The Analysis of Cash Flow Sensitivity of Cash among Chinese Listed Firms: Under the Perspective of Financial Constraint

Abstract

This paper investigates the cash flow sensitivity of cash of Chinese listed firms (WRDS Database) during 2009–2017. By using the two-step system GMM method, this paper shows the following findings: First, in general, cash flow sensitivity of cash is negative for Chinese firms. Second, financial constraint, firm size and the paying of dividends can affect the cash flow sensitivity of cash; this sensitivity tends to be much stronger when enterprises face stronger financial constraints, smaller firm size, and no cash paying of dividends. Third, the cash flow sensitivity of cash is negative (positive) when the firm has a positive (negative) cash flow. Finally, net working capital plays a smoothing role on cash holdings, and sales of the fixed asset also affect cash flow sensitivity of cash positively.

Key Words： Cashflow Sensitivity of Cash　Financial Constraint　Working Capital

Sales of Fixed Asset

1.Introduction

The concept of financial constraint was first raised by Fazzari *et al*(1988), which refers to the phenomenon that the cost of external financing is higher than the internal corporate financing and the state that companies cannot get the external financing. The theory of financial constraint is mainly built upon the incomplete market. Fazzari *et al* show that there is some difference between the cost of external financing and internal financing and the cost of external financing exceeds that of internal financing most of the time. When firms could not get enough money from the internal financing, that might turn to some external financial instit\ution for help. However, these firms are likely to forgo some valuable investment due to the high cost of external financing.

Firms especially those micro business firms face an increasingly tighter financial constraint after the financial crisis in 2008. It becomes even more difficult for the firms to get external financing with the increasing cost of external financing, which is related to the severe problem of moral hazard after the 2008 financial crisis. Additionally, the growth of Chinese economy relies deeply on the industry of

real estate and infrastructure, and this leads to a large amount of money flowing to real estate industry and infrastructure, the interests of which are not fully determined by the market. The imbalance of money flowing causes the problem of inefficient capital market in China. (Chen *et al*, 2015) All these problems exacerbate the issue of getting financing from external institutions.

For those firms that face severe financial constraint and cannot get external financing, they have no choice but get financed by their own capital accumulation. Capital could be accumulated in different ways such as cash, equity investment, bond, receivable, etc. Among these forms of capitals, cash would be a perfect choice because of its best liquidity. Firms with more serious financial constraint might tend to hold more cash in order to finance some valuable projects. The importance of holding cash are illustrated as follows. On the one hand, firms can use cash to support some valuable investment opportunities in the future. (FHP, 1988; Hoshi et al., 1991; Carpenter,1993; Himmelberg and Peterson, 1994) On the other hand, cash holding can help firms out when they are faced with some short-debt crisis. (Acharya et al., 2007; Almeida et al., 2004; Bates et al., 2009) Almeida (2004) uses the concept: cash flow sensitivity of cash for the first time. Almeida shows that the amount of cash holding by the firm is closely related to its internal cash flow and firms with different financial constraint tend to hold a different amount of cash. The goal of this paper is to show whether cash holding is sensitive to internal cash flow in Chinese listed firms, to demonstrate how the cash flow sensitivity of cash varies in firms with different financial constraint and to find the factors that affect the cash flow sensitivity of cash in Chinese listed firms.

Comparing to the existing research, the contributions of this paper are stated in the following four aspects. First, the research in this paper includes the latest and widest data ever since. This paper employs entrepreneurial data of the entire Chinese listed firms from 2009 to 2017, which comes from the Compustat database from Wharton Research Data Service. The large sample not only strengthens the explanatory power of the model but offers a new sight to look into the capital floating process in China after the 2008 financial crisis. Second, as the author knows, this paper is the first to find that cash holding is sensitive to cash in Chinese firms after the 2008 financial crisis, which supports the conclusion of Riddick and Whited (2009) and demonstrates that the results of Almeida (2004) are not applicable to China. Third, this paper takes important heterogeneities (financial constraint index, firm size, dividend payment, Tobin Q, etc.) into consideration, which enriches the research of cash flow sensitivity. Finally, this paper offers a mechanism that can explain the variation of cash flow sensitivity.

When some firms are facing serious financial constraint, they may choose to sell their fixed asset to get more cash flow in order to finance their ongoing projects.

Considering the potential endogenous problems in the panel data of thousands of firms, this paper employs the systematic GMM method to make regression analysis. (Arellano and Bond, 1991). We draw several conclusions from the regression analysis. First, the phenomenon that cash flow is sensitive to cash also exists in China, and the cash flow is negatively sensitive to cash holding. Second, this paper shows that the cash flow sensitivity of cash varies in terms of firms that have different directions of internal cash flow. The cash holding tends to be negatively sensitive to cash flow for those firms who own positive internal cash flow and vice versa. Third, this paper also demonstrates how the magnitude of cash flow sensitivity of cash differs in firms with varying financial constraint, under the direct and indirect measurement of financial constraint. Firms in the face of more serious financial constraint are more likely to have a higher magnitude of cash flow sensitivity of cash. Besides, this paper gives the evidence that some financial factors such as working capital, expenditure and short debt have an important influence on the cash flow sensitivity of cash. Since working capital is easy to be transferred into cash, firms with more working capital are more likely to hold less cash. Short debt affects the magnitude of cash flow sensitivity of cash in an opposite way. It is an obligation for the firms to pay back the debt in a short time. As a result, more debts especially short debt lead to a higher level of cash holding. Finally, this paper finds an important mechanism that firms with severe financial constraint would sales its fixed asset to gain more working capital and cash in order to sustain the operation of the company. Sales of a fixed asset can make a huge effect on the magnitude of cash flow sensitivity of cash.

