CASH HOLDING AND FIRM VALUE: EVIDENCE FROM THE US MARKET FROM 1999 TO 2015

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Abstract

This paper investigates the effect of cash holding on firm value based on a sample of the US industrial firms during the period from 1999 to 2015. The study tests the existence of a linear relationship between cash holdings and firm value. This study also investigates whether there exists an optimum cash level (a non-linear relationship where after a certain level of cash, corporate value declines). This paper uses fixed effect model on unbalanced panel data of listed the US companies (exclude financial firms) during the period of 1999-2015. Our results suggest that there is a positive linear relationship between cash holding and firm value. In addition, the results do also support the hypothesis that there exists an optimum level of cash holding for the US industrial firms from 1999 to 2015.

Keywords: Cash holding; Firm value

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1. Introduction

It is a well-documented fact that U.S. companies hold significant amounts of cash. At the end of fiscal 2015, from Compustat Database, cash was 21.6% of the total assets of the firms, with the percentage increasing over recent years. Apart from that, for many firms, the dollar value of cash holdings was also large. For example, at the end of 2015, cash holdings of Apple, Microsoft, Alphabet/Google, Cisco, and Oracle were respectively $216 billion, $102.6 billion, $73.1 billion, $60.4 billion, and $52.3 billion, which make up 30 percent of all non-financial U.S. companies' cash.

The research on the effect of cash holdings on firm value has received much attention in recent years. According to an article 'Capital Pains: Big Cash Hoards' on The Wall Street Journal, the piles of cash and stockpile of repurchased shares at some companies have hit record levels and continue to grow along with corporate earnings. Some investors carp about managers hoarding cash rather than building their businesses, while data show companies have in fact been reinvesting in themselves, and some are also acquiring other companies. According to S&P research in 2006, 174 S&P Industrials' cash and the companies' holdings in their own stock topped $790 billion in the first quarter, or nearly 20% of their total stock-market value. There is a secular increase in the cash holdings of the typical firm from 1980 to 2006. In a regression of the average cash ratio on a constant and time, the time has a significantly positive coefficient, implying that the average cash ratio has increased by 0.46% per year. That is to say, the average

cash ratio almost doubled during that period, from 10.5% in 1980 to 23.2% in 2006 (Thomas et al., 2009). Following Jensen (1986), we would expect firms with agency problems to accumulate cash if they do not have good investment opportunities and their management does not want to return cash to shareholders. Without agency problems, improvements in information and financial technology since the early 1980s should have led to a reduction in corporate cash holdings. For example, as more types of derivatives have become available, firms can hedge more effectively so the precautionary demand for cash should be lower than 20 years ago. It is, therefore important to analyze the determinants of corporate cash holdings.

Empirical studies have produced mixed results with corporate cash holdings have both positive and negative effects on the firm value. There are several reasons why cash holdings may increase firm's value. First, from the precautionary perspective, as a result of information asymmetry, firm holding enough cash could own flexibility to prevent some unexpected events happening, such as cash shortfalls. Therefore, liquidity constraint costs and the uncertainty of cash flow could be eliminated. Second, from the transaction perspective, firms could use cash holdings to cover their current transaction costs (Keynes, 1936). Third, firms could prevent underinvestment costs by using their own cash. Without raising funds from outside sources, firms could use internal funds to undergo profitable projects. Underinvestment cost can also be used to answer the question why firms give up the opportunities to invest in positive NPV project. As Faulkender and Wang (2006) mentioned that when access to capital becomes more difficult, it is more likely to forgo positive NPV projects. There are also some other motives – income

motive and business motive. Both the income motive and the business motive are dealing with the interval between the time of inflow and the time of outflow. The rapid growth of information technology firms leads to the rising importance of R&D (Research and Development) in the overall economy. R&D is intrinsically connected with uncertainty, which requires firms to hold more cash to deal with it (Juan M. Sánchez and Emircan Yurdagul, 2013). In addition, an increasing share of R&D-intensive firms has entered the stock market with higher cash balances over the last 35 years. (Juliane Begenau and Berardino Palazzo, 2016)

For the negative effects, on the one hand, holding cash may mean opportunity costs. With the same risk level, the return rate on holding cash is much lower than that of other investments. The firm may have to give up some profitable investments to maintain higher liquidity level. In addition, excess cash reserves could cause agency problems between shareholders and managers. Because of the large cash amount, the managers may invest money in inefficient investments to obtain non-pecuniary benefits; while at the same time decrease shareholders' wealth (Jensen and Meckling, 1976).

