms facing better business conditions and keeping better financial position (i.e., smaller demand for working capital), but driven also by precautionary saving motive.

JEL classification: E22, G31, G32

Keywords: Cash Holdings, Cash Inflow, Precautionary Motive

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* Hosono: Faculty of Economics, Gakushuin University, kaoru.hosono(at)gakushuin.ac.jp; Miyakawa (corresponding author): Hitotsubashi University Business School, dmiyakawa(at)hub.hit-u.ac.jp; Takizawa: Faculty of Economics, Gakushuin University, miho.takizawa(at)gakushuin.ac.jp. This research was conducted as a part of the Economic and Social Research Institute (ESRI) research project (Revitalizing the economy: Structural challenges faced by firms and households). We would like to thank Wako Watanabe, Tatsuo Senga, Johannes Wieland, Takashi Unayama, Arito Ono, Nobuo Kagomiya, Etsuro Shioji, and the participants of a seminar at ESRI for their helpful suggestions. Miyakawa gratefully acknowledges financial supports from the Grant-in-Aid for Scientific Research No. 16K03736 and 17H02526 from the grant-in-aid from Zengin Foundation for Studies on Economics and Finance as well as the generous data provision by Tokyo Shoko Research (TSR), Ltd. through the collaborative research works between Hitotsubashi University and TSR.

**細野　薫：学習院大学経済学部経済学科教授 kaoru.hosono(at)gakushuin.ac.jp、宮川　大介（責任著者）：一橋大学大学院経営管理研究科准教授 dmiyakawa(at)hub.hit-u.ac.jp、滝澤　美帆：学習院大学経済学部経済学科教授 miho.takizawa(at)gakushuin.ac.jp.

日本企業の現金保有行動：

大規模企業レベルパネルデータを用いた実証分析

滝澤 美帆・細野　薫・宮川 大介

＜要旨＞

本稿では、日本企業の現金保有行動について、1994 年から 2016 年の期間に亘る最大 40 万社からなる企業レベルの大規模パネルデータを用いて実証的に検討した。得られた結果は、以下の通りである。第一に、日本企業の現金保有比率（対総資産及び対売上高）は 2000 年代後半から平均的に上昇しているが、同時にそのばらつきも拡大している。第二に、こうした現金保有比率の平均的な上昇に際して、現金保有比率のキャッシュインフローに対する感応度が上昇している。また、こうした傾向は、運転資金需要が低く企業金融面で有利なポジションにあると考えられる企業でより顕著である一方、信用力の乏しい少数の販売先を顧客として抱えている企業においてもまた強く確認される。これらの結果は、近年における日本企業の現金保有比率の上昇傾向が、良好な企業業績と金融環境を背景としている一方、依然として予備的貯蓄動機に基づく現金保有行動も窺えるなど、個々の企業の異質な動機を反映したものであることを示唆している。

JEL classification: E22, G31, G32

Keywords: 現金保有、キャシュインフロー、予備的貯蓄動機

1. Introduction

Corporate savings have been reported to exhibit an increasing trend in many countries including the US, Japan, Germany and China. Karabarbounis and Neiman (2012) show that 30 out of the 44 countries with more than 10 years of data exhibited increasing trends in the share of saving in corporate sector. Such an increase in corporate savings is accompanied by an increase in corporate holdings of cash. Bates et al. (2009), among others, show that the average cash-to-assets ratio of the US corporations increased by 0.46% per year from 1980 to 2006. Given an increasing trend of corporate savings and cash holdings have significant impacts on the flow of funds, and thereby on corporate investment, tax revenues, and distribution of wealth, understanding what drives such dynamics of corporate savings has been one of the most important issues from the viewpoints of policymakers, practitioners, and academic researchers.

Against this background, it has still been an open question both from practical and academic perspectives why firms hold more cash than they used to do. The extant studies have been mainly hypothesizing that firms need to hold liquidity as they are facing financial friction, and attempting to test if this is the case. To proxy for the degree of financial friction, the extant literature has employed, for example, firms' leverage, cash-flow uncertainty, relationship to their lender banks, and so on. While these mechanism is intuitive, there are several details missed in the extant discussions. Among many, we think it is important to explicitly analyze how firm-to-firm trade and the relationship between firms and their transaction partners matter for cash holding. To illustrate, firms transacting with a larger number of transaction partners are supposed to be less worried about the default or the product disruption of one of those, thus do not necessarily hold large amount of cash. We think it is informative to empirically examine such a relationship between firms' cash holdings and transaction relationships.

Toward this end, first, we use Japanese firm-level big data accounting for at most 400 thousand firms per a year over twenty three years from 1994 to 2016, and document how the distribution of firms' cash holding has been evolving over those two decades. Our descriptive analyses suggest that since the late 2000s, firms on average increased its intensity of cash holding represented by the ratio of cash to firm size (e.g., total assets or sales). This trend has been also accompanied by increasing dispersion of cash holding among firms. We report that such a pattern is robust against the employment of various firm size measures (e.g., total assets or sales) and the restriction of our data to balanced panel data. This fact implies while the recent trend of higher cash holding is firmly confirmed on average, there is also a substantial degree of firm-level heterogeneity in terms of the level of cash holding and it has been magnified recently.

Given such empirical illustration, second, we document how firms have increased its cash holdings. To illustrate, firms can increase its cash holdings through larger cash inflow as well as better positions in trade finance (e.g., smaller size of shorter duration for account receivables), selling tangibles, borrowing more, etc. The results of our panel estimation, which takes into account the comprehensive list of those possible channels leading to the changes in cash holdings, show that, the sensitivity of the change in cash holdings with respect to the change in cash inflow becomes substantially larger since the late 2000s. Such a stronger positive correlation between the change in cash holdings and cash inflow is confirmed with controlling for other potential sources leading to the change in cash holdings. Such a tendency that better performed firms are more likely to accumulate cash, which results in wider dispersion of cash holding among firms becomes more apparent once we include new entrant firms to our analysis. Interestingly, based on the analyses using unbalanced panel data including newly entrant firms and exiting firms, in addition to the abovementioned larger cash inflow, larger long-term borrowing and smaller account receivables also contribute to higher cash holding while the change in tangibles become less important to the change in cash holdings. These findings suggest that, on the one hand, firms accumulate their cash by taking advantage of better business and financing conditions when they perform better. On the other hand, when firm perform worse, they conversely show the decline in cash holding. We should note that such polarization of firms in terms of cash holding (i.e., “second moment”) emerged at the same time as the average increasing trend (i.e., “first moment”) in cash holdings.

Given the abovementioned unconditional linkage between cash inflow and cash holdings over the recent periods, we further take into account firm-level heterogeneity in terms of firms’ balance sheet conditions. Somewhat surprisingly, our empirical results suggest that firms holding smaller account receivables and/or inventory (and larger account payables) in fact tend to show higher sensitivity of the change in cash holdings with respect to cash inflow over the recent periods. This result suggests that firms facing smaller demand for working capital are more likely to secure larger amounts of cash. Such a fact is surprising given the extant discussion considering financial friction as the determinants of cash holding. Namely, if firms are in a better financial position, i.e., smaller demand for working capital, they are not supposed to secure larger cash. The abovementioned results would, however, imply those firms in better financial position are the ones accumulating more cash. As we discuss later, we may need additional mechanisms such as uncertainty faced by firms to reconcile this puzzling result.

Regarding the positive association between financial friction and cash holding, we also confirm that firms with smaller number of transaction partners or transacting with partners showing worse creditworthiness typically show such a higher sensitivity of the change in cash holdings with respect to cash inflow. On the one hand, firms with relatively high cash inflow,

which are able to hold larger cash, tend to show lower cash holdings when the number of their transaction partners is large enough. On the one hand, even firms with relatively low cash inflow, which are predicted to hold smaller cash, exhibit higher cash holding when they are transacting with smaller number customers.

These results obtained from the conditional estimates suggest that firms' recent tendency to hold larger cash is driven by heterogeneous motivations. Firms facing better business conditions and better financial positions are more likely to accumulate cash. Nonetheless, firms facing precautionary saving motive have been also accumulating cash. We think it is one contribution of the present paper to show that these heterogeneous motivations for firms to hold cash have been working behind the dynamics of firms' cash holding, which is missed in the extant studies.

The rest of the present paper proceeds as follows. Section 2 briefly reviews the related extant literature. Section 3 explains the data we use for our analysis and show empirical findings. Section 4 concludes and discusses the future research issues.

2. Related studies

A number of extant studies have investigated the reasons for the increasing trend of corporate savings and cash holdings. While different researches put emphasis on different factors, most of the extant studies have been attributing such an increasing trend in firms' cash holding at least partly to financial constraints that firms face. As one prominent study, Bates et al. (2009) empirically examine the reasons for the increase in the cash-to-assets ratios of US corporations from 1980 to 2006, finding that cash ratios increased because firms' cash flows become riskier, firms held fewer inventories and receivables, and firms became increasingly R&D intensive. Their findings are consistent with the theoretical illustration based on firms' precautionary motive for cash holdings but not with the agency conflicts between managers and shareholders (see Jensen, 1986, among others). Harford et al. (2014) focus on a specific type of liquidity risk: refinancing risk. Using data from US firms from 1980 to 2008, they find that the maturity of firms' long-term debt has shortened markedly, which suggests a higher risk of refinancing and explains a large fraction of the increase in cash holdings over time.