2. Related Literature and relative contribution

The research in this paper may relate to the existing literature in several aspects. Basically, there are two different points of view for the direction of cash flow sensitivity of cash. On the one hand, Almeida et al (2004) model the link between financial constraints and corporate liquidity demand and empirically estimate the cash flow sensitivity of cash using a large sample of manufacturing firms over the 1971 to 2000 period. They use five alternative approaches, payout policy, asset size, bond rating, commercial paper ratings, and KZ index, to partition the sample into unconstrained and constrained firms. This paper demonstrates that the propensity to save from cash inflows is positive for the constrained firms, but is indistinguishable from zero for the unconstrained ones. On the other hand,

the work of Riddick and Whited (2009), which employs a completely different theoretical and empirical setting from Almeida *et al* (2004) shows that the cash flow is negatively sensitive to the shift of cash holding. The empirical research of Riddick and Whited (2009) and Almeida (2004) differs in the following two aspects: First, Riddick and Whited (2009) take some elements which are closer to the reality such as depreciation rate of capital and cash flow shock into consideration. Moreover, these additional elements of Riddick and Whited (2009) have nothing to do with productivity. Second, Riddick and Whited (2009) point out that if there are some measurement errors in one explanatory variable, the effect of other explanatory might change, thus causing some inaccuracy. Nevertheless, the regression of Riddick and Whited (2009) does not include the influence of other entrepreneurial features such as asset size, capital expenditure, non-cash working capital and short debt that would definitely affect the magnitude of cash flow sensitivity. Based on the study of Riddick and Whited (2009), Bao *et al* (2012) implement some modification to the regression model of Riddick and Whited (2009), which includes depreciation rate, cash flow shock, asset size, capital expenditure, non-cash working capital, and short debt. Their augmented empirical model affirms the conclusion in Riddick and Whited (2009) that the cash flow sensitivity of cash is generally negative. Apart from that, they contend that the cash flow sensitivity is asymmetric to cash flow. Using a sample of manufacturing firms from 1972 to 2006, they document that cash flow sensitivity of cash is negative when a firm face a positive cash flow environment, supporting Riddick and Whited (2009), but the cash flow sensitivity of cash is positive when a firm faces a negative cash flow.

Financial constraint is an invisible variable that can not be captured from reality. Therefore, it is the key point of this paper to precisely measure the variable of financial constraint. Generally, there are three ways of measurement in the existing literature. First and foremost, the method of cash flow sensitivity of investment. The method of measuring financial constraint was firstly implemented by Fazzari, Hubbard, and Petersen (FHP, 1988,2000) and other researchers have also proved that cash flow sensitivity of investment is an effective measurement of financial constraint by their empirical work. (Cleary, 1999; Erickson and Whited, 2000; Alti, 2003; Moyen, 2004; Cummins *et al*, 2006). Besides, some research shows that this measurement is also practical in estimating the financial constraint of Chinese firms. (Hericourt and Poncet, 2009; Ding *et al*, 2013; Cull *et al*, 2015) They demonstrate that most of the investment of Chinese firms comes from the internal cash flow. Second, some other papers adopt a single indicator of a firm's features as the measurement of financial

constraint. For example, their indicators can be dividend payout ratio (Glichrist, 1990), firm size (Ritter, 1987; Titman and Wessels, 1988) and time interest earned ratio (Aggarwal and Zong, 2003). The final measurement of financial constraint is the integrated index that takes multiple indicators into consideration. Kaplan and Zingale (1997) lucubrate the cash flow sensitivity of investment, raised by Fazzari, Hubbard, and Petersen (FHP, 1988,2000) to measure the financial constraint and find that some firms that are financially constrained according to the cash flow sensitivity of investment do not have any financial constraints. Moving forward, Lamont *et al.* (2001) construct the KZ index on the basis of the study of Kaplan and Zingale (1997). Lin and Bo (2012) analyze the magnitude of financial constraint in Chinese listed firms between 1999 to 2008 by using the KZ index. In general, they show that Chinese listed firms are financially constrained. Additionally, Whited and Wu (2006) build up the WW index based on the KZ index. These measurements of financial constraint have both advantages and disadvantages. The cash flow sensitivity of investment is the first measurement of financial constraint and has been widely adopted by researchers. But this measurement is constructed based on the theory that investment of financially constrained firms relies more on their internal cash flow. A higher magnitude of cash flow sensitivity of cash indicates that a firm is more financially constrained. However, the result of Fazzari, Hubbard, and Petersen (FHP, 1988,2000) seems not robust and some later empirical work contradicts their conclusion. (Kaplan and Zingale, 1997) The method that uses a single indicator of firms as the measurement of financial constraint is quite straightforward and easy-to-operate while this method is limited because it cannot distinguish the magnitude of the financial constraint of different firms. Accordingly, this paper adopts several measurements of financial constraints, including WW index, dividend payout ratio, and firm size.

The definition of working capital refers to the aggregation of current asset and current liabilities. It represents the level and the usage of short-term resources of a firm. Working capital can be easily transferred to cash and enable the firm to smooth its internal cash flow. Besides, more working capital promotes the sale and revenue, which can accelerate the development of firms. If a firm has a high level of inventory, it can quickly get cash by selling its inventory. Apart from that, holding inventory reduces the selling cost caused by a shortage of finished good. (Blinder and Maccini, 1991; Fazzari and Petersen, 1993). Moreover, firms can promote their sales by offering loans on credit through the existing inventory. Business credit furnished an opportunity for price discrimination and helps firms maintain a long-term stable relationship with customers. The firm can choose to collect the account

receivable to raise the level of cash holding confronted with cash flow shock. (Brennan et al., 1988; Long et al., 1993 and Summers and Wilson, 2002). Meantime, other financial factors such as short debt, capital expenditure and firm size and Tobin Q, etc. play an important part in the level of cash holding. Firms with more short debt, less expenditure, and higher Tobin Q tend to hold more cash.

