

Why Do U.S. Firms Hold Too Much Cash?

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Abstract

U.S. firms have increased their cash to reach a record-high level after the 2008 financial crisis. Based on quarterly data of publicly listed, non-financial U.S. firms between 2001 and 2015, we assess whether cash has become less valuable as cash holdings have increased, and if its effects on firm value have changed after the 2008 financial crisis. Our evidence suggests that the relation between cash holdings and firm characteristics has changed for the post-crisis period. Unlike the pre-crisis period, the value of cash falls after the financial crisis, implying that large cash holdings are less appreciated by the market, lowering the firm value. This implies that the agency motive well explains the increase in cash holding after the 2008 financial crisis.

Key words: cash holding, firm value, agency costs, investment, financial crisis

JEL code: G01, G32

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1. Introduction

Over the last decades, U.S. firms have accumulated record-high levels of cash holdings. The increasing pattern in cash holding is persistent after the 2008 financial crisis. The annual average cash ratio until 2009 was around 8.8 percent, while after that point the cash ratio was above 10 percent. After going through the exogenous shock, firms are increasingly holding large amount of cash. While firms can benefit from seemingly excess cash due to a precautionary savings role in times of dislocation in market for external capital, the benefit from large cash holding no longer holds due to the potential for managerial entrenchment out of agency problems (e.g., Dittmar and Mahrt-Smith, 2007; Harford, 1999; Harford et al., 2008; Pinkowitz et al., 2006). Moreover, corporate environments suggest that firms might not necessarily benefit from increasing their cash holdings after the 2008 crisis. For example, aggregate investment had declined, suggesting firms have smaller investment or growth opportunities. In addition, aggregate bank lending has increased, suggesting that firms can borrow from banks more easily. Such observations suggest that large cash holding does not help firm exploit investment opportunities or avoid refinancing risk and, neither the precautionary motive (i.e., the need to hold cash as a safety margin to avoid financial distress costs) nor the transaction motive (i.e., the need to hold cash to satisfy transaction activities) fully explain why firms increase cash holding.

Motivated by this observation, we argue that the agency motive is a main driver for the recent increase in cash holdings. Specifically, we hypothesize that high cash holding after the 2008 crisis is more explained by agency motive, rather than other motives. Consequently, cash holdings do not contribute to firm value as much as they did before the 2008 crisis. In contrast to previous studies which argue that the precautionary or the transaction motives are the main reason for the increasing trend of cash holding (Mulligan, 1997; Bates et al., 2009) and that agency conflicts do not contribute to the increase in cash holdings before the 2008 crisis (Bates et al. 2009), we investigate whether the valuation toward cash holding has changed, comparing the post-crisis period with the pre-crisis counterpart. As high cash holdings allow managers to pursue private benefits (Jensen, 1986), shareholders can discount the value of cash holdings in anticipation of such agency incentives. So, we argue that an increase in cash holding does not increase firm value as much as it did before the crisis.

Based on quarterly data of publicly listed, non-financial U.S. firms between 2001 and 2015, we first examine whether agency motive, along with other motives for holding cash, contribute to the increase in cash holding after 2008 crisis; Next, we examine why firms hold cash and whether cash has become less valuable as cash holdings have increased, and if its effects on firm valuation has changed after the financial crisis.

Our evidence suggests that the relation between cash holdings and firm characteristics has changed for the post-crisis period. Specifically, bigger firms hold larger amount of cash; debt financing plays an important role for corporate cash holdings. Unlike the pre-crisis period, investment rate and industry sigma are insignificant with respect to their effect on the cash holding, implying that the precautionary motive less explains the increase in corporate cash holdings. We also test our hypotheses using subsamples: Our analysis shows that

financially-not-constrained firms with good investment opportunities, as measured through market to book ratio and R&D to sales, increase their cash holding more in the post-crisis period relative to the pre-crisis period, suggesting the precautionary motive plays an important role. In contrast, financially-constrained firms with investment opportunities, or adverse market conditions reduce their cash holdings in the post-crisis period, suggesting that the precautionary motive does not explain their increase of cash holding. In addition, in both financially-constrained and not-constrained firms, larger firms increase their cash holding in the post-crisis period than the pre-crisis period, which implies that the transaction motive after the 2008 financial crisis gets weaker.

In sum, after the 2008 financial crisis, larger firms hold larger amount of cash suggesting that the transaction motive do not explain why these larger firms hold cash. The precautionary motive loses its significance in explaining why financially-not-constrained firms with good investment opportunities increase cash holdings during the post-crisis period. In addition, firms with debt issuance also hold more cash. Moreover, our findings that the value of cash holdings on Tobin's Q decreases during the post-crisis period suggest that the agency motive partially explains corporate cash holdings.

Unlike the pre-crisis period (Bates et al., 2009), the value of cash after the financial crisis falls as the cash holding increases, implying that large cash holdings are less appreciated by the market, lowering the firm value. That is, this study contributes to the growing literature on cash holdings, in that we show that the increase in cash in the post-crisis period is driven by agency motive, which is different from the pre-crisis counterpart. Moreover, the increase in cash can be detrimental to the market value of firm, as we show that market does not appreciate the higher level of cash holding. Thus, significant, negative effect of cash holdings on firm value suggests that the increase in cash holdings is a by-product of agency problems, going back to Jensen's (1986) argument. The lower value of cash holding in the post crisis period is larger and significant in firms that do not have bond ratings. Another contribution is that we look into the over-time variation in cash holding motives in explaining the relation between cash holding and firm value in the post-crisis period.

The remainder of this paper is organized as follows. Section 2 discusses prior research on the corporate cash holdings. Section 3 develops hypotheses. Section 4 describes our data and empirical strategy. Section 5 presents our empirical results. Section 6 concludes.

2. Literature review

The literature has focused on four motives for firms holding cash: the transaction motive, the precautionary motive, the tax motive, and the agency motive (see Bates et al. (2009) for a review). According to the transaction motive, firms hold cash to avoid transaction costs associated with liquidating certain assets. The transaction motive implies that economies of scale leads large firms hold less cash (Mulligan 1997).

Precautionary motives imply that firms, facing potential borrowing constraints, hold cash to soften adverse situation in the market. Empirical studies focus on precautionary motives to explain why firms hold cash before the 2008 crisis. Specifically, Bates et al. (2009) argue that the relation between cash holdings and firm characteristics hardly changes during the pre-crisis period. Firms with larger short term debt or debt with a short maturity hold more cash to reduce important costs from refinancing their debt (Brunnermeier and Yogo, 2009; Harford et al., 2014). As losing an investment opportunity due to adverse shocks and financial distress is more costly for firms with better investment opportunities, firms with high R&D or with high intangible assets hold more cash for the precautionary motive (Bates et al., 2009; Opler et al., 1999; Almeida et al., 2004; Han and Qiu, 2007; Riddick and Whited 2009; Acharya et al., 2007). For example, cash plays important role in strengthening innovation when the industry is R&D intensive (Lyandres and Palazzo, 2012). Moreover, the rise in intangibles is the most important determinant of corporate cash holdings (Falato et al., 2013). Technology spillovers and market rivalry in R&D activities help explain why innovative companies hold large amount of cash (Qiu and Wan, 2015).

Finally, as argued by Jensen (1986), entrenched managers would rather keep their cash than increase distribution to shareholders when the firm has poor investment opportunities. While there is no direct test, previous studies implies the agency motive in cash holdings by discussing the costs and benefits of large corporate cash holdings, and by examining whether high cash holdings are generally better or worse for a firm. Until now, empirical findings are mixed.

On the one hand, large cash holding can benefit firms with financial constraints since cash holdings allow those firms to invest in good projects that might otherwise be bypassed (e.g., Kim et al, 1998; Opler et al., 1999; Denis and Sibilkov, 2010; Duchin et al., 2010; Harford et al., 2014). Firm's large cash holding strengthens firm's ability to invest in future and to compete successfully in the product market (Haushalter et al., 2007; Fresard, 2010). Also, Liu and Mauer (2011) find that CEO's risk-taking incentive is significantly positively related to cash holdings.

On the other hand, other studies relate to costs incurring from holding large cash. In addition to cash retention problem by reducing corporate payouts (Jensen, 1986; Bliss et al., 2015), in firms facing agency problems, such activities as acquisition by those firms with large cash holdings can be value decreasing (e.g., Harford, 1999; Harford et al., 2008). Finally, applying excess cash measure, Dittmar and Mahrt-Smith (2007) show that firms facing severe agency problems suffer from negative effect of large cash holdings on their operating performance.

3. Hypothesis development

The persistent, increasing pattern in cash holdings to date is notable in the aggregate behavior of U.S. firms. Specifically, the annual average cash ratio until 2009 was around 8.8 percent, while after that point the

cash ratio was above 10 percent (see Figure 1). Unlike the cash ratio however, investment rate (capital expenditure/total asset), keeps decreasing. While aggregate capital expenditure or aggregate fixed investment in real dollar terms is increasing (Figure 2), these two patterns (the level of capital expenses increases, the investment rate is decreasing) are consistent when we consider the respective increase in assets. Moreover, as Figure 2 shows, bank net lending increases after the initial contraction at the beginning of the 2008 crisis and firms are highly leveraged after the financial crisis. These observations that investment rate keeps decreasing and that bank net lending increases after the financial crisis in the midst of the increase in cash imply that these factors (investment rate and bank net lending) affect firms' motive to hold cash.

We also divide firms into constrained and unconstrained firms via bond rating availability, and see how cash holding motives hold for both types of firms, as in figure 3. In figure 3, we apply measures for investment opportunities (Tobin's Q), size and refinancing risk (short-term debt ratio) to investigate how different firm group's cash ratio evolves. It turns out that firms with better investment opportunities (higher tobin's Q) hold higher cash, which supports precautionary motive. Secondly, when we look at firms based on their size, big firms hold less amount of cash, but the difference is smaller in financially constrained firms, which implies that transaction motive gets weaker in explaining cash holding motive for constrained firms. Thirdly, firms with higher refinancing risk hold less amount of cash than low risk firms in both constrained and unconstrained firms, and this observation contradicts the first, since it does not support the precautionary motive. Thus, these observations motivate us to investigate cash holding motives for firms after the 2008 crisis.

