

Financial constraint measurements, cash flow sensitivity and financial flexibility management*

Weihan CUI

Abstract

Firms can miss out on investment opportunities owing to cash shortfalls. This is solved by accumulating cash holdings among other strategies. Examining the validity of financial constraint measurements involved in this financial flexibility management is a valid topic of research, especially in the Japanese context. This study investigates the applicability of the various measurements, some of which are included in classic empirical models together with the cross-term of cash flow. Our regression results show that payout payment dummy has explanatory power over changes in cash holdings, while the KZ index is more applicable for cash holding determinants and the cash flow sensitivity of investments analysis. Financially constrained firms appear to save more from cash flow and have greater reliance on internal cash flow for investment than their unconstrained counterparts. This study also provides evidence of Japanese firms' precautionary motive for accumulating cash holdings.

Keywords: Financial constraints, cash holdings, cash flow, investment, growth opportunity

1. Introduction

Financial flexibility refers to a firm's ability to respond to unexpected investment opportunities due to cash shortfalls in a timely and value-maximizing manner (Denis, 2011), which has been debated for its role in financial decision-making and determining firms' capital structure (Graham and Harvey, 2001). A firm can prepare financial flexibility by accumulating cash holdings (Almeida et al. 2011), unused debt capacity (Denis and McKeon, 2011), and improving its ability to raise funds in the equity market (DeAngelo and DeAngelo, 2007). The value of financial flexibility differs with the external financing cost facing by a firm, Bliss et al. (2015) conducted an analysis of firms' payout policy during the 2008–2009 financial crisis and find that, firms that are fragile to negative credit supply shocks are more likely to decrease dividends and share repurchases to preserve cash holdings. Financial constraint measurements were used to quantify the cost of the external financing environment. Various financial constraint measurements have been applied in the literature on financial flexibility (see Cui. 2020 for an example), while each is reasonable and applicable under certain circumstances, the validity of financial constraint measurements is still worth exploring,

especially for Japanese firms, which are known to hold enormous cash holdings while simultaneously bearing outstanding debt (Cui, 2020).

This study investigates the applicability of a series of financial constraint measures under different research theme. We choose three classic empirical models related to financial flexibility analysis, which are cash flow sensitivity of cash model (Almeida et al. 2004), cash holding determinants model (Opler et al. 1999) and cash flow sensitivity of investment model (Hadlock and Pierce, 2010), all the three models include cash flow and the market-to-book ratio as independent variables. Financially constrained firms have different propensity for accumulating financial flexibility, for example, Almeida et al. (2004) provide evidence that financially constrained firms save more aggressively from cash flow than unconstrained firms. Follow this argument, if a financial constraint measurement is applicable for identifying financially constrained firms in financial flexibility analysis, it should be able to affect financial flexibility such as cash holdings through cash flow. By including interaction terms of financial constraint measurements and cash flow, we are able to observe how each financial constraint term impacts financial flexibility through cash flow. In this paper, all three models provide empirical evidence of the effect of five financial constraint measurements on cash flow sensitivity of cash holdings, cash holdings and cash flow sensitivity of investment.

Notice that an applicable financial constraint measurement not only need to provide significant results in empirical regression, but also should not change the original sign of cash flow parameter, in other words, including interaction terms should not bring severe multicollinearity problem and compromise the integrity of existing empirical models, resulting in displaying different result of relationship between cash flow and dependent variables from existing literature. To be more specific, there are two benchmark for an interaction term included regression model to be considered as reasonable: significantly positive result of cash flow parameter and significantly positive result of market-to-book ratio, as cash flow boost cash holding increasing (Almeida et al. 2004., Opler et al. 1999) and firms with higher market-to-book ratio have more growth opportunities, therefore have motivation to accumulate financial flexibility (cash holdings) for future investment (e.g. Strebuleave and Yang, 2013). To confirm these two benchmarks, we run univariate regressions for each model and provide consistent results for the coefficients of cash flow and the market-to-book ratio. Using the consistency of these two variables as benchmarks, we exclude financial constraint measurements in which the cross-term changes the relationship between cash flow or the market-to-book ratio and the dependent variable.

We find that, among the five main financial constraint measurements in this study, the

payout payment dummy provide reasonable results in the analysis of cash flow sensitivity of cash, KZ index is more applicable for cash holding determinant analysis and the analysis of investment and cash flow. Furthermore, we find that Japanese firms with more growth opportunities accumulate slightly more cash holdings for future investment, which is in the line with existing literature. However, this effect will be dominated by a stronger negative impact of growth opportunity on cash holdings through cash flow, if firms have higher market-to-book ratios (i.e. more growth opportunities). A firm with abundant growth opportunities faces costly external financing environment and is considered as financially constrained (Leary and Michaely, 2011., Bessler et al. 2013). Such a firm relies more on internal financing and therefore extracts funds more aggressively from cash flow for investment (Hadlock and Pierce, 2010), resulting in a lower cash holding and higher investment. These results contribute to the literature on financial flexibility and financial constraints by providing empirical evidence on cash flow sensitivity and cash-holding determinant models.

The remainder of this paper is organized as follows: Section 2 describes the methodology used in this study. Section 3 presents our estimation results. Section 4 concludes the paper.

2. Methodology

As financial constraints impact firms' financial flexibility management (Bessler et al. 2013), they should be able to trigger changes in financial flexibility proxies. In the existing literature, financial flexibility is represented by a variety of variables, including fixed assets and short-term debt. Cash holdings are an essential resource of financial flexibility (Denis, 2011), therefore, this study chooses to follow the main stem of the literature on cash holdings. As financially constrained firms present higher cash flow sensitivity of cash (Almeida et al. 2004), this study investigates the effect of financial constraints on financial flexibility, especially through the cash flow channel. Each financial constraint measurement examined in this study is crossed with cash flow, and the cross-term is then included in different empirical models as an independent variable.