The present paper is closely related to the literature on how financial constraints lead to cash holdings. As one prominent study, Almeida et al. (2004), using data from US manufacturing firms over the 1971 to 2000 period, find that financially constrained firms have a positive propensity to save cash out of cash flows (cash flow sensitivity of cash), while unconstrained firms do not. Denis and Sibilkov (2009) also examine why cash holdings are more valuable for

financially constrained firms than for unconstrained firms, and conclude that greater cash holdings are associated with higher levels of investment for financially constrained firms with high hedging needs. Their results suggest that greater cash holdings of constrained firms are a natural (value-increasing) response to costly external financing. One of the biggest challenges these researches face is how to classify firms into financially constrained and unconstrained firms. Almeida et al. (2004), for example, use several financial constraints criteria: the payout ratio (the ratio of dividends and stock repurchases to operating income), the asset size, bond ratings, commercial paper ratings, and the Kaplan-Zingales index (Kaplan and Zingales 1997). Although these measures are fairly plausible, they may still suffer from serious endogeneity and selection problems. For example, among the firms that are classified as a financially constrained due to the lack of bond ratings, there may be firms that do not need external finance due to the lack of investment opportunities as well as those that are really constrained. The present paper at least party aims at contributing the extant studies focusing on financial constraint by putting a special emphasis on the friction associated with firm-to-firm transaction relationships.

3. Data and empirical findings

3.1 Data

In this section, we will go over the data we use in the present study. All the data are provided by TSR (Tokyo Shoko Research Ltd.), which is one of the largest credit reporting agencies in Japan, through the joint research agreement between TSR and Hitotsubashi University. TSR is a private company operating in the areas of credit research, publishing, and database distribution. The central product TSR provides is the unsolicited-basis company report accounting for the performance of each targeted firm, which they sell to a variety of clients including banks, security firms, non-financial enterprises, and governmental organizations.

The main data source for this paper is an annual-frequency panel of Japanese firm data accounting for firms' financial statement information over 1994 to 2016 fiscal year. As each firm could have different accounting periods, we need to classify those different accounting periods into corresponding fiscal year. In the present paper, we treat the accounting periods ending between June of the year t and the May of the year $t+1$ as the ones corresponding to the fiscal year t. We exclusively focus on the firms accompanied by the financial statement information.[1]

[1] Another data file provided by TSR covers much larger number of firms than the one we are using in the present paper. Give such a larger data do not contain comprehensive financial statement information, we decide on using the current sample selection criterion.

In addition to the firm-level characteristics, the dataset also includes linked firm-firm pair-level data accounting for firms' supply chain network. The data comprise of a pair of firm A and B under a transaction relationship, which are identified as of the end of each accounting period. Each pair is accompanied by an identifier specifying the relationship between those two firms (e.g., firm B is a customer, supplier, or shareholder of firm A). We use the data to identify each firms' transaction relationships in the later section.

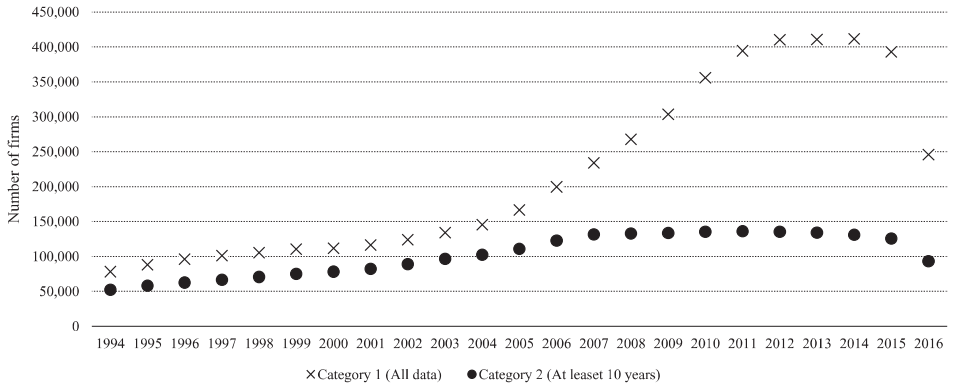
3.2 Evolution of cash holding distribution

As a first step of our analysis, we use the abovementioned TSR data to document how the distribution of firms' cash holding has been evolving over the last two decades. To measure firms' cash holdings, we employ the ratio of cash to total asset (cash-to-total asset ratio) and the ratio of cash to sales (cash-to-sales ratio). Given the TSR data is unbalanced panel data, we use the following three data configurations alternatively; all the data provided by TSR, the group of firms staying in the TSR data at least 10 years over the twenty three years from 1994 to 2016, and the group of firms always staying in the data over the same periods (i.e., 15,020 firms).

In order to see the evolution of sample size, Figure 1 shows the number of firms categorized in the first category (i.e., all data) as well as the second category (i.e., firms staying in the data at least for 10 years). First, we can see the number of firms in the first category largely increased over the 2000s. This is due to the expansion of TSR data coverage, which had been including a larger number of small and medium enterprises. Second, while we can see the same pattern for the second category, the dynamics of the number of firms is much more stable than the first category especially from the late 2000s. This illustration suggests us the necessity to analyze both the whole unbalanced data and the (largely) balanced data because the empirical results based on the whole unbalanced data are more largely reflecting the characteristics of possibly smaller entrants and exit firms possibly worse in terms of their quality. Given this discussion, we compare the empirical results obtained from the three datasets and how each result is robust against the choice of dataset.

The two panels in Figure 2 correspond to the violin plot of the cash-to-total asset ratio (Panel (a)) and the cash-to-sales ratio (Panel (b)) for the all sample firms in each year over five year intervals.

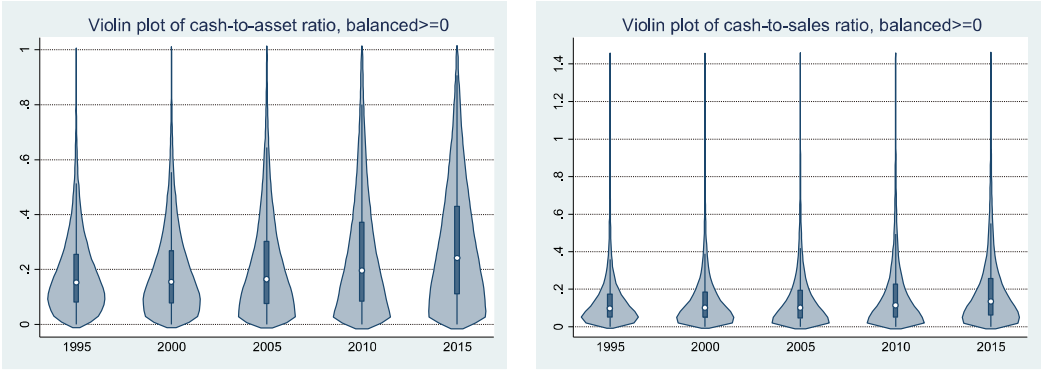
Figure 1 Evolution of firm numbers



Note: The x and circle account for the numbers of firms in each category and in each year. For the latter category, we identify the firms showing up at least 10 times in our annual-frequency data and count how many of those firms are recorded in each year.

Figure 2 Distribution of cash holdings

Panel (a) Panel (b)



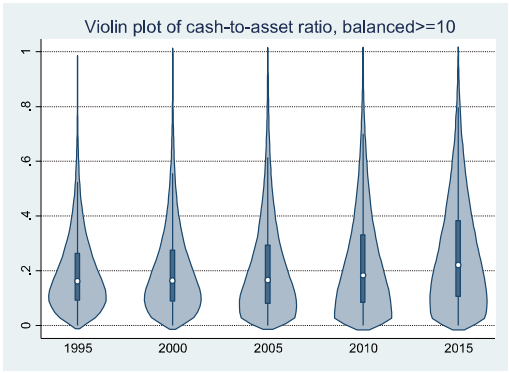
Note: The left and right panels depict the violin plots for firms' cash-to-asset ratio and cash-to-sales ratio, respectively. The plots are made for each year over the five-year intervals.

We can immediately notice that the median level of cash holdings denoted by the white circle in the plots increased over the years regardless of the measures for the cash holdings. Also, the dispersion of the cash holdings become larger over the years.

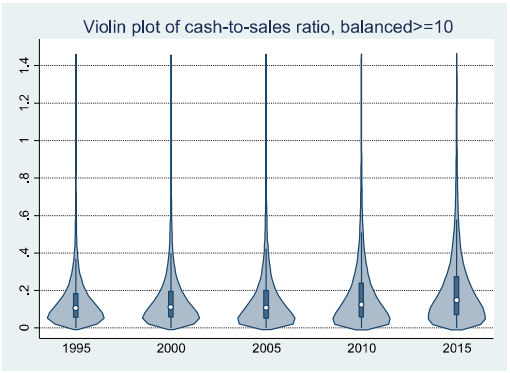
Given these two features we can observe in Figure 2 could be potentially driven by the inclusion of entrant firms to TSR data, we repeat the same illustration for the more balanced panel data. The upper panels (i.e., (a) and (b)) in Figure 3 use the data of the firms staying in the data at least 10 years while the lower panels (i.e., (c) and (d)) in Figure 3 use the completely balanced samples.