In short, these figures suggest that, after the 2008 financial crisis, precautionary or transaction motive does not hold to explain the reason why firms hold large amounts of cash, relative to the pre-crisis period.

[Figure 1]

[Figure 2]

[Figure 3]

In this paper, we first examine what factors cause the increase in cash. As in the figures above, the relation during the post-crisis changes from the relation during the pre-crisis period. That is, given that debt financing, represented by bank net lending, increase and the investment rate decrease, corporate motives to hold cash might have changed after the 2008 financial crisis. This conjecture leads to our first hypothesis that investigates the cash-holding determinants in the pre-crisis period are different from those in post-crisis period. If this holds, precautionary motive which well explains the increase in cash holding before the 2008 financial crisis, as in Bates et al. (2009), will not explain cash determinants in the post-crisis period.

H-1: Precautionary motive and transaction motive become weaker in explaining the cash increase for the post-crisis period.

Next, we examine whether firms hold so much cash for agency motive. Previous studies have mixing results in that agency problems provide a plausible explanation for the increasing cash holdings of firms (Bates

et al., 2009; Dittmar and Mahrt-Smith, 2007). In addition, given the concave relation between cash holding and firm value (Martinez-Sola et al., 2011), the persistent pattern of the increase in corporate cash holding implies that the relationship between market value and cash holdings is non-linear. In particular, we conjecture that the market raises doubts about whether successful firms tend to accumulate more cash when the market starts recovering from the 2008 economic crisis. When empirical analysis shows a negative association between the market value of a firm and cash holding, we may conclude that firms hold cash for the agency motive, thus going back to Jensen's (1986) agency explanation.

H-2: The value of cash after the financial crisis falls, implying that too much cash is less appreciated by the market.

Finally, hypotheses above require that we have to test whether cash determinants and cash effect on a firm's Tobin's Q hold for different types of firms. Given that the precautionary motive relates to financial distress costs or investment opportunities and that the agency motive relates to managerial entrenchment, it is important to categorize firms based on financial constraints and on corporate governance, and to see if cash determinants and the value of cash differ across these firm types. This leads to our third hypothesis:

H-3: The weakness of transaction and precautionary motive, relative to the strength of agency motive hold for different types of firms, based on financial constraints and corporate governance.

That is, we hypothesize that the transaction motive gets weaker in explaining the increase in cash holding, and that the precautionary motive well explains the cash holding by financially unconstrained firms, relative to financially constrained firms. As for financially constrained firms and for firms with poor corporate governance, we hypothesize that those firms exhibit the stronger evidence of supporting agency costs of holding cash.

4. Data and Methodology

4.1. Sample

First, we test why firms hold cash. Firms can hold cash to avoid transaction costs (which are smaller for large firms), to soften adverse movements in the market (when firms make a large investment or borrowing), or to pursue managers' private benefits (for review, see Opler et al. 1999, and Bates et al. 2009). Second, we examine whether the relation has changed after the financial crisis. We assess whether cash has become less valuable as cash holdings have increased, and if its effects on firm valuation (measured through Tobin's Q) has changed after the 2008 financial crisis. Some prior studies correlate agency costs of cash with the value of corporate cash holdings (e.g., Harford, 1999; Harford et al., 2008; Dittmar and Mahrt-Smith, 2007). Third, we test whether subsamples of firms, based on financial constraints and corporate governance, hold different results regarding cash holding motives.

Our sample consists of quarterly data on publicly traded, non-financial U.S. firms available on Compustat database from 2001 to 2015. We define the beginning of the financial crisis as the third quarter of 2007 (2007Q3), as in Duchin et al. (2010) and Kahle and Stulz (2013), ending in the second quarter of 2009 (2009Q2). We begin our main sample in the third quarter of 2001 (2001Q3) in order to equally divide the main sample period into pre- and post-crisis periods¹. Thus the pre-crisis period is defined as 2001Q3 to the second quarter of 2007 (2007Q2), and the post-crisis period is from the third quarter of 2009 (2009Q3) to the second quarter of 2015 (2015Q2). Using quarterly data provide us with a timelier source of information useful to examine corporate decisions on cash holdings and allows us to overcome the limited time period after the 2008 financial crisis.

We exclude financial firms and utilities with SIC codes of 4900-4949 and 6000-6969. Following Gulen and Ion (2016), all observations have total assets. We exclude firms with sales or book equity smaller or equal to zero. For firms that change their fiscal year convention, we keep the most recent fiscal year convention. This leaves us final sample of 288,322 out of 306,433 firm-quarter observations. As in table 1, R&D and acquisition have smaller sample size due to missing variables, so based on Bates et al. (2009), we replace missing variables with zero for the two variables. We winsorize all independent variables at the 1st and 99th percentiles to lessen the influence of outliers. We detail the construction of the variables in the Appendix.

4.2. Methodology and Variables

In order to assess whether cash has become less valuable as cash holdings have increased, and if its effects on firm valuation has changed after the financial crisis, we employ two analyses: determinants of cash holdings in equation (1) and impact of cash holdings on market value of the firm in equation (3) following Bates et al. (2009). Just like Bates et al. (2009) that investigate changes in the relation between cash holdings and firm characteristics by including all interaction variables between the time-indicator variables and independent variables, equation (1) includes all independent variables are interacted with the indicator variables for the pre- and post-crisis period.

The specification for testing determinants of cash holdings is as follows:

$$Cash_{i,t} = \beta_0 + \beta_1 X_{i,t} + \beta_2 Pre \cdot X_{i,t} + \beta_3 Post \cdot X_{i,t} + \mu_i + \tau_t + \varepsilon_{i,t} \quad (1)$$

Dependent variable, $Cash_{i,t}$ is the cash-to-asset ratio for firm i at time t . $X_{i,t}$ stands for firm-level independent variables which include Tobin's Q, log(assets) (as a proxy for firm size), cash flow to assets, net working capital to assets, capital expenditure to assets, leverage, industry cash flow risk, dividend payout dummy, R&D to sales, acquisition to assets, debt or equity issuance and proximity to an IPO as in Bates et al. (2009). Following Gulen and Ion (2016), we normalize investment rate (measured as capital expenditure to assets), cash flow and cash

¹ Duchin et al. (2010) explains that this balanced approach has the advantage of reducing effects from any seasonal pattern in the data.

holdings by lagged total assets. Pre is a dummy variable for pre-crisis period, and Post is a dummy variable for post-crisis period. μ_i is firm fixed effects, and τ_t represents a set of fiscal and calendar-quarter dummies included to control for seasonality.

In equation (1), the coefficients for interaction terms, β_2 and β_3 measure the additional effect of firm-level variables before the financial crisis and that of post-crisis period, respectively. Thus, if β_2 or β_3 are significantly different from zero, the respective variable has a significant different effect on cash determinant in the pre-crisis or in the post-crisis periods compared to the effect during the crisis.

As the dependent variable, we also use the change in the cash balance from a four-way decomposition of net income in Dechow et al. (2008) ².

$$\Delta\text{Cash} = \text{Accruals} - \text{Net Income} - \text{Dist_Equity} - \text{Dist_Debt} \quad (2)$$

where ΔCash is the retained cash component after cash is distributed to capital providers; Accruals is the total accruals, defined as the change in non-cash assets (i.e., total assets – cash – short-term investments) less the change in non-debt liabilities (i.e., total liabilities – debt). Dist_Equity is net distributions to equity holders, defined as the reduction in equity. Equity is calculated as total assets less total liabilities. Dist_Debt is net distributions to debt holders, defined as the reduction in debt. Debt is calculated as long-term debt plus short-term debt.

The specification for the relation between the market value of a firm and cash holdings is as follows (Bates et al., 2009):

$$Q_{i,t} = \beta_0 + \beta_1 E_{i,t} + \beta_2 dE_{i,t} + \beta_3 dE_{i,t+2} + \beta_4 dNA_{i,t} + \beta_5 dNA_{i,t+2} + \beta_6 RD_{i,t} + \beta_7 dRD_{i,t} + \beta_8 dRD_{i,t+2} + \beta_9 I_{i,t} + \beta_{10} dI_{i,t} + \beta_{11} dI_{i,t+2} + \beta_{12} D_{i,t} + \beta_{13} dD_{i,t} + \beta_{14} dD_{i,t+2} + \beta_{15} dQ_{i,t+2} + \beta_{16} \text{Cash}_{i,t} + \beta_{17} \text{Cash}_{i,t} * \text{Pre} + \beta_{18} \text{Cash}_{i,t} * \text{Post} + \varepsilon_{i,t} \quad (3)$$

In equation (3), dependent variable, Q is the market value of the firm calculated as fiscal year-end as the sum of the market value of equity and the book value of debt (short-term and long-term debt) divided by total assets. Firm value (Q), as the market value, reflects all currently available information and investors' expectation of future values. Thus, Q equation includes current financial variable information, their changes from the past, and expected changes to the future (Bates et al. 2009; Pinkowitz and Williamson, 2004; Dittmar and Mahrt-Smith, 2007; Pinkowitz et al., 2006). In equation (3), X_t is the level of variable X in time t divided by the level of total assets in time t; dX_t is its change from t-2 to t divided by total assets at t, $(X_t - X_{t-2})/Asset_t$; dX_{t+2} is its expected change from t to t+2 divided by total assets at t, $(X_{t+2} - X_t)/Asset_t$. E(Earnings) is earnings before extraordinary items plus interest, deferred tax credits, and investment tax credits; A(Assets) is total assets;

² Dechow et al. (2008) originally conduct a four-way decomposition of net income into total accruals, change in the cash balance, issuances/distributions to equity, and issuances/distributions to debt. $\text{Income} = \text{Accruals} + \Delta\text{CASH} + \text{Dist_Equity} + \text{Dist_Debt}$

RD(R&D) is the R&D expense; I(Interest) is the interest expense; D(Dividends) is dividends defined as common dividend paid; NA(Net Assets) is net assets defined as total assets minus cash; CASH corresponds to cash holding. For cash holding, we added interaction terms with dummy variables for pre- and post-crisis period, respectively to see if the effect of cash holding on a market value of a firm changes after the financial crisis. That is, two interaction terms with cash examine whether the value of cash change from the pre-crisis to the post-crisis period.