Numerous empirical work has proved that divestiture, share transfer, merger, acquisition, and asset replacement could significantly affect the firm performance and stock return in developed countries. (John and Ofek, 1995; Mulherin and Boone, 2000; Clubb and Stouraitis, 2002) Huang and Chen (2012) document that Chinese firms may choose to sell out some of their old fixed assets to finance new projects or new assets. Moreover, some researchers demonstrate that when firms are facing severe financial constraint, selling old fixed assets can increase the wealth and profit of the firm, thus improve the cash holding and cash flow. However, the influence of selling a fixed asset on the cash flow sensitivity of cash has not been studied up till now.

Taking all the existing research into consideration, the cash flow sensitivity of cash in Chinese firms is a valuable research topic. Firms with different financial constraint and different direction of internal cash flow may differ in the cash flow sensitivity of cash. Other financial factors such as the working capital are likely to influence the magnitude of cash flow sensitivity of cash. Based on the existing literature and research, this paper presents the following hypotheses:

Hypothesis 1: Generally speaking, the cash flow is negatively sensitive to cash in Chines firms

Hypothesis 2: The cash flow sensitivity of cash is asymmetric to the direction of the cash flow. The cash flow sensitivity is positive when a firm faces negative cash flows and vice versa.

Hypothesis 3: The magnitude of cash flow sensitivity of cash are different between firms that face different content of financial constraints. The cash flow is more sensitive to cash holding for the firms which face more severe financial constraints.

Hypothesis 4: Since working capital can be easily transferred to cash, firms with more working capital tend to hold less cash.

Hypothesis 5: Selling fixed asset in a financial year brings out the wealth effect to the firm, thus decreasing the level of cash holding.

3.Methodology

3.1 Regression Model

The methodology in this paper is based on Almeida et al (2004) but adds some modification. The regression model is as follows

$$\Delta CashHoldings_{it} = \alpha_0 + \alpha_1 CashFlow_{it} + \alpha_2 Neg_{it} + \alpha_3 Neg * CashFlow_{it} + \alpha_4 Expenditure_{it} + \alpha_5 ShortDebt_{i,t-1} + \alpha_6 \Delta NCWC_{it} + \alpha_7 Size_{it} + \alpha_8 Q_{it} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The variable *ΔCashHoldings* is the difference in cash between year *t* and year *t−1* divided by total assets. The variable *CashFlow* is earnings before extraordinary items and depreciation divided by total assets, which equals the sum of net profit and depreciation. *Q* is the sum of the market value of equity and total book assets minus the book value of equity divided by the book value of total assets, *Size* is the natural log of total assets, *Expenditure* is capital expenditures divided by total assets. *NCWC* is net non-cash working capital (working capital minus cash) divided by total assets and *ΔNCWC* is *NCWC* in year t minus *NCWC* in year *t−1*, and *ShortDebt* is short-term debt divided by total assets. *FixedAssetSales* is the income that the firm earned by selling its fixed asset.

Based on the regression model in Bao et al (2012), we add the dummy variable *Neg* and the interaction variable *Neg*Cashflow* to examine whether there is an asymmetry of cashflow sensitivity in firms with different cashflow.

If we employ the OLS regression to analyze the result, we might be bothered by the endogeneity in the following two ways. Firstly, there exists simultaneous causality between a firm's cash holding and financial constraint. Firm's severe financial constraint may due to lack of cash. Second, the special feature of dynamic panel data can lead to the problem of the omitted variable. For example, some management system factors that can not be easily observed and measured such as entrepreneurship may also influence the level of cash holding. Giving the above considerations, this paper implements the system GMM method to solve the endogenous problem. (Arellano and Bond,1991; Blundell and Bond, 1998).

This paper uses two methods to check whether if it is reasonable to use the system GMM method. First, *m(n)* test is included to examine *n-th* autocorrelation of regression errors. If the regression results can exclude the possibility of n-th autocorrelation of errors, the results are explainable. If the regression results cannot exclude the n-th autocorrelation of errors, then we should further set the *n+1* regression

to solve the autocorrelation of instrument variables. The null hypothesis of m(n) test is there does not exist any autocorrelation problem of regression errors in the model. Additionally, this paper also uses the Sargan test to check whether there is an overidentified problem in the instrument variables. The null hypothesis of the Sargan test is there isn't any overidentified in the regression model.

According to the above hypothesis, the GMM estimation of α_1 should be negative, which means that the cash holding is negatively sensitive to cash flow. In order to verify there is an asymmetry in the cash flow sensitivity of cash in Chinese listed firms, we expect the estimation of α_3 to be positive. A possible explanation of this phenomenon would be that firms with negative cash flow tend to use cash to financially support those existing projects. Besides, variable *Size* which represents the level of firm asset is used to decrease the scale effect of cash saving. Tobin Q measures the firm's future investment opportunity, because the investment opportunity may affect the cash holding in the future. The reason why expenditure is contained in the model is that capital expenditure decreases the future cash holding. Non-cash working capital plays a role as the cash equivalent in this model. If the firm has a high level of short debt at the beginning of the year, it is more likely that this firm tends to have a high outflow of cash flow this year. The higher possibility of cash outflow gives firms more incentives to save money.

3.2 Measurement of financial constraint

Based on the existing literature, this paper uses three ways to measure financial constraint: WW index, firm size, and payment of cash dividend.