Figure 3 Distribution of cash holdings

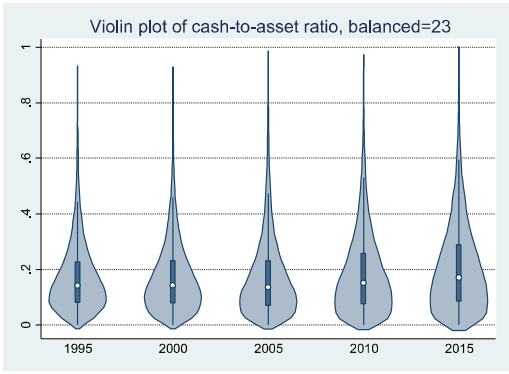
Panel (a)



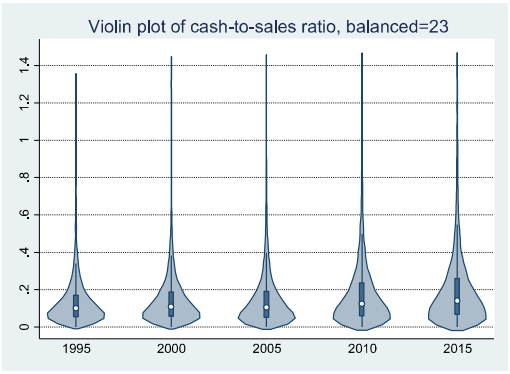
Panel (b)



Panel (c)



Panel (d)



Note: The two panels in upper and lower row depict the violin plots for firms' cash-to-asset ratio (left panel) and cash-to-sales ratio (right panel), respectively. The plots are made for each year over the five-year intervals.

The evolution of the distribution of cash holdings becomes less apparent in the four panels in Figure 3 than that in Figure 2. Nonetheless, we can still largely confirm, first, that the median level of the cash holdings represented by the white circle increased since the late 2000s. This is consistent with the increasing trend in firms' cash holding widely reported in the extant literature. As the second feature, we can also see that the distribution becomes wider. These descriptive analyses suggest that since the late 2000s, firms on average increased its intensity of cash holding represented by the ratio of cash to firm size while such a trend has been also accompanied by increasing dispersion of cash holding among firms. Regardless of whether we use different firm size measures or how we restrict our data to survived firms, we can confirm the same pattern.

To see the evolution of firms' cash holding more explicitly, we also run the following firm-level panel estimation as in the form of the equation (1), which has cash-to-total asset ra-

tio for firm i at year t ($CASHRATIO_{i,t}$) as the dependent variable, and regress it only on the firm-level fixed-effect η_i and year-specific effect η_t. After estimating the equation (1), we can take out the estimated year-fixed effect and also predict the average level of $CASHRATIO_{i,t}$, which are plotted in Figure 4, respectively.

$$CASHRATIO_{i,t} = \eta_i + \eta_t + \varepsilon_{i,t} \tag{1}$$

Figure 4 Year-effect and predicted cash-to-total asset ratio

Note: The left panel plots the estimated year fixed-effect in the equation (1) while the right panel plots the average of predicted $CASHRATIO_{i,t}$ in each year over the five-year intervals.

We can clearly see the upward trend of the year-effect from the late 2000s. In particular, there is a clear upward dynamics in the estimated year-effect after 2008 and continuing until the end of our sample periods. Furthermore, we can also find that such an upward trend became more apparent from the year of 2011 when Japan experienced a massive earthquake in the east side of Japan. Although it is not the central theme to dig into the discussion of macroeconomic factors potentially leading to recent increase in firm-level cash holding and we would rather control for those factors by including the year-fixed effect in our estimation, we should note that there is a large swing of the cash holding in the aggregate level.

Beside the existence of potential aggregate-level factors leading to large firm-level cash holding, these illustrations also naturally motivate us to study which firms increase cash holdings in what ways with taking into account firm-level various heterogeneity. Understanding the channels through which firms accumulate cash would be informative to examine the current status of firms' cash holdings.

3.3 How do firms accumulate cash?

Given the evolution of distribution accounting for firms' cash holding since the late 2000s,

we examine how the pattern of accumulating cash changed over time. To illustrate, firms can accumulate cash through various channels ranging from larger cash inflow, shortening the duration for account receivables, selling tangibles, borrowing more, and so on. To see the association between the change in cash-to-total asset ratio and those potential sources for changing the cash holding, we run the following firm-level panel estimation in the form of the equation (2).

$$\Delta CASHRATIO_{i,t} = \alpha CASHINFLOW_{i,t} + \sum_{k=1}^{K} \beta_k \Delta x_{i,t}^{k} + \eta_i + \eta_t + \varepsilon_{i,t} \quad (2)$$

In this equation (2), the dependent variable is $\Delta CASHRATIO_{i,t}$, which represents the change in cash-to-total asset ratio from the year *t-1* to *t* of firm *i*. We choose the change in (not the level of) $CASHRATIO_{i,t}$ as we are interested in how the firms' cash holdings have been evolving. As the right hand-side variables, first, we use $CASHINFLOW_{i,t}$, which accounts for the log of firm *i*'s post-tax net profit in the year *t*. The employment of this variable as a key independent variable is suggested by the empirical analysis in Almeida et al. (2004), which examines the responses of cash holdings with respect to cash inflow and the heterogeneity of the responses between financial constrained and unconstrained firms. In this unconditional estimation represented by the equation (2), we also control $\Delta x_{i,t}^{k}$ for other sources leading to the change in $CASHRATIO_{i,t}$. $\Delta x_{i,t}^{k}$ represents the log difference of account receivables ($\Delta REC_{i,t}$), log difference of account payables ($\Delta PAY_{i,t}$), log difference of inventory ($\Delta INV_{i,t}$), log difference of short-term borrowing ($\Delta SBO_{i,t}$), log difference of long-term borrowing ($\Delta BOR_{i,t}$), and log difference of tangibles ($\Delta TAN_{i,t}$) from the year *t-1* to *t* of firm *i*. Estimating α as a coefficient associated with $CASHINFLOW_{i,t}$ with controlling for such a comprehensive list of $\Delta x_{i,t}^{k}$ intends to identify the direct channel running from $CASHINFLOW_{i,t}$ to $\Delta CASHRATIO_{i,t}$, which is not confounded by other major sources leading to the change in $\Delta CASHRATIO_{i,t}$.

Under this formulation, positive $\alpha > 0$ simply means that the post-tax net profit (i.e., a proxy for cash inflow) does not entirely go away from the company but stay in it as cash. Obviously, cash inflow can be used for various reasons including reimbursement of debt, which neutralize the effect of $CASHINFLOW_{i,t}$ on $\Delta CASHRATIO_{i,t}$. The purpose of controlling for the change in long-term borrowing ($\Delta BOR_{i,t}$) is exactly for taking care of this complication. Namely, controlling for the effect of $\Delta BOR_{i,t}$ on $\Delta CASHRATIO_{i,t}$ and the estimate the impact of $CASHINFLOW_{i,t}$ makes it possible for us to pin down the association between $CASHINFLOW_{i,t}$ and $\Delta CASHRATIO_{i,t}$. In addition to these covariates, we also control for the firm fixed-effect η_i and year-fixed effect η_t.

While the equation (2) specifically aims at estimating the association between the "change" in cash holding and the corresponding cash inflow as well as other firm attributes, it is also

informative to see the linkage between the "level" of cash holding and those items as in the form of equation (3).

$$CASHRATIO_{i,t} = \alpha' CASHINFLOW_{i,t} + \sum_{k=1}^{K} \beta_k{}' \Delta x_{i,t}^{k} + \eta'_i + \eta'_t + \varepsilon'_{i,t} \quad (3)$$

Graham and Leary (2018), for example, employ such a formulation and empirically document the time-series and cross-firm variation in corporate cash holdings for US firms. We should note that such a formulation as in the equation (2), which focuses on the change in cash holding, is an extended version of the equation (3). Namely, the equation (2) accounts for the equation (3) with an additional term accounting for the lagged $CASHRATIO_{i,t-1}$ on the right hand-side with assuming that its coefficient is one. To be more explicit, the equation (2) can be rewritten as follows:

$$CASHRATIO_{i,t} = CASHRATIO_{i,t-1} + \alpha CASHINFLOW_{i,t} + \sum_{k=1}^{K} \beta_k \Delta x_{i,t}^{k} + \eta_i + \eta_t + \varepsilon_{i,t}$$

Nonetheless, given the estimates of α' and $\beta_k{}'$ could be more easily interpreted because those are directly connected to the level of cash holding and useful to see, for example, the dynamics of the estimated year-fixed effects, we will also estimate the equation (3) and report the results. In this equation, we have the level of the firm-level cash holding as the dependent variable so that we can follow the empirical approach as in, for example, Graham and Leary (2018).

Table 1 Summary statistics

Variable	Definition	No. Obs a. All data	Mean	Std. Dev.	Min	Max	No. Obs b. 10 years	Mean	Std. Dev.	Min	Max	No. Obs c. Balance	Mean	Std. Dev.	Min	Max
CASHRATIO	Cash-to-total asset ratio in the year *t*	4,777,215	0.245	0.203	0	1	2,694,809	0.265	0.222	0	1	349,494	0.179	0.137	0	1
ΔCASHRATIO	Change in cash-to-total asset ratio from the year t-1 to t of firm i	3,606,068	0.003	0.115	-4.206	3.417	1,732,409	0.003	0.135	-4.206	3.417	348,068	0.002	0.064	-0.855	0.975
CASHINFLOW	Log of firm i's post-tax net profit	3,611,910	8.349	2.267	0.000	21.733	1,931,147	7.749	2.001	0.000	20.286	302,142	10.588	2.297	0.000	21.733
ΔREC	Log difference of account receivables	3,320,817	-0.007	0.833	-13.789	13.656	1,510,563	-0.003	0.911	-12.573	13.134	344,418	-0.007	0.548	-10.959	10.170
ΔPAY	Log difference of account payables	3,098,606	-0.017	0.853	-13.316	11.210	1,341,717	-0.014	1.010	-11.212	11.166	340,321	-0.014	0.453	-10.077	9.063
ΔINV	Log difference of inventory	2,991,017	0.000	0.970	-13.146	12.288	1,279,256	0.002	1.049	-12.881	12.288	337,745	-0.003	0.654	-13.146	10.628
ΔSBO	Log difference of short-term borrowing	1,984,124	-0.013	0.812	-13.131	12.645	850,977	-0.002	0.858	-11.505	11.396	237,953	-0.025	0.651	-11.983	12.429
ΔBOR	Log difference of long-term borrowing	2,654,385	-0.017	0.561	-10.911	11.280	1,216,265	-0.006	0.576	-9.634	11.280	265,903	-0.040	0.541	-10.083	10.837
ΔTAN	Log difference of tangibles	3,524,438	0.001	0.551	-14.627	12.786	1,662,497	-0.001	0.667	-14.627	12.786	347,643	0.003	0.279	-9.879	7.047

Note: The table above summarizes the variables used for our estimation. The left, center, and right columns of the table accounts for the summary statistics based on all the TSR data, the largely balanced panel data consisting of the firms staying in the data least 10 years in total, and the balanced panel data constructed over our sample periods.