In equation (3), the coefficients for cash holdings' interaction terms, β_{17} and β_{18} , measure the additional effects of cash holding on Tobin's Q during the pre-crisis and post crisis period compared to those of cash holding during the crisis period, respectively. Especially, if β_{18} is significantly negative, it implies that the value of post-crisis cash holding falls below the level during the crisis, and that the increase in cash holding does not result in the higher market value of a firm.

As part of robustness test, we examine whether equations (1) and (3) hold in subsamples based on financial constraints and corporate governance. Financial constraint is a useful way to compare how precautionary motive works for different types of firms: Financially unconstrained firm, given that it has enough financing capacity to make future investments, has little precautionary motive for cash holdings. Financially constrained firms, on the other hand, cannot make future investments without reducing current investments, so it holds more cash to invest more in the future (Han and Qiu, 2007). In addition, corporate governance links to agency theory. Entrenched managers will be more likely to retain free cash flow, which implies that firms with more entrenched management (i.e., bad corporate governance) would hold more cash. We consider a firm as financially constrained if it has short-term or long-term debt outstanding but does not have a bond rating each quarter, and unconstrained otherwise as in Duchin et al. (2010). In this way, firms with zero debt and no debt rating are included in unconstrained firms. Bond ratings exogenously affect a firm's access to debt financing (Faulkender and Petersen, 2006), and firms with bond rating information have lower cost of capital than others, so it can be one of measures of financing constraints (Duchin et al., 2010).

In addition, we also group firms using Gompers, Ishii and Metrick (2003) corporate governance index (GIM index henceforth) to see if firms with good and bad governance hold the same result for cash valuation as a robustness test. GIM index measures governance provisions into firm's charter and by-law provisions that restrict shareholder rights. A high GIM index is associated with weak shareholder rights, that is, poor corporate governance, and a low GIM index relates to good corporate governance. Since the data for the index is assembled and reported every two years, we keep the index unchanged in the year following the most recent report when dealing with years with no index available, as in Dittmar and Mahrt-Smith (2007). We classify firms as poor or good governance by dividing the sample at the median each year using GIM index.

As an additional robustness test, we employ excess cash as measured in Dittmar and Mahrt-Smith (2007) to see if the deviation from the "normal cash" strengthens our result in that the valuation for the excess

cash is not appreciated in the market over the post-crisis period. The following regression equation is from Dittmar and Mahrt-Smith and its residuals are used to compute excess cash:

$$\ln\left(\frac{Cash_{i,t}}{NA_{i,t}}\right) = \beta_0 + \beta_1 \ln(NA_{i,t}) + \beta_2 \frac{FCF_{i,t}}{NA_{i,t}} + \beta_3 \frac{NWC_{i,t}}{NA_{i,t}} + \beta_4 (IndustrySigma)_{i,t} + \beta_5 \left(\frac{MV_{i,t}}{NA_{i,t}}\right) + \beta_6 \frac{RD_{i,t}}{NA_{i,t}} + \mu_i + \tau_t + \varepsilon_{i,t} \quad (4)$$

where Cash stands for cash and equivalents at time t; NA is net assets, calculated by subtracting cash and equivalents from total assets at time t; FCF is operating income minus interest minus taxes over time t; NWC is current assets minus current liabilities minus cash at time t; industry sigma is industry average of prior 10 year standard deviation of FCF/NA; MV is market value at time t, calculated by price times shares plus total liabilities; RD is R&D expenditures, set to zero if missing over time t.³

Tables 1 provides summary statistics for our sample during 2001Q3 – 2015Q2. The average cash ratio for the entire sample period is 20.5%, and both financially unconstrained and constrained firms increase their average cash ratio from pre-crisis to post-crisis period. The average Tobin’s Q is 1.872 for entire sample, and the median is 1.432.

Last four columns show the subgroup means and whether each subgroup mean in the pre-crisis period differs from the post-crisis counterpart when firms are grouped into “good” (i.e., financially unconstrained) and “bad” (i.e., financially constrained) firms based on their bond rating availability. The mean of good firm variables in the pre-crisis period are significantly different from the post-crisis counterpart, except for net working capital, sales growth, cash, cash flow, R&D and total investment; On the other hand, the mean of bad firm variables before the financial crisis are significantly different from the respective post-crisis variables, except for market to book ratio, acquisition, and investment.

[Table 1]

5. Empirical results

5.1. The determinants of cash holding

Table 2 is the results for determinants of entire sample based on equation (1). Size, debt issuance and ST debt hold significantly positive coefficient on both cash and retained cash. It means that bigger firms hold larger amount of cash; debt financing plays an important role for corporate cash holdings. Unlike the pre-crisis period, investment rate and industry sigma are insignificant with respect to their effect on the cash holding, implying that the precautionary motive less explains the increase in corporate cash holdings.

[Table 2]

³ We also use total assets denominator instead of net assets, when estimating equation (3), and the result does not change.

Table 3 is the results for determinants of cash holdings for financially unconstrained firms which do not have bond rating information. Relative to pre-crisis period, market to book, size and debt issuance have positive and significant coefficients. On the other hand, net working capital (NWC), dividend dummy, acquisition, equity issuance turns out to be negatively and significantly affecting the corporate cash holding in the post-crisis period. Coefficients of R&D to sale ratio, equity issuance, and loss dummy are similar to those in the pre-crisis period. As for retained cash, the sign of the coefficients are mostly the same as cash determinants, but each coefficient loses its significance. Firms with better investment opportunities hold more cash, and bigger firms hold more cash. However, firms are holding or collecting cash via debt financing, as seen in the coefficient for debt issuance.

[Table 3]

Table 4 presents the result for determinants of financially constrained firms' cash holdings. In this case, market to book, and size maintain the same sign and the significance of their coefficients as the pre-crisis counterpart. On the other hand, leverage, acquisition and spread are insignificantly negative in the pre-crisis period, but gain their significance after the financial crisis. Only the coefficient for short-term debt changes the sign and significance after the financial crisis. Both financially constrained and unconstrained firms' debt issuance have significantly positive coefficient, which are consistent with what we observe in figure 1. As in the case of financially unconstrained firms, retained cash hold mostly the same coefficient as cash determinants, but cash flow, equity issuance and loss dummy are significantly positive in the case of constrained firms. In sum, these results support the fact that both the sign and the strength of the relation between cash holdings and firm characteristics changes for the post-crisis period, and the change is prominent in the case of good firms.

[Table 4]

In the two analyses, both good and bad firms with investment opportunities hold more cash, and bigger firms hold larger amount of cash. Note that debt financing during the post-crisis period significantly affect the corporate cash holding, which supports the fact that firms try to hold as much cash as they can draw.

5.2. Cash holdings and Market value of the firm

Table 5 examines if the increase in cash holdings can be explained by agency problems, and if market still appreciates the persistent pattern of the increase in cash holdings. First, we run regressions using equation (3) using the entire sample. The pre-crisis coefficient of cash is positive and the post-crisis coefficient of cash is negative. Coefficients on these interaction variables change from positive to negative, and significantly different from zero both for pre- and for post-crisis period. These results provide the evidence that the effect of cash on firm value is less in the post-crisis period than the pre-crisis counterpart.

[Table 5]

The third column is based on financially unconstrained firms. Coefficients on the interaction variables with cash, and pre- and post-crisis dummies change the sign as in table 5, but only significantly different from zero for the pre-crisis period, suggesting the evidence of a decrease in the value of cash in the post-crisis period is unclear.

On the other hand, for financially constrained firms in the fourth column coefficients on the interaction variables with cash, and pre- and post-crisis dummies are the same as in the case of financially unconstrained firms, but in this case, both are significant as seen in the result for the entire sample, exhibiting the stronger evidence of supporting agency costs of holding cash. In sum, agency problem appears capable of explaining post-crisis evidence. In particular, such evidence is prominent for financially constrained firms, meaning that their value of cash falls during the post-crisis period. Also, our result supports the fact that the market no longer appreciates the increase in cash holding, since too much cash results in the decrease in the market value of a firm.

In addition, we run the same regressions using annual data as robustness tests in table 6, to make sure that the result in table 5 is not due to any fluctuations in quarterly data. Our results using annual data are very similar to those earlier results suggesting that our results do not stem from fluctuations in our quarterly data.⁴

[Table 6]

Moreover, we do the same analyses for the change in cash versus the change in the market value of a firm in table 7. We examine whether marginal increase in cash results in the change in the market value of a firm. It turns out that the marginal effect of cash holding in the post-crisis period is less than the effect in the pre-crisis period, and that the effect is significantly negative for financially unconstrained firms during the post-crisis period. It implies that even though the effect of cash level on firm value is unclear, adding marginal dollar of cash holding cannot be always helpful to financially unconstrained firms.

[Table 7]

Table 8 reports the results using GIM index. Relative to firm with good governance, bad governance firms suffer from lower valuation for cash holdings after the financial crisis. Especially, the post-crisis cash holding level is detrimental to the market value of a firm with bad governance. Only for firms with good governance, the valuation for marginal cash is higher than pre-crisis counterpart, which differs from our result.

[Table 8]

Additionally, table 9 reports the stronger results when employing the excess cash into the analyses. The excess cash holding is negatively valued over the post-crisis period, and this result is prominent for firms with bad governance. This result supports the fact that large holding can be detrimental to the firm value, given the relation between cash holding and firm value is concave.

[Table 9]

⁴ We also do the analyses for cash determinants using annual data, and the result remains the same.

5.3. Summary and discussions

We examine why firms have increased their cash so much to reach a record-high level after the 2008 financial crisis. We analyze the change in cash determinant, and the relation between market value of a firm and cash holding. Unlike the pre-crisis period, the transaction and precautionary motive get weaker in explaining the increase in cash holding after the 2008 crisis; regarding the relationship between the market value of a firm and the value of cash holdings, some firms hold too much cash because of agency problems. In addition, both financially unconstrained and constrained firms experience the change in cash determinant, and the value of cash holding over time: Firstly, firms with good investment opportunities hold more cash, and bigger firms hold larger amount of cash. The result implies that transaction motive gets weaker in explaining the increase of cash holdings for the post-crisis period. On the other hand, precautionary motive hold for financially unconstrained group, given that financially-less-constrained firms' investment opportunities (measured through market to book ratio and R&D to sales) significantly and positively affect the increase in cash holdings. However, precautionary motive does not hold for financially-constrained firms and for the entire sample.

