Abnormal Cash Holdings and the Cost of Equity Capital

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This study examines the implications of abnormal cash holdings on the cost of equity capital. We find the positive relation between abnormal cash holdings and the cost of equity capital, suggesting investors require the higher cost of equity capital for firms having abnormal cash holdings. Specifically, while both insufficient and excess cash holdings are positively related to the cost of equity capital, the effect of insufficient cash holdings on the cost of equity capital is stronger than the effect of excess cash holdings. Further, the positive relation is more pronounced for firms with high information asymmetry among investors, suggesting that the informational role of abnormal cash holdings is more significant for firms with poor information environment. Overall, our empirical evidence supports that investors recognize abnormal cash holdings, both insufficient and excess cash holdings, as the value relevant signals in determining the cost of equity capital.

JEL classification: G30, G32, M40, M41
Keywords: Abnormal cash holdings; Cost of equity capital; Information asymmetry

1. Introduction

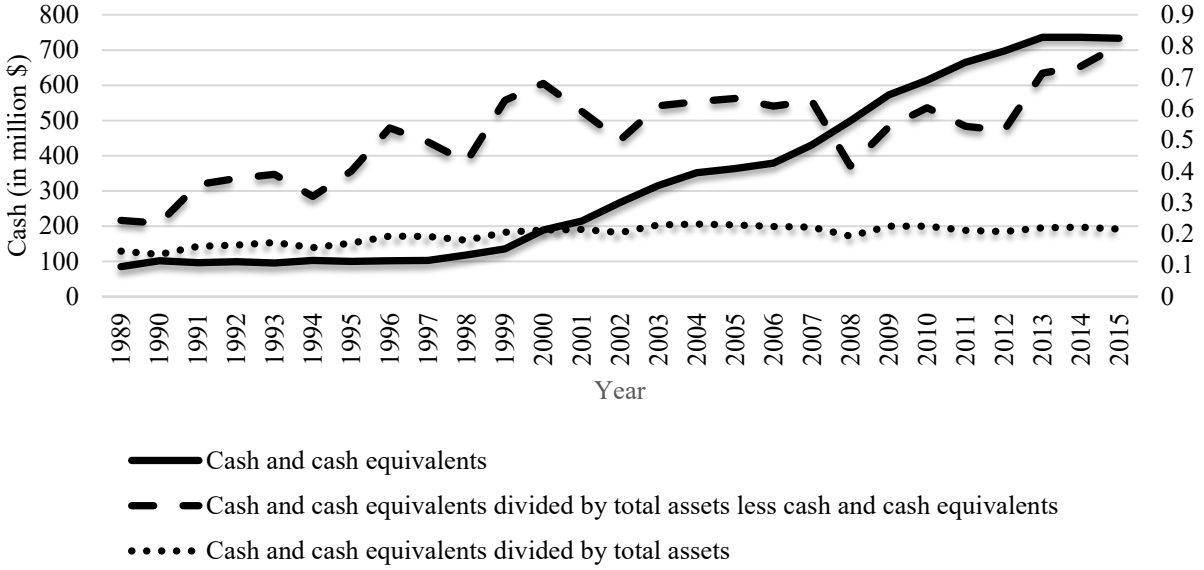
This study examines whether investors understand the implications of abnormal cash holdings on firms' performance and risk and incorporate this information into determining the cost of equity capital. Opler et al. (1999) show that a firm may have its optimal level of cash reserves through a static tradeoff between costs and benefits from carrying cash. That is, a divergence from the optimal level of cash holdings could provide clues for future firm performance and valuation. A significant stream of research investigates the economic effect of abnormal cash holdings, especially excess cash, on firm performance and finds that excess cash holdings are negatively related with firms' future performance, particularly for firms with poor corporate governance (e.g., Harford, 1999; Dittmar and Mahrt-Smith, 2007; Harford et al., 2008). Recently, Oler and Picconi (2014) find that both insufficient and excess cash holdings lead to a decrease in future firm performance. Although prior studies prove the impact of abnormal cash holdings on a firm's performance, there has been little on how investors assess the divergence from the optimal level of cash holding in deciding the level of cost of equity capital.[1] This study addresses this gap in the

[1] Exception to the evidence is Palazzo (2012) which shows the positive relation between expected stock returns and cash holdings. However, we primarily focus on the abnormal cash holdings

literature to expand our understanding of investors' assessment of the abnormal cash holdings for the cost of equity capital.

Figure 1 shows that both the cash and cash to asset ratio in U.S. firms have increased substantially over the last 25 years. The average cash reserves in 2015 represent 733 million, reflecting 21% of total assets and a great increase from 85 million (14% of total assets) in 1989. As a level of cash reserves increases, the importance of understanding the determinants and consequences of cash reserves has been well emphasized by academia as well as industry. For instance, The Wall Street Journal (2010) reports that U.S. firms keep building up stockpiles of cash rather than investing.[2] Bates et al. (2009) provide the evidence of precautionary motive for hoarding cash which explains why U.S. firms hold more cash than before. More importantly, using a static tradeoff model of cash holdings, Opler et al. (1999) theorize that divergences from the optimal level of cash (both insufficient and excess cash) could induce additional costs to firms. Whereas excess cash holdings have been the primary focus of researchers and practitioners under a substantial increase in cash reserves, much less attention has been given to the insufficient cash holdings which would reflect unique dimensions for cash holdings.

Figure 1. Trend in cash and cash holdings ratio.



Based on the tradeoff model of Opler et al. (1999), we posit that a deviation from the optimal cash level, such as insufficient and excess cash, contains a distinct signal

including both excess and insufficient cash holdings and their relative significance while Palazzo (2012) pertain to the excess cash holdings.

[2] Justin Lahart, "U.S. Firms Build up Record Cash Piles", The Wall Street Journal, June 10, 2010; Justin Lahart, "Companies Cling to Cash", The Wall Street Journal, December 10, 2010; Ben Casselman and Justin Lahart, "Companies Shun Investment, Hoard Cash", The Wall Street Journal, September 17, 2011.

about a firm's future performance and potential risk. For instance, agency problems between shareholders and managers are more severe for firms with excess cash reserves (e.g., Jensen, 1986; Stulz, 1990). Self-interested managers are more likely to spend excess free cash flow for their private benefits rather than for shareholders' benefits, resulting in poor performance for firms with excess cash holdings (e.g., Dittmar and Mahrt-Smith, 2007; Harford et al., 2008).[3] Insufficient cash reserves also cause potential costs such as underinvestment or expensive external financing (e.g., Jensen and Meckling, 1976; Myers and Majluf, 1984). Consistently, Oler and Picconi (2014) find that abnormal cash holdings, both excess and insufficient cash holdings, are negatively related to firm performance. If investors can recognize the mechanisms of abnormal cash holdings on firm performance and incorporate them into the cost of equity capital, investors would reasonably require the higher cost of equity capital for firms with more abnormal cash holdings. Since this tendency might be even more significant for firms with worse information environment, we predict the impact of the abnormal cash holdings to be more pronounced for firms with greater information asymmetry.