There are three main empirical models in this study: the cash flow sensitivity of cash model from Almeida et al. (2004), the cash holding determinants model from Opler et al. (1999), and the cash flow sensitivity of investment model from Hadlock and Pierce (2010). Almeida et al. (2004) provide a theoretical model to explain that, as financially constrained firms cannot finance necessary funds for investment through external financing, they need to

prepare cash holdings by saving from cash flow, while financially unconstrained firms do not need to do so. Therefore, financially constrained firms should save more from cash flow than unconstrained firms, or in other words, financially constrained firms have higher cash flow sensitivity of cash. Almeida et al. (2004) categorize the observations as financially constrained firms and financially unconstrained firms, then regress the change in cash holding ratio (i.e. cash savings) on cash flow and a series of other variables. They find that financially constrained firms show higher cash flow sensitivity than their counterparts, which means that financially constrained firms save more aggressively than unconstrained firms. By including the cross-term of financial constraint measurement and cash flow in this model, we can observe how financial constraints impact a firm's saving behavior through cash flow.

To further investigate financial flexibility, it is necessary to use a more common benchmark variable, such as cash holdings (ratio). Opler et al. (1999) provide a classic model of cash holding determinants in which the parameter of the cross-term coefficient provides information regarding how financial constraints affect cash holdings through cash flows. Finally, Hadlock and Pierce (2010) model presents more information on financial flexibility management from the perspective of investment, which is considered one of the main purposes of accumulating financial flexibility. A financially constrained firm faces higher external financing costs and has to rely more on internal funds; therefore, it extracts more from cash flow for investment, resulting in financially constrained firms showing higher cash flow sensitivity of investment.

The empirical models are presented as follows:

$$\begin{aligned} \Delta Cashholdings_{it} = & \alpha_0 + \alpha_1 Fincon * CF_{it} + \alpha_2 CF_{it} + \alpha_3 M/B_{it} + \alpha_4 Size_{it} \\ & + \alpha_5 CAPEX_{it} + \alpha_6 NWC_{it} + \alpha_7 \Delta Shortdebt_{it} + \xi_{it} \end{aligned} \quad (1)$$

$$\begin{aligned} Cashholdings_{it} = & \beta_0 + \beta_1 Fincon * CF_{it} + \beta_2 CF_{it} + \beta_3 M/B_{it} + \beta_4 Size_{it} + \beta_5 NWC_{it} \\ & + \beta_6 CAPEX_{it} + \beta_7 \Delta Leverage_{it} + \beta_8 R\&D_{it} + \beta_9 Payout Dummy_{it} + u_{it} \end{aligned} \quad (2)$$

$$CAPEX_{it} = \gamma_0 + \gamma_1 Fincon * CF_{it} + \gamma_2 CF_{it} + \gamma_3 M/B_{it} + v_{it} \quad (3)$$

Equations (1), (2), and (3) present the cash flow sensitivity of cash model of Almeida et al. (2004), the cash holding determinants model of Opler et al. (1999), and the cash flow sensitivity of investment model of Hadlock and Pierce (2010), respectively. $\Delta Cashholdings_{it}$ is change in cash holding to asset ratio, CF_{it} is cash flow to asset ratio, $Fincon * CF_{it}$ is the cross-term of financial constraint and cash flow ratio, M/B_{it} is market-to-book ratio, $Size_{it}$ is natural log of

book asset, $CAPEX_{it}$ is capital expenditure, defined as the difference of fixed asset (Takami, 2016), NWC_{it} is change in net working capital, $\Delta Shortdebt_{it}$ is change in short-term debt ratio, $Leverage_{it}$ is the total liability to asset ratio, $R\&D_{it}$ is R&D to sales ratio, $Payout\ Dummy_{it}$ is the dummy which takes value of 1 if a firm pays payout in corresponding year and zero otherwise. This dummy is also used as a financial constraint measure; see Dang (2013) for an example, which provide evidence for that firms issue different level of debt based on dividend payment.

For example, the SA index (Hadlock and Pierce, 2010) was developed to provide a more precise measurement of financial constraints after the KZ index (Lamont et al. 2001), both SA index and KZ index are positively related to the degree of financial constraint, meaning that a higher index indicates a higher external financing cost environment. The SA index and KZ index are calculated as follows:

$$KZ\ index = -1.002 * CashFlow + 0.283 * M/B + 3.139 * Leverage \\ -39.368 * Payout - 1.315 * Cashholdings \quad (4)$$

$$SA\ index = -0.737 * Size + 0.043 * Size^2 + 0.04 * Age \quad (5)$$

We crossed both indices with cash flow ratios to form the cross-terms of SA_CF and KZ_CF and then include SA_CF and KZ_CF in Equations (1) to (3) as $Fincon * CF_{it}$ separately. The regression was conducted using OLS and GMM for each cross-term included model. If SA_CF shows a significant and consistent sign in a model without changing the sign of cash flow and the market-to-book ratio compared with the univariate analysis, then we can say that SA_CF provides a financial constraint measurement with integrity. A positive sign of the cross-term indicates that financial constraints impact cash savings (or cash holdings and investments) by increasing cash flow sensitivity.

In addition to the (1) SA index and (2) KZ index, the other financial constraint measurements in this study are (3) Payout payment dummy, which takes the value of 1 if a firm pays payout in a corresponding fiscal year and 0 otherwise; this dummy is widely used to represent financial constraint as not making payout payment is considered as sign of financially constrained of a firm (Strebulaev and Yang, 2013), (4) Payout constrained dummy, which takes the value of 1 if a firm is in the bottom three deciles of the industry payout ranking in the corresponding year (Fazzari et al. 1988), (5) Asset constrained dummy, which takes the value of 1 if a firm' asset size is ranked in the bottom three deciles on an annual basis (Gilchrist and Himmelberg, 1995).