Secondly, the value of cash on firm value decreases in the post-crisis period for the two types of firms, as well as the entire sample. That is, agency problem appear capable of explaining post-crisis evidence that the value of cash holdings decreases over time. In particular, such evidence is prominent for financially constrained firms, meaning that their value of cash falls during the post-crisis period. Also, our result supports the fact that the market less appreciates the increase in cash holding, since too much cash result in the decrease in the market value of a firm. When we do additional tests by applying GIM index, the result is similar in that firms with bad governance suffer from low valuation for cash holding over the post-crisis period. The result gets even stronger when we adopt excess cash measure into the analyses, since the cash valuation is not only less appreciated but also it turns out to be detrimental to the firm value. Thus, the two additional tests supports our main result that large cash holding does not guarantee the higher market value of a firm after the 2008 financial crisis.

These results are meaningful in that it provides us with the empirical evidence that too much cash can be detrimental to the market value of a firm, which gives less justification for firms to hold cash. Our results indicate that further improvements could have happened if cash holding associated with the quality of corporate governance is filtered out. In this way, we can extract the cash holding from agency effect then analyze if firms use the rest of cash component for investment or other spending, which we leave for future research.

6. Conclusions

In this study, we analyze whether the persistent increase in cash-to-asset ratio of U.S. firms continues to be appreciated after financial crisis. Building on the previous literature we assess whether cash has become less valuable as cash holdings have increased, and if its effects on firm valuation has changed after the financial crisis.

Our evidence suggests that the relation between cash holdings and firm characteristics changes for the post-crisis period. We find that the main reasons for the increase in the cash ratio of good firms in the post-crisis period are that market to book, size, and debt issuance have increased, and net working capital, dividend dummy, acquisition, equity issuance have fallen, which are different from pre-crisis period. We find that the transaction motive gets weaker in explaining the increase in cash holding; the precautionary motive, on the other hand, well explains the cash holding by financially-less constrained firms, but generally loses its explanatory power for financially-constrained firms' cash holding and the entire sample during the post-crisis period. For the case of financially unconstrained firms, the main reasons for the increase in cash results from the fact that leverage, acquisition and spread have fallen, and short-term debt has increased. The change in the sign and the strength of the relation are prominent in the case of good firms. Although prior studies such as Bates et al. (2009) show that the precautionary motive to hold cash is a critical determinant of the demand for cash, our result for the post-crisis period indicates that this may not necessarily hold, especially when the economy has gone through such exogenous shock as financial crisis.

Moreover, our results regarding the relationship between the market value of a firm and the value of cash holdings, could be consistent with the hypothesis that some firms hold too much cash because of agency problems. Unlike the pre-crisis period, the value of cash after the financial crisis falls over time, implying that large cash holdings are less appreciated by the market, lowering the firm value. Further evidence shows that the increase in cash hardly results in higher corporate investment.

Given the concave relation between cash holding and firm value (Martinez-Sola et al., 2011), the persistent pattern of the increase in corporate cash holding implies that the relationship between market value and cash holdings cannot be consistent. As mentioned, cash holding helps firms to forestall financial distress cost and underinvestment problem, but there are also costs to large corporate cash holdings. Thus, persistent and increasing pattern in cash should be taken cautiously.

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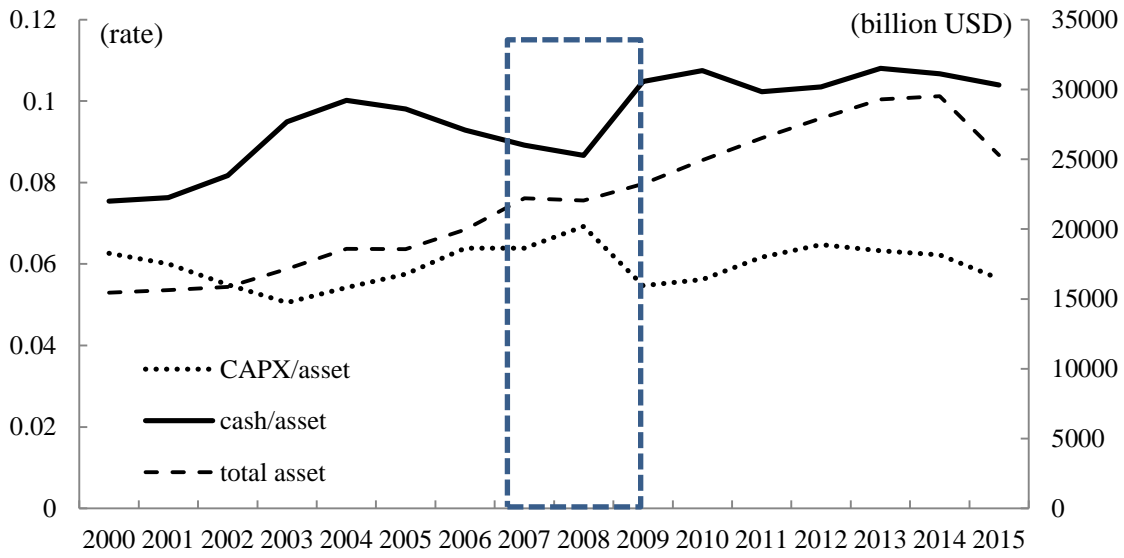


Figure 1. Aggregate investment and cash ratio, calculated as the total annual Investment (CAPX/Assets) and cash-to-asset ratio from 2000-2015 for firms excluding financial firms (SIC code 6000-6999) and utilities (SIC code 4900-4949), with total asset. Data come from the COMPUSTAT database.

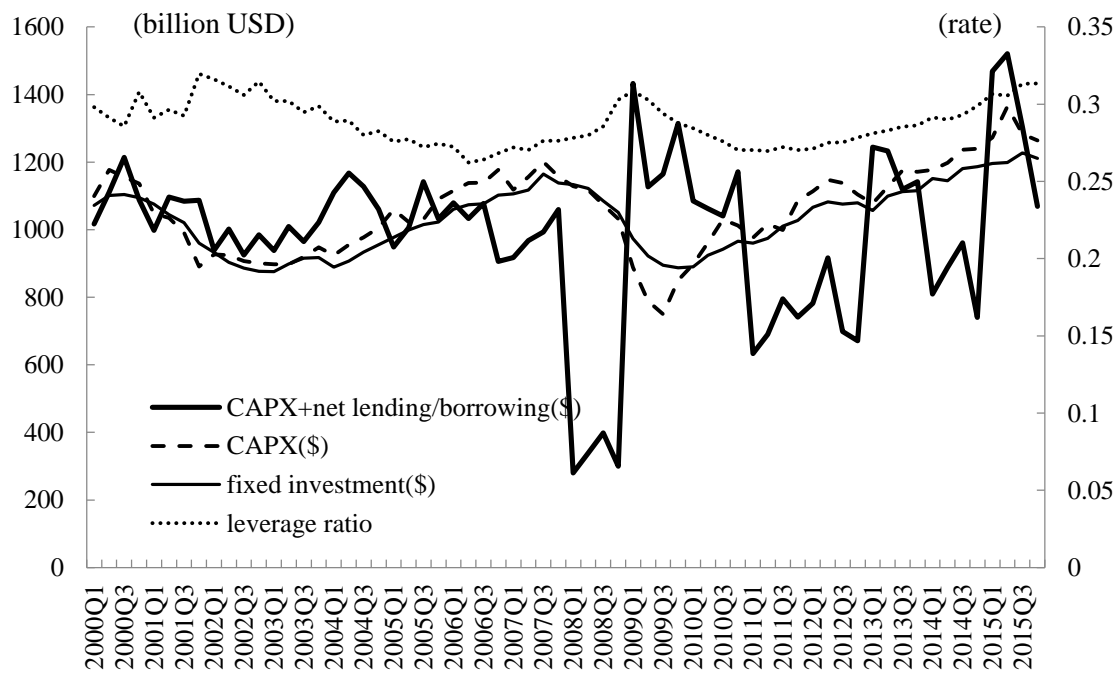
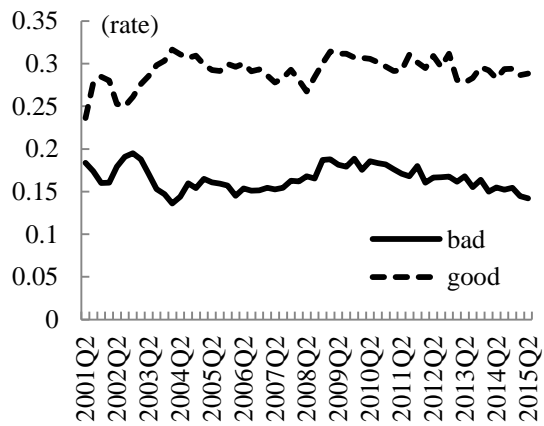
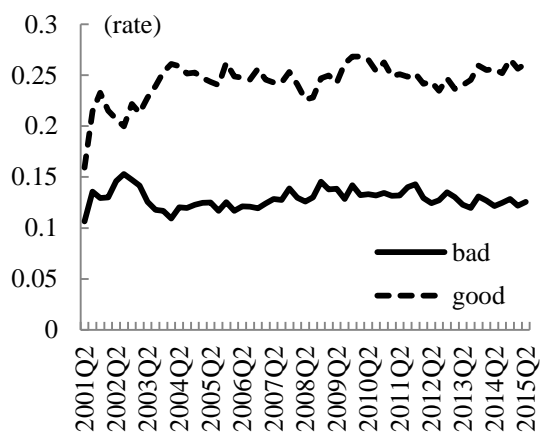


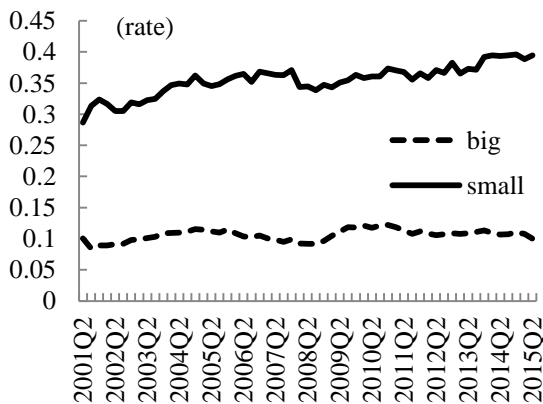
Figure 2. Quarterly gross investment, defined as the sum of capital expenditure (CAPX) and net lending (or borrowing), capital expenditure (CAPX) and fixed investment for nonfinancial corporations from 2000-2015. Data come from the Federal Reserve's seasonally adjusted Flow of Funds accounts, converted into real terms using CPI (base year=2000), and the Compustat database for the leverage ratio, which is the sum of long-term debt and short-term debt divided by total asset.