To test our predictions, we investigate the relationship between abnormal cash holdings and the cost of equity capital. Following Oler and Picconi (2014), the abnormal cash holdings are measured by subtracting a firm's optimal level of cash from a reported level of cash.[4] We primarily employ four measures of the implied cost of equity capital which are frequently used in the cost of equity capital literature together with a composite measure of four. The implied cost of equity capital is specified as an internal rate of return in various valuation models (Gebhardt et al., 2001; Gode and Mohanram, 2003; Botosan and Plumlee, 2005; Pastor et al., 2008; Botosan et al., 2011; Li et al., 2013).

First, we examine whether investors require the higher cost of equity capital for firms with abnormal cash holdings. After controlling for the related firm risk characteristics prior studies identified, we find that abnormal cash holdings are positively related to the cost of equity capital. Specifically, our evidence shows the positive effect of both insufficient and excess cash holdings on the cost of equity capital while the effect of insufficient cash holdings is stronger than excess cash holdings. This suggests that investors understand the implications from abnormal cash holdings on firm performance and demand higher cost of equity capital for firms with more abnormal cash holdings. We further document that the signaling effect of abnormal cash holdings on the cost of equity capital is greater for firms with higher information asymmetry. This is consistent with the signaling role of abnormal cash holdings that varies with firms' information environment. Our additional analyses confirm that our findings are robust to the endogeneity concern. Finally, a sub-

[3] However, Mikkelson and Partch (2003) find no significant relation between excess cash holding and poor firm performance.

[4] Oler and Picconi (2014) modify the models of Opler et al. (1999) and Bates et al. (2009) to predict an optimal level of cash holdings for a firm.

sample test excluding observations from the financial crisis period (2007-2008) reveals that the main results of our study are not sensitive to the influence of the financial crisis.

This study makes contributions to the literature in three significant ways. First, our investigation into the signaling effect of abnormal cash holdings adds to the literature examining the influences of cash holdings on investors' decision-making. We convey a clear message that the abnormal level of cash holdings is a critical element for investors to determine the cost of equity capital. This paper complements prior studies on how the cash holdings affect firm performance by linking investors' recognition of the implications with their determinations on the cost of equity capital (e.g., Harford, 1999; Dittmar and Mahrt-Smith, 2007; Harford et al., 2008; Oler and Picconi, 2014). It is worth mentioning that the signal from abnormal cash holdings is incremental to those from fundamental firm risk characteristics.

Second, this study contributes to the theory of the static tradeoff of cash holdings. Opler et al. (1999) show that it is optimal for firms to build cash up to the level where the marginal benefits of holding cash are equal to the marginal costs. That is, a deviation from a firm's target cash induces additional inefficiency on its performance. Consistent with the theory, our empirical evidence demonstrates that an increased degree of abnormal cash holdings could lead to an increase in the cost of equity capital. In this respect, our findings complement the evidence in Opler et al. (1999) and Oler and Picconi (2014) that support the static tradeoff theory. Finally, this paper advances our understandings of the relative importance of insufficient versus excess cash holdings on the cost of equity capital. Our results indicate that insufficient cash holdings are more critical element than excess cash holdings in the process of the cost of equity capital.

This paper proceeds as follows. In the next section, we review the related literature and develop our hypotheses. Section 3 addresses the research design including variable measurements and data used in the empirical analyses. In Section 4, we test our predictions and report empirical results. Section 5 provides results from robustness tests. Section 6 concludes the paper.

2. Motivation and Predictions

Related Research and Motivation

Extant literature examines the implications of cash holdings on firm performance and risk. First, prior studies discussing the relationship between cash holdings and firm performance mainly pertain to the agency cost caused by excess cash holdings (e.g., Harford, 1999; Dittmar and Mahrt-Smith, 2007; Harford et al., 2008; Oler and Picconi, 2014). Harford (1999) explores the acquisition behavior of firms with excess cash holdings and finds a higher likelihood of engaging less efficient acquisitions, leading to a decrease in firm value. Similarly, Dittmar and Mahrt-Smith (2007) show that poorly governed firms with excess cash reserves are more likely to dissipate cash in a way that negatively affects a firm's operating performance. Harford et al. (2008)

also provide evidence of the negative relation between excess cash holdings and future profitability conditional on weak governance structures. Recently, Oler and Picconi (2014) directly examine the relation between abnormal cash holdings and future performance and report that firms with abnormal cash holdings, both insufficient and excess cash, performed poorly in the future. In this respect, prior studies support the abnormal cash holdings viewed as signals of poor future performance.

Another stream of literature investigates the implications of cash holdings on a firm's potential risk. A growing body of literature examines the determinants of cash holdings and identifies a precautionary motive as one of the motives why firms hold cash (e.g., Opler et al., 1999; Han and Qiu, 2007; Bates et al., 2009; Acharya et al., 2012; Palazzo, 2012).[5] For instance, Opler et al. (1999) show that firms with more growth opportunities and riskier cash flows appear to hold more cash to avoid expensive external financing caused by potential financial constraints. Bates et al. (2009) also find that a firm's cash ratio increases as its cash flow become riskier, supporting the precautionary reason for cash reserves. Similarly, Acharya et al. (2012) examine the relation between cash holdings and credit risk and document the positive relation between cash holdings and credit spreads. These evidence support that riskier firms appear to retain more cash because of the precautionary motive.

In sum, prior studies that examined the cash holdings focus primarily on the correlation of cash holdings, especially excess cash holdings with agency costs and future performance. Accordingly, they provide evidence that firms with excess cash holdings are subject to severe agency problems and, consequently, perform poorly in the future. However, they do not consider whether investors understand the meaning of insufficient cash holdings. In this study, we investigate whether abnormal, either insufficient or excess, cash holdings provide investors with a distinct signal for future performance and valuation, and thereby influence a firm's cost of equity capital.