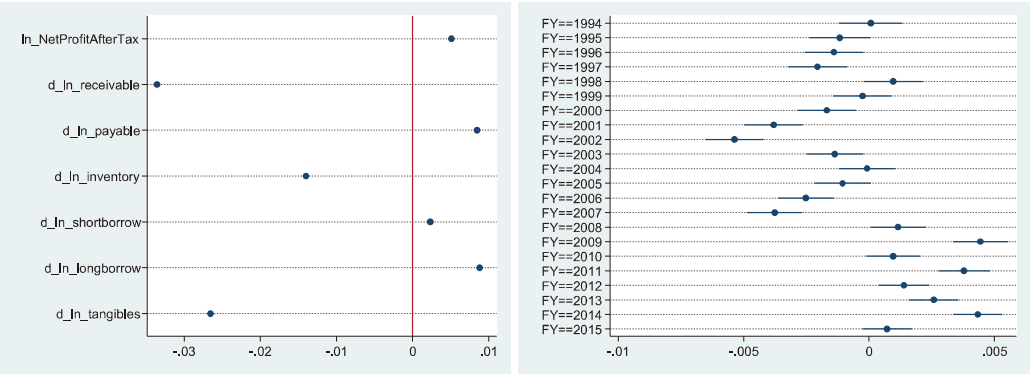
For these estimations, we use the following three data configuration: First, we use all the TSR data as the imbalance panel data. Second, we use the largely balanced panel data consisting of the firms staying in the data least 10 years in total. Third one is the balanced panel data constructed over our sample periods. Table 1 summarizes those three data sets and show the summary statistics of each variable we use in our estimation.

We estimate the equation (2) by using all the data accounting for the periods from 1994 to 2016. The left and right panels of Figure 5 show the estimate results for α and β_k (left panel) as well as that for η_t (right panel), respectively. Each dot corresponds to the point estimate, which is accompanied by 95% confidence interval.

Given we are estimating the relationships among major items of an accounting identity, first, it is natural to observe in Panel (a) in Figure 5 that cash-to-asset ratio has positive association with the cash inflow (i.e., the log of firm *i*'s post-tax net profit: *ln_NetProditAfterTax* in the following figures) as well as the log difference of account receivables, short-term borrowing, and long-term borrowing while cash-to-asset ratio has negative association with the log difference of account receivables, inventory, and tangibles. As firms have larger amounts in their asset (liability or net worth) side, firms' cash holding measured by the cash-to-total asset ratio tends to be smaller (larger).

Figure 5　Estimated coefficients: All periods

Panel (a)　　Panel (b)



Note: The left panel plots the estimate results for α and β_k (left panel) as well as that for η_t (right panel), which we obtain from the estimation using all the TSR data. Each dot corresponds to the point estimate, which is accompanied by 95% confidence interval.

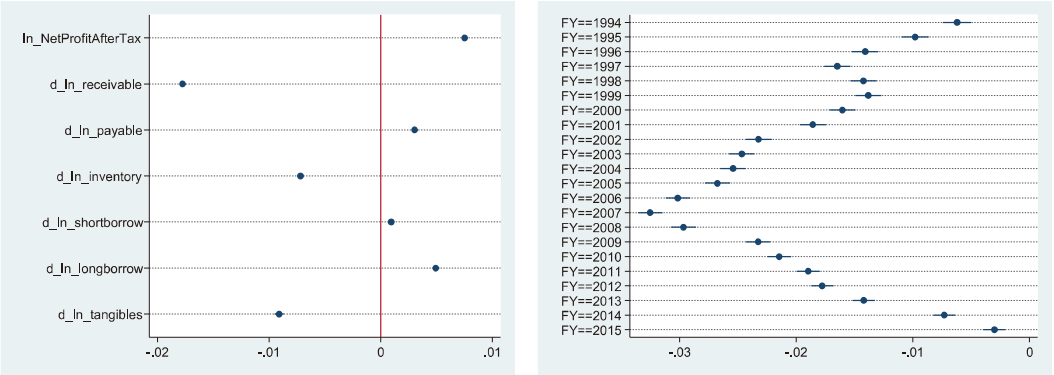
Second, somewhat consistent with our observations in Figure 4, the point estimates of the year-specific effects show the larger numbers from the late 2000s. As we are estimating the model augmented by a large number of firm characteristics and fixed-effects, the level of the point estimates itself is hard to interpret. Still, we can clearly see the relatively large

year-specific effect, for example, in the year of 2009 (i.e., the accounting periods ending on June of the year 2009 and the May of the year 2010) followed by the relatively higher levels of year-effect than for the periods up to the late 2000s. This observation again allows us to confirm the recent trend of firms' increasing cash holdings.

Figure 5′ repeats the same exercise for the equation (3). First, we can confirm the response of the level of cash holding to each independent variable is qualitatively same as we reported in Figure 5. One thing we can notice from Figure 5′ is that now the positive coefficient associated with the cash inflow (i.e., *ln_NetProditAfterTax*) is the largest among the other items associated with positive coefficients. Given the standard deviation of the cash inflow is larger than that for other independent variables (See Table 1), we can confirm that the cash inflow is the one most largely driving the level of firms' cash holding. Second, as we found in Figure 4, Panel (b) of Figure 5′ shows the clear dynamics of the year-effect.

Figure 5′ Estimated coefficients: All periods

Panel (a) Panel (b)

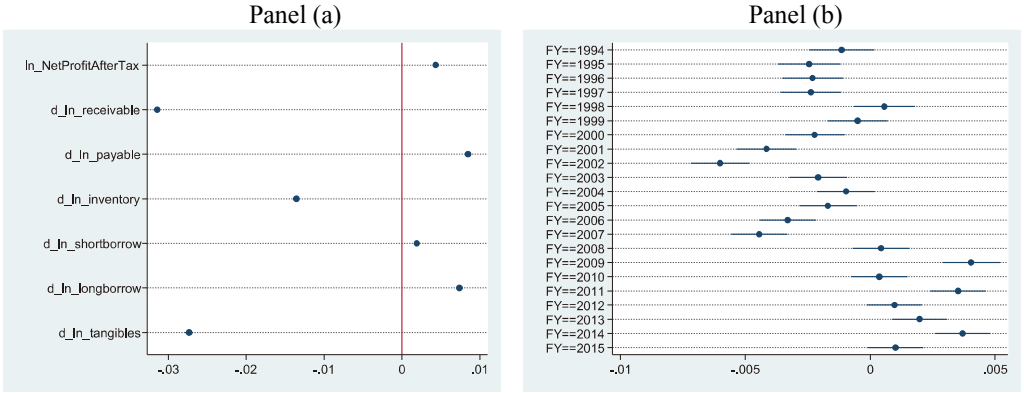


Note: The left panel plots the estimate results for α' and β'_k (left panel) as well as that for η'_t (right panel), which we obtain from the estimation using all the TSR data. Each dot corresponds to the point estimate, which is accompanied by 95% confidence interval.

How does the change in data configuration affect the abovementioned results? Figure 6 and Figure 7 repeat the same firm-level panel estimation for $\Delta CASHRATIO_{i,t}$ by using the largely balanced panel data consisting of firms staying in the TSR data at least for 10 years in total (Figure 6) and the balanced panel data constructed over the sample periods (Figure 7). We can immediately confirm that the association between $\Delta CASHRATIO_{i,t}$ and the right hand-side variables are in the same pattern as we observed in Figure 5. Thanks to the large number of observation stored in our datasets, the confidence band is narrow enough to be confident about the statistical significance of those estimated coefficients even in the case of balanced panel estimation. We can also confirm the same pattern for the year-effect as in Figure 5.

One more pattern we can confirm from these sets of estimated results is the cyclical patterns associated with the year-effect. To be more precise, regardless of the data configuration, we have the down-ward trend of the year-effect over the periods from 1998 to 2002 and the periods from 2004 to 2007. Although we cannot pin down the background mechanism generating this pattern from our simple panel estimation, it is informative to note such a downward trend is observed during the periods showing relatively strong economic activities. Distinct from this cyclical trend, the year-effect from the late 2000s shows stably high level, which suggests that firms' cash holding increased steadily over those years.