3. Results

The data used in this paper were collected from Nikkei NEEDS Financial Quest, which includes Japanese listed firms from 1996 to 2015. Table 1 presents a statistical summary of the dataset. Table 2 shows the results of the univariate analysis for each model. Column (1) presents the univariate analysis results of cash flow sensitivity of cash model, based on Almeida et al. (2004). Column (2) presents the results of the cash holding determinant model based on Opler et al. (1999). Column (3) presents the results of cash flow sensitivity of investment model, based on Hadlock and Pierce (2010). The univariate analysis results for cash flow and the market-to-book ratio are consistent with the literature; both variables show positive and significant coefficients. These results imply that, overall, higher cash flows boost cash savings, as well as higher cash balances, and investments. Firms with more growth opportunities save cash more aggressively, hold higher cash balances, and invest more. The results of the market-to-book ratio are consistent with the precautionary motive for accumulating financial flexibility (Denis, 2011). When external financing is costly, firms with more growth opportunities face higher opportunity costs if they are forced to forgo valuable investment projects owing to insufficient funds. Therefore, firms with high market-to-book ratios are motivated to hedge risk by accumulating financial flexibility such as cash holdings to ensure sufficient funds for future investments. One may notice that these results seem to conflict with previous research on the cash policies of Japanese firms (Cui, 2020), which will

Table 1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
SA index	48,325	-2.366	0.531	-3.118	2.012
KZ index	35,858	6.097	19.079	-53.183	2072.287
Payout payment dummy	48,325	0.991	0.096	0.000	1.000
Payout constrained dummy	23,904	0.500	0.500	0.000	1.000
Asset constrained dummy	31,965	0.500	0.500	0.000	1.000
Change in cash holding ratio	44,884	0.002	0.051	-1.443	0.793
Cash flow ratio	48,325	0.070	0.061	-3.634	0.578
Market-to-book ratio	48,325	1.172	0.674	0.064	41.284
Size	48,325	10.954	1.463	5.476	19.492
CAPEX	44,884	0.008	0.095	-9.838	0.865
NWC	44,884	0.002	0.067	-0.911	1.166
Change in short term debt	41,363	-0.003	0.067	-3.856	0.744
Cash ratio	48,325	0.182	0.308	0.000	29.927
Leverage	48,325	3.274	21.215	0.000	2604.833
R&D	25,074	0.027	0.119	0.000	10.838

Note: This table presents summary statistics of the sample data.

Table 2: Results of univariate analysis

VARIABLES	(1)	(2)	(3)
	Cash flow sensitivity of cash	Cash holding determinants	Cash flow sensitivity of investment
CF	0.128*** (0.004)	0.135*** (0.023)	0.383*** (0.007)
M/B	0.005*** (0.000)	0.068*** (0.002)	0.009*** (0.001)
Size	0.000*** (0.000)	-0.032*** (0.001)	
CAPEX	-0.004 (0.003)	-0.086*** (0.014)	
NWC	0.217*** (0.003)	0.325*** (0.020)	
Change in Short-term debt	0.088*** (0.003)		
Leverage		-0.000*** (0.000)	
R&D		1.507*** (0.018)	
Dividend payment		-0.076*** (0.014)	

Note: This table presents the results of univariate analysis for each model. Column (1) presents the regression results of cash flow sensitivity of cash model based on Almeida et al. (2004). Column (2) presents the results of cash holding determinants model based on Opler et al. (1999). Column (3) presents the results of cash flow sensitivity of investment model based on Hadlock and Pierce (2010). Standard errors are in the parentheses. ***, ** and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.1$ respectively.

be discussed later.

Given the univariate analysis results of cash flow and the market-to-book ratio are stable and consistent with the existing literature, we can use the direction of the relationship between cash flow or the market-to-book ratio and the dependent variable as the benchmark to identify whether the added cross-term in the model is reasonable. If adding a cross-term neither changes the sign nor compromises the significance of the coefficients of cash flow and the market-to-book ratio, then the financial constraint measure of which the cross-term is added is considered applicable.

Table 3 shows the detailed regression results of the cash flow sensitivity of cash model, including the financial constraint cross-terms. Each cross-term is tested by OLS and GMM to provide both pooled cross-sectional and panel regression results, with the endogeneity problem being dealt with. The dependent variable is the change in cash holding ratio, or in other words, cash savings. As the model of Almeida et al. (2004) focus on comparing firms'

Table 3: Financial constraint and cash flow sensitivity of cash

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	GMM	OLS	GMM	OLS	GMM	OLS	GMM	OLS	GMM
SA_CF	-0.009 (0.006)	-0.494*** (0.030)								
KZ_CF			-0.001*** (0.000)	0.015*** (0.002)						
Payout payment_CF					-0.085*** (0.022)	-3.185*** (0.130)				
Payout_CF							0.007 (0.007)	0.776*** (0.056)		
Asset_CF									0.017** -0.008 0.058***	-0.165*** -0.053 0.157***
CF	0.045*** (0.014)	-1.159*** (0.075)	0.065*** (0.005)	-0.017 (0.011)	0.151*** (0.021)	3.119*** (0.125)	0.060*** (0.006)	-0.227*** (0.021)	-0.007 0.003***	-0.034 0.002***
M/B	0.003*** (0.000)	0.002*** (0.000)	0.002*** (0.000)	0.003*** (0.001)	0.003*** (0.000)	0.007*** (0.001)	0.002*** (0.001)	0.013*** (0.001)	0.000	0.001
Size	0.000 (0.000)	0.011*** (0.001)	-0.000** (0.000)	-0.001*** (0.000)	-0.000 (0.000)	0.001*** (0.000)	-0.000 (0.000)	-0.002*** (0.000)	0.000	-0.003***
CAPEX	-0.027*** (0.003)	-0.054*** (0.003)	0.031*** (0.004)	0.016*** (0.005)	-0.027*** (0.003)	-0.038*** (0.004)	0.028*** (0.005)	-0.002 (0.006)	-0.028*** -0.003	-0.033*** -0.004
NWC	0.337*** (0.004)	0.360*** (0.005)	0.379*** (0.005)	0.387*** (0.006)	0.337*** (0.004)	0.358*** (0.005)	0.371*** (0.006)	0.353*** (0.008)	0.342*** -0.005	0.371*** -0.006
Change in Short-term debt	0.278*** (0.004)	0.300*** (0.005)	0.332*** (0.005)	0.347*** (0.006)	0.279*** (0.004)	0.309*** (0.005)	0.320*** (0.006)	0.319*** (0.008)	0.272*** -0.005	0.306*** -0.006
Constant	-0.008*** (0.002)	-0.119*** (0.007)	-0.001 (0.002)	0.005** (0.002)	-0.005*** (0.002)	-0.008*** (0.002)	-0.002 (0.002)	0.003 (0.002)	-0.009*** -0.002	0.022** -0.01
Observations	41,363	41,363	32,759	32,759	41,363	41,363	21,615	21,615	27,493	27,493
R-squared	0.189		0.196		0.189		0.201		0.191	