Hypothesis Development

Abnormal Cash Holdings and the Cost of Equity Capital

As pointed out in Opler et al. (1999), the optimal level of cash holdings is determined when the incremental benefits from an increase in cash holdings equal its incremental costs. This static tradeoff model indicates that diverging from the optimal cash level incurs additional costs. Consistent with the theory, prior studies

[5] Other motives for firms to hold liquidity assets such as cash include 1) the transaction motive, 2) the tax motive, and 3) the agency motive. For the transaction motive, Keynes (1936) find that the transaction costs associated with the transformation of noncash assets into cash causes firm to hold cash. Foley et al. (2007) suggest the tax-based explanation for cash reserves by showing that firms facing high tax for repatriating foreign income tend to hold more cash abroad. According to the agency motive, entrenched managers hold more cash to obtain their personal interests at shareholder cost (Jensen, 1986). Dittmar et al. (2003) document great cash holding for firms located in the countries with more agency problems.

find that firms with abnormal cash holdings such as insufficient and excess cash holdings are more likely to be exposed to agency problems and report poor future performance (e.g., Harford, 1999; Dittmar and Mahrt-Smith, 2007; Harford et al., 2008; Oler and Picconi, 2014). In other words, the abnormal cash holdings reflect a distinct signal of poor future performance and potential risk from agency problem. If investors can apprehend the consequences of abnormal cash holdings, they should demand the greater cost of equity capital when a firm's cash level deviates from estimated target cash. Therefore, we advance the following hypothesis:

H1: Abnormal cash holdings is positively associated with the cost of equity capital.

The Effect of the Information Environment on the Relation between Abnormal Cash Holdings and the Cost of Equity Capital

Given H1, it is logical to raise a question as to whether the information environment around firms influences investors' reliance on the effect of abnormal cash holdings on the cost of equity capital. If the relation between abnormal cash holdings and the cost of equity capital is indeed driven by the information signal effect of abnormal cash holdings, then the signals by abnormal cash holdings should be more valuable for firms with poor information environment.[6] As investors' costs in acquiring and processing information increase with information asymmetry, the incremental advantage of the information signaled by abnormal cash holdings would be higher for firms with greater information asymmetry. We, therefore hypothesize that the effect of abnormal cash holdings on the cost of equity capital would be stronger for firms facing greater information asymmetry. Our second hypothesis is as follows:

H2: The positive relation between abnormal cash holdings and the cost of equity capital is more pronounced for firms with high information asymmetry among investors.

3. Research Design

Variable Measurement

Measurement of Abnormal Cash Holdings

Following Oler and Picconi (2014), we first estimate a firm's optimal level of cash to measure abnormal cash holdings. Oler and Picconi (2014) modify the model of Opler et al. (1999) and develop the following Equation (1) for the target cash estimation. Oler and Picconi (2014) use the firm-specific effects that are significantly

[6] The literature of estimation risk supports that heterogeneous information among investors increases estimation risk, leading to an increase in the cost of equity (e.g., Barry and Brown, 1985; Coles et al., 1995). With the assumption of imperfect market competitions, Lambert et al. (2011) analytically provide the evidence of the indirect link between information risk and the cost of equity via information asymmetry among investors.

influencing the firm's cash management behavior: assets, working capital, cash flow volatility, R&D expense, dividend payment, sales growth, operating cash flow, firm age, and foreign tax issues (Variable descriptions are in appendix 1). Using a Tobit regression, we estimate Equation (1) over the 5-year rolling period, ending in the prior year to the estimation year. The target cash is determined by multiplying the estimated coefficients from the rolling regressions and the related financial information of the estimation year.[7] This estimated target cash is a proxy for a firm's optimal cash level at the end of the estimation year.

$$Cash_{it} = \beta_0 + \beta_1 Asset_{it} + \beta_2 Working\_Capital_{it} + \beta_3 Cap\_Expenditure_{it} + \beta_4 Ind\_Sigma_{it} + \beta_5 R\&D_{it} + \beta_6 Dividend_{it} + \beta_7 Sales\_Growth_{it} + \beta_8 CFO_{it} + \beta_9 Age_{it} + \beta_{10} Foreign\_Tax_{it} + Year\ Fixed + Industry\ Fixed + \varepsilon_{it} \quad (1)$$

To construct a firm-year specific measure of abnormal cash holdings, we subtract the estimated target cash (*Target_Cash*) from the reported cash (*Cash*) and use the absolute value of the difference between the target cash and the reported cash (*Cash_Diff*) as a proxy for abnormal cash holdings (*Abs_Cash_Diff*). By construction, higher values of *Abs_Cash_Diff* indicate greater deviations from optimal cash levels. Alternatively, we break down the abnormal cash holdings into insufficient cash holdings and excess cash holdings. Insufficient cash holdings (*Insufficient_Cash*) is defined as the absolute value of *Cash_Diff* for the negative cash difference and 0 otherwise and shows whether a firm is underfunded compared to its optimal level of cash. Excess cash holdings (*Excess_Cash*), on the other hand, is defined as the value of *Cash_Diff* for the positive cash difference and 0 otherwise and it measures the degree of the overfunded status of a firm.

Measurement of the Cost of Equity Capital

To estimate the cost of equity capital, we primarily use the implied cost of equity capital as an ex- ante proxy for the cost of equity capital. There has been a variety of valuation models acceptable in the literature to measure the implied cost of equity capital, and no specific model is superior to others (Botosan and Plumlee, 2005; Guay et al., 2011). Therefore, for the robustness of our results, we utilize the four valuations models that are most frequently used in estimating the implied cost of equity capital; GLS Model (Gebhardt et al., 2001), CT Model (Claus and Thomas, 2001), MPEG Model (Easton, 2004), and OJN Model (Ohlson and Juettner-Nauroth, 2005). We use analysts' earnings forecasts to estimate expected future earnings and growth rate in the four models. Appendix 2 provides the details of each specification with the definition of variables used and the assumptions applied in the model. As a result, the four specifications, GLS Model, CT Model, MPEG Model, and OJN Model yield four measures of the implied cost of equity capital, *R_GLS, R_CT, R_MPEG*, and *R_OJN*, respectively.

[7] For instance, we estimate Equation (1) using data from year 2010 to year 2014 for 2015's target cash estimation. Multiplying these estimated coefficients and the corresponding financial information of year 2015 yields the estimated target cash level for year 2015.