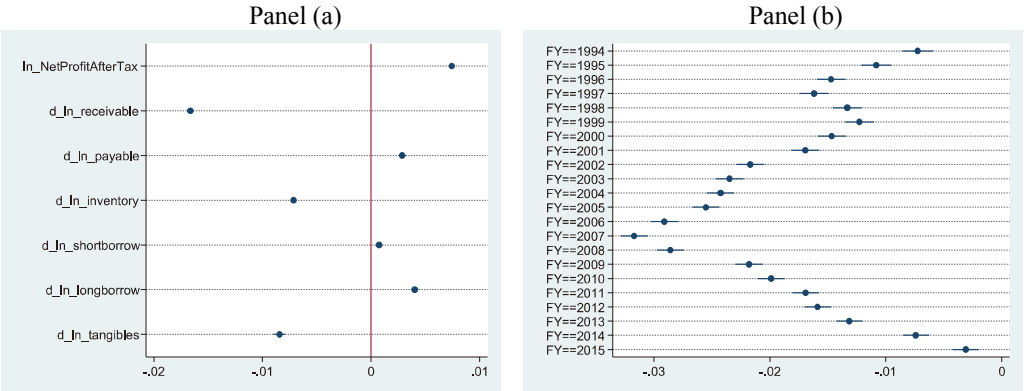
Figure 6　Estimated coefficients: All periods



Note: The left panel plots the estimate results for α and β_k (left panel) as well as that for η_t (right panel), which we obtain from the largely balanced panel data consisting of firms staying in the TSR data at least for 10 years in total. Each dot corresponds to the point estimate, which is accompanied by 95% confidence interval.

Figure 6′ repeats the same exercise for the equation (3), which confirms the implication we obtained in Figure 6.

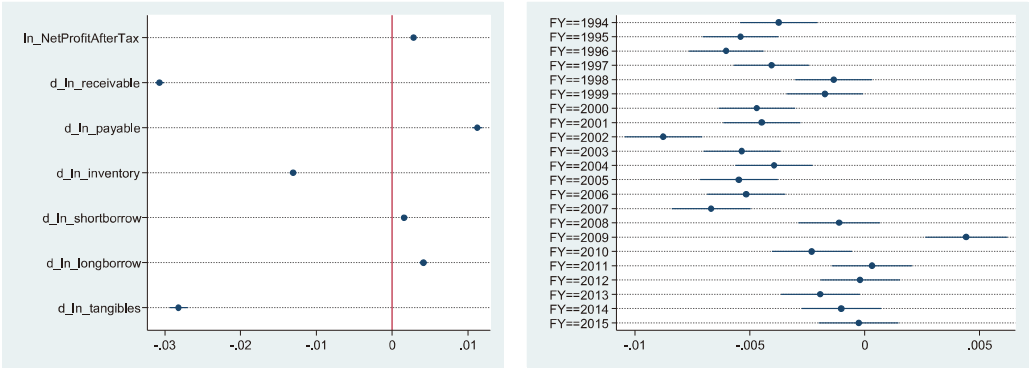
Figure 6′　Estimated coefficients: All periods



Note: The left panel plots the estimate results for α' and β'_k (left panel) as well as that for η'_t (right panel), which we obtain from the largely balanced panel data consisting of firms staying in the TSR data at least for 10 years in total. Each dot corresponds to the point estimate, which is accompanied by 95% confidence interval.

Figure 7　Estimated coefficients: All periods

Panel (a)　　Panel (b)

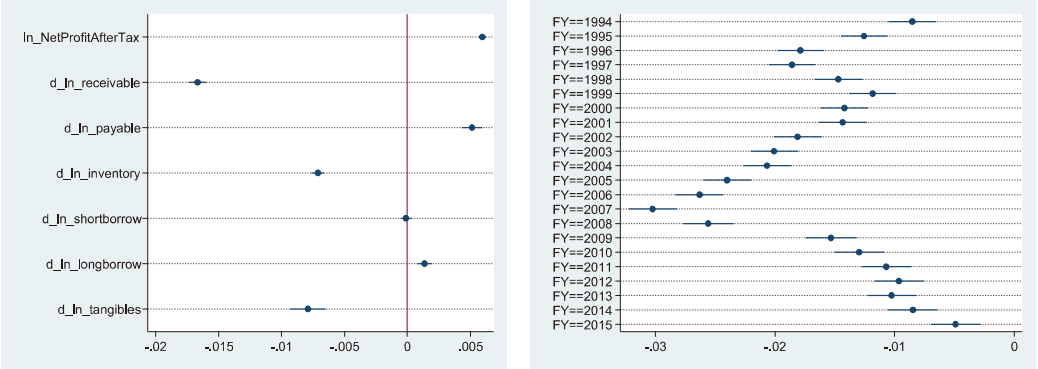


Note: The left panel plots the estimate results for α and β_k (left panel) as well as that for η_t (right panel), which we obtain from the balanced panel data constructed over the sample periods. Each dot corresponds to the point estimate, which is accompanied by 95% confidence interval.

Figure 7′ repeats the same exercise for the equation (3), which confirms the implication we obtained in Figure 7.

Figure 7′　Estimated coefficients: All periods

Panel (a)　　Panel (b)



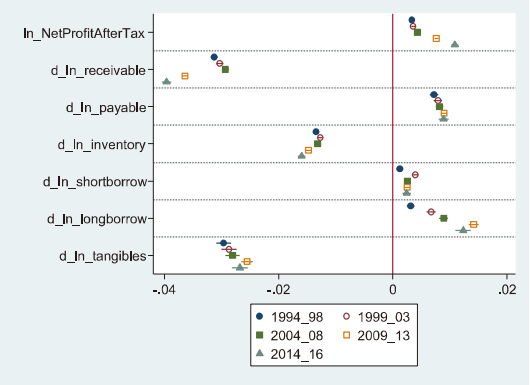
Note: The left panel plots the estimate results for α' and β'_k (left panel) as well as that for η'_t (right panel), which we obtain from the balanced panel data constructed over the sample periods. Each dot corresponds to the point estimate, which is accompanied by 95% confidence interval.

Given these natural results reported in the previous subsection, it is informative to see how these associations have been evolving over the sample periods. If we find greater association between the cash holdings and specific variables, we can infer that the main sources for accumulating cash have been changing over the last two decades. In order to explicitly see the evolution of the estimated coefficients over the periods from 1994 to 2016, we split the periods

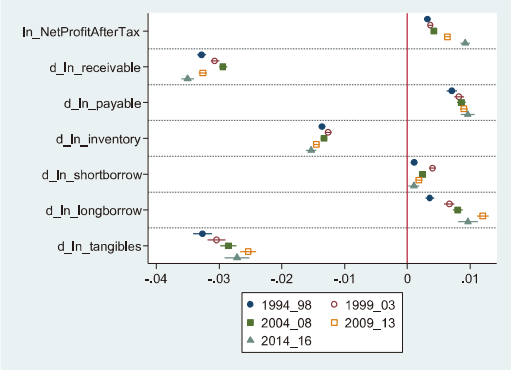
into five sub-periods (i.e., 1994-1998, 1999-2003, 2004-2008, 2009-2013, 2014-2016) and estimate the equation (2) separately for each period under the three data configuration presented above.

Figure 8 Estimated coefficients: Sub-periods

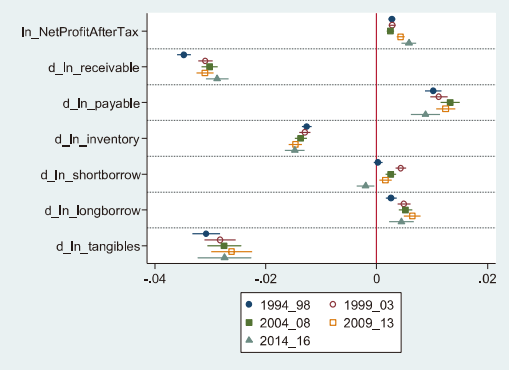
Panel (a): All data



Panel (b): 10-year balance data



Panel (b): Balanced panel



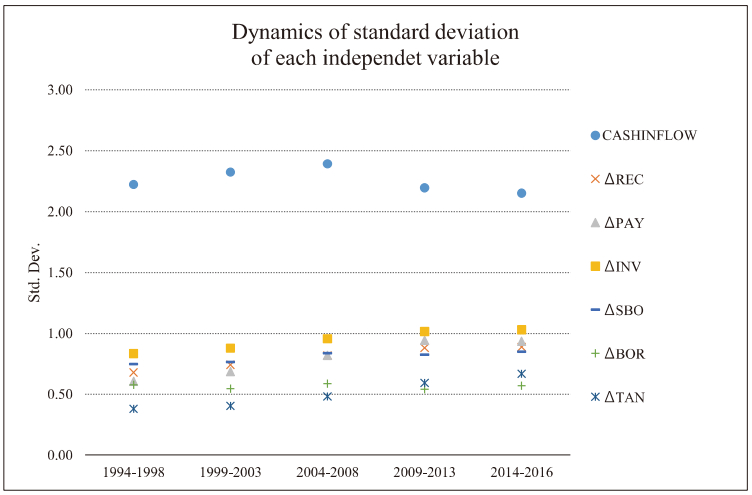
Note: The three panel plot the estimate results for α and β_k (left panel), each one of which account for the estimated coefficients we obtain from the all TSR data (panel (a)), the 10-year balanced data (panel (b)), and the balanced panel data constructed over the sample periods (panel (c)). For each variable we plot the coefficient associated with each sub-period. The first coefficient from the above corresponds the oldest period (i.e., 1994-1998), which is followed by that for more recent periods. Each marker corresponds to the point estimate, which is accompanied by 95% confidence interval.

Figure 8 summarize the estimation results. Same as in Figure 5 to 7, we restrict our sample to either the all TSR data shown in panel (a), the 10-year balanced data show in panel (b), and the balanced panel data constructed over the sample periods shown in panel (c). Each mark shows the point estimate of α and β_k over each sub-period with 95% confidence band. The results show that, the sensitivity of the change in cash holdings with respect to the change in

cash inflow (i.e., α) becomes substantially larger since the late 2000s.[2] This implies that better performed firms are more likely to accumulate cash, which leads to wider dispersion of cash holding among firms. This tendency becomes more apparent once we include new entrant firms to our analysis (i.e., panel (a) and (b)).