Note: This table presents the results of regressions focusing on financial constraints and cash flow sensitivity of cash. The dependent variable is the change in cash holding ratio. Standard errors are indicated in parentheses. ***, **, and * indicate p<0.01, p<0.05, and p<0.1 respectively.

propensity to save cash out of cash flow (cash flow sensitivity of cash) between financially constrained firms and unconstrained firms, what we need to look at here is the sign of the cross-term. For example, in Column (2), SA_CF shows a significantly negative sign, as a higher SA index means a more financially constrained situation, this negative result indicates that, compared to less financially constrained firms, more constrained firms have lower cash flow sensitivity of cash, or we can say that more constrained firms save less from cash flow than the counterparts. However, this negative result is not reasonable. In Column (2), cash flow shows a significantly negative result, which means that higher cash flow will cause less change in the cash holding ratio; in other words, it will cause the firm to save less. This result is not consistent with Table 2, in which cash flow is significantly positive in Column (1); therefore, the SA index is a questionable financial constraint measure for Japanese firms, although the cross-term of the SA index and cash flow shows a significant result.

We discard the other financial constraint measures from Table 3. In Columns (9) and (10), the cash flow and market-to-book ratio show results that consistent with those in Table 2. However, the cross-term of the asset-constrained dummy and cash flow shows different signs, implying that the asset-constrained dummy is not applicable to the cash flow sensitivity of cash model. Among all the financial constraint measurements in Table 3, only the payout dummy presents acceptable results. In Columns (5) and (6), the cross-term of the payout payment dummy and cash flow shows significantly negative results without changing or compromising the coefficients of cash flow and the market-to-book ratio. The positive result of cash flow means that higher cash flow boosts cash savings, and the significantly negative sign on the cross-term of the payout payment dummy and cash flow indicates that, firms that making payout payments save less from cash flow. This result is understandable, as payout payments decrease a firm's cash holdings. As payout payment dummy is negatively related to the degree of financial constraint, we can say that the results of Payout payment_CF indicated that more financially constrained firms saving more from cash flow than less constrained firms, this is consistent with Almeida et al. (2004). Table 3 shows that most financial constraint measurements are not applicable when analyzing the effect of financial constraints on cash flow sensitivity, except for the payout dummy.

Table 4 shows the regression results of the cash holding determinants model based on Opler et al. (1999), including the cross-terms of financial constraint measurements and cash flow. While Table 3 provides information on dynamic changes in cash holdings, Table 4 captures a broader picture of cash holding. After excluding the inconsistent results of cash flow and the market-to-book ratio, we can see that the cross-term of the KZ index and cash

Table 4: Financial constraints and cash holding determinants

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	GMM	OLS	GMM	OLS	GMM	OLS	GMM	OLS	GMM
SA_CF	-0.048 (0.049)	-1.357*** (0.120)								
KZ_CF			-0.038*** (0.002)	-0.133*** (0.006)						
Asset_CF					0.216*** (0.084)	6.984*** (0.369)				
Payout payment_CF							0.200 (0.162)	-2.984*** (0.603)		
Payout_CF									-0.772*** (0.042)	-1.446*** (0.149)
M/B	0.038*** (0.004)	0.042*** (0.007)	0.029*** (0.002)	0.034*** (0.007)	0.061*** (0.005)	0.227*** (0.013)	0.038*** (0.004)	0.040*** (0.007)	0.026*** (0.003)	0.017*** (0.005)
CF	0.117 (0.123)	-2.997*** (0.288)	0.323*** (0.027)	0.593*** (0.073)	0.067 (0.072)	-4.045*** (0.225)	0.031 (0.159)	3.108*** (0.599)	0.474*** (0.034)	0.798*** (0.043)
Size	-0.030*** (0.002)	0.007* (0.003)	-0.028*** (0.001)	-0.013*** (0.001)	-0.028*** (0.002)	0.096*** (0.007)	-0.031*** (0.001)	-0.031*** (0.001)	-0.029*** (0.001)	-0.025*** (0.001)
NWC	0.366*** (0.033)	1.176*** (0.057)	0.258*** (0.024)	0.744*** (0.048)	0.449*** (0.046)	1.209*** (0.092)	0.367*** (0.033)	1.177*** (0.057)	0.327*** (0.031)	0.720*** (0.039)
CAPEX	0.011 (0.020)	0.028 (0.067)	-0.052*** (0.018)	-0.687*** (0.058)	0.030 (0.026)	-0.023 (0.105)	0.012 (0.020)	0.059 (0.067)	0.005 (0.021)	-0.806*** (0.050)
Leverage	-0.000 (0.000)	0.002*** (0.001)	-0.003*** (0.000)	-0.028*** (0.002)	-0.000 (0.000)	-0.002** (0.001)	-0.000 (0.000)	0.002*** (0.001)	-0.001*** (0.000)	0.000 (0.001)
RD	1.632*** (0.017)	2.318*** (0.014)	0.724*** (0.039)	0.118** (0.057)	1.657*** (0.020)	2.371*** (0.020)	1.631*** (0.017)	2.281*** (0.014)	0.584*** (0.049)	0.536*** (0.048)
Payout dummy	-0.056*** (0.018)	-0.129* (0.073)	-0.080*** (0.011)	-0.919*** (0.056)	-0.063*** (0.024)	0.178* (0.100)				
Constant	0.464*** (0.026)	0.128* (0.073)	0.507*** (0.014)	1.219*** (0.052)	0.439*** (0.032)	-1.257*** (0.124)	0.426*** (0.015)	0.400*** (0.011)	0.448*** (0.013)	0.400*** (0.007)
Observations	24,129	21,909	21,466	19,980	15,997	14,474	24,129	21,909	14,196	13,189
R-squared	0.301		0.106		0.325		0.301		0.110	