In detail, GLS and CT models are based on a residual income valuation model with different assumptions about the expected earnings growth rates and terminal period as follows:

$$SP_{it} = BV_{it} + \sum_{\tau=1}^{q} \frac{(ROE_{it+\tau} - IRR) \times BV_{it+\tau-1}}{(1+IRR)^{\tau}} + \frac{(ROE_{it+q} - IRR) \times BV \times (1+G)}{(IRR-G) \times (1+IRR)^{q}} \quad (2)$$

In this equation, *IRR* represents the internal rate of return which is a proxy of the implied cost of equity capital to be estimated. *SP* is the stock price at the end of fiscal year, *BV* is book value of equity per share, *ROE* is a return on equity, and *G* is the expected earnings growth rate. Consistent with Gebhardt et al. (2001), we estimate *R_GLS* assuming the mean-reverts *ROE* toward the historical industry median *ROE* from q = 3 to q = 11, and the zero-growth (i.e., *G*=0) *ROE* after q = 11. As in Claus and Thomas (2001), *R_CT* is estimated by assuming the growing *ROE* at a rate of analysts' consensus until q = 5 and at a rate of an inflation rate (i.e., *G* = US 10-year bond yield – 3 percent) after q = 5.

Both MPEG and OJN models are the modified specifications of an abnormal earnings growth valuation model in estimating the implied cost of equity capital. However, they differ in assumptions on dividend and earnings growth patterns as follows:

$$SP_{it} = \frac{EPS_{it+1}}{IRR} + \frac{EPS_{it+2} + IRR \times DIV_{it+1} - (1+IRR) \times EPS_{it+1}}{IRR \times (IRR-G)} \quad (3)$$

In this equation, EPS_{it+1} denotes earnings per share of year *t+1* predicted at year *t*. DIV_{it+1} represents a dividend per share of year *t+1* forecasted at year *t*. Following Easton (2004) and Easton and Monahan (2005), we estimate *R_MPEG* with the assumption of the zero-growth EPS after year t+1 (i.e., *G*=0). Similarly, *R_OJN* is derived by the modified earnings growth model (Ohlson and Juettner-Nauroth, 2005). In *OJN* model, the expected earnings growth rate (*G*) is simultaneously determined with the implied cost of equity capital (*R_OJN*).

To test our hypotheses, we use a composite measure (*R_MN*) of the implied cost of equity capital.[8] Since four measures of the implied cost of equity capital are based on different assumptions of valuation model specifications such as types, forecast horizons, and growth rates, those differences might influence our findings. To address this concern, we create a composite measure (*R_MN*) that is the equally-weighted average of four individual measures (e.g., Dhaliwal et al., 2006; Hail and Leuz, 2006).

Sample and Descriptive Statistics

We initially build our sample with firms having the required data to measure the implied cost of equity capital and abnormal cash holdings over the period from 1984-2014. The sample period begins in 1984 because analysts' earnings forecasts, one of

[8] When we alternatively use four individual measures of the implied cost of equity capital in testing hypotheses, the results do not alter our inferences.

the components used in estimating the implied cost of equity capital, are only available from 1984. We extract the sample from the junction of COMPUSTAT, CRSP,

Table 1. Descriptive statistics.

Variable	*N*	*Mean*	*STD*	*25%*	*Median*	*75%*
Panel A. Cost of Equity Capital						
R_MPEG	25,382	0.1230	0.0553	0.0891	0.1101	0.1432
R_OJN	25,382	0.1288	0.0474	0.0953	0.1188	0.1510
R_CT	25,382	0.1528	0.0715	0.1048	0.1433	0.1878
R_GLS	25,382	0.0930	0.0293	0.0743	0.0905	0.1081
R_MN	25,382	0.1245	0.0421	0.0960	0.1170	0.1438
Panel B. Cash Variables						
Cash	25,382	0.2888	0.5304	0.0315	0.1083	0.3194
Log Cash	25,382	-2.3459	1.6629	-3.4455	-2.2156	-1.1385
Company cash and cash equivalent divided by total assets	25,382	0.1630	0.1726	0.0305	0.0977	0.2421
Target Cash	25,382	-0.5101	0.6393	-0.8716	-0.3979	-0.0503
Cash_Diff	25,382	-0.2177	0.7761	-0.6291	-0.1713	0.2058
Abs_Cash_Diff	25,382	0.5875	0.5518	0.1866	0.4151	0.8189
Insufficient_Cash	25,382	0.4026	0.5198	0.0000	0.1713	0.6291
Excess_Cash	25,382	0.1849	0.4280	0.0000	0.0000	0.2058
Panel C. Other Explanatory Variables						
Beta	25,382	1.2642	0.7363	0.7797	1.1579	1.6210
Size	25,382	7.3594	1.6515	6.1960	7.2592	8.4228
MB	25,382	3.6036	4.1298	1.6749	2.5457	4.0180
AQ	25,382	0.0142	0.0183	0.0037	0.0097	0.0184
Asset	25,382	7.1441	1.6694	5.9392	7.0500	8.2490
Std_CFO	25,382	0.0694	0.0846	0.0306	0.0482	0.0767
Std_Sales	25,382	0.2293	0.2027	0.1037	0.1706	0.2806
OPCycle	25,382	4.6393	0.7250	4.2639	4.7220	5.1042
PNEarn	25,382	0.1806	0.2329	0.0000	0.1000	0.3000
Int_Capital	25,382	0.2842	0.2282	0.1016	0.2149	0.4131
Int_Intangible	25,382	0.0623	0.1555	0.0000	0.0212	0.0826
D_Intangible	25,382	0.2884	0.4530	0.0000	0.0000	1.0000
Lev	25,382	0.4029	0.1801	0.2644	0.4019	0.5283
Mom	25,382	0.1576	0.5128	-0.1067	0.0714	0.3090
Irisk	25,382	0.1000	0.0564	0.0612	0.0869	0.1236

Notes: The variables are defined as in Appendix 2.

Table 2. Pearson (Spearman) correlation coefficients in upper (lower) triangle.

Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. R_MN	1.00	**0.09**	**0.18**	**-0.10**	**0.10**	**-0.29**	**-0.02**	**0.08**	**-0.13**	**0.09**
2. Abs_Cash_Diff	**0.09**	1.00	**0.68**	**0.46**	**0.07**	**-0.11**	**0.03**	0.01	**-0.13**	**0.12**
3. Insufficient_Cash	**0.19**	**0.56**	1.00	**-0.33**	**-0.04**	**-0.11**	**-0.03**	**-0.05**	**-0.03**	**-0.08**
4. Excess_Cash	**-0.16**	**-0.03**	**-0.83**	1.00	**0.14**	-0.01	**0.07**	**0.07**	**-0.13**	**0.24**
5. Beta	**0.13**	**0.06**	**-0.05**	**0.09**	1.00	**-0.15**	**-0.02**	**0.10**	**-0.16**	**0.23**
6. Size	**-0.27**	**-0.09**	**-0.10**	**0.06**	**-0.16**	1.00	**0.22**	**-0.13**	**0.89**	**-0.24**
7. MB	**-0.25**	0.01	**-0.10**	**0.12**	**-0.07**	**0.36**	1.00	**0.04**	-0.01	**0.12**
8. AQ	**0.05**	**-0.03**	**-0.08**	**0.08**	**0.07**	**-0.05**	**-0.02**	1.00	**-0.16**	**0.20**
9. Asset	**-0.11**	**-0.10**	0.00	**-0.05**	**-0.15**	**0.88**	0.01	**-0.05**	1.00	**-0.35**
10. Std_CFO	**0.11**	**0.04**	**-0.12**	**0.15**	**0.25**	**-0.37**	**0.08**	**0.17**	**-0.48**	1.00
11. Std_Sales	**0.11**	**0.05**	**-0.03**	**0.06**	**0.16**	**-0.34**	0.00	**0.08**	**-0.37**	**0.49**
12. OPCycle	**0.04**	**-0.03**	**-0.15**	**0.17**	**0.09**	**-0.03**	**0.02**	**0.15**	**-0.08**	**0.08**
13. PNEarn	**0.15**	**0.02**	0.00	0.01	**0.29**	**-0.30**	**-0.09**	**0.26**	**-0.25**	**0.37**
14. Int_Capital	**0.14**	**0.04**	**0.24**	**-0.23**	**-0.18**	**0.12**	**-0.11**	**-0.10**	**0.23**	**-0.28**
15. Int_Intangible	**-0.09**	**0.05**	**-0.17**	**0.22**	**0.19**	**0.04**	**0.22**	**0.12**	**-0.12**	**0.21**
16. D_Intangible	**0.06**	**-0.02**	**0.11**	**-0.15**	**-0.11**	**-0.07**	**-0.15**	**-0.09**	**0.02**	**-0.05**
17. Lev	**0.19**	**-0.03**	**0.22**	**-0.26**	**-0.09**	**0.11**	**0.05**	-0.01	**0.34**	**-0.21**
18. Mom	**-0.23**	**0.01**	**0.02**	**-0.01**	**-0.03**	**0.14**	**0.31**	0.00	**0.01**	**-0.02**
19. Irisk	**0.24**	**0.06**	**0.03**	**-0.01**	**0.30**	**-0.50**	**-0.11**	**0.05**	**-0.49**	**0.44**

Variable	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*
1. R_MN	**0.08**	**0.03**	**0.15**	**0.13**	**-0.01**	**0.06**	**0.22**	**-0.18**	**0.24**
2. Abs_Cash_Diff	**0.05**	**-0.03**	**0.06**	**0.04**	**0.10**	**-0.04**	**-0.05**	**0.04**	**0.07**
3. Insufficient_Cash	**-0.01**	**-0.11**	**-0.02**	**0.24**	**-0.07**	**0.07**	**0.17**	0.00	-0.01
4. Excess_Cash	**0.08**	**0.10**	**0.11**	**-0.24**	**0.21**	**-0.14**	**-0.27**	**0.04**	**0.09**
5. Beta	**0.14**	**0.07**	**0.33**	**-0.17**	**0.13**	**-0.12**	**-0.09**	**0.06**	**0.31**
6. Size	**-0.28**	0.00	**-0.29**	**0.10**	**-0.01**	**-0.08**	**0.09**	**0.05**	**-0.43**
7. MB	0.01	0.00	**0.05**	**-0.08**	**0.09**	**-0.09**	**-0.21**	**0.20**	-0.00
8. AQ	**0.11**	**0.11**	**0.26**	**-0.15**	**0.09**	**-0.08**	**-0.01**	**0.02**	**0.14**
9. Asset	**-0.30**	**-0.05**	**-0.29**	**0.22**	**-0.11**	**0.01**	**0.30**	**-0.08**	**-0.43**
10. Std_CFO	**0.33**	**0.03**	**0.43**	**-0.22**	**0.21**	**-0.09**	**-0.16**	**0.08**	**0.31**
11. Std_Sales	1.00	**-0.17**	**0.16**	**-0.21**	0.01	**0.07**	0.01	**0.04**	**0.26**
12. OPCycle	**-0.13**	1.00	**0.03**	**-0.36**	**0.16**	**-0.25**	**-0.13**	**0.01**	**0.03**
13. PNEarn	**0.20**	**0.05**	1.00	**-0.17**	**0.24**	**-0.09**	-0.01	**0.09**	**0.35**
14. Int_Capital	**-0.26**	**-0.26**	**-0.19**	1.00	**-0.22**	**0.31**	**0.14**	**-0.03**	**-0.09**
15. Int_Intangible	0.01	**0.38**	**0.19**	**-0.40**	1.00	**-0.25**	**-0.16**	0.01	**0.11**
16. D_Intangible	**0.02**	**-0.30**	**-0.07**	**0.25**	**-0.79**	1.00	**0.14**	**-0.01**	-0.01
17. Lev	**-0.01**	**-0.13**	**0.02**	**0.17**	**-0.26**	**0.14**	1.00	**-0.01**	**-0.07**
18. Mom	**-0.03**	-0.00	0.00	-0.01	-0.01	-0.00	-0.01	1.00	**0.18**
19. Irisk	**0.32**	**0.04**	**0.37**	**-0.10**	**0.10**	**0.01**	**-0.10**	**-0.06**	1.00

Notes: The variables are defined as in Appendix 2. Bold numbers represent the statistical significance at least at 10% levels (two-sided).

and I/B/E/S. Specifically, accounting data are obtained from the COMPUSTAT annual file while stock market data are collected from the CRSP daily file.[9] We also use the I/B/E/S unadjusted detail file to obtain analysts' earnings forecasts as well as earnings growth forecasts. To be comparable with the previous literature, we also exclude observations in the utility and financial service industries. These data requirements and selection criteria yield 25,382 firm-year observations in the final sample. All continuous variables are winsorized at the top and bottom 1% level to mitigate any influence from outliers.