We follow Cristina Martinez-Sola, Pedro J Garcia-Teruel, Pedro Martinez-Solano's (2011) paper by examining the relationship between cash holdings and firm value. We formulate hypotheses that there is equilibrium for the trade-off between the benefits and costs of cash holdings. Our empirical analysis studies whether there is a positive or negative effect of cash on corporate value and whether there is a non-linear relationship with the turning point being the

optimal result for cash holdings. In order to do this, we employ two models. The first model is based on the hypothesis that there is a linear relationship between cash holding and firm value. The second model is used to investigate whether there is a non-linear relationship (concave) between cash holdings and firm value - an optimal cash level at which to maximize their value. To obtain robustness, two proxies for firm value are used – Tobin's Q and Market-to-Book Ratio. To avoid omitted-variable bias in explaining cash holdings of these firms, five control variables were also included namely the change of CASH, EBIT, intangible assets and firm size. This paper shows empirically that cash holding and firm value have a positive significant relationship, and there exists an optimal level of cash holdings for US industrial firms for a sample of 5,040 companies and 41,095 observations from 1999 to 2015.

The structure of the paper is as following. The second part is the theoretical and empirical literature review on the firm value and cash holdings. The third part focuses on the data, variables, and cash ratio comparison. The next section introduces the regression models and analyzes the effect of cash holdings and other control variables on firm value. The last section contains the conclusion of this study and suggestions for future research in this area.

2. Literature Review

2.1 Theoretical foundation

There are several motives to explain why firms would like to hold much cash. The first one is the Income-motive. There is inconsistence between the time of income and the time of the expenditure. Holding cash can help to make up for the interval between the receipt and disbursement. Cash holding gives corporations liquidity; In other words, corporations are capable of paying off their obligations on time even if there are some emergencies. The second one is the Business-motive. Similar to Income-motive, cash can also be used to bridge the interval between the receipt of sale revenue and the disbursement of business costs. The strength of Business-motive demand mainly lies on the value of present output, the value of present income, and the number of hands through which output passes. The third one is the Precautionary-motive. Cash is beneficial to seize the unforeseen opportunities of advantageous purchases (the transactional motive). Cash holding can also prevent underinvestment cost. Outside funds may require higher costs as a result of adverse selection under information asymmetry circumstance, but as an internal fund, cash can reduce costs and obtain more benefits (Keynes, 1936). What's more, cash also makes a contribution to deal with sudden expenditure. Gill and Shah (2012) highlights that in order to grow sales and profits, firms should build up cash reserves by making sure that the timing of cash movements would lead to an overall positive cash flow situation. Similarly, Cossin and Hricko (2004) illustrated that appropriate cash holding

permits optimal timing of an investment and therefore avoid the underpricing issue. There is also some literature suggests that firms hold cash to protect themselves from the predatory behavior of their competitors. The interdependence of firms' investment opportunities with rivals or market concentration can be used to measure predatory risk. Previous studies indicate that cash holdings increase with the increase of predation risk that firms face. Haushalter, Klasa and Maxwell (2007) and Morellec and Nikolov (2008) argue that firms are likely to save more cash when they have faced more intensive competition. Frederiek and Cynthia Van Hulle (2013) illustrated that cash holdings are worth more when the likelihood of predatory behavior among rivals in a specific industry is higher. They make the conclusion that a firm is more willing to maintain cash reserves when its market share is low. What's more, this relation between market share and cash holdings is most significant when the risk of predation is high. Haushalter, Klasa, and Maxwell (2007) show that when firms choose their cash position, they consider both market concentration and market share (competitive position relative to rivals within the industry). Consequently, cash is viewed as a vital ingredient that lets a business to survive and prosper.