Whited and Wu (2006) construct an index to measure the financial constraint. Compared to the KZ index raised in the Kaplan and Zingals (1997), Whited and Wu believe WW index is more in accordance with the features of financial constraint. The process of constructing the WW index is as follows.

$$\text{WW } index_{it} = -0.091 \times CashFlow_{it} - 0.662 \times DIVPOS_{it} + 0.021 \times TLTD_{it} - 0.44 \times Size_{it} + 0.102 \times ISG_{it} - 0.035 \times SG_{it}$$

where $\text{CashFlow}_{\text{it}}$ is the ratio of cash flow to the firm i's total asset in year t. $DIVPOS_{\text{it}}$ is a dummy variable which equals to one if the firm i pays cash dividend to the shareholders in year t $TLTD_{it}$ is the ratio of long-term debt to total asset. $Size_{it}$ is the logarithm of firm i's total asset in year t. ISG_{it} is the sales growth rate of the industry where the firm i belongs to according to the SIC in year

t code and SG_{it} is the sales growth rate of firm i in year t.

In each fiscal year, this paper sorts the sample firms in terms of the level of WW index. A firm with a higher WW index tends to face more severe financial constraint. Firms with WW index greater than the median level of the whole sample is viewed as those faced with more serious financial constraint. This paper also treats those firms whose WW index is less than the median level of the full sample as the ones that are not seriously financially constraint.

Almeidia (2004) raises several measurements that can evaluate the level of financial constraint, which includes dividend payment level, firm size, rating of a corporate bond, rating of commercial paper, and KZ index. Taking the data in WRDS database into consideration, this paper also chooses the firm size and dividend payment as the measurement of financial constraint.

Firm size has been widely adopted to measure the degree of financial constraint. (Guariglia, 2008) The existing literature has shown that small firms are hard to get financed from banks because of the lack of collateral and credit record, especially the long term debt. (Beck et al., 2011; Berger and Udell, 2006) On the contrary, large firms are more likely to get external financing. (Kusnadi and Wei, 2011). As a result, this paper ranks the sample firms in terms of the total asset and treat firm with total asset below the median level of the whole sample as those financially constrained firms.

Bao et al. (2012) have proved that if a firm does not pay a cash dividend to its shareholder in the fiscal year *t*, it is more likely to be financially constrained. The payment of a cash dividend in year *t* indicates that not only the firm has a positive and significant profit, but also the firm has more ample cash on its balance sheet. Given these reasons, this paper employs whether the firm pays a cash dividend in fiscal year *t* as a measurement of financial constraint.

3.3 Regression model including sales of the fixed asset

Next, this paper modifies the basic regression model by adding the dummy variable of sales of the fixed asset, $AssetSales_{it}$, which equals to one if the firm sales its fixed asset within the fiscal. year. I also consider the interaction variable $CashFlow * AssetSales_{it}$

$$\Delta CashHoldings_{it} = \beta_0 + \beta_1 CashFlow_{it} + \beta_2 AssetSales_{it} + \beta_3 AssetSales * CashFlow_{it} + \beta_4 Expenditure_{it} + \beta_5 ShortDebt_{i,t-1} + \beta_6 \Delta NCWC_{it} + \beta_7 Size_{it} + \beta_8 Q_{it} + \varepsilon_{it} \quad (2)$$

The definition of variables in model (2) is just the same as that in model (1). According to the hypothesis, β_2 should be positive, which indicates that selling fixed asset can increase the cash holding.

Furthermore, we expect the estimation of β_3 should be positive. That is to say, if a firm sells its fixed asset in a fiscal year, its cash holding tens to be more sensitive to the cash flow. The possible mechanism is that selling fixed asset would increase the cash flow, the risk-averse firm tends to save a proportion of money out of the increased cash flow.

4.Data

This paper collects financial data on firms from the Compustat Database from Wharton Research Data Service. The sample includes all the listed firms whose stocks are traded in Shanghai and Shenzhen Exchange. This paper deletes the samples where the key variables are missing. Additionally, I trim all variables at the upper and lower 1 percentile to mitigate the outliers and eradicate error. (G Guaiglia, 2016)

Table 1 Sample Summary Statistics

This table reports the descriptive statistics and mean comparisons of the variables in basic regression. The variable *ΔCashHoldings* is the difference in cash between year *t* and year *t−1* divided by total assets. The variable *CashFlow* is earnings before extraordinary items and depreciation divided by total assets, which equals the sum of net profit and depreciation. *Q* is the sum of the market value of equity and total book assets minus the book value of equity divided by the book value of total assets, *Size* is the natural log of total assets, *Expenditure* is capital expenditures divided by total assets. *NCWC* is net non-cash working capital (working capital minus cash) divided by total assets and *ΔNCWC* is *NCWC* in year t minus *NCWC* in year *t−1*, and *ShortDebt* is short-term debt divided by total assets. *FixedAssetSales* is the income that the firm earned by selling its fixed asset.

Variables	Obs	Mean	St.Dev.	Min	Max
ΔCashHoldings	27385	0.018	0.114	-0.268	0.518
CashFlow	27385	.060	.062	-.230	.222
Expenditure	27385	0.048	0.051	-0.040	0.239
NCWC	27076	-681.52	4245.03	-30100	8754.57
ΔNCWC	22820	0.006	0.103	-0.295	0.358
ShortDebt	25724	0.107	0.110	0	0.476
Size	27385	22.053	1.423	19.276	27.072
Q	27385	2.219	2.110	0.122	12.300
FixedAssetSales	26411	0.003	0.010	0.000	0.070

Table 1 reports the descriptive statistics of the key regression variables. The mean change in cash holding *(ΔCashHoldings*) is 0.018, showing that there is only a small change in the firm' cash holdings in the full sample. On average, cash flow accounts for about 6% of the firm's total asset. As for the

non-cash working capital (*NCWC*), the sample has -681.52 million yuan non-cash working capital on average, which indicates that firms have less current asset than current liability. Similar to the change in cash holding, there is a tiny small change (0.6%) in the firm's non-cash working capital as well. When we turn to other control variables, the *ShortDebt* has a mean 0.107 for the full sample, *Q* has a mean 2.219 and *FixedAssetSales* has a mean of 0.003.