Note: This table presents the results of the regressions that focus on financial constraints and cash holding determinants. The dependent variable is the cash holding ratio. Standard errors are indicated in parentheses. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.1$ respectively.

flow performs better than the others. A significantly negative parameter of the KZ index cross-term indicates that being more financially constrained (represented by a higher KZ index) weakens the positive effect of cash flow on cash holdings. With a one-unit increase in cash flow, financially constrained firms save fewer cash holdings than do unconstrained firms. Adequate cash flows compile cash holdings, but financial constraints lower the efficiency of building cash holdings. Though Bessler et al. (2013) use different variable for financial flexibility, they provide evidence for that financially constrained firms have difficulties in accumulating financial flexibility, our findings are in the line with them. Similar results can be observed in Columns (9) and (10), which present the results of the regressions with the payout constraint cross-term. The payout dummy is removed from the empirical model in Columns (7)–(10) to avoid multicollinearity. In the unreported results, we conduct an analysis with the payout dummy included, and the results are not significantly different. Table 4 provides a possible explanation for why financially constrained firms save less than their counterparts.

The regression results of the financial constraint cross-term and cash flow sensitivity of investment based on Equation (3) are presented in Table 5. Again, the KZ index cross-term shows better results than the other terms. We have seen from the Table 2 that, higher cash flow or market-to-book ratio (more growth opportunities) causes investment to increase. The parameter of the KZ index cross-term in Table 5 is significantly positive, which means that when a firm is financially constrained, it extracts more funds from cash flows for investment. The results of the KZ index cross-term in Table 4 imply that financially constrained firms save less than unconstrained firms, with the results of Table 5 indicating that financially constrained firms rely more on internal funds for investment than unconstrained firms, so that they have difficulties building cash holdings, resulting in a fragile financial condition, especially in anticipation of increasing financing costs, such as an economic recession. We also conduct an additional regression with each financial constraint measurement and all other explanatory variables being the same, the results are showed in Appendix.

To test the integrity of the KZ index and other financial constraint measurements, Table 6 provides a robustness check. As previously explained in this section, firms with more growth opportunities face higher opportunity cost when external financing is expensive. Raising external funds is costly for these firms, so they can also be regarded as financially constrained. By including the cross-term of the market-to-book ratio and cash flow in each model, we can observe more details of firms' financing behavior. The market-to-book ratio cross-term fails to provide stable results for the cash flow sensitivity of cash model, as shown

Table 5: Financial constraints and cash flow sensitivity of investment

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	GMM	OLS	GMM	OLS	GMM	OLS	GMM	OLS	GMM
SA_CF	-0.097*** (0.009)	-1.477*** (0.026)								
KZ_CF			0.003*** (0.000)	0.051*** (0.002)						
Payout payment_CF					0.005 (0.039)	-1.105*** (0.123)				
Payout_CF							0.222*** -0.012	2.708*** (0.061)		
Asset_CF									0.115*** (0.013)	3.085*** (0.063)
M/B	0.002*** (0.001)	-0.002 (0.002)	0.006*** (0.001)	0.010*** (0.002)	0.002*** (0.001)	0.010*** (0.002)	0.006*** -0.001	0.069*** (0.003)	-0.000 (0.001)	0.047*** (0.002)
CF	0.142*** (0.023)	-2.662*** (0.065)	0.266*** (0.008)	0.528*** (0.015)	0.374*** (0.038)	2.037*** (0.123)	0.251*** -0.01	-0.275*** (0.028)	0.375*** (0.013)	-1.102*** (0.047)
Constant	-0.020*** (0.001)	-0.041*** (0.002)	-0.018*** (0.001)	-0.057*** (0.002)	-0.021*** (0.001)	-0.069*** (0.002)	-0.023*** -0.001	-0.115*** (0.003)	-0.022*** (0.001)	-0.061*** (0.003)
Observations	44,884	44,884	35,858	35,858	44,884	44,884	23,904	23,904	29,727	29,727
R-squared	0.060		0.045		0.057		0.066		0.073	

Note: This table presents the results of regressions that focus on financial constraints and the cash flow sensitivity of investments. Capital expenditure is the dependent variable. Standard errors are indicated in parentheses. ***, **, * indicate p<0.01, p<0.05, and p<0.1 respectively.