However, holding cash also implies several problems. Holding more cash may lead to opportunity cost and agency problems between managers and shareholders. Opportunity cost means that firms lose some opportunities to profit or benefit. In contrast, lacking monitoring by capital market, the benefit of corporate liquidity in undertaking projects rather than raising outside funds may become a cost (Jensen and Meckling, 1976). The free cash flow could raise managers' discretion, which would decrease shareholders' interest in the meantime (Jensen,

1986). Likewise, Byrd (2010) argues that agency problems between shareholders and managers over payout policies always remained a reason for conflict. Increase in free cash flow is related to the increase in agency conflicts (Masood & Shah, 2014). Different scholars hold different views towards agency cost of holding cash. From Myers and Majluf (1984)‘s perspective, firms should hold large cash balance because it can contribute to financial flexibility and will not lead to any agency cost. However, it is a totally different story for Jensen (1986), who maintained that there is no need for firms to hold large cash balance because it will increase agency costs but has nothing to do with financial flexibility. DeAngelo and DeAngelo (2007) think that cash will influence both financial flexibility and agency cost. They argue that investors need to limit cash of firms to decrease agency costs but in the meanwhile also encourage managers to maintain a cash cushion to obtain financial flexibility. According to Opler, Pinkowitz, Stulz and Williamson (1999), the lower rate of return of these assets is one of the costs of holding liquid assets because of a liquidity premium and tax disadvantages. The extra cash may lead to unwise future investments such as ambitious acquisitions (Lang, Stulz & Walkling, 1991).

The costs and benefits of holding cash suggest that an optimum cash level may exist. Kim et al. (1998) predict that the costs and the benefits of cash holding may be traded off and lead to an optimum cash level. When the marginal costs of cash just offset the marginal benefits, the optimum cash level exists. It is a non-linear (concave) relationship. Consequently, the turning point will represent the maximum value of the company. According to Masood and Shah (2014), maintaining an optimal level of cash is an essential factor of good corporate governance.

2.2 Empirical Studies

There are many different factors that could lead to different cash holding levels, such as growth opportunity, corporate governance, the country's fiscal policy and the companies' financial conditions. Growth opportunity and firm size are main determinants of cash holding. Aydin Ozkan and Neslihan Ozkan (2004) investigates the empirical determinants of corporate cash holdings for a sample of UK firms and the results reveal that firms' growth opportunities, cash flows, liquid assets, leverage and bank debt are important in determining cash holdings. Opler et al. (1999) make the same conclusion about the relationship between growth opportunities and cash holding by collecting data from 1048 publically traded US firms from 1971 to1994 to find the determinants of corporate cash holdings. By doing time-series and cross-section tests, they found that firms with strong growth opportunities and riskier cash flows hold higher ratios of cash than total non-cash assets. Firms that have the greatest access to the capital markets tend to hold lower ratios of cash to total non-cash assets. Jiyoung Kim, Hyunjoon Kim and David Woods (2011) investigate the determinants of cash-holding levels for restaurant firms using a panel data of 125 publicly traded US restaurant firms between 1997 and 2008 and they concluded that investment opportunities influence cash holding level. They also figure out that large restaurant firms are more likely to hold liquid assets other than cash. In line with Kim's research, Megginson and Wei (2010) researched on China's share-issue privatized firms from 1993-2007. They reached the conclusion that smaller firms hold more cash. According to Zhu Jigao and Lu Zhengfei (2003)'s research, firms that grow rapidly tend to hold more cash.