Interestingly, from the panel (a) and (b) where the data include newly entrant firms and exiting firms, larger long-term borrowing and smaller account receivables in addition to the abovementioned larger cash inflow also contribute to higher cash holding over the recent periods. We can also find that, in panel (a) and (b), the change in tangibles become less important to the change in cash holdings over the recent periods. Thus, we can presume that well-performed firms tend to accumulate their cash by taking advantage of better business (higher cash inflow) and financing conditions (larger long-term borrowing and smaller account receivables). This also means that firms with worse performance actually show the decline in cash holding. We should note that such a polarization of firms in terms of cash holding emerged at the same time as the average increasing trend in cash holdings.

Figure 9 Dispersion of independent variables: Sub-periods



Note: The panel plot the standard deviations of the each dependent variable, which is measured for each sub-period

So far, we have been focusing on the size of the point estimates of the coefficients and documenting the dynamics of those coefficients. We should note, however, that the actual economic impact associated with the variation of each independent variable onto the dispersion of the dependent variable might be different if the dispersion of the independent variables vary a lot over the sample periods. If this is the case, larger coefficients can not necessarily be inter-

[2] We also confirm the robustness of this result in the case that we use in the level of cash instead of $\Delta CASHRATIO_{i,t}$.

preted as in the way we explained above. Given this concern, Figure 9 depict the dynamics of the standard deviation of the independent variables we use for the equations (2) and (3). What we can observe from this figure is, first, the small change in the dispersion of the cash inflow. Second, we can also find the increase in the dispersion of the variables accounting for the trade credit variables. The point estimates we reported have already implied the possibility that well-performed firms tend to accumulate their cash more by taking advantage of higher cash inflow and financing conditions. These two facts observed in Figure 9 further suggest that those implication are robust in terms of economic impacts as the product of coefficient and the dispersion become larger for the cash inflow and trade credit varaibles. We will provide more detailed discussion for this issue in the latter section again.

3.4 Conditional effect of cash inflow

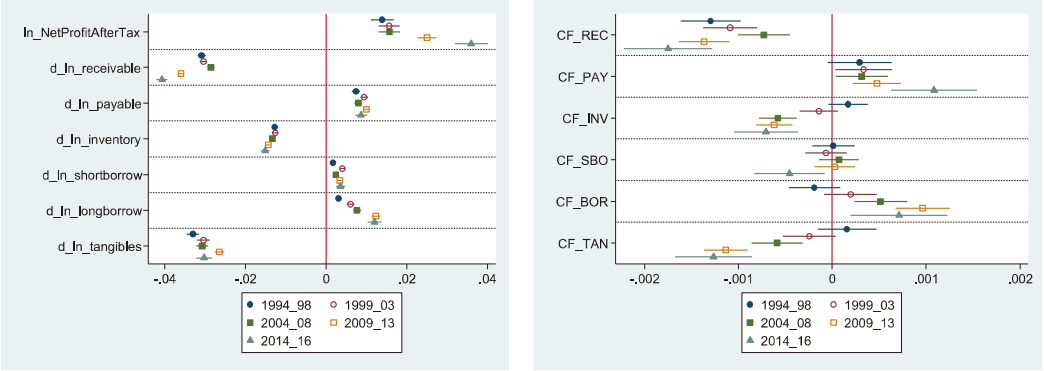
Given that the hike in the positive coefficient associated with $CASHINFLOW_{i,t}$ is one salient feature over the recent years, it would be further informative to see under what situation such a positive impact running from $CASHINFLOW_{i,t}$ to $\Delta CASHRATIO_{i,t}$ becomes more apprent. This discussion would allow us to more precisely understand the mechanism governing the polarization of cash holdings. For this purpose, we estimate the following equation (4) which augments the equation (2) with the level of each balance sheet variables $x_{i,t-1}^{k}$ as of *t-1* as well as its interaction term with $CASHINFLOW_{i,t}$. We are specifically interested in the coefficients γ_k, which are associated with the interaction terms between $x_{i,t-1}^{k}$ and $CASHINFLOW_{i,t}$. The set of these coefficients γ_k summarize the impact of $CASHINFLOW_{i,t}$ conditional on the level of $x_{i,t-1}^{k}$.

$$\Delta CASHRATIO_{i,t} = \alpha CASHINFLOW_{i,t} + \sum_{k=1}^{K} \beta_k \Delta x_{i,t}^{k} + \sum_{k=1}^{K} \gamma_k x_{i,t-1}^{k} \times CASHINFLOW_{i,t} + \sum_{k=1}^{K} \delta_k x_{i,t-1}^{k} + \eta_i + \eta_t + \varepsilon_{i,t} \quad (4)$$

Figure 10 plots the point estimates of α and β_k in the left panel and set of γ_k in the right panel. First, we can observe that the $CASHINFLOW_{i,t}$ shows substantially higher association with $\Delta CASHRATIO_{i,t}$ over the recent periods (i.e., 2009-2013 and 2014-2016). Second, we can see such a positive impact of $CASHINFLOW_{i,t}$ is conditional on the level of other balance sheet items (i.e., $x_{i,t-1}^{k}$). Namely, smaller account receivables, larger account payables, smaller inventory, larger long-term borrowing, and smaller tangible assets as of *t-1* lead to substantially larger marginal effect running from $CASHINFLOW_{i,t}$ to $\Delta CASHRATIO_{i,t}$. To illustrate, the results associated with the account receivables, inventory, and account payables imply that firms with smaller working capital demand can more easily convert their cash inflow to their cash holdings. Given the discussions in the extant studies, which consider the fi-

nancial friction as the main determinant of cash holding, this result is in fact surprising. According to a theoretical discussion, firms with smaller need for finance (i.e.,, smaller working capital in the current context) does not need to secure larger cash, which is not the case here.

Figure 10 Estimated coefficients: Sub-periods and interaction term (all data)



Note: The three panel plot the estimate results for α and β_k (left panel) as well as γ_k (right panel), each one of which account for the estimated coefficients we obtain from the all TSR data. For each variable we plot the coefficient associated with each sub-period. The first coefficient from the above corresponds the oldest period (i.e., 1994-1998), which is followed by that for more recent periods. Each dot corresponds to the point estimate, which is accompanied by 95% confidence interval.

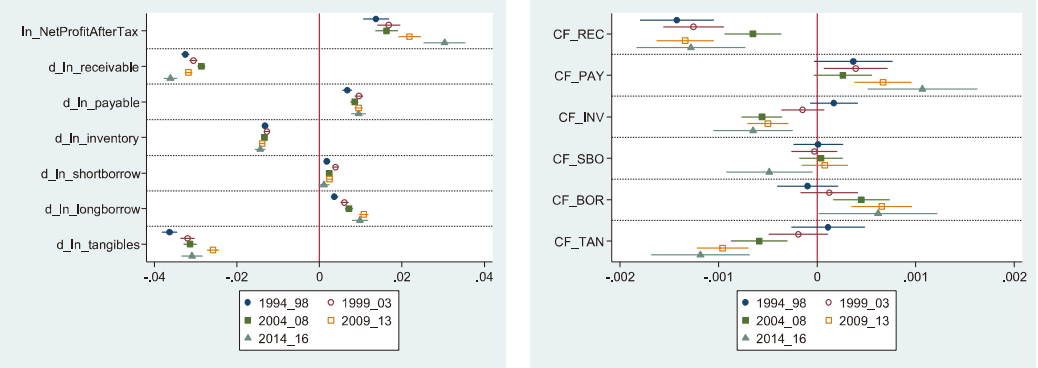
We should also note that such a pattern becomes more apparent over the recent periods. This result reassures the findings we have already reported, i.e., firms with better financial position actually accumulate their cash holdings. Related to this point, another interesting pattern could be found for the coefficient associated with the interaction term between cash inflow in year *t* and the long-term borrowing as of year *t-1*. Larger positive coefficient of this interaction term means that firms with larger long-term borrowing tend to convert more cash inflow to cash holdings. Such a larger sensitivity of cash holdings with respect to cash inflow in the case of more levered firms could be the case, for example, when firms are facing larger uncertainty and, thus would largely like to accumulate cash if they can. Our result also suggests that firms are more likely to accumulate cash when facing more relaxed borrowing condition.

The coefficient associated with the interaction term between cash inflow in year *t* and the tangible assets as of year *t-1* shows negative sign. This implies that firms with more tangible assets and thus need to implement a certain level of capital investment could not largely convert its cash inflow to cash holdings.

Figure 11 and 12 check the robustness of the results we observed in Figure 10 by using the two other data configurations. Presumably due to the reduction of sample size, the confidence band becomes larger but the estimated with the coefficient associated with the interaction term between cash inflow in year *t* and the account payable and inventory as of year *t-1* shows the

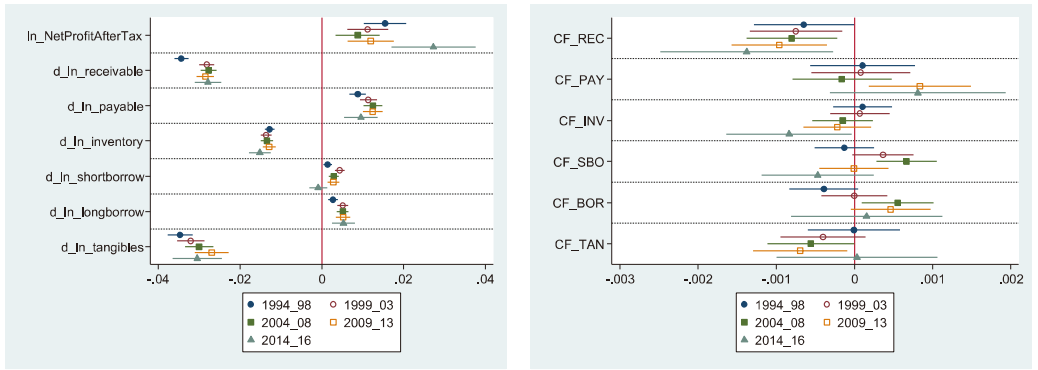
same implication as we reported.