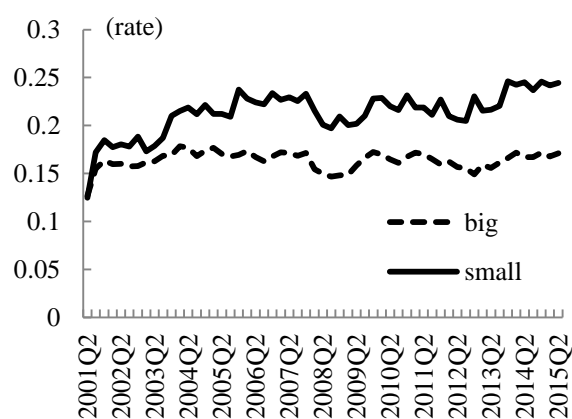
(a) investment opportunities



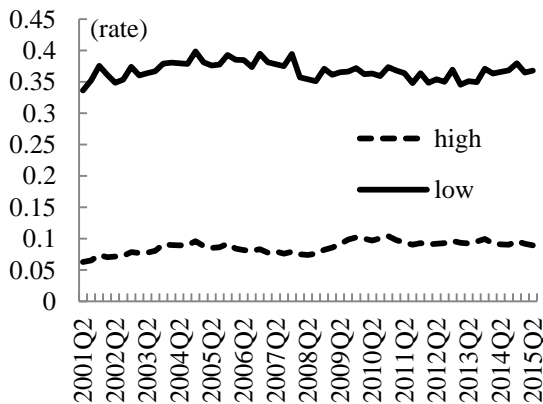
(a) Investment opportunities



(b) size

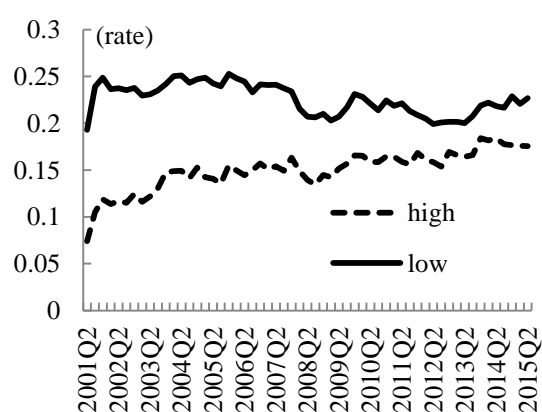


(b) size



(c) Refinancing risk

Unconstrained firms



(c) Refinancing Risk

Constrained firms

Figure 3. Cash-to-asset ratio for financially unconstrained and unconstrained firms excluding financial firms (SIC code 6000-6999) and utilities (SIC code 4900-4949). Following Duchin et al. (2010), we consider a firm financially constrained if it has short-term or long-term debt outstanding but does not have a bond rating each quarter, and unconstrained otherwise. We classify firms with good and bad investment opportunities by dividing the sample at the median each quarter using Tobin's Q; big and small firm using size; high and low financing risk using short term debt ratio. Data come from compustat database.

Table 1: Summary Statistics

This table presents summary statistics of the main variables used in the analysis for the quarterly data from 2001Q3 to 2015Q2. Pre-crisis period refers to the period 2001Q3 to 2007Q2. Crisis period refers to the period 2007Q3 to 2009Q2, and post-crisis period refers to the period 2009Q3 to 2015Q2. We calculate means, medians, standard deviations, minimum and maximum over the entire sample period. Capital expenditure (CAPEX), cash flow, cash holdings are normalized by total assets at the beginning of the quarter. Following Duchin et al. (2010), we consider a firm financially constrained (“bad”) if it has short-term or long-term debt outstanding but does not have a bond rating each quarter, and unconstrained (“good”) otherwise.

	N	Mean	Median	Std. Dev.	Min	Max	Good firm (n=121,175)			Bad firm		
							pre-	post	t-stat	pre	post	t-stat
CAPEX/Assets	288,322	0.015	0.007	0.027	-0.002	0.189	0.014	0.014	-2.41	0.014	0.016	-0.27
R&D	121,713	0.018	0.000	0.041	0.000	0.272	0.015	0.015	-1.47	0.019	0.020	-1.76
Acquisition	58,496	0.005	0.000	0.021	-0.002	0.161	0.005	0.005	2.21	0.005	0.005	-0.26
Q	288,322	1.872	1.432	1.388	0.341	8.331	1.732	1.714	2.92	1.978	1.985	-0.82
Cash flow	288,322	-0.013	0.021	0.162	-1.161	0.190	0.013	0.012	0.97	-0.028	-0.035	6.46
Cash	288,322	0.205	0.113	0.228	0.000	0.919	0.229	0.231	-1.53	0.186	0.189	-2.75
Sales Growth (SG)	288,322	1.212	0.061	7.784	-0.995	70.182	0.722	0.730	-0.22	1.362	1.765	-9.28
NWC	288,322	-0.133	0.013	0.922	-7.331	0.521	0.016	0.013	1.50	-0.217	-0.263	8.00
Log (Asset)	288,322	5.218	5.340	2.619	-1.663	10.966	6.197	6.525	-22.44	4.150	4.608	-40.17
leverage	288,322	0.321	0.190	0.560	0.000	4.295	0.231	0.217	8.50	0.378	0.403	-7.33
LT debt	288,322	0.196	0.099	0.269	0.000	1.513	0.203	0.196	5.01	0.190	0.199	-6.54
ST debt	288,322	0.108	0.010	0.371	0.000	3.024	0.026	0.020	13.99	0.165	0.173	-3.67
Debt issue	288,322	0.006	0.000	0.058	-0.159	0.360	0.001	0.002	-5.13	0.007	0.010	-6.61
Equity issue	288,322	0.019	0.000	0.092	-0.076	0.642	0.011	0.010	3.07	0.025	0.023	3.63

Table 1.1 Correlation Matrix

This table presents correlation matrix of the main variables used in the analysis for the quarterly data from 2001Q3 to 2015Q2. Pre-crisis period refers to the period 2001Q3 to 2007Q2. Crisis period refers to the period 2007Q3 to 2009Q2, and post-crisis period refers to the period 2009Q3 to 2015Q2. Capital expenditure (CAPEX), cash flow, cash holdings are normalized by total assets at the beginning of the quarter. The lower left, diagonal, and upper right matrices contain the correlations, variances, and covariances respectively.

	Investment	RD	ACQ	CF	cash	SG	NWC	size	leverage	LTdebt	STdebt	Debt issue	Equity issue
Investment	0.0007	-0.0002	0.0001	0.0005	-0.0006	0.0369	0.0003	0.0048	-0.0005	0.0003	-0.0003	0.0002	0.0002
RD	-0.0018	0.0017	-0.0001	-0.0027	0.0038	0.0213	-0.0079	-0.0313	0.0019	-0.0007	0.0020	0.0001	0.0011
ACQ	0.0270	-0.0189	0.0004	0.0001	-0.0003	0.0059	0.0006	0.0041	-0.0001	0.0001	-0.0002	0.0002	0.0003
CF	0.0122	-0.4110	0.0460	0.0263	-0.0062	-0.0316	0.0839	0.1918	-0.0367	-0.0014	-0.0281	-0.0015	-0.0056
Cash	-0.1007	0.4088	-0.0670	-0.1684	0.0521	0.0087	-0.0087	-0.1485	-0.0220	-0.0165	-0.0055	-0.0001	0.0046
SG	0.1729	0.0665	0.0360	-0.0250	0.0049	60.5625	-0.1830	-0.6656	0.0996	0.0353	0.0565	0.0186	0.0455
NWC	0.0153	-0.2080	0.0320	0.5608	-0.0417	-0.0255	0.8502	0.9411	-0.3857	-0.0222	-0.2913	-0.0071	-0.0142
Size	0.0669	-0.2899	0.0736	0.4511	-0.2484	-0.0326	0.3897	6.8579	-0.3485	0.0932	-0.3526	-0.0106	-0.0568
Leverage	-0.0033	0.0839	-0.0150	-0.4042	-0.1727	0.0228	-0.7466	-0.2375	0.3139	0.0857	0.1682	0.0061	0.0038
LTdebt	0.0528	-0.0658	0.0244	-0.0327	-0.2701	0.0169	-0.0898	0.1323	0.5688	0.0723	0.0044	0.0027	-0.0008
STdebt	-0.0336	0.1338	-0.0319	-0.4671	-0.0658	0.0195	-0.8515	-0.3629	0.8091	0.0446	0.1376	0.0025	0.0039
Debtissue	0.1461	0.0778	0.2352	-0.1653	-0.0013	0.0414	-0.1340	-0.0701	0.1898	0.1767	0.1172	0.0033	-0.0004
equityissue	0.0912	0.3106	0.0190	-0.3742	0.2212	0.0633	-0.1672	-0.2354	0.0744	-0.0353	0.1139	-0.0081	0.0085

Table 2: The Determinants of Cash Holding for Entire Sample

The dependent variable is firm-level quarterly cash holding from 2001Q3 to 2015Q2 for publicly traded, non-financial firms. All equations quarterly time dummies and firm dummies. P-values in parentheses are based on standard errors robust to clustering by firm and year. Variable definitions are in the Appendix.