Sulaman Jamil, Amna Anwar, Naila Afzaal, Adnan Tariq, Mohsin Asif (2016) used a sample of 50 Public Limited non-financial companies listed on Karachi Stock Exchange over the period of 2012-2014 and they conclude that firm size significantly affect the corporate cash holdings. However, debt structure, leverage and Return on Asset are non-significant and have a negative association with cash holdings. Hardin et al. (2009) investigated the factors influencing the cash holdings of REITs. By using Ordinary Least Square (OLD) method, they analyze a sample of 1114 observations for 194 real estate investment trusts (REITS) in the US from 1998 and 2006. The results show that cash holdings of REITS have a negative relationship with funds from operations, leverage, and internal advisement.

When it comes to the determinants of firm value, most studies concentrate on the relationship between financial leverage and firm value. The study of Bambang Sudiyatno, Elen Puspitasari and Andi Kartika (2012) shows that company performance as a variable that is affected by the company's policies and influence the value of the company. The study was conducted in Indonesia Stock Exchange (IDX) with a sample of manufacturing firms listed on the IDX in 2008 to 2010 with the purpose of sampling method and the results showed that financial leverage has a significant positive effect on the level of significance of 5% of the value of the company. Thi Phuong Vy Le and Duc Nam Phung (2013) used fixed effect model on data of all listed companies (exclude financial firms and banks) in Hochiminh Stock Exchange during the period of 2008-2011 and concluded an increase in debt leverage of listed firms decrease firm value. However, Walaa Wahid Elkelish and Andrew P. Marshall (2012) investigated the impact

of financial structure on firm value in the United Arab Emirates emerging market by using the financial statements of a stratified random sample of unlisted food firms are analyzed during the period 1996-2000. Empirical results show that debt to equity ratio has no impact on firm value.

There is not much research on the straight link between cash holdings and firm value. Cristina Martínez-Sola and Pedro J. García-Teruel (2011) contrast the effect of cash holding on firm value for a sample of US industrial firms over the period 2001-2007 and verify that there is an optimal level of cash holding. Tiago Rodrigues Loncan and João Frois Caldeira (2014) use panel data regressions the relationship among capital structure, cash holdings, and firm value for a sample of publicly traded Brazilian firms and also concluded that there is an optimum threshold level of cash holding. This paper contributes to figure out the relationship between cash holding and firm value using a more up-to-date database. Moreover, in order to ameliorate the literature, following Cristina and Pedro (2011)'s research, this paper analyzes how the cash holdings affect firm value for a sample of US industrial firms over the period 1999-2015. It hypothesizes that there is an equilibrium for the benefits and costs of cash holdings and tries to find that the optimum cash level.

3. Data and Variables

3.1 Data

The annual data come from COMPUSTAT database (1999 -2015). We collect data about industrial firms, which headquartered in USA. Firms with fewer than 5 years' observations are not included in the sample. We have deleted observations with errors or lost values from the sample. We also eliminated the outliers by deleting the first and last 1 percent of each key variable. The final result is an unbalanced panel containing 5,040 companies and 41,095 observations, which could help us to avoid survival bias.

3.2 Variables

Table 2. Variables and Explanations

Variables	Explanations
CASH	Cash and Short-term investments divided by total assets
CASH2	CASH multiplied by CASH
DCASH	The change of CASH divided by total assets
EBIT	Earning before interest and tax divided by total assets
INT	Intangible Asset divided by Total Assets
MKB1	Market-to-Book Ratio
SIZE	Natural logarithm of total assets
Q	Tobin's Q

The key dependent variable we analyze is Tobin's Q, which is used to replace the firm value. It is common in corporate finance studies to evaluate firm (Tong, 2008; Lin and Su, 2008;

Servaes and Lins, 2008). Tobin's Q is calculated as follows:

$$Q = \frac{Total\ Assets - Book\ Value\ of\ Equity + Market\ Value\ of\ Equity}{Total\ Assets}$$

In order to obtain a more robust result, we use another proxy to represent the firm value. According to Chuang and Pruitt (1994), we can use the following method to approximate Tobin's Q, which is the Market-to-Book Ratio:

$$MKB1 = \frac{Market\ Value\ of\ Assets}{Total\ Assets}$$

Researchers have identified several factors that might explain variations in corporate cash holdings i.e. Size, growth, leverage, dividend payouts, capital expenditures, net working capital, cash flow and profitability (Opler et al. (1999); Chen, 2008; Ammann et al. 2010; Ogundipe, Ogundipe, & Ajao, 2012; Masood & Shah, 2014). Gill and Shah (2010) reveal that firm size largely affect cash holdings of Canadian firms.