Figure 11 Estimated coefficients: Sub-periods and interaction term (10-year balanced)



Note: The three panel plot the estimate results for α and β_k (left panel) as well as γ_k (right panel), each one of which account for the estimated coefficients we obtain from the 10-year balanced data. For each variable we plot the coefficient associated with each sub-period. The first coefficient from the above corresponds the oldest period (i.e., 1994-1998), which is followed by that for more recent periods. Each dot corresponds to the point estimate, which is accompanied by 95% confidence interval.

Figure 12 Estimated coefficients: Sub-periods and interaction term (balanced)



Note: The three panel plot the estimate results for α and β_k (left panel) as well as γ_k (right panel), each one of which account for the estimated coefficients we obtain from the balanced panel data. For each variable we plot the coefficient associated with each sub-period. The first coefficient from the above corresponds the oldest period (i.e., 1994-1998), which is followed by that for more recent periods. Each dot corresponds to the point estimate, which is accompanied by 95% confidence interval.

As we have already pointed out, in order to precisely interpret the economic impacts associated with the estimated coefficients, we need to take into account the dynamics of standard deviation associated with each independent variable. For this purpose, we did the following exercise. First, we computed the standard deviation of all the variables in the right hand-side of the equation (4). Second, we computed the predicted change in the dependent variable (i.e.,

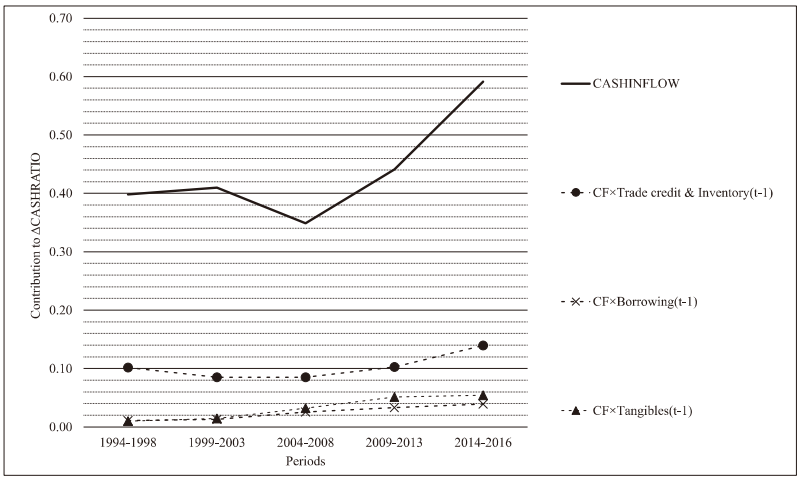
$\Delta CASHRATIO$) by multiplying such standard deviation to the estimated coefficient including the cross-terms so that we can see the change in $\Delta CASHRATIO$ generated by one standard deviation change in each right hand-side variable. Third, we compute the contribution associated with the one standard deviation change in each independent variable as a share to one standard deviation of $\Delta CASHRATIO$. This share accounts for how much of the change in $\Delta CASHRATIO$ could be accounted for by the change in each independent variable. As we have already confirmed, each independent variable has either positive or negative coefficient, which shows the increase in a specific independent variable leads to either larger or smaller $\Delta CASHRATIO$. For the purpose of presentation, we measure the absolute value of the products between the standard deviation and the estimated coefficient, then sum up the contributions of trade credit-related variables and inventory (i.e., "Trade credit & Inventory"). Also, the short-term and long-term borrowing are summarized in one category (i.e., "Borrowing"). Those numbers are summarized in Figure 13 where the solid line accounts for the dynamics of the product between the estimated coefficient associated with and the standard deviation of $CASHINFLOW$. The other three dashed lines accounts for that of the three interaction terms (i.e., $CASHINFLOW$ with "Trade credit & Inventory" variable, "Borrowing" variables, and tangibles) over each sub-period.

Figure 13 suggests, first, that the contribution associated with $CASHINFLOW_{i,t}$ has been becoming the largest in the most recent period (i.e., 2014-2016). Also, the contribution shows a clear upward trend from the period of 2009-2013. In terms of the economic impact, the solid line suggests that the one standard deviation increase in $CASHINFLOW$ accounts for around 60% of the one standard deviation change in $\Delta CASHRATIO$ in the period 2014-2016.

Second, we can further confirm that the contribution originated from the interaction term between $CASHINFLOW$ and "Trade credit & Inventory" variables show the similar pattern and sizable impact. To interpret the results precisely, we should note that both the interaction terms between $CASHINFLOW$ with account receivables and inventory have negative coefficients while the interaction term between $CASHINFLOW$ with account payable has a positive coefficient. Thus, the sum of the absolute values of the products between the standard deviations and the estimated coefficients, which is denoted by "Trade credit & Inventory" (dashed line with black circle), accounts for how much percentage of one standard deviation of $\Delta CASHRATIO$ could be explained by the one standard deviation decrease in account receivables and inventory as well as the one standard deviation increase in account payable each category when those change are accompanied by the one standard deviation change in $CASHINFLOW$. The results in Figure 13 denoted by "Trade credit & Inventory" suggests that, if those "Trade credit & Inventory" change by one standard deviation in the favor direction of larger $\Delta CASHRATIO$, the one standard deviation increase in $CASHINFLOW$ accounts for

around 15% of the one standard deviation change in $\Delta CASHRATIO$. By construction, this 15% is added up to the abovementioned unconditional contribution of $CASHINFLOW$ (i.e., 60% of the one standard deviation change in $\Delta CASHRATIO$). These exercise tells us that the interpretation of the estimated coefficients are confirmed in terms of the economic impacts.

Figure13 Decomposition of the dispersion of cash holding (all data)



Note: The panel depict the dynamics of the multiplication between the estimated coefficient associated with a specific (or a group of) independent variable(s) and the standard deviation of the variable(s). The solid line accounts for the dynamics of the multiplication between the estimated coefficient associated with $CASHINFLOW$ and the standard deviation of $CASHINFLOW$. The other three dashed lines accounts for that of the three interaction terms (i.e., $CASHINFLOW$ with "Trade credit & Inventory" variable, "Borrowing" variables, and tangibles) over each sub-period.

3.5 Heterogeneity in transaction relations

Figure 2 and 3 presented in the previous section suggest that while firms' cash holding on average show the increasing trend over the recent periods, there is still a substantial degree of firm-level heterogeneity represented by firms' balance sheet conditions. In particular, it is an important finding that the status of trade finance (i.e., the level of account receivables and account payables) affect the marginal impact of cash inflow onto cash holdings more in the recent periods. Regardless of whether we focus on the statistical significance or economic impacts, we confirm that larger $CASHINFLOW$ leads to higher $\Delta CASHRATIO$ and this tendency becomes more apparent when firms are facing smaller demand for working capital (i.e., smaller account receivables and inventory as well as larger account payables).

These results are not consistent with firms' precautionary saving motive as firms in better position in trade credit tend to accumulate more cash. Following this context, in this section, we would revisit firms' precautionary motives with respect to real transaction with customers and suppliers. We presume that, if well-performed firms are transacting with a larger number

of customers, there is smaller need for the firms to secure cash for the purpose of payment as the default risk associated each customer is well diversified. In a similar sense, if well-performed firms are transacting with a larger number of suppliers, there is smaller need for the firms to secure cash for the purpose of payment as the risk of product disruption associated each supplier is well diversified. Thus, such firms can pay out larger amount of cash inflow for various purposes (e.g., investment, dividend, repayment of debt etc.) and result in moderate cash holdings. On the other hand, even if firms with high profit, they might not pay out the cash if worried about their trade relations.

To test this intuition more explicitly, we run the following cross-sectional regression of the equation (5) where $CASHRATIO_i$ accounts for the cash-to-total asset ratio of firm *i* as of 2014 while the cash inflow we featured in the previous study is proxied for by $\mathbf{1}(HIGH\ PROFIT\_SALES)_i$, the dummy variable taking value of one if pre-tax net profit-to-sales ratio is greater than sample median. To measure the heterogeneity of trade relations, we measure the number of customers and suppliers (NUM_C_i and NUM_S_i). In this regression, we expect $\gamma_1 > 0$ as we confirmed in the previous section while $\gamma_3 < 0$ and $\gamma_5 < 0$ based on the abovementioned presumption.

In order to control for various firm attributes potentially confounding the γ_1, γ_3, and γ_5, we control for the following variables z_i^k consisting of the natural logarithm of sales in year *t-1*, the sales grows from year *t-2* to *t-1*, the dummy variable taking value of one if firm exhibits loss in year *t-1*, the difference of such loss dummy from *t-2* to *t-1*, the natural logarithm of the number of employees in year *t-1*, firm age, the dummy variable taking value of one if firm owns a single establishment, the dummy variable taking value of one if firm is listed, the natural logarithm of total assets in year *t-1*, tangible assets total assets ratio in year *t-1*, liability to total assets ratio in year *t-1*, bank borrowing to total assets ratio in year *t-1*, fixed assets to equity ratio in year *t-1*, the natural logarithm of EBITDA in year *t-1*, the dummy variable taking value of one if firm experienced default prior to year *t*, the number of lender banks, and the dummy variable taking value of one if firm changed its main bank from year *t-1* to *t*, and the industry dummy variables accounting for two-digit industry classification.