	Cash			Retained cash		
		Interaction with Pre-Crisis dummy	Interaction with Post-crisis dummy		Interaction with Pre-Crisis dummy	Interaction with Post-crisis dummy
Q	0.0037 (0.000)	0.0032 (0.000)	0.0017 (0.011)	0.0415 (0.000)	-0.0180 (0.000)	-0.0163 (0.001)
Size	0.0323 (0.000)	0.0005 (0.148)	0.0026 (0.000)	-0.4415 (0.000)	0.0010 (0.723)	0.0071 (0.011)
CF	0.0291 (0.000)	-0.0184 (0.0004)	-0.0166 (0.002)	0.2965 (0.000)	0.0177 (0.634)	0.3612 (0.000)
NWC	-0.0219 (0.000)	-0.0068 (0.000)	0.0044 (0.004)	-0.3693 (0.000)	-0.0366 (0.001)	0.0027 (0.811)
Investment	-0.2422 (0.000)	0.0539 (0.011)	-0.0174 (0.447)	-0.7556 (0.000)	-0.4305 (0.004)	-0.6472 (0.000)
Leverage	-0.0395 (0.000)	0.0002 (0.908)	-0.0039 (0.075)	-0.1226 (0.000)	-0.0585 (0.000)	-0.0604 (0.000)
Industry Sigma	0.0005 (0.671)	0.0002 (0.018)	-0.0001 (0.132)	0.0009 (0.031)	0.0004 (0.604)	-0.0003 (0.968)
Dividend	-0.0004 (0.767)	0.0013 (0.410)	-0.0018 (0.261)	0.0172 (0.103)	0.0043 (0.712)	-0.0013 (0.908)
R&D/Sales	0.0013 (0.000)	-0.0001 (0.965)	-0.0002 (0.940)	0.0190 (0.000)	-0.0046 (0.027)	0.0031 (0.169)
ACQ	-0.4490 (0.000)	0.0116 (0.582)	-0.0887 (0.000)	-0.2605 (0.000)	-0.2054 (0.172)	-0.2532 (0.106)
Debtissue	0.0906 (0.000)	0.0137 (0.109)	0.0560 (0.000)	-0.7856 (0.000)	0.0498 (0.413)	0.2983 (0.000)
Equityissue	0.2207 (0.000)	-0.0065 (0.309)	-0.0086 (0.191)	-0.5185 (0.000)	0.0142 (0.757)	0.1229 (0.009)
Loss	-0.0030 (0.002)	-0.0021 (0.063)	0.0001 (0.877)	0.1592 (0.000)	-0.0280 (0.000)	0.0132 (0.121)
Tbill	-0.0008 (0.197)	-0.0014 (0.011)	0.0239 (0.001)	-0.0006 (0.890)	0.0134 (0.001)	-0.0777 (0.131)
Spread	-0.0007 (0.294)	-0.0018 (0.132)	-0.0040 (0.000)	0.0254 (0.000)	-0.0232 (0.006)	-0.0007 (0.913)
ST debt	-0.0240 (0.000)	-0.0115 (0.001)	0.0163 (0.000)	-0.4831 (0.000)	0.0775 (0.003)	0.1899 (0.000)
Ipo1	0.0038 (0.510)	0.0202 (0.000)	0.0087 (0.092)	0.1043 (0.007)	0.0476 (0.341)	0.0971 (0.025)
Ipo2	0.0024 (0.646)	0.0110 (0.019)	0.0086 (0.045)	0.0875 (0.019)	0.0343 (0.264)	0.0505 (0.101)
Ipo3	0.0011 (0.863)	0.0086 (0.052)	0.0070 (0.124)	0.0723 (0.143)	0.0304 (0.338)	0.0412 (0.206)
Ipo4	0.0009 (0.893)	0.0060 (0.393)	0.0048 (0.395)	0.0438 (0.288)	0.0298 (0.338)	0.0347 (0.393)
Ipo5	0.0008 (0.987)	0.0024 (0.720)	0.0037 (0.536)	0.0406 (0.407)	0.0099 (0.836)	0.0268 (0.468)
R-Square	0.84			0.59		
N	288,322			288,322		

Table 3: The Determinants of Cash Holding For Financially-less Constrained Firms

The dependent variable is firm-level quarterly cash holding from 2001Q3 to 2015Q2 for financially-less-constrained, publicly traded, non-financial firms. A firm is financially less constrained when it has a bond rating each quarter. All equations quarterly time dummies and firm dummies. P-values in parentheses are based on standard errors robust to clustering by firm and year. Variable definitions are in the Appendix.

	Cash		Retained cash			
		Interaction with Pre-Crisis dummy	Interaction with Post-crisis dummy		Interaction with Pre-Crisis dummy	Interaction with Post-crisis dummy
Q	0.0027 (0.002)	0.0003 (0.692)	0.0024 (0.015)	0.0206 (0.000)	-0.0132 (0.010)	-0.0299 (0.000)
Size	0.0359 (0.000)	0.0002 (0.685)	0.0025 (0.000)	-0.4071 (0.000)	-0.0017 (0.554)	0.0084 (0.002)
CF	0.0405 (0.000)	-0.0430 (0.000)	0.0108 (0.319)	0.0872 (0.101)	0.1084 (0.069)	0.4833 (0.000)
NWC	-0.0497 (0.000)	0.0070 (0.026)	-0.0068 (0.025)	-0.3296 (0.000)	0.1684 (0.000)	-0.0574 (0.000)
Investment	-0.3434 (0.000)	0.010 (0.004)	-0.0250 (0.505)	-2.1740 (0.000)	0.0464 (0.813)	0.1164 (0.577)
Leverage	-0.0224 (0.000)	-0.0073 (0.074)	-0.0053 (0.235)	-0.2037 (0.000)	-0.0661 (0.003)	-0.0159 (0.523)
Industry Sigma	0.0001 (0.665)	0.0002 (0.078)	-0.0001 (0.148)	0.0005 (0.434)	0.0006 (0.351)	-0.0005 (0.391)
Dividend	0.0007 (0.666)	-0.0001 (0.948)	-0.0044 (0.022)	0.0192 (0.043)	-0.0057 (0.589)	0.0036 (0.734)
R&D/Sales	-0.0002 (0.564)	0.0011 (0.007)	0.0012 (0.010)	-0.0017 (0.436)	0.0107 (0.000)	0.0158 (0.000)
ACQ	-0.4957 (0.000)	0.0813 (0.005)	-0.0691 (0.020)	-1.1598 (0.000)	-0.4780 (0.003)	-0.2819 (0.088)
Debtissue	0.1158 (0.000)	0.0177 (0.275)	0.0963 (0.000)	-0.9481 (0.000)	0.1115 (0.217)	0.1548 (0.101)
Equityissue	0.2378 (0.000)	-0.0521 (0.000)	-0.0463 (0.000)	-0.4868 (0.000)	-0.1446 (0.012)	0.0733 (0.211)
Loss	0.0001 (0.900)	-0.0035 (0.022)	-0.0030 (0.054)	0.1011 (0.000)	-0.0134 (0.120)	-0.0016 (0.852)
Tbill	-0.0011 (0.170)	0.0002 (0.754)	0.0332 (0.000)	-0.0087 (0.058)	0.0125 (0.004)	-0.0385 (0.437)
Spread	0.0003 (0.717)	-0.0015 (0.334)	-0.0040 (0.000)	0.0212 (0.000)	-0.0278 (0.002)	-0.0012 (0.849)
ST debt	-0.0269 (0.000)	0.0226 (0.011)	0.0061 (0.568)	-0.3222 (0.000)	0.0055 (0.911)	-0.1718 (0.004)
Ipo1	0.1115 (0.232)	0.0291 (0.000)	0.0147 (0.013)	0.0504 (0.255)	0.0728 (0.038)	0.0643 (0.053)
Ipo2	0.0084 (0.289)	0.0139 (0.028)	0.0059 (0.409)	0.0332 (0.522)	0.0507 (0.315)	0.0601 (0.094)
Ipo3	0.0044 (0.565)	0.0105 (0.246)	0.0050 (0.430)	0.0300 (0.571)	0.0210 (0.698)	0.0572 (0.224)
Ipo4	0.0044 (0.644)	0.0051 (0.412)	0.0010 (0.897)	0.0172 (0.686)	0.0156 (0.656)	0.0411 (0.328)
Ipo5	0.0033 (0.655)	0.0043 (0.653)	0.0003 (0.967)	0.0076 (0.853)	0.0079 (0.820)	0.0157 (0.693)
R-Square	0.87			0.68		
N	121,175			121,175		

Table 4: The Determinants of Cash holding for Financially-constrained Firm

The dependent variable is firm-level quarterly cash holding from 2001Q3 to 2015Q2 for financially constrained, publicly traded, non-financial firms. A financially-constrained firm has short-term or long-term debt outstanding but does not have a bond rating each quarter. All equations quarterly time dummies and firm dummies. P-values in parentheses are based on standard errors robust to clustering by firm and year. Variable definitions are in the Appendix.