Table 1 provides the summary statistics of the sample used in the empirical analyses. Panel A of Table 1 presents the descriptive statistics of the implied cost of equity capital measures. *R_MPEG*, *R_OJN*, *R_CT*, and *R_GLS* have mean (median) values of 12.30%, 12.88%, 15.28%, and 9.30% (11.01%, 11.88%, 14.33%, and 9.05%) with standard deviations of 5.53%, 4.74%, 7.15%, and 2.93%, respectively. Our main variable, a composite measure (*R_MN*) has a mean of 12.45% with a standard deviation of 4.21%, which indicates large variation across the distribution. Panel B reports the descriptive statistics of cash variables. Our sample firms on average retain cash about 28.88% (16.30%) of their other assets (total assets). This cash level is less than the average optimal level of cash by 0.2177, indicating that firms usually hold less cash than their target cash level. The absolute value of the difference between the estimated target cash and actual cash has a mean (median) of 0.5875 (0.4151). In Panel C, other explanatory variables show a similar range of the descriptive statistics to those of previous literature (e.g., Francis et al., 2004; 2008; Chen et al., 2011).

Table 2 presents the Pearson (Spearman) correlation coefficients in upper (lower) triangle for the variables used in the empirical analysis. Both Pearson and Spearman correlations between a composite measure of the implied cost of equity capital (*R_MN*) and abnormal cash holdings (*Abs_Cash_Diff*) are positively significant (ρ=0.09). This evidence supports our first hypothesis, the positive relation between abnormal cash holdings and the cost of equity capital. Consistent with Fama and French (1993), the identified risk factors such as *Beta, Size,* and *MB*, are correlated with the composite measure (*R_MN*) in expected directions. Also, as in Bhattacharya et al. (2012), accrual quality (*AQ*) shows significant and positive correlation with the composite measure (*R_MN*).

4. Empirical Analysis

The Effect of Abnormal Cash Holdings on the Cost of Equity Capital

We conjecture that abnormal cash holdings provides the signals of a firm's future performance and risk that helps investors determine the cost of equity capital.

[9] The accounting data include cash, asset, capital expenditure, cash flow from operation, R&D expense, dividend, sales, foreign pretax income, PPE, and advertising expense. The stock market data include stock price and bid-ask spread.

To examine the influence of abnormal cash holdings on the cost of equity capital, we estimate the following model with year and industry fixed effects:

$$R\_MN_{it} - R_{ft} = \beta_0 + \beta_1 Abs\_Cash\_Diff_{it-1} + \beta_2 Beta_{it-1} + \beta_3 Size_{it-1} + \beta_4 MB_{it-1} + \beta_5 AQ_{it-1} + \beta_6 Asset_{it-1} + \beta_7 Std\_CFO_{it-1} + \beta_8 Std\_Sales_{it-1} + \beta_9 OPCycle_{it-1} + \beta_{10} PNEarn_{it-1} + \beta_{11} Int\_Capital_{it-1} + \beta_{12} Int\_Intangible_{it-1} + \beta_{13} D\_Intangible_{it-1} + \beta_{14} Lev_{it-1} + \beta_{15} Mom_{it-1} + \beta_{16} Irisk_{it-1} + Year\ Fixed + Industry\ Fixed + \varepsilon_{it} \quad (4)$$

The dependent variable, $R\_MN\text{-}R_f$, is a composite measure of the four implied cost of equity capital. R_f is risk-free rate. The yield on 10-year Treasury Bond is used as the risk-free rate. The variable of interest is *Abs_Cash_Diff*. If firms with greater abnormal cash holdings experience a higher cost of equity capital (H1), the coefficient of *Abs_Cash_Diff*, β_1, should be positive.

Following prior studies that examine firm characteristics affecting the cost of equity capital, we include various variables in the regression model. First, three risk factors, *Beta*, *Size*, and *MB* are controlled to capture the incremental effect of abnormal cash holdings to the existing firm-specific risk (Sharpe, 1964; Lintner, 1965; Fama and French, 1992). *Beta* is measured by estimating a daily return regression on value-weighted market returns over 250 trading days prior to the fiscal year-end. Firm size (*Size*) is a natural logarithm of the market value of equity at the end of the fiscal year while Market-to-Book ratio (*MB*) is calculated as the ratio of the market value of equity to the book value of equity at the end of fiscal year. To control for the quality of accounting information, we include Accrual Quality (*AQ*) which is estimated as in McNichols (2002).[10] In addition, following Francis et al. (2004), we control the determinants of earnings attributes which affect to the cost of equity capital; *Asset*, *Std_CFO*, *Std_Sales*, *OPCycle*, *PNEarn*, *Int_Capital*, *Int_Intangible*, and *D_Intangible*. We control *Lev*, *Mom*, and *Irisk* (Chen et al., 2011). Appendix 2 provides the detailed definitions of those determinants.

Table 3 tabulates the regression results of the effect of abnormal cash holdings on the cost of equity capital. As predicted in H1, Column 1 shows that abnormal cash holdings are significantly and positively (β_1=0.0029) associated with the cost of equity capital at the 1% level. This evidence suggests that investors require the greater cost of equity capital as a firm's abnormal cash holdings increases. The signaling effect of abnormal cash holdings on the cost of equity capital is also economically important. For example, the coefficient of *Abs_Cash_Diff* indicates that the cost of equity capital increases by 0.0016 as *Abs_Cash_Diff* increases by one standard deviation.[11] This

[10] There is still on-going debate on whether accrual quality is a priced risk factor or not. First, Francis et al. (2005) find that accrual quality is a priced risk factor using a time-series model. However, using a two-stage asset price model, Core et al. (2008) show that accrual quality is not a priced risk factor. Recently, some papers suggest that accrual quality is still a price risk factor when the economic shocks are appropriately controlled in the two-stage asset pricing model (Kim and Qi, 2010; Ogneva, 2012).

[11] We multiply the standard deviation of *Abs_Cash_Diff* and the regression coefficient of *Abs_Cash_Diff* (0.5518*0.0029=0.0016).

increase represents a 1.29% increase relative to 0.1245, the mean value of *R_MN* in our sample. Overall, these findings support that investors understand the implications of abnormal cash holdings on future performance, and demand the higher cost of equity capital for firms with a greater deviation from the optimal level of cash holdings.