Table 2 Pearson and Spearman correlation.

This table reports the descriptive statistics and means comparisons of the variables in basic regression. The variable *ΔCashHoldings* is the difference in cash between year t and year t−1 divided by total assets. The variable *CashFlow* is earnings before extraordinary items and depreciation divided by total assets, which equals the sum of net profit and depreciation. *Q* is the sum of the market value of equity and total book assets minus the book value of equity divided by the book value of total assets, *Size* is the natural log of total assets, *Expenditure* is capital expenditures divided by total assets. *NCWC* is net non-cash working capital (working capital minus cash) divided by total assets and *ΔNCWC* is *NCWC* in year *t* minus *NCWC* in year t−1, and *ShortDebt* is short-term debt divided by total assets. *FixedAssetSales* is the income that the firm earned by selling its fixed asset. * p < 0.1, ** p < 0.05, *** p < 0.01

Variables	ΔCashHoldings	CashFlow	Expenditure	ShortDebt	ΔNCWC	Size	Q	AssetSales
ΔCashHoldings	1							
CashFlow	0.146***	1						
Expenditure	-0.078***	0.218***	1					
ShortDebt	-0.088***	-0.268***	0.017***	1				
ΔNCWC	-0.279***	0.196***	-0.122***	0.193***	1			
Size	-0.048***	-0.011*	-0.044***	0.024***	-0.078***	1		
Q	0.128***	-0.013**	0	0.228***	0.093***	0.519***	1	
FixedAssetSales	-0.006	-0.048***	-0.190***	0.066***	0.041***	0.086***	0.038***	1

Table 2 reports the Pearson and Spearman correlation coefficients between all the variables. While many correlation coefficients are less than 0.3, *Q* and *Size* have a correlation of 0.519. The high correlation shows that the measurement error in *Q* will greatly bias the estimated coefficient of *Size* in the OLS regression. The partial correlation between *ΔCashHoldings* and *CashFlow* is significantly positive. The variables *CashFlow* and *Expenditure* are positively correlated, indicating that firms with higher cash flow are more likely to invest in new projects. The change in non-cash working capital Δ*NCWC* is significantly positively correlated to *CashFlow*. This shows that firms with more working capital have a relatively strong ability to get cash.

Table 3 reports the summary statistics of key regression variables after sorting the full sample firms by the level of cash flow and the WW index. It can be observed in Table 3 that firms with positive cash flow tend to have more cash holding than those with negative cash flow. The same contract holds as for the capital expenditure, non-cash working capital, and the firm size. On the contrary, firms with negative cash flow have more net working capital, short debt, and the sales of fixed asset. There is no significant difference between the two groups. Firms with higher WW index are viewed as ones faced with serious financial constraint. Financially constrained firms tend to have more cash holding, cash flow, capital expenditure, net working capital, and non-cash working capital, but have less short debt and firm size. Besides, we cannot find a significant contract in the Tobin Q and sales of a fixed asset

Table 3 Summary Statistics of Firms with Different Characteristics.

This table reports the descriptive statistics of the variables in terms of a different classification. The variable *ΔCashHoldings* is the difference in cash between year t and year t−1 divided by total assets. The variable *CashFlow* is earnings before extraordinary items and depreciation divided by total assets, which equals the sum of net profit and depreciation. *Q* is the sum of the market value of equity and total book assets minus the book value of equity divided by the book value of total assets, *Size* is the natural log of total assets, *Expenditure* is capital expenditures divided by total assets. *NCWC* is net non-cash working capital (working capital minus cash) divided by total assets, and *ShortDebt* is short-term debt divided by total assets. *FixedAssetSales* is the income that the firm earned by selling its fixed asset. * p < 0.1, ** p < 0.05, *** p < 0.01

Variables		All Firms	Cashflow		WW index	
			CF>0	CF<=0	High	Low
CashHoldings	Mean	0.022	0.024	-0.007	0.027	0.016
	St.Dev.	0.119	0.120	0.091	0.140	0.087
CashFlow	Mean	0.079	0.088	-0.038	0.081	0.076
	St.Dev.	0.065	0.058	0.034	0.072	0.053
Expenditure	Mean	0.062	0.064	0.037	0.064	0.060
	St.Dev.	0.053	0.054	0.043	0.055	0.051
NWC	Mean	-989.4	-1027.7	-453.0	-751.3	-1393.0
	St.Dev.	8749.6	9033.5	2358.6	9926.8	6248.9
ShortDebt	Mean	0.124	0.122	0.148	0.112	0.143
	St.Dev.	0.118	0.117	0.135	0.116	0.118
NCWC	Mean	0.016	0.018	-0.008	0.026	0.005
	St.Dev.	0.093	0.092	0.111	0.095	0.089
Size	Mean	7.829	7.859	7.377	7.162	8.934
	St.Dev.	1.436	1.447	1.164	1.183	1.095
Q	Mean	1.024	1.024	1.023	1.020	1.031
	St.Dev.	0.035	0.035	0.034	0.033	0.037
FixedAssetSales	Mean	0.002	0.002	0.004	0.002	0.002
	St.Dev.	0.007	0.007	0.012	0.008	0.007