CASH (Cash and Short-term investments divided by total assets) is the key independent variable. CASH2 (CASH multiplied by CASH) and CASH are used to determine the turning point. The other important control variables include investment in intangible assets, firm size, and leverage, which McConnell and Servaes (1990), and Morck et al. (1988) consider as important determinants of Tobin's Q. In this paper, we use INT (Intangible Asset divided by Total Assets), DCASH (The change of CASH divided by total assets) and SIZE (Natural logarithm of total assets), to represent the control variables.

Table 3. Summary and Descriptive Statistics

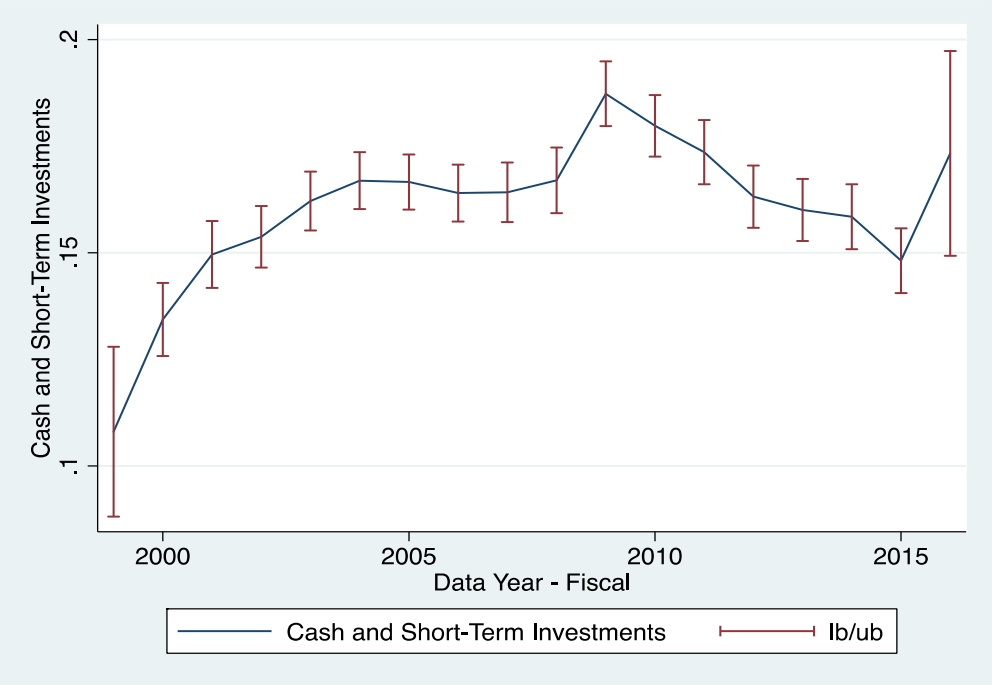
Variable	Obs	Mean	Std. Dev.	Min	Max
Q	41,095	1.739431	0.876419	0.839986	5.488421
MKB1	41,095	1.159092	0.955179	0.091287	4.797709
CASH	41,095	0.162981	0.187285	1.78e-06	0.985004
DCASH	35,917	-0.00014	0.012711	-0.993410	0.493319
EBIT	41,095	0.01397	0.250324	-8.948165	3.40878
SIZE	41,095	6.12726	2.097195	-2.017406	10.9960
INT	41,095	0.192501	0.198367	0.00002	0.99998

Table 3 shows summary and descriptive statistics of all variables regarding to total observations. For the US industrial firms, the mean cash ratio is 16.3%, which is in line with the values in the same market (USA), 10.5% in 1980 and 23.2% in 2006 (Thomas *et al*., 2009), 17% of USA firms reported by Opler (1998), Abel (2008) 15% for Swedish small manufacturing firms (Abel, 2008), 14% for South Korean firms (Lee, 2010), 13.5% for Pakistani firm (Afza, 2006).