To further examine the relative magnitude of the impact of two components in abnormal cash holdings, insufficient and excess cash, we replicate Equation (4) after replacing *Abs_Cash_Diff* with *Insufficient_Cash* and *Excess_Cash.* Column 2 of Table 3 presents the results of the effect of insufficient and excess cash holdings on the cost of equity capital. We find significantly positive coefficients (0.0057 and 0.0028) on insufficient and excess cash holdings, suggesting that any deviations on either side of the optimal level of cash holdings impose additional costs such as higher cost of equity capital. More importantly, the impact of insufficient cash holdings on the cost of equity capital is stronger than that of excess cash holdings. We interpret this evidence as indicative that investors consider the insufficient cash relative to the excess cash as more critical signals on a firm's future performance and risk.

Table 3. Effect of abnormal cash holdings on implied cost of equity capital.

Variable	***Coeff.***	***Coeff.***
Intercept	0.0855***	0.0837***
Abs_Cash_Diff	0.0029***	
Insufficient_Cash		0.0057***
Excess_Cash		0.0028***
Beta	0.0019***	0.0019***
Size	-0.0215***	-0.0219***
MB	0.0020***	0.0021***
AQ	0.0974***	0.0985***
Asset	0.0179***	0.0178***
Std_CFO	0.0343***	0.0349***
Std_Sales	0.0078***	0.0078***
OPCycle	0.0029***	0.0029***
PNEarn	0.0082***	0.0080***
Int_Capital	0.0148***	0.0138***
Int_Intangible	0.0027	0.0028
D_Intangible	-0.0006	-0.0006
Lev	0.0095***	0.0083***
Mom	-0.0085***	-0.0085***
Irisk	0.1055***	0.1052***
N	25,382	25,382
Adj. R-sq.	82.81%	82.82%

Notes: The variables are defined as in Appendix 2. *t*-statistics are based on robust standard errors clustered at firm levels. *, **, and *** indicate the significance level at .10, .05, and .01, respectively.

Taken together, the results in Table 3 advocate that an increase in the level of abnormal cash holdings could lead to an increase in the cost of equity capital. Investors can recognize the implications of abnormal cash holdings on future performance and require the higher cost of equity capital for a firm with either insufficient or excess cash holdings. This is also consistent with the static tradeoff theory of Opler et al. (1999) that deviating from a firm's optimal cash level induces additional inefficiency for firms.

The Effect of the Information Environment on the Relation between Abnormal Cash Holdings and the Cost of Equity Capital

Our second hypothesis predicts that the impact of abnormal cash holdings on the cost of equity capital would be greater for firms with high information asymmetry because the signals from abnormal cash holdings could be more useful for investors who cover firms with poor information environment. We then investigate how a firm's information environment affects the relation between abnormal cash holdings and the cost of equity capital by estimating the following regression;

$$R\_MN_{it} - R_{ft} = \beta_0 + \beta_1 Abs\_Cash\_Diff_{it-1} + \beta_2 Abs\_Cash\_Diff_{it-1} * HSpread_{it-1} + \beta_3 HSpread_{it-1} + \sum \beta_k Controls_{it-1} + Year\ Fixed + Industry\ Fixed + \varepsilon_{it} \quad (5)$$

We use the bid-ask spread as a proxy of information asymmetry among investors (Jaffe and Winkler, 1976; Copeland and Galai, 1983; Glosten and Milgrom, 1985).[12] *HSpread* is an indicator variable of high bid-ask spread which equals one if a firm's average bid-ask spread over prior 12 months is in the top quartile of the distribution for a given year. If the effect of abnormal cash holdings on the cost of equity capital is stronger for firms with high information asymmetry (*HSpread*=1), we expect the coefficient on *Abs_Cash_Diff*HSpread* to be positive.

Table 4 provides regression results for the effect of information asymmetry on the relation between abnormal cash holdings and the cost of equity capital. Column 1 of Table 4 shows that the estimated coefficient on *Abs_Cash_Diff*HSpread* is significantly positive (0.0043) at 5% level, suggesting a stronger impact of abnormal cash holdings on the cost of equity capital for high information asymmetry firms (*HSpread*=1). Specifically, the effect of abnormal cash holding on the cost of equity capital is 3.39 times greater[13] for firms with high information asymmetry than for other firms, and the difference is economically significant.[14] Column 2 of Table 4 also presents the results for H2 when abnormal cash holdings are broken down into insufficient and excess cash holdings. We find that the positive association of insufficient cash holdings with the cost of equity capital is more pronounced when a

[12] Alternatively, we use return volatility over prior 12 months as a proxy of information asymmetry and the results remain qualitatively similar.

[13] We compare the regression coefficients of *Abs_Cash_Diff* for firms with high information asymmetry and for firms without high information asymmetry (0.0018+0.0043=0.0061 vs. 0.0018).

[14] For instance, when the abnormal cash holdings increase by one standard deviation, firms with high information asymmetry experience an increase in the cost of equity by 24 basis points more than other firms (0.5518*0.0043=0.0024).

firm's information environment is poor (*HSpread*=1). However, the positive relation between excess cash holdings and the cost of equity capital is not significant between high and low information asymmetry firms.

Table 4. Effect of information asymmetry on the relation between abnormal cash holdings and implied cost of equity capital.

Variable	*Coeff.*	*Coeff.*
Intercept	0.0785***	0.0770***
Abs_Cash_Diff	0.0018**	
Insufficient_Cash		0.0040***
Excess_Cash		0.0021*
Abs_Cash_Diff × *HSpread*	0.0043**	
Insufficient_Cash × *HSpread*		0.0064**
Excess_Cash × *HSpread*		0.0039
HSpread	0.0040***	0.0022
Beta	0.0021***	0.0021***
Size	-0.0202***	-0.0201***
MB	0.0020***	0.0020***
AQ	0.0932***	0.0942***
Asset	0.0173***	0.0173***
Std_CFO	0.0349***	0.0355***
Std_Sales	0.0077***	0.0077***
OPCycle	0.0028***	0.0029***
PNEarn	0.0068***	0.0065***
Int_Capital	0.0142***	0.0134***
Int_Intangible	0.0031	0.0031
D_Intangible	-0.0006	-0.0005
Lev	0.0100***	0.0089***
Mom	-0.0088***	-0.0089***
Irisk	0.0932***	0.1021***
N	24,179	24,179
Adj. R-sq.	83.16%	83.17%

Note: The variables are defined as in Appendix 2. *t*-statistics are based on robust standard errors clustered at firm levels. *, **, and *** indicate the significance level at .10, .05, and .01, respectively.