5. Empirical Results

5.1 GMM estimation of the basic model

Table 4 reports the estimation results of the model (1) using system GMM method. It shows that the difference in firm's cash holding is negatively sensitive to the cash flow and the estimation is significant under the 1% level, which supports Riddick and Whited (2009) and Bao *et al* (2012). It can conclude from the estimation result that cash holding is negatively sensitive to cash flow among Chinese listed firms. Firm size has a significantly negative relation to the cash holding. Large firms tend to keep less cash on their balance sheet. Column 2 contains the dummy variable *Neg* and the interaction variable *Neg*Cashflow* to check whether there is a difference in cash flow sensitivity among firms with different direction of cash flow. For the firms with negative cash flow, the cash holding is positively sensitive to cash flow while the cash flow sensitivity is negative for the firms with positive cash flow, but this estimation is not significant under the level of 10%. The level of cash holding is still positively related to the cash holding, which is significant under the 1% level. Column 3 adds other variables such as capital expenditure, short debt, and non-cash working capital. It shows that cash holding is negatively sensitive to the cash flow and the estimation is significant under the 1% level. The increase of cash holding is negatively related to the firm size, capital expenditure, and non-cash working capital. Short debt has a significant positive relation to the cash holding, which means that firms with more short debt have to hold more cash in order to pay back the debt in the short run. Tobin Q is still positively related to the cash holding but not significant even under the 10% level. Base on the regression of column 3, column 4 takes the dummy *Neg* and the interaction *Neg*Cashflow* into consideration and finds an asymmetry in the cash flow sensitivity. The estimation of other variables is identical to column 3. Additionally, the Sargan test and AR(2) test of all four estimations are above 0.05, indicating that the choice of instrument variable is reasonable.

Given the estimation result of the basic model, we can get several implications. First, the finding that cash holding is sensitive to cash flow also holds for the Chinese listed firms, which support the research of Almeidia *et al* (2004). Meantime, this paper also proves that cash holding is negatively sensitive to cash flow for Chinese listed firms in general. This finding contradicts the research of Almeidia *et al* (2004) and supports Riddick and Whited (2009). Second, though cash holding is sensitive to cash flow in general, the direction of the sensitivity is different in firms with the diverse direction of cash flow. Cash holding is negatively sensitive to cash flow for the listed firms with

positive cash flow and vice versa. The estimations are both significant even under the level of 1%. This finding is identical to the asymmetry in Bao *et al* (2012). Finally, working capital plays an important role in the change in the firm's cash holding. The estimation results show that non-cash working capital is significantly negative to the increase of cash holding. Firms with more working capital have a stronger ability to change the current asset to cash and this mechanism makes firms keep less cash on their accounts. Working capital plays a role of smoothing in the cash holding.

Table 4 Basic Regression of Model (1).

This table reports the GMM estimation result of the model (1). The variable *ΔCashHoldings* is the difference in cash between year t and year t−1 divided by total assets. The variable *CashFlow* is earnings before extraordinary items and depreciation divided by total assets, which equals the sum of net profit and depreciation. *Neg* is a dummy variable which equals one if the firm *i* has negative cash flow in year *t*. *Size* is the natural log of total assets, *Expenditure* is capital expenditures divided by total assets. *NCWC* is net non-cash working capital (working capital minus cash) divided by total assets, and ΔNCWC is the difference of *NCWC* between year *t* and *t-1*. *ShortDebt* is short-term debt divided by total assets. *Q* is the sum of the market value of equity and total book assets minus the book value of equity divided by the book value of total assets, *AssetSales* is the income that the firm earned by selling its fixed asset. * p < 0.1, ** p < 0.05, *** p < 0.01

	Dependent Variable: ΔCashHoldings			
Variables	(1)	(2)	(3)	(4)
CashFlow	-1.451***	-0.373	-1.611***	-1.446***
	(0.164)	(0.324)	(0.184)	(0.379)
Neg		-0.059**		-0.121***
		(0.023)		-0.025
Neg∗CashFlow		1.375***		2.589***
		(0.428)		(0.541)
Size	-0.010***	-0.135***	-0.051***	-0.083***
	(0.004)	(0.039)	(0.006)	(0.024)
Expenditure			-0.310***	-0.429***
			(0.054)	(0.075)
ShortDebt			0.270***	0.713***
			(0.034)	(0.189)
ΔNCWC			-0.068***	-0.072***
			(0.022)	(0.023)
Q	0.712	1.53	0.866	0.976
	(0.509)	(1.094)	(0.65)	(0.712)
Constant	-0.535	-0.41	-0.369	-0.218
	(0.493)	(1.079)	(0.623)	(0.758)
AR(2)	0.058	0.298	0.323	0.314
Sargan test	0.526	0.046	0.393	0.098
Observations	23106	23106	21496	21496

5.2 GMM estimation of the firms with different financial constraint

In order to examine whether the cash flow sensitivity differs among firms with different financial constraint, this paper categorizes the full sample into two groups according to the WW index, firm size and whether pay a cash dividend. Firms with above median level are viewed as financially constrained ones. Generally speaking, cash flow sensitivity differs in firms with different financial constraint. Table 5 shows that whatever indicator that we employ to measure the degree of financial constraint, cash holding tend to be much more sensitive to cash flow in firms with more serious financial constraint. This finding indicates that the cash holding on the balance sheet is more sensitive to the firm's cash flow among Chinese listed firms. Firms with severe financial constraint rely more heavily on internal financing, which means that firms are more likely to get financed by its cash holding. Furthermore, column 1 to 4 shows that the smoothing effect of working capital becomes more prominent when firms are faced with serious financial constraint. It proves from a side perspective that working capital is an effective tool for remitting the financial constraint. Finally, the magnitude of short-term debt becomes larger in financially constrained firms, which indicates that external money is more efficient when firms facing severe financial constraint.

Table 5 Regression of Firms with Different Financial Constraint.