3.3 Cash Ratio Comparison

Cash is the main variable in our model. It is really important to figure out the trend of cash ratio as time passes. Therefore, in this part, we investigate the trends of cash ratio for the US industrials from 1999 to 2015.

Figure 1. Cash Ratio Comparison



From this graph, we can obtain that the trend of average cash ratio experienced a huge upward during 2007 to 2009. We observed that firms tend to hold more cash during financial crisis when they are faced with more risk of predation and for precautionary motive. Since 2009, it has decreased dramatically until 2015. That is because the economic situation turned better, the cash holding began to decrease.

4. Methodology

4.1 Models

We use Simple Least Square model to test which of the variables has significant effect on the cash holding decision taken by the US industrial firms. So model 1 is established:

Model 1

$$V_{it} = \beta_0 + \beta_1 CASH_{it} + \beta_2 EBIT_{it} + \beta_3 DCASH_{it} + \beta_4 SIZE_{it} + \beta_5 INT_{it} + \lambda_t + \varepsilon_{it}$$

Where V_{it} represents the firm value of firm i in year t, which we use Tobin's Q and MKB1 to calculate; β represents firm-specific effects; $CASH_{it}$ is cash and short-term investments divided by total assets; $EBIT_{it}$ represents the profitability; $DCASH_{it}$ is the change in CASH holding between the previous year and current year, and INT_{it} measures the growth opportunities; λ_t are dummy variables that change in time but are equal for all firms in each of the periods considered; ε_{it} is the disturbance term.

Model 2

$$V_{it} = \beta_0 + \beta_1 CASH2_{it} + \beta_2 CASH_{it} + \beta_3 DCASH_{it} + \beta_4 LEV_{it} + \beta_5 SIZE_{it} + \beta_6 INT_{it} + \lambda_t + \varepsilon_{it}$$

Kim et al. (1998)'s research reveals that there is an optimum cash level. Model 2 is a non-linear model, which is established based on Cristina Martinez-Sola *et al.* (2012). We added CASH2 (CASH square) to test both transactional and precautionary motives for holding cash,

and whether the optimal level of cash holdings exists. Masood and Shah (2014) claimed that an optimal level of cash is an essential factor of good corporate governance.

4.2 Multicollinearity Test

Table 4. Correlation Matrix for Model 1

	Q	MKB1	CASH	DCASH	EBIT	SIZE	INT
Q	**1.0000**						
MKB1	**0.9411**	**1.0000**					
	0.0000						
CASH	**0.3638**	**0.4553**	**1.0000**				
	0.0000	*0.0000*					
DCASH	**-0.0139**	**-0.0027**	**0.0678**	**1.0000**			
	0.0083	*0.6134*	*0.0000*				
EBIT	**-0.1450**	**-0.0652**	**-0.1997**	**0.1069**	**1.0000**		
	0.0000	*0.0000*	*0.0000*	*0.0000*			
SIZE	**-0.2501**	**-0.2641**	**-0.3044**	**0.0308**	**0.4038**	**1.0000**	
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*		
INT	**0.0685**	**0.0832**	**-0.1626**	**-0.0266**	**-0.0264**	**-0.0340**	**1.0000**
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	

Table 5. Correlation Matrix for Model 2

	Q	MKB1	CASH2	CASH	DCASH	EBIT	SIZE	INT
Q	**1.0000**							
MKB1	**0.9411**	**1.0000**						
	0.0000							
CASH2	**0.3110**	**0.3834**	**1.0000**					
	0.0000	*0.0000*						
CASH	**0.3638**	**0.4553**	**0.9354**	**1.0000**				
	0.0000	*0.0000*	*0.0000*					
DCASH	**-0.0139**	**-0.0027**	**0.0747**	**0.0678**	**1.0000**			
	0.0083	*0.6134*	*0.0000*	*0.0000*				
EBIT	**-0.1450**	**-0.0652**	**-0.2201**	**-0.1997**	**0.1069**	**1.0000**		
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*			
SIZE	**-0.2501**	**-0.2641**	**-0.2668**	**-0.3044**	**0.0308**	**0.4038**	**1.0000**	
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*		
INT	**0.0685**	**0.0832**	**-0.1732**	**-0.1626**	**-0.0266**	**-0.0264**	**-0.0340**	**1.0000**
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	