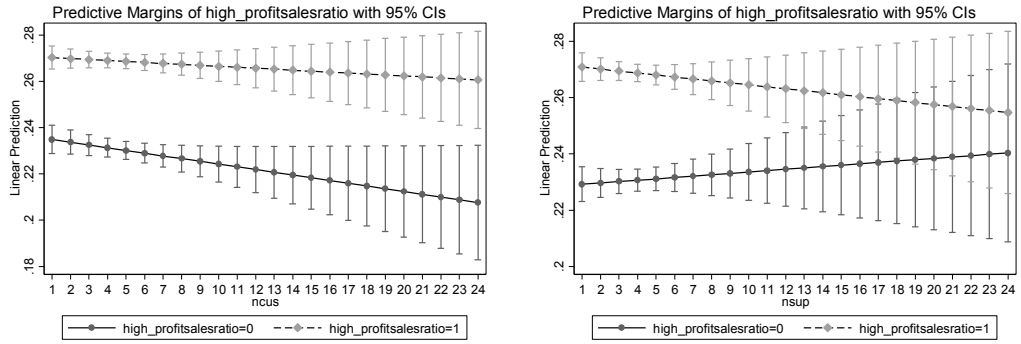
$$CASHRATIO_i = \gamma_0 + \gamma_1 \mathbf{1}(HIGH\ PROFIT\_SALES)_i + \gamma_2 NUM\_C_i + \gamma_3 \mathbf{1}(HIGH\ PROFIT\_SALES)_i \times NUM\_C_i + \gamma_4 NUM\_S_i + \gamma_5 \mathbf{1}(HIGH\ PROFIT\_SALES)_i \times NUM\_S_i + \sum_{k=1}^{K} \theta_k z_i^k + \varepsilon_i \quad (5)$$

Figure 14 shows the estimated conditional slope with respect to the high profit-to-sales ratio dummy conditional on NUM_C_i and NUM_S_i.[3] As we predicted, firms with higher cash

[3] Given the non-linearity of the model, the estimated conditional slope shows some curves.

inflow (i.e., dashed line) tend to hold more cash than firms with lower cash inflow (i.e. solid line). Nonetheless, even firms with high cash inflow show lower cash holdings when the number of transaction partners (i.e., customers and suppliers) is smaller. Conversely, even firms with relatively low cash inflow, which are expected to hold smaller cash, exhibit higher cash holding when they are transacting with the smaller number of customers.

Figure 14 Conditional impact over the number of customers and suppliers



Note: The figure plots the estimated conditional slopes with respect to the high cash inflow dummy on the number of customers (left panel) and the number suppliers (right panel) with its 95% confidence band.

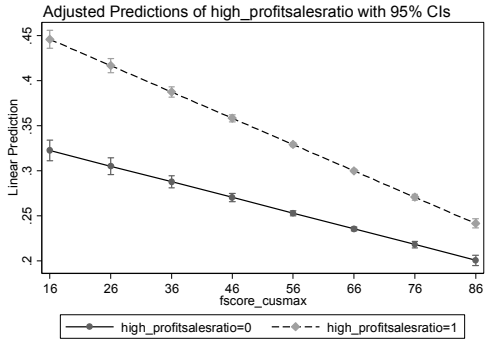
Figure 15 repeats the same exercise by replacing NUM_C_i an NUM_S_i with the variable representing the creditworthiness of customers $CUSTOMER\_QUALITY_i$ (*fscore_cusmax*), which is summarized in the equation (6).

$$CASHRATIO_i = \gamma_0 + \gamma_1 \mathbf{1}(HIGH\ PROFIT\_SALES)_i + \gamma_2 CUSTOMER\_QUALITY_i + \gamma_3 \mathbf{1}(HIGH\ PROFIT\_SALES)_i \times CUSTOMER\_QUALITY_i + \sum_{k=1}^{K} \theta_k z_i^k + \varepsilon_i \quad (6)$$

To measure the customers' quality, we use the maximum creditworthiness score among firm *i*'s direct (i.e., first-tier) customers. The credit worthiness score is provided by TSR, Ltd. and takes values between 0 and 100 where the larger number corresponds to better quality (see, Miyakawa et al. 2019 for more detail).[4] In this regression, we expect $\gamma_1 > 0$ as we confirmed in the previous section while $\gamma_3 < 0$ based on the abovementioned presumption.

[4] The number is computed as the sum of the four sub-scores accounting for (i) the ability of owner (max: 20 points) based on the business attitude, experience, their asset condition, and so on, (ii) the growth possibility (max: 25 points) based on past sales growth, the growth of profit, the characteristics of products, and so on, (iii) stability (max: 45 points) based on firm age, stated-capital, financial statement information, room of collateral provision, real and financial transaction relationships, and so on, and (iv) reputation (max 10 points) based on the level of disclosure and overall reputation.

Figure 15 Conditional impact over the creditworthiness of customers



Note: The figure plots the estimated conditional slopes with respect to the high cash inflow dummy on the maximum credit worthiness score (i.e., *fscore*) with its 95% confidence band.

Figure 15 shows the estimated slope with respect to the high profit-to-sales ratio dummy conditional on $CUSTOMER\_QUALITY_i$ (*fscore_cusmax*). As we predicted, firms with higher cash inflow (i.e., dashed line) tend to hold more cash than firms with lower cash inflow (i.e. solid line). Nonetheless, even firms with high cash inflow show lower cash holdings when the quality of their customers is higher (i.e., higher *fscore_cusmax*). Conversely, even firms with relatively low cash inflow, which are expected to hold smaller cash, exhibit higher cash holding when they are transacting with lower quality customers.

3.6 Policy implication

Throughout this section, we have documented the firm-level heterogeneity in terms of their balance sheet as well as attributes of firms' transaction partners. These descriptive analyses provide us at least three policy implications.

First, the substantial role of firm-level heterogeneity especially in regard of cash inflow and the status of firm-to-firm transaction (i.e., trade credit and trader partners' quality) suggest the importance of micro-level empirical analysis in the policy discussion. While a simple illustration provided in, for example, Figure 2 could suggest the fact that the increase in the first moment of the cash holding is also accompanied by the increase in the cross-sectional dispersion of cash holding, we have not seen specific policy discussions paying an attention to this point. It is fair to alert that policy discussion not based on valid empirical analysis could mislead the policy design. In this context, it is also meaningful to highlight the abovementioned fact from an opposite angle. Namely, higher sensitivity of cash holding with respect to cash inflow suggests firms with lower cash inflow cannot secure their cash holding. This is one of the empirical facts policy makers may take into account. We should remember that this fact is

obtained under the model with year-fixed effects, which presumably account for various aggregate-level shock. Even if we can successfully take care of negative aggregate shock such as financial crisis through some policy measures, our findings still suggest a room of taking care of the firms with smaller buffer for their cash position.

Second, among those important firm-level heterogeneities, the fact that firms with larger cash inflow are accumulating larger size of cash over the recent period, which is more apparent when firms do not need larger working capital, is suggestive. Standard theory of precautionary saving suggest that firms hold cash with some sort of anxiety for future finance, which motivates them to save more. From the fact that even seemingly well-performing firms in a better financial position are accumulating cash, we might better to presume that micro-level uncertainty as well as the aggregate-level factors we highlighted in, for example, Figure 4, play substantial role in the context of firm's saving behavior. Although it is beyond the scope of this paper, digging into those firm-level uncertainty (e.g., Senga 2018) would one promising direction future research should pursue.

Third, apart from the discussion on firm-level uncertainty, our findings still suggest that precautionary saving motive matters, which is confirmed through the analyses highlighting the role of transaction network in terms of firms' cash holding. Given a large accumulation of firm-to-firm transaction network data such as the one provided by Tokyo Shoko Research (TSR), Ltd. (see, for example Miyakawa 2019), it would be a promising direction to see the relationship between the network structure and firms' cash holding behavior. If firms are facing more secure transaction network, which could be achieved by, for example, payment system governed by highly sophisticated system such as blockchain, firms might not need to hold a large amount of cash in their hand. The recent discussion on ICT and other technological issues are in this sense well connected to the main theme of the present paper.

4. Conclusion

In the present paper, to investigate the status of firms' cash holdings, first, we document how the distribution of firms' cash holding has been evolving over the last two decades. Our descriptive analyses suggest that since the late 2000s, firms on average have increased its size-adjusted cash holding. This trend has been also accompanied by increasing dispersion of cash holding among firms, which suggests the presence of firm-level heterogeneity behind the recent trend of larger cash holdings. Second, we document how firms have increased their cash holdings. The results of our panel estimation show that the sensitivity of the change in cash holdings with respect to the change in cash inflow becomes substantially larger since the late

2000s. This implies that better-performed firms have become more likely to accumulate cash. Given the results from this unconditional estimation, we further take into account firm-level heterogeneity in terms of their balance sheet conditions and found that firms holding smaller account receivables and/or inventory tend to show further higher sensitivity. This implies that firms with smaller working capital needs can save more cash, which is somewhat surprising given the extant studies considering financial friction as the key determinants of cash holding. We also confirm that firms with smaller number of customer typically show such a higher sensitivity.

These results we present in the present paper jointly suggest that firms' recent tendency to hold larger cash is driven by a combination of larger cash inflow and firms' various motivations. On the one hand, well-performing firms with better business conditions and financial positions are more likely to accumulate cash. On the other hand, firms having precautionary saving motive have been also accumulating cash. These heterogeneous motivations for firms to hold cash need to be simultaneously considered to understand firms' cash holding behavior more precisely.

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