	Cash	Interaction with Pre-Crisis dummy	Interaction with Post-crisis dummy	Retained cash	Interaction with Pre-Crisis dummy	Interaction with Post-crisis dummy
Q	0.0043 (0.000)	0.0035 (0.000)	0.0024 (0.011)	0.0526 (0.000)	-0.0197 (0.007)	-0.0139 (0.067)
Size	0.0406 (0.000)	0.0023 (0.000)	0.0026 (0.000)	-0.4568 (0.000)	0.0034 (0.513)	0.0059 (0.242)
CF	0.0156 (0.005)	-0.0094 (0.128)	-0.0096 (0.130)	0.3515 (0.000)	-0.0223 (0.653)	0.3131 (0.000)
NWC	-0.0153 (0.000)	-0.0098 (0.000)	0.0023 (0.235)	-0.3873 (0.000)	-0.0644 (0.000)	0.0184 (0.242)
Investment	-0.1904 (0.000)	0.0377 (0.159)	-0.0349 (0.228)	-1.7010 (0.000)	-0.5361 (0.012)	-0.8103 (0.000)
Leverage	-0.0303 (0.000)	-0.0005 (0.827)	-0.0051 (0.063)	-0.0819 (0.000)	-0.0827 (0.000)	-0.0919 (0.000)
Industry	0.0004 (0.740)	0.0003 (0.140)	-0.0004 (0.824)	0.0007 (0.409)	0.0001 (0.938)	0.0007 (0.672)
Sigma	-0.0020 (0.374)	0.0027 (0.269)	-0.0002 (0.923)	0.0110 (0.540)	0.0148 (0.457)	0.0040 (0.844)
Dividend	0.0022 (0.000)	-0.0008 (0.036)	-0.0005 (0.156)	0.0257 (0.000)	-0.0106 (0.000)	-0.0008 (0.805)
R&D/Sales	-0.4019 (0.000)	-0.0020 (0.944)	-0.0524 (0.083)	-1.3107 (0.000)	-0.0549 (0.811)	-0.2018 (0.405)
ACQ	0.0855 (0.000)	0.0034 (0.734)	0.0360 (0.000)	-0.7225 (0.000)	0.0323 (0.693)	0.3429 (0.000)
debtissue	0.2038 (0.000)	0.0050 (0.543)	0.0063 (0.457)	-0.5747 (0.000)	0.0884 (0.184)	0.1886 (0.005)
Equityissue	-0.0043 (0.002)	-0.0012 (0.431)	0.0014 (0.381)	0.1965 (0.000)	-0.0431 (0.000)	0.0261 (0.050)
Loss	-0.0004 (0.597)	-0.0030 (0.000)	0.0257 (0.013)	0.0070 (0.323)	0.0137 (0.037)	-0.1034 (0.214)
Tbill	-0.0009 (0.355)	-0.0020 (0.226)	-0.0041 (0.001)	0.0276 (0.000)	-0.0179 (0.178)	0.0007 (0.942)
Spread	-0.0184 (0.000)	-0.0118 (0.007)	0.0135 (0.002)	-0.5339 (0.000)	0.0730 (0.038)	0.2270 (0.000)
ST debt	0.0095 (0.223)	0.0173 (0.002)	0.0079 (0.175)	0.1665 (0.004)	0.0593 (0.434)	0.1290 (0.050)
Ipo1	0.0040 (0.674)	0.0150 (0.022)	0.0071 (0.382)	0.1278 (0.023)	0.0583 (0.195)	0.0635 (0.178)
Ipo2	0.0036 (0.695)	0.0045 (0.439)	0.0061 (0.436)	0.1083 (0.085)	0.0334 (0.477)	0.0394 (0.483)
Ipo3	0.0032 (0.661)	0.0034 (0.717)	0.0060 (0.317)	0.0861 (0.253)	0.0056 (0.914)	0.0381 (0.544)
Ipo4	0.0013 (0.845)	0.0007 (0.935)	0.0056 (0.420)	0.0647 (0.396)	0.0017 (0.981)	0.0187 (0.178)
Ipo5						
R-Square	0.83			0.60		
N	167,147			167,147		

Table 5: OLS Regression Results for the Market Value

The dependent variable is the market value of the firm (Tobin's Q) in year t. For each independent variable X, X_t is the level in year t, divided by the level of total assets in year t; dX_t is its change from t-2 to t, divided by total assets in year t ($(X_t - X_{t-2})/A_t$); dX_{t+2} is its expected change from t+2 to t, divided by assets in year t ($(X_{t+2} - X_t)/A_t$). Good firms are financially-less constrained firms, and bad firms are financially-constrained firm has short-term or long-term debt outstanding but does not have a bond rating each quarter. P-values in parentheses are based on standard errors robust to clustering by firm and year. Variable definitions are in the Appendix.

Variable	Entire sample	Good	Bad
Earnings	-7.4665 (0.000)	-7.4537 [0.000]	-7.0091 [0.000]
Darnings	-0.0008 (0.000)	0.0001 [0.939]	-0.0007 [0.000]
dEarnings t+2	-0.0003 (0.000)	0.0141 [0.000]	-0.0006 [0.000]
dNet Assets	-0.1500 (0.366)	0.1801 [0.379]	-0.4706 [0.044]
dNet Assets t+2	0.1072 (0.580)	-0.3487 [0.118]	-0.2040 [0.426]
R&D	4.5237 (0.000)	7.8981 [0.000]	6.8942 [0.000]
dR&D	-0.0002 (0.792)	0.0005 [0.760]	0.0247 [0.000]
dR&D t+2	-0.0080 (0.101)	0.0059 [0.260]	-0.0526 [0.000]
Interest	7.6607 (0.952)	0.0039 [0.981]	6.5655 [0.972]
dInterest	8.0727 (0.305)	0.9067 [0.498]	-9.6223 [0.686]
dInterest t+2	3.6831 (0.952)	0.0058 [0.860]	1.5328 [0.957]
Dividends	5.5621 (0.972)	6.8352 [0.986]	3.7884 [0.979]
dDividends	0.0014 (0.974)	-0.1039 [0.910]	0.0008 [0.986]
dDividends t+2	-2.9832 (0.962)	-8.5029 [0.984]	-9.3411 [0.962]
dValue2	-0.0009 (0.000)	-0.0007 [0.000]	-0.0018 [0.000]
Cash	-2.4356 (0.000)	-2.6931 [0.000]	-1.8537 [0.000]
Cash*pre	2.7628 (0.000)	0.5833 [0.035]	4.1216 [0.000]
Cash*post	-2.2210 (0.000)	-0.1401 [0.638]	-2.9386 [0.000]
Pre	-0.2776 (0.009)	0.1276 [0.239]	-0.4857 [0.003]
Post	1.1671 (0.000)	0.4243 [0.000]	1.5044 [0.000]
R square	0.88	0.80	0.89

Table 6: OLS Regression Results for the Market Value (Annual)

The dependent variable is the market value of the firm (Tobin's Q) in year t. For each independent variable X, X_t is the level in year t, divided by the level of total assets in year t; dX_t is its change from t-2 to t, divided by total assets in year t ($(X_t - X_{t-2})/A_t$); dX_{t+2} is its expected change from t+2 to t, divided by assets in year t ($(X_{t+2} - X_t)/A_t$). Good firms are financially-less constrained firms, and bad firms are financially-constrained firm has short-term or long-term debt outstanding but does not have a bond rating each quarter. P-values in parentheses are based on standard errors robust to clustering by firm and year. Variable definitions are in the Appendix.

Variable	Entire sample	Good	Bad
Earnings	-9.8311 (0.000)	-6.6524 (0.000)	-9.9135 (0.000)
Darnings	-0.0315 (0.000)	0.0128 (0.051)	-0.0329 (0.000)
dEarnings t+2	-0.0006 (0.000)	-0.0339 (0.000)	-0.0005 (0.000)
dNet Assets	0.2749 (0.171)	0.4506 (0.035)	0.5109 (0.093)
dNet Assets t+2	-0.2019 (0.402)	0.9484 (0.000)	-1.6260 (0.000)
R&D	1.1766 (0.187)	-0.0139 (0.989)	2.8201 (0.027)
dR&D	-0.0229 (0.004)	0.0420 (0.002)	0.0024 (0.840)
dR&D t+2	0.0423 (0.000)	-0.0196 (0.199)	-0.0354 (0.121)
Interest	5.5176 (0.855)	-0.6221 (0.993)	4.8113 (0.790)
dInterest	9.0527 (0.419)	-4.8310 (0.414)	1.6275 (0.131)
dInterest t+2	6.1665 (0.860)	-0.0261 (0.148)	0.2651 (0.790)
Dividends	-7.2813 (0.912)	-7.0751 (0.918)	-8.7980 (0.947)
dDividends	-0.0150 (0.937)	-0.0018 (0.987)	-0.0064 (0.990)
dDividends t+2	-5.5507 (0.957)	4.8367 (0.896)	-2.2501 (0.920)
dValue2	-0.0016 (0.000)	-0.0077 (0.000)	-0.0016 (0.000)
Cash	6.0703 (0.000)	2.6567 (0.000)	9.7143 (0.000)
Cash*crisis	-1.7192 (0.000)	-0.9739 (0.001)	-2.7731 (0.000)
Cash*post	-0.7800 (0.012)	-0.6454 (0.019)	-1.0576 (0.057)
Crisis	-0.2374 (0.042)	-0.3512 (0.000)	-0.0525 (0.776)
Post	0.0646 (0.513)	-0.1707 (0.051)	0.2434 (0.139)
R square	0.72	0.82	0.74

Table 7: OLS Regression Results for the Δ Market Value

The dependent variable is the change in market value of the firm (Tobin's Q) in year t. For each independent variable X, X_t is the level in year t, divided by the level of total assets in year t; dX_t is its change from t-2 to t, divided by total assets in year t ($(X_t - X_{t-2})/A_t$); dX_{t+2} is its expected change from t+2 to t, divided by assets in year t ($(X_{t+2} - X_t)/A_t$). Good firms are financially-less constrained firms, and bad firms are financially-constrained firm has short-term or long-term debt outstanding but does not have a bond rating each quarter. P-values in parentheses are based on standard errors robust to clustering by firm and year. Variable definitions are in the Appendix.

Variable	Entire sample	Good	Bad
Earnings	-0.4039 (0.000)	-0.1579 (0.000)	-0.5258 (0.000)
Darnings	-0.0002 (0.003)	0.0049 (0.000)	-0.0002 (0.038)
dEarnings t+2	-0.0007 (0.000)	0.0133 (0.000)	-0.0006 (0.018)
dNet Assets	0.5009 (0.000)	0.3954 (0.000)	0.5091 (0.000)
dNet Assets t+2	-0.3789 (0.000)	-0.8906 (0.000)	-0.2860 (0.007)
R&D	0.6698 (0.030)	1.6628 (0.000)	-0.5412 (0.221)
dR&D	0.0003 (0.350)	0.0057 (0.000)	-0.0040 (0.176)
dR&D t+2	0.0056 (0.018)	-0.0001 (0.946)	0.0114 (0.003)
Interest	-7.7206 (0.888)	0.0806 (0.466)	-2.1921 (0.872)
dInterest	-8.8300 (0.017)	0.1939 (0.001)	-6.1980 (0.003)
dInterest t+2	-3.2072 (0.896)	0.9771 (0.882)	-9.8581 (0.893)
Dividends	-3.3791 (0.947)	-0.7248 (0.888)	-9.7067 (0.988)
dDividends	-0.0057 (0.787)	-0.0017 (0.997)	-0.0058 (0.814)
dDividends t+2	-1.4078 (0.996)	-9.3716 (0.979)	8.1026 (0.984)
dValue2	-0.0002 (0.000)	-0.0001 (0.000)	-0.0002 (0.000)
Δ Cash	3.2131 (0.000)	2.8180 (0.000)	3.3133 (0.000)
Δ Cash*crisis	-0.1518 (0.340)	-0.9667 (0.000)	0.1300 (0.583)
Δ Cash*post	0.5908 (0.000)	-0.2391 (0.094)	0.9694 (0.000)
Crisis	-0.1944 (0.000)	-0.1342 (0.002)	-0.2381 (0.000)
Post	-0.1902 (0.002)	-0.1433 (0.029)	-0.2442 (0.017)
R square	0.33	0.43	0.35

Table 8: OLS Regression Results for the Market Value and for the Change Using GIM Index

The dependent variable is the change in market value of the firm (Tobin's Q) in year t. For each independent variable X, X_t is the level in year t, divided by the level of total assets in year t; dX_t is its change from t-2 to t, divided by total assets in year t ($(X_t - X_{t-2})/A_t$); dX_{t+2} is its expected change from t+2 to t, divided by assets in year t ($(X_{t+2} - X_t)/A_t$). We classify firms as poor("poor") or good governance("good") by dividing the sample at the median each year using GIM index. A high GIM index is associated with weak shareholder rights, that is, poor corporate governance, and a low GIM index relates to good corporate governance. P-values in parentheses are based on standard errors robust to clustering by firm and year. Variable definitions are in the Appendix.