Table 6: Regression results of models with cross-term of M/B

VARIABLES	Cash flow sensitivity of cash		Cash holding determinants		Cash flow sensitivity of investment	
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	GMM	OLS	GMM	OLS	GMM
M/B_CF	-0.001 (0.004)	0.079*** (0.025)	-0.133*** -0.033	-4.079*** -0.148	0.035*** (0.003)	0.134*** (0.005)
CF	0.070*** (0.007)	-0.063* (0.036)	0.411*** -0.059	5.757*** -0.22	0.300*** (0.010)	0.624*** (0.018)
M/B	0.003*** (0.001)	-0.004* (0.002)	0.052*** -0.005	0.441*** -0.017	-0.000 (0.001)	0.005*** (0.002)
Size	-0.000 (0.000)	0.000** (0.000)	-0.031*** -0.001	-0.033*** -0.001	-0.000 (0.001)	0.005*** (0.002)
CAPEX	-0.027*** (0.003)	-0.041*** (0.003)	0.034 -0.021	-0.116 -0.082		
NWC	0.337*** (0.004)	0.367*** (0.005)	0.367*** -0.033	1.047*** -0.071		
Change in Short-term debt	0.279*** (0.004)	0.308*** (0.005)				
Leverage			-0.000 (0.000)	0.002*** -0.001		
RD			1.627*** -0.017	2.116*** -0.018		
Payout payment			-0.052*** -0.018	-0.302*** -0.09		
Constant	-0.006*** (0.002)	0.001 (0.003)	0.460*** -0.023	0.237*** -0.085	-0.016*** (0.001)	-0.053*** (0.002)
Observations	41,363	41,363	24129	21909	44,884	44,884
R-squared	0.189		0.302		0.060	

Note: This table presents the results of the models with M/B cross-term. Standard errors are indicated in parentheses. ***, ** and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.1$ respectively.

in Columns (1) and (2). However, in Column (5) and (6), the cross-term presents significantly positive results, this means that firms with more growth opportunities extract more funds from cash flow for investment, which is consistent with what we have seen about KZ index in Table 5.

While the market-to-book ratio shows positive results in Columns (3) and (4), the cross-term of the market-to-book ratio and cash flow shows negative results. This indicates that although firms with more growth opportunities have a precautionary motivation to accumulate cash holdings to prepare for future investment, their demand for immediate investment funds drives them to extract from cash flow, so much so that the precautionary motive (positive effect of market-to-book ratio on cash holdings) is dominated by their

investment funds demand (negative effect of market-to-book ratio cross-term on cash holding). Cui (2020) provides empirical evidence that Japanese firms with fewer growth opportunities are more likely to hold more cash than debt, resulting in virtually no outstanding debt. Firms with fewer growth opportunities are likely to hold more cash than debt, implying that firms with more growth opportunities are likely to hold more debt than cash. As seen in Table 2, a higher market-to-book ratio (more growth opportunities) is related to more cash holdings. Thus, Japanese firms that have more growth opportunities, rely more on internal funds for investment and may simultaneously issue debt to build up cash balances, which may explain why leverage shows a significant but merely zero effect on cash holdings. Different behavioral patterns may exist regarding the relationship between debt and cash holdings: firms with more growth opportunities are financially constrained and issue debt for cash, while firms with fewer growth opportunities are unconstrained and use cash to pay down outstanding debt.

4. Conclusion

This study examined the applicability of various financial constraint measurements for liquidity management analysis of Japanese firms. Our empirical results demonstrate that the KZ index is more applicable in cash holding determinants and cash flow sensitivity of investment analysis. The payout payment dummy fits better in cash flow sensitivity of cash model. Overall, financially constrained firms appear to save more from cash flow, hold lower cash balances, and extract more from cash flow for investments than unconstrained firms. We also find evidence that Japanese firms with more growth opportunities accumulate cash holdings for precautionary measures, however, this behavior is dominated by the urgent need for internal funds when firms have higher market-to-book ratio and therefore face more financially constrained environment, resulting in an unusual negative relationship between growth opportunities and cash holdings.

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Appendix:

In Appendix, we provide more regression results on applicability of financial constraint measures. Instead of following existing literature and using different regression models with different control variables, we here regress the three dependent variables on the same control variables, as well as financial constraint measures and their cross-terms with cash flow. The regression models are as follows:

$$\begin{aligned} \Delta Cashholdings_{it} = & \alpha'_0 + \alpha'_1 Fincon_{it} + \alpha'_2 Fincon * CF_{it} + \alpha'_3 CF_{it} + \alpha'_4 M/B_{it} + \alpha'_5 Size_{it} \\ & + \alpha'_6 CAPEX_{it} + \alpha'_7 NWC_{it} + \alpha'_8 Leverage_{it} + \alpha'_9 \Delta Shortdebt_{it} + \zeta'_{it} \end{aligned} \quad (A1)$$

$$\begin{aligned} Cashholdings_{it} = & \beta'_0 + \beta'_1 Fincon_{it} + \beta'_2 Fincon * CF_{it} + \beta'_3 CF_{it} + \beta'_4 M/B_{it} + \beta'_5 Size_{it} \\ & + \beta'_6 CAPEX_{it} + \beta'_7 NWC_{it} + \beta'_8 Leverage_{it} + \beta'_9 \Delta Shortdebt_{it} + u'_{it} \end{aligned} \quad (A2)$$

$$\begin{aligned} CAPEX_{it} = & \gamma'_0 + \gamma'_1 Fincon_{it} + \gamma'_2 Fincon * CF_{it} + \gamma'_3 CF_{it} + \gamma'_4 M/B_{it} + \gamma'_5 Size_{it} \\ & + \gamma'_6 CAPEX_{it} + \gamma'_7 NWC_{it} + \gamma'_8 Leverage_{it} + \gamma'_9 \Delta Shortdebt_{it} + v'_{it} \end{aligned} \quad (A3)$$

Panel A presents results of Equation (A1), Panel B presents results of Equation (A2) and Panel C presents results of Equation (A3). After discarding results with negative or insignificant parameters of cash flow and market-to-book ratio, we can see that in Panel A, payout payment dummy and payout constrained dummy show significant results; in Panel B, SA index, KZ index, payout constrained dummy and asset constrained dummy show significant results; in Panel C, it's KZ index, payout constrained dummy and Asset constrained dummy.