This table reports the GMM estimation result of the model (1) but categorizes the full sample firms into two groups by WW index, firm size and whether the firm pays dividends in a fiscal year. The two Fazzari represent the firms that face serious financial constraint and loose financial constraint. The variable *ΔCashHoldings* is the difference in cash between year t and year t−1 divided by total assets. The variable *CashFlow* is earnings before extraordinary items and depreciation divided by total assets, which equals the sum of net profit and depreciation. *Neg* is a dummy variable which equals one if the firm *i* has negative cash flow in year *t*. *Size* is the natural log of total assets, *Expenditure* is capital expenditures divided by total assets. *NCWC* is net non-cash working capital (working capital minus cash) divided by total assets, and ΔNCWC is the difference of *NCWC* between year *t* and *t-1*. *ShortDebt* is short-term debt divided by total assets. *Q* is the sum of the market value of equity and total book assets minus the book value of equity divided by the book value of total assets, *AssetSales* is the income that the firm earned by selling its fixed asset. * p < 0.1, ** p < 0.05, *** p < 0.01

Variables	Dependent Variable: ΔCashHoldings					
	WW index		Size		Dividends	
	(1) High	(2) Low	(3) Small	(4) Large	(5) Div<0	(6) Div>=0
CashFlow	-8.171***	-0.362	-6.988***	-0.562**	-2.942**	-1.236***
	(1.525)	(0.243)	(1.526)	(0.239)	(1.330)	(0.263)
Neg	-0.533***	-0.039**	-0.534***	-0.074***	-0.314**	-0.101***
	(0.101)	(0.016)	(0.111)	(0.023)	(0.133)	(0.017)

Neg∗CashFlow	10.601***	0.864**	9.248***	1.896***	4.841**	2.242***
	(1.937)	(0.390)	(1.942)	(0.498)	(2.231)	(0.359)
ΔNCWC	-1.537**	-0.187***	-2.192**	-0.869**	-0.096	-0.070***
	(0.638)	(0.022)	(0.856)	(0.356)	(0.475)	(0.023)
ShortDebt	0.953***	0.101***	1.199***	0.238***	0.399	0.355***
	(0.233)	(0.026)	(0.255)	(0.087)	(2.837)	(0.051)
Expenditure	-0.022	-0.376***	-0.317	-0.541***	1.014	-0.485***
	(0.263)	(0.042)	(0.238)	(0.131)	(0.808)	(0.057)
Size	-0.334***	0.014	-0.164*	-0.080	-0.160	-0.057***
	(0.118)	(0.019)	(0.088)	(0.054)	(0.119)	(0.021)
Q	0.186	-0.468**	-1.197	-0.147	-0.159	0.197
	(1.353)	(0.206)	(1.688)	(0.344)	(2.060)	(0.210)
Constant	2.982*	0.410	2.913*	0.957*	1.548	0.413***
	(1.605)	(0.306)	(1.608)	(0.580)	(2.207)	(0.099)
AR(2)	0.784	0.659	0.081	0.706	0.587	0.608
Sargan test	0.096	0.107	0.063	0.064	0.593	0.068
Observations	11553	11553	11553	11553	422	22684

5.3 GMM estimation of the model including sales of the fixed asset.

The existing literature does not take the sales of fixed asset into consideration, but firms with severe financial constraint are more likely to sell its fixed asset to get financed in the short run. In this paper, I try to examine whether selling fixed asset could affect the cash flow sensitivity. This paper adds the dummy variable *AssetSales* (equals one if the firm sells its fixed asset in a fiscal year and zero otherwise) into the basic model and Table 6 reports the estimation results. Following the method of Table 5, I just categorize the full sample firms by the direction of cash flow.

Column 1 and 2 do not include the sales of a fixed asset. We can see that the estimation result is consistent with that in Table 5: there is an asymmetry of the cash flow sensitivity in the firms with different direction of cash flow. Column 3 and 4 take the sales of fixed asset into consideration. It shows that cash holding is positively sensitive to cash flow regardless of the direction of cash flow. This indicates that firms that sell their fixed asset in a fiscal year tend to save most of the income on their account in case of emergency. Selling fixed asset brings a wealth effect to the firms.

For those firms with positive cash flow, cash holding is much more sensitive to cash flow among

firms that do not sell their fixed asset in a fiscal year, That means that a small increase of cash flow would decrease the cash holding sharply. For those firms that sell their fixed asset in a fiscal year, the magnitude of cash flow sensitivity of cash is smaller. However, for those firms with negative cash flow, cash holding is negatively sensitive to cash flow among firms that do not sell their fixed asset in a fiscal year but positively sensitive to cash flow among firms that sell their fixed asset in a fiscal year.

Table 6 Regression of Model with Sales of the Fixed Asset.

This table reports the GMM estimation result of the model (1) but categorizes the full sample firms into two groups by WW index, firm size and whether the firm pays dividends in a fiscal year. The two groups represent the firms that face serious financial constraint and loose financial constraint. The variable *ΔCashHoldings* is the difference in cash between year t and year t−1 divided by total assets. The variable *CashFlow* is earnings before extraordinary items and depreciation divided by total assets, which equals the sum of net profit and depreciation. *Neg* is a dummy variable which equals one if the firm *i* has negative cash flow in year *t*. *Size* is the natural log of total assets, *Expenditure* is capital expenditures divided by total assets. *NCWC* is net non-cash working capital (working capital minus cash) divided by total assets, and ΔNCWC is the difference of *NCWC* between year *t* and *t-1*. *ShortDebt* is short-term debt divided by total assets. *Q* is the sum of the market value of equity and total book assets minus the book value of equity divided by the book value of total assets, *AssetSales* is the income that the firm earned by selling its fixed asset. * p < 0.1, ** p < 0.05, *** p < 0.01