Variable	poor	good	Δ poor	Δ good
Earnings	-7.9582 (0.000)	-7.4669 (0.000)	-0.3675 (0.000)	-0.5535 (0.000)
darnings	-0.0051 (0.000)	-0.0005 (0.002)	0.0003 (0.588)	-0.0002 (0.017)
dEarnings t+2	-0.0006 (0.009)	-0.0002 (0.000)	0.0002 (0.064)	-0.0009 (0.000)
dNet Assets	0.1777 (0.497)	0.5108 (0.056)	0.4252 (0.000)	0.5840 (0.000)
dNet Assets t+2	-0.6938 (0.014)	-0.0690 (0.815)	-0.8671 (0.000)	-0.1288 (0.283)
R&D	1.3089 (0.000)	5.0582 (0.000)	0.2399 (0.598)	0.3701 (0.479)
dR&D	0.0010 (0.855)	0.0006 (0.939)	0.0044 (0.124)	0.0003 (0.419)
dR&D t+2	0.0247 (0.000)	-0.1395 (0.000)	0.0086 (0.004)	-0.0010 (0.857)
Interest	4.5118 (0.943)	0.5102 (0.001)	-3.5458 (0.871)	-0.0570 (0.577)
dInterest	1.2910 (0.812)	6.7551 (0.067)	-7.6335 (0.000)	2.0689 (0.015)
dInterest t+2	9.6412 (0.938)	8.9450 (0.153)	-9.7125 (0.906)	8.9450 (0.153)
Dividends	4.0219 (0.385)	-6.1503 (0.960)	2.0224 (0.640)	-6.1503 (0.960)
dDividends	-0.0007 (0.985)	-0.0218 (0.926)	-0.0053 (0.795)	-0.0218 (0.926)
dDividends t+2	-0.0852 (0.852)	3.6111 (0.991)	-0.0473 (0.955)	3.6111 (0.991)
dValue2	-0.0013 (0.000)	-0.0002 (0.000)	-0.0003 (0.000)	-0.0002 (0.000)
Cash	-0.9643 (0.094)	2.2782 (0.000)	4.1228 (0.000)	2.2782 (0.000)
Cash*pre	2.4243 (0.000)	0.9471 (0.000)	-0.9068 (0.000)	0.9471 (0.000)
Cash*post	-1.7147 (0.000)	2.1602 (0.000)	-1.6754 (0.000)	2.1602 (0.000)
pre	-0.0875 (0.618)	0.1841 (0.007)	0.2443 (0.000)	0.1841 (0.007)
Post	1.3910 (0.000)	-0.0278 (0.695)	0.0338 (0.634)	-0.0278 (0.695)
R square	0.88	0.89	0.31	0.36

Table 9: OLS Regression Results for the Market Value Versus Excess Cash

The dependent variable is the change in market value of the firm (Tobin's Q) in year t. For each independent variable X, X_t is the level in year t, divided by the level of total assets in year t; dX_t is its change from t-2 to t, divided by total assets in year t ($(X_t - X_{t-2})/A_t$); dX_{t+2} is its expected change from t+2 to t, divided by assets in year t ($(X_{t+2} - X_t)/A_t$). We classify firms as poor or good governance by dividing the sample at the median each year using Gompers index. A high Gompers index is associated with weak shareholder rights, that is, poor corporate governance, and a low Gompers index relates to good corporate governance. P-values in parentheses are based on standard errors robust to clustering by firm and year. Variable definitions are in the Appendix.

Variable	Entire sample	good	bad	Δ Entire	Δ Good	Δ Bad
Earnings	-5.6374 (0.000)	-3.9553 (0.000)	-5.4436 (0.000)	-0.3986 (0.000)	-0.3003 (0.000)	-0.4234 (0.000)
darnings	-0.0038 (0.000)	0.0009 (0.390)	-0.0031 (0.000)	0.0007 (0.013)	0.0012 (0.363)	0.0009 (0.009)
dEarnings t+2	-0.0004 (0.004)	0.0026 (0.179)	-0.0005 (0.003)	0.0002 (0.772)	0.0217 (0.000)	0.0001 (0.872)
dNet Assets	-0.4501 (0.000)	0.3722 (0.001)	-0.8114 (0.000)	-0.2610 (0.000)	-0.2328 (0.000)	-0.4034 (0.000)
dNet Assets t+2	0.3026 (0.025)	-0.2940 (0.026)	0.7585 (0.000)	0.7052 (0.000)	0.2285 (0.002)	0.8924 (0.000)
R&D	5.8231 (0.000)	8.5761 (0.000)	9.5227 (0.000)	-3.2274 (0.000)	-2.5372 (0.000)	-3.2087 (0.000)
dR&D	0.0251 (0.000)	-0.1889 (0.000)	0.0242 (0.000)	0.0020 (0.284)	-0.0131 (0.714)	0.0041 (0.085)
dR&D t+2	-0.0571 (0.000)	-0.3088 (0.000)	-0.0540 (0.000)	0.0181 (0.000)	0.1493 (0.006)	0.0177 (0.000)
Interest	-8.5913 (0.988)	-0.8405 (0.624)	9.1575 (0.994)	7.8657 (0.967)	0.9388 (0.066)	2.0705 (0.979)
dInterest	-1.5756 (0.315)	-7.1576 (0.762)	-1.9749 (0.450)	-6.3444 (0.000)	6.7898 (0.000)	-6.0858 (0.000)
dInterest t+2	2.5891 (0.970)	0.1785 (0.375)	5.5687 (0.968)	4.1762 (0.955)	3.9827 (0.660)	4.8184 (0.959)
Dividends	2.1126 (0.949)	1.8351 (0.937)	6.2181 (0.968)	-5.3317 (0.899)	-0.4952 (0.799)	-7.5358 (0.971)
dDividends	0.0006 (0.980)	-0.0533 (0.911)	0.0008 (0.980)	-0.0037 (0.803)	-0.1174 (0.706)	-0.0034 (0.851)
dDividends t+2	-9.0690 (0.966)	4.1893 (0.995)	-9.2597 (0.959)	-9.4982 (0.968)	-3.2976 (0.930)	2.2933 (0.994)
dValue2	-0.0008 (0.000)	-0.0003 (0.000)	-0.0019 (0.000)	-0.0001 (0.000)	0.0004 (0.053)	0.0001 (0.179)
ExcessCash	-3.4609 (0.000)	-1.1745 (0.000)	-4.4573 (0.000)	-0.2186 (0.169)	-0.6059 (0.001)	-0.2204 (0.359)
ExcessCash*pre	2.2943 (0.000)	0.4660 (0.000)	3.7061 (0.000)	-0.3128 (0.063)	0.1961 (0.314)	-0.4032 (0.115)
ExcessCash*post	-0.1756 (0.336)	0.7231 (0.000)	-1.0820 (0.001)	-1.1157 (0.000)	-0.7444 (0.000)	-1.2367 (0.000)
pre	0.4060 (0.000)	0.1373 (0.005)	0.4742 (0.000)	0.1386 (0.000)	0.0754 (0.012)	0.1924 (0.000)
Post	0.4871 (0.000)	0.4371 (0.000)	0.5012 (0.000)	-0.0114 (0.722)	-0.0267 (0.388)	-0.0131 (0.806)
R square	0.89	0.82	0.80	0.36	0.45	0.37

Appendix: Variable Definitions

Variable	Definition
Acquisitions	Acquisition / book assets
Cash	Cash and short-term investments / lagged total assets.
Cash Flow(CF)	Operating income before depreciation / lagged total assets.
Credit spread	The difference between the AAA and BBB yields published by the Federal Reserve.
Dividends (D)	Common dividends
Debt issuance	(Long-term debt issuance – long-term debt reduction) / total assets
Dividend dummy	It is one in quarters in which a firm pays a common dividend.
Earnings (E)	Earnings before extraordinary items + interest + income statement deferred tax credits + investment tax credits
Equity issuance	(Sale of common and preferred stock – purchase of common and preferred stock) / total assets.
Interest (I)	Interest expense
Industry Sigma	The mean of the standard deviations of cash flow / assets over 10 years for firms in the same, 2-digit SIC code industry
IPO1-5 dummy	It is one if the firm went public 1, 2, 3, 4 or 5 years ago
Investment	Quarterly capital expenditure / lagged total assets ⁵ .
Leverage	(Long-term debt + debt in current liabilities) / book assets
Loss dummy	It is one if net income is less than zero, and zero otherwise
Net Assets (NA)	Net assets, calculated as book value of total assets – cash
NWC	Net working capital (current assets – current liabilities – cash) / total assets.
R&D	Research and development expense or zero when missing
R&D to sales	R&D expense / sales
Log (Assets)	Log(total assets).
T-bill yield	The average 3-month rate published by the Federal Reserve
Tobin's Q(Q)	Market value of assets (total assets + market value of common equity (common shares outstanding*price close) – book value of common equity – deferred taxes) / (0.9*book value of assets + 0.1* market value of assets).

⁵ For year-to-date items such as capital expenditure, we subtract the previous quarter's capital expenditure from the current quarter's for fiscal quarters, 2, 3, and 4. The same adjustment is applied for other year-to-date items.