In Panel A, both cross-terms of payout payment dummy and payout constrained dummy show negative signs. However, payout payment dummy is negatively related to the degree of financial constraint, while payout constrained dummy is positively related. The result of payout constrained dummy cross-term contradicts with what we have seen in Table 3, so payout constrained dummy is discarded as well. Similarly, in Panel B, SA index is discarded for displaying opposite results from Table 4, remaining KZ index, payout constrained dummy and asset constrained dummy show meaningful significant results. Among them, asset constrained dummy shows better results than previously. Panel C shows the most different results from previous analysis. In Table 5, only KZ index shows meaningful significant results, but in Panel C, payout constrained dummy and asset constrained dummy also show meaningful significant results. Overall, the results in Panel A, Panel B and Panel C are not

conflict with the main conclusion of this paper.

Panel A. Additional regression of cash flow sensitivity of cash model. The dependent variable is change in cash holdings.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	GMM	OLS	GMM	OLS	GMM	OLS	GMM	OLS	GMM
SA index	0.005*** (0.020)	0.004*** (0.024)								
SA_CF	-0.001 (0.003)	-0.001 (0.003)								
	-0.038*** (0.000)	-0.035*** (0.000)								
KZ index	-0.008 (0.001)	-0.01 (0.001)	-0.001*** (0.000)	-0.000 (0.000)						
KZ_CF			-0.001*** (0.000)	-0.000 (0.000)						
Payout payment dummy					0.005** (0.002)	0.003 (0.003)				
Payout payment_CF					-0.002 (0.002)	-0.003 (0.003)				
Payout constrained dummy					-0.095*** (0.012)	-0.155*** (0.014)				
					-0.022 (0.007)	-0.027 (0.007)				
Payout_CF							0.007*** (0.001)	0.007*** (0.001)		
Asset constrained dummy							-0.059*** (0.012)	-0.053*** (0.014)		
Asset_CF									-0.003** (0.001)	0 (0.001)
CF	-0.023 (0.020)	-0.032 (0.024)	0.063*** (0.005)	0.054*** (0.006)	0.161*** (0.022)	0.202*** (0.026)	0.110*** (0.009)	0.097*** (0.011)	0.026*** (0.008)	0.042*** (0.009)
M/B	0.003*** (0.000)	0.003*** (0.000)	0.002*** (0.000)	0.002*** (0.001)	0.003*** (0.000)	0.003*** (0.000)	0.002*** (0.001)	0.002*** (0.001)	0.003*** (0.000)	0.003*** (0.001)
Size	-0.001*** (0.000)	-0.000 (0.000)	-0.000*** (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	-0.000* (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.001 (0.000)
CAPEX	-0.027*** (0.003)	-0.037*** (0.003)	0.032*** (0.004)	0.026*** (0.005)	-0.027*** (0.003)	-0.037*** (0.003)	0.030*** (0.005)	0.024*** (0.006)	-0.028*** (0.003)	-0.039*** (0.004)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
NWC	0.337*** (0.004)	0.366*** (0.005)	0.381*** (0.005)	0.408*** (0.006)	0.338*** (0.004)	0.366*** (0.005)	0.374*** (0.006)	0.395*** (0.007)	0.342*** (0.005)	0.368*** (0.006)
Leverage	0.000*** (0.000)	0.000*** (0.000)	0.003*** (0.001)	0.001 (0.001)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Change in Short-term debt	0.279*** (0.004)	0.308*** (0.005)	0.333*** (0.005)	0.363*** (0.006)	0.279*** (0.004)	0.308*** (0.005)	0.323*** (0.006)	0.346*** (0.007)	0.272*** (0.005)	0.303*** (0.006)
Constant	0.014*** (0.004)	0.008 (0.005)	-0.001 (0.002)	-0.002 (0.002)	-0.010*** (0.003)	-0.011*** (0.003)	-0.006*** (0.002)	-0.008*** (0.002)	-0.001 (0.004)	-0.011** (0.004)
Observations	41,363	41,363	32,759	32,759	41,363	41,363	21,615	21,615	27,493	27,493
R-squared	0.190		0.197		0.190		0.203		0.191	

Panel B. Additional regression of cash holding determinants. The dependent variable is cash holdings.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
SA index	OLS 0.007** (0.003)	GMM 0.006*** (0.001)	OLS 0.007*** (0.001)	GMM 0.006*** (0.001)	OLS 0.007*** (0.001)	GMM 0.006*** (0.001)	OLS 0.007*** (0.001)	GMM 0.006*** (0.001)	OLS 0.007*** (0.001)	GMM 0.006*** (0.001)
SA_CF	0.087*** (0.026)	0.079*** (0.011)								
KZ index			-0.029*** (0.001)	-0.015*** (0.000)						
KZ_CF			-0.009*** (0.001)	-0.007*** (0.000)						
Payout payment dummy					-0.060*** (0.007)	-0.050*** (0.003)				
Payout payment_CF					0.456*** (0.072)	0.424*** (0.030)				
Payout constrained dummy							-0.017*** (0.004)	-0.013*** (0.002)		