Table 4 and table 5 above describe the correlation matrix of the key variables. We test the multi-collinearity using 5% significant level, and find that no high correlations exist among these independent variables. As a result, there is no significant multi-collinearity problem.

4.3 Fixed Effect vs. Random Effect

According to the Hausman Test, all the results show that the Prob > chi2 = 0.0000. Therefore, we don't accept the H0, which proves that the fixed effect is in a dominance place.

Table 6. Effect Tests[1]

	Model 1		Model 2	
	(1) Q	(2) MKB1	(1) Q	(2) MKB1
Fixed Effect	✔	✔	✔	✔
Random Effect				

[1] *See details in Appendix 1*

5. Regression Results

5.1 Total Regression Results

Table 7. Total Regression Results[1]

	MODEL 1		MODEL 2	
	(1) Q	(2) MKB1	(1) Q	(2) MKB1
CASH2			-0.941***	-1.293***
			(-4.62)	(-6.37)
CASH	0.647***	1.118***	1.266***	1.969***
	(9.00)	(15.11)	(9.19)	(14.04)
DCASH	-1.448**	-2.168***	-1.395**	-2.095***
	(-2.75)	(-3.46)	(-2.63)	(-3.37)
EBIT	0.315***	0.588***	0.314***	0.586***
	(4.51)	(7.70)	(4.49)	(7.69)
SIZE	-0.234***	-0.177***	-0.228***	-0.169***
	(-15.26)	(-11.18)	(-14.90)	(-10.74)
INT	-0.342***	-0.226**	-0.347***	-0.234**
	(-4.87)	(-3.13)	(-4.96)	(-3.24)
_cons	3.298***	2.157***	3.215***	2.044***
	(30.64)	(19.48)	(29.73)	(18.51)
N	35917	35917	35917	35917
adj. R-sq	0.130	0.151	0.132	0.155

T statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Table 7 reveals the results of the regression of model 1 using two different proxies for firm

[1] The results do not show the coefficients and t-test statistics of year dummy variables

value. In the first and the third columns the calculation of firm value is Tobin´s Q (Q). In the second and forth columns Market-to-Book Ratio (MKB1) is proxy for firm value.

Consistent with expectation, we can obtain the conclusions that there is a positive relationship between cash holding (CASH) and firm value at 1% significant level under model 1. Different proxies for firm value (Q, MKB1) indicate the robustness of the conclusion. Therefore, if the firm holds more cash, it could increase the firm value potentially.

For other control variables, EBIT has a 1% significant positive relationship with the firm values for both Tobin's Q (Q) and Market-to Book Ratio (MKB1), showing that the firm value increases as the profitability increases. INT (Intangible assets) has a negative impact on firm value at less than 5% significant level, which is in line with Lin and Su (2008), who also find a negative relation for growth opportunities. This result shows that firms with higher growth opportunities have a lower value on the stock market. One explanation might be that firms with more growth opportunities could face higher unsystematic risk (Cao, Simin and Zhao, 2008), and following Shin and Stulz (2000), Tobin's Q decreases with the firm's unsystematic risk, showing that investment opportunities do not mitigate the adverse impact of increase of risk on firm's value. Besides, the coefficients between SIZE and the firm value are negative and significant at 1% level, which is in line with Le Tuan Bach *et al.* (2014), who showed a 5 % negative significant level.