	Dependent Variable: ΔCashHoldings			
Variables	(1)	(2)	(3)	(4)
	CF>0	CF<=0	CF>0	CF<=0
CashFlow	-1.858***	1.546***	-13.790***	-1.599
	(0.365)	(0.366)	(2.072)	(1.332)
AssetSales			-1.178***	-0.100
			(0.173)	(0.126)
AssetSales∗CashFlow			12.802***	3.114**
			(1.907)	(1.350)
Expenditure	-0.429***	-0.434***	-0.284**	-0.444***
	(0.070)	(0.117)	(0.123)	(0.119)
ShortDebt	0.399***	0.247***	0.402***	0.247***
	(0.072)	(0.056)	(0.057)	(0.064)
Size	-0.087***	-0.019***	-0.070***	-0.008
	(0.029)	(0.006)	(0.011)	(0.009)
ΔNCWC	-0.043*	-0.254***	-0.010	-0.208***
	(0.026)	(0.057)	(0.044)	(0.063)
Q	0.385	-0.606	0.067	0.072
	(0.303)	(0.909)	(1.149)	(1.152)
Constant	0.448***	0.763	1.823*	0.069
	(0.124)	(0.899)	(1.090)	(1.133)
AR(2)	0.449	0.204	0.687	0.530
Sargan test	0.346	0.775	0.061	0.937
Observations	20,832	1,386	20,860	1,386

6. Robustness Check

The main robustness checks of this paper are some modification to the form of the regression model. Riddick and Whited (2009) show that the form of cash flow sensitivity to cash might be non-linear for those large or intermediate firms. So this paper takes the non-linear effect into consideration. Following the research of Peterson (2011), this paper also includes the lagged effect of independent variables. Table 7 shows the regression results of the robustness check.

Column 1 adds the squared *CashFlow* into regression. The estimation of the independent variables is positive and significant under the 1% level. Moreover, this estimation of independent variables is consistent with the result of basic regression. Column 2 considers the potential effect of lag variables. The estimation of variable *L.CashFlow* is negative and significant, indicating that there is a negative relationship between one-period lag cash flow and cash holding. The estimation of other variables is similar as the result in Table 4. In a word, the change of the regression model does not affect the main estimation, which proves that the regression result of this paper is quite robust.

Table 7 Robustness Check.

This table reports the GMM estimation result of the robustness check. The variable *ΔCashHoldings* is the difference in cash between year *t* and year *t−1* divided by total assets. The variable *CashFlow* is earnings before extraordinary items and depreciation divided by total assets, which equals the sum of net profit and depreciation.*Sqr_Cashflow* is the square of *CashFlow* in year *t*. *Size* is the natural log of total assets, *Expenditure* is capital expenditures divided by total assets. *NCWC* is net non-cash working capital (working capital minus cash) divided by total assets, and ΔNCWC is the difference of *NCWC* between year *t* and *t-1*.ShortDebt is short-term debt divided by total assets. *Q* is the sum of the market value of equity and total book assets minus the book value of equity divided by the book value of total assets, *L.CashFlow, L.Expenditure, and L.*$\Delta NCWC$ are the one-period lag variable of *CashFlow, Expenditure,* and $\Delta NCWC$ respectively. * p < 0.1, ** p < 0.05, *** p < 0.01

Variables	Dependent Variable: ΔCashHoldings	
	(1)	(2)
CashFlow	6.099***	
	(1.051)	
Sqr_Cashflow	-23.912***	
	(4.178)	
Expenditure	-1.071***	
	(0.135)	
ShortDebt	0.860***	
	(0.160)	
Size	-0.228***	0.014
	(0.057)	(0.019)
Q	1.895***	-0.113
	(0.607)	(0.186)

ΔNCWC	-0.290***	
	(0.052)	
L.CashFlow		-0.666**
		(0.314)
L.Expenditure		-1.023***
		(0.248)
L.ΔNCWC		-1.254***
		(0.420)
Constant	-0.421	0.044
	(0.292)	(0.113)
AR(2)	0.357	0.202
Sargan test	0.278	0.056
Observations	22,206	17,016

7. Conclusion

This paper examines whether the cash holding is sensitive to the cash flow among Chinese listed firms from 2009 to 2018. Besides, the analysis also takes the financial constraint faced by Chinese firms into consideration and examines whether the magnitude of cash flow sensitivity differs in firms with different degree of financial constraint. Considering the potential endogenous problems in the panel data of thousands of firms, this paper employs the systematic GMM method.

This paper has proved several conclusions from the regression analysis. First, the phenomenon that cash flow is sensitive to cash also exists in China, and the cash flow is negatively sensitive to cash holding. Second, this paper shows that the cash flow sensitivity of cash varies in terms of firms that have different directions of internal cash flow. The cash holding tends to be negatively sensitive to cash flow for those firms who own positive internal cash flow and vice versa. Third, this paper also demonstrates how the magnitude of cash flow sensitivity of cash differs in firms with varying financial constraint, under the direct and indirect measurement of financial constraint. Firms in the face of more serious financial constraint are more likely to have a higher magnitude of cash flow sensitivity of cash. Besides, this paper gives the evidence that some financial factors such as working capital, expenditure and short debt have an important influence on the cash flow sensitivity of cash. Since working capital is easy to be transferred into cash, firms with more working capital are more likely to hold less cash. Short debt affects the magnitude of cash flow sensitivity of cash in an opposite way. It is an obligation for the firms to pay back the debt in a short time. As a result, more debts especially short debt lead to a higher level of cash holding. Finally, this paper finds an important mechanism that firms with severe financial constraint would sales its fixed asset to gain more working capital and cash in order to sustain

the operation of the company. Sales of a fixed asset can make a huge effect on the magnitude of cash flow sensitivity of cash.

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