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Payout_CF							-0.484*** (0.040)	-0.451*** (0.016)		
Asset constrained dummy										
Asset_CF									-0.031*** (0.005)	-0.031*** (0.002)
CF	0.359*** (0.065)	0.332*** (0.027)	0.038** (0.017)	0.098*** (0.007)	-0.284*** (0.071)	-0.263*** (0.030)	0.256*** (0.031)	0.274*** (0.013)	-0.188*** (0.033)	-0.168*** (0.014)
M/B	0.031*** (0.001)	0.027*** (0.001)	0.034*** (0.001)	0.026*** (0.001)	0.029*** (0.001)	0.025*** (0.001)	0.023*** (0.002)	0.019*** (0.001)	0.031*** (0.002)	0.026*** (0.001)
Size	-0.027*** (0.001)	-0.026*** (0.000)	-0.023*** (0.001)	-0.023*** (0.000)	-0.023*** (0.000)	-0.022*** (0.000)	-0.023*** (0.001)	-0.023*** (0.000)	-0.035*** (0.001)	-0.034*** (0.000)
CAPEX	-0.045*** (0.009)	-0.084*** (0.004)	-0.052*** (0.013)	-0.109*** (0.005)	-0.050*** (0.009)	-0.087*** (0.004)	-0.060*** (0.016)	-0.112*** (0.006)	-0.037*** (0.011)	-0.080*** (0.004)
NWC	0.287*** (0.013)	0.362*** (0.005)	0.318*** (0.016)	0.390*** (0.006)	0.289*** (0.013)	0.364*** (0.005)	0.338*** (0.020)	0.416*** (0.008)	0.325*** (0.016)	0.404*** (0.007)
Leverage	-0.000*** (0.000)	-0.000*** (0.000)	0.091*** (0.003)	0.048*** (0.001)	-0.000*** (0.000)	-0.000*** (0.000)	-0.001*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
Change in Short-term debt	0.168*** (0.013)	0.226*** (0.005)	0.231*** (0.017)	0.282*** (0.007)	0.166*** (0.013)	0.225*** (0.005)	0.243*** (0.020)	0.293*** (0.008)	0.184*** (0.016)	0.243*** (0.007)
Constant	0.427*** (0.014)	0.422*** (0.005)	0.371*** (0.006)	0.380*** (0.002)	0.423*** (0.008)	0.415*** (0.003)	0.404*** (0.008)	0.403*** (0.003)	0.518*** (0.014)	0.517*** (0.005)
Observations	41,363	41,363	32,759	32,759	41,363	41,363	21,615	21,615	27,493	27,493
R-squared	0.083		0.125		0.084		0.122		0.106	

Panel C. Additional regression of cash flow sensitivity of investment model. The dependent variable is change in capital expenditure.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	GMM	OLS	GMM	OLS	GMM	OLS	GMM	OLS	GMM
SA index	-0.002 (0.002)	0.002 (0.002)								
SA_CF	-0.201*** (0.014)	-0.270*** (0.015)								
KZ index			0.002*** (0.000)	0.002*** (0.000)						
KZ_CF			0.002*** (0.000)	0.002*** (0.000)						
Payout payment dummy					0.026*** (0.004)	0.019*** (0.004)				
Payout payment_CF					-0.031 (0.040)	-0.071* (0.041)				
Payout constrained dummy							-0.011*** (0.002)	-0.011*** (0.002)		
Payout_CF					0.192*** (0.017)	0.193*** (0.018)				
Asset constrained dummy									-0.010*** (0.003)	-0.009*** (0.002)
Asset_CF									0.311*** (0.019)	0.373*** (0.019)
CF	-0.183*** (0.036)	-0.336*** (0.037)	0.218*** (0.007)	0.202*** (0.007)	0.334*** (0.040)	0.388*** (0.040)	0.128*** (0.013)	0.115*** (0.014)	0.141*** (0.015)	0.122*** (0.015)
M/B	0.005*** (0.001)	0.005*** (0.001)	0.011*** (0.001)	0.011*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.012*** (0.001)	0.011*** (0.001)	0.005*** (0.001)	0.004*** (0.001)
Size	0.008*** (0.000)	0.009*** (0.000)	0.003*** (0.000)	0.004*** (0.000)	0.003*** (0.000)	0.004*** (0.000)	0.004*** (0.000)	0.004*** (0.000)	0.006*** (0.001)	0.007*** (0.001)
CAPEX										

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
NWC	-0.139*** (0.007)	-0.113*** (0.007)	-0.383*** (0.007)	-0.410*** (0.006)	-0.138*** (0.007)	-0.111*** (0.007)	-0.380*** (0.008)	-0.407*** (0.008)	-0.086*** (0.009)	-0.039*** (0.009)
Leverage	-0.000*** (0.000)	-0.000*** (0.000)	-0.007*** (0.001)	-0.006*** (0.001)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
Change in Short-term debt	0.411*** (0.007)	0.432*** (0.007)	-0.007 (0.007)	-0.066*** (0.007)	0.420*** (0.007)	0.443*** (0.007)	0.009 (0.009)	-0.043*** (0.009)	0.538*** (0.009)	0.589*** (0.009)
Constant	-0.111*** (0.008)	-0.107*** (0.007)	-0.051*** (0.003)	-0.056*** (0.002)	-0.078*** (0.005)	-0.077*** (0.005)	-0.053*** (0.003)	-0.058*** (0.003)	-0.072*** (0.008)	-0.088*** (0.007)
Observations	41,363	41,363	32,759	32,759	41,363	41,363	21,615	21,615	27,493	27,493
R-squared	0.209		0.167		0.201		0.175		0.247	

財務制約，キャッシュフロー感応度と財務的柔軟性

崔 ワ イ カ ン

要 旨

本研究では、財務的柔軟性における様々な財務制約の測定方法の妥当性を調査した。キャッシュ・フローと様々な財務制約を表す変数の交差項を実証モデルに加え、回帰分析を行う。その結果、ペイアウト支払ダミーは現金保有量の変化に対して説明能力を持ち、KZ 指数は現金保有量の決定要因や投資に対するキャッシュ・フロー感応度に関する分析において適用性が高いことが示された。財務的制約のある企業は財務制約のない企業と比べ、キャッシュ・フローからより多く現金保有を捻出し、投資に必要な資金は内部資金に多く依存する。本研究はまた、現金保有に対する日本企業の予備的な動機のエビデンスをも提供している。

キーワード：財務制約，現金保有，キャッシュフロー，投資，成長機会