For model 2, we assume there exists a non-linear relationship between cash holding (CASH) and firm value and we add a variable - CASH2, which is the square of CASH. The significance at 1% level and negative coefficients of CASH2 for both models demonstrate the robustness of our findings regarding to the non-linear relationship. This result is consistent with Cristina Martinez-Sola, Pedro J Garcia-Teruel, Pedro Martinez-Solano's (2011) study, which shows that cash holding increases the value of the firm up to the breakpoint, after which, increases in the cash holding reduces the firm value. And also, the significance and coefficient of other control variables do not have many changes.

6. Conclusion

Following the previous research, this paper aims to analyze the relationship between firm value and cash holdings. A sample of 41,095 observations the US industrial firms from 1999 to 2015 were chosen to study the whole situation. Firstly, we empirically test the linear relationship between firm value and cash holdings along with the other control variables. Secondly, the non-linear relationship is established to find whether the optimal cash level exist to maximize the firm value. The results confirm that there exists a level of cash holding which maximizes firm value. This level varies depending on firm specifics like growth potential, the change of cash, size and profitability.

It is still important in future work to figure out the other control variables to make the regression results more robust. What's more, if we had more time, we would test whether deviation from the optimum level would decrease the firm value. Additionally, a separation of every industry could be made to undergo a detailed analysis.

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Appendix 1

Table 1. Test the Effect of MKB1 in Model 1

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
CASH	1.181034	1.654702	-.4736685	.0242599
DCASH	-2.097659	-1.907818	-.1898408	.1409511
EBIT	.6014391	.4081101	.193329	.0129463
SIZE	-.1720812	-.1292575	-.0428237	.0060186
INT	-.1643043	.1800073	-.3443116	.0276531

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 822.80
Prob>chi2 = 0.0000

In this part, we use MKB1 to replace the firm value, and CASH, EBIT, SIZE, INV and DCASH as the independent variables. Based on the result that the Prob>chi2 = 0.0000, the test doesn't accept the H0, proving that the fixed effect is in a dominance place.

Table 2. Test the Effect of Q in Model 1

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
CASH	.7116331	1.076437	-.3648034	.0241553
DCASH	-1.380852	-1.390288	.0094363	.1405435
EBIT	.3063768	.0953593	.2110175	.012901
SIZE	-.1968315	-.1288051	-.0680264	.0059667
INT	-.2851576	-.0260921	-.2590655	.0274877

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 831.68
Prob>chi2 = 0.0000

In this part, we use Q to replace the firm value, and CASH, EBIT, SIZE, INV and LEV as the independent variables. Based on the result that the Prob>chi2 = 0.0000, the test doesn't

accept the H0, proving that the fixed effect is in a dominance place.

Table 3. Test the Effect of MKB1 in Model 2

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
CASH2	-1.194444	-1.348399	.1539554	.042263
CASH	1.963048	2.543773	-.5807246	.036639
DCASH	-2.026619	-1.80189	-.2247294	.1409861
EBIT	.6022645	.3969127	.2053519	.0129477
SIZE	-.1688419	-.1263674	-.0424745	.006024
INT	-.1719291	.1736232	-.3455524	.0276841

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 870.37
Prob>chi2 = 0.0000

In this part, we use MKB1 to replace the firm value, and add CASH2 to the independent variables compared with Model 1. Based on the result that the Prob>chi2 = 0.0000, the test doesn't accept the H0, proving that the fixed effect is in a dominance place.

Table 4. Test the Effect of Q in Model 2

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
CASH2	-.9428647	-1.007289	.0644243	.0422659
CASH	1.328936	1.738376	-.4094402	.0365558
DCASH	-1.324775	-1.311362	-.0134129	.1404397
EBIT	.3070283	.0873945	.2196338	.0128822
SIZE	-.1942745	-.1267725	-.067502	.0059684
INT	-.2911764	-.0324296	-.2587468	.0274839

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 853.30
Prob>chi2 = 0.0000

In this part, we use Q to replace the firm value, and add CASH2 to the independent variables compared with Model 2. Based on the result that the Prob>chi2 = 0.0000, the test doesn't accept the H0, proving that the fixed effect is in a dominance place.