In sum, the results from Table 4 suggests that the positive relation between abnormal cash holdings and the cost of equity capital is more apparent when firms are subject to greater information asymmetry. The evidence indicates that the influence of abnormal cash holdings on the cost of equity capital varies with the extent to which the signals from abnormal cash holdings are informative for investors. This is supportive of our main argument that the implications from abnormal cash holdings are useful for investors to determine the cost of equity capital, especially when the implications are more beneficial for investors.

5. Robustness Check

Endogeneity

Thus far, we provide consistent results of the positive impact of abnormal cash holdings on the cost of equity capital. However, some may argue that a firm's financing cost would determine the level of cash holdings. For example, firms with a higher cost of equity capital hold more cash for the precautionary purpose. If this is the case, there exists a causal relationship running from the cost of equity capital to abnormal cash holdings. In addition, our main findings may suffer from an omitted variable problem if the positive relation between abnormal cash holdings and the cost of equity capital is endogenously determined by any omitted variables. To assure the causality and robustness to the omitted variable bias, we estimate the original models in the change specifications. Specifically, if the change in the abnormal cash holdings leads to the change in the cost of equity capital in the predicted directions, it is likely the firm's abnormal cash holdings that induces the cost of equity capital to increase.

The results of the change specifications are reported in Table 5. In column 1, we find that the change in the abnormal cash holdings are positively (0.0021) and significantly associated with the change in the cost of equity capital, supporting the positive causal effect of the abnormal cash holdings on the cost of equity capital. The positive coefficients on $\Delta Insufficient\_Cash^{*}\Delta HSpread$ and $\Delta Excess\_Cash^{*}\Delta HSpread$ in column 4 (0.0073 and 0.0038, respectively) suggest that the positive effect of the change in the insufficient and excess cash holdings is greater for firms operating under high information asymmetry. Overall, the results in Table 5 advocates the argument that a firm's deviation from the optimal level of cash holdings has a causal effect on the increase in the cost of equity capital.

To avoid the endogeneity concerns, in particular, reverse causality, we further adopt seemingly unrelated regressions by considering the cost of equity capital as the additional determinants of abnormal cash holdings. Untabulated results still confirm our hypotheses, that is, abnormal cash holdings increase the cost of equity capital, implying that the reverse causality concern is not a critical issue.

Financial Crisis

Our sample period covers the subprime financial crisis of 2007-2008. Anecdotal evidence indicates that a firm's financing decision behaves differently during the financial crisis. For example, many firms postponed their investment and hoarded cash for precautionary motives. Thus, it can be argued that the financial crisis period may include any bias in the results. To address the concern for the potential influence of the financial crisis on the cash holdings and the cost of equity capital, we test whether our findings are robust to the exclusion of the subprime financial crisis period, 2007-2008.

Table 6 reports the results of the sub-sample analysis. Similar with the prior results, column 1 shows that our main finding of the positive (0.0026) relation between abnormal cash holdings and cost of equity capital holds after excluding the

observations from the financial crisis period. In column 3, we still find the positive coefficient (0.0042) on the interaction term *Abs_Cash_Diff*HSpread*, suggesting that the stronger impact of abnormal cash holdings on the cost of capital for firms with high information asymmetry. In sum, the main result of our study generally holds during non-crisis periods and ensures the robustness to the financial crisis.

Table 5. Change regressions.

Variable	***Coeff.***	***Coeff.***	***Coeff.***	***Coeff.***
Intercept	0.0787***	0.0786***	0.0787***	0.0786***
ΔAbs_Cash_Diff	0.0021***		0.0021***	
ΔInsufficient_Cash		0.0025**		0.0026**
ΔExcess_Cash		0.0009		0.0009
ΔAbs_Cash_Diff × *ΔHSpread*			0.0017	
ΔInsufficient_Cash × *ΔHSpread*				0.0073*
ΔExcess_Cash × *ΔHSpread*				0.0038
ΔHSpread			0.0008	0.0008
ΔBeta	0.0012	0.0012	0.0011	0.0011
ΔSize	-0.0225***	-0.0225***	-0.0223***	-0.0222***
ΔMB	0.0019***	0.0019***	0.0020***	0.0020***
ΔAQ	0.0334	0.0331	0.0332	0.0331
ΔAsset	0.0121***	0.0122***	0.0125***	0.0125***
ΔStd_CFO	-0.0178	-0.0173	-0.0158	-0.0156
ΔStd_Sales	-0.0007	-0.0007	-0.0017	-0.0017
ΔOPCycle	-0.0019	-0.0019	-0.0020	-0.0020
ΔPNEarn	0.0127**	0.0125**	0.0129**	0.0127**
ΔInt_Capital	-0.0002	-0.0015	-0.0010	-0.0023
ΔInt_Intangible	-0.0005	-0.0005	-0.0005	-0.0004
ΔD_Intangible	0.0001	0.0001	0.0002	0.0002
ΔLev	0.0148***	0.0146***	0.0148***	0.0144***
ΔMom	-0.0104***	-0.0104***	-0.0105***	-0.0105***
ΔIrisk	0.0212***	0.0212***	0.0200***	0.0198***
N	16,749	16,749	15,831	15,831
Adj. R-sq.	93.23%	93.23%	93.41%	93.41%

Note: The variables are defined as in Appendix 2. *t*-statistics are based on robust standard errors clustered at firm levels. *, **, and *** indicate the significance level at .10, .05, and .01, respectively.

Table 6. Excluding financial crisis period (2007-2008).

Variable	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*
Intercept	0.0905***	0.0885***	0.0834***	0.0818***
Abs_Cash_Diff	0.0026***		0.0016*	
Insufficient_Cash		0.0057***		0.0042***
Excess_Cash		0.0027**		0.0021*
Abs_Cash_Diff × *HSpread*			0.0042*	
Insufficient_Cash × *HSpread*				0.0058*
Excess_Cash × *HSpread*				0.0037
HSpread			0.0038***	0.0022
Beta	0.0016***	0.0016***	0.0017***	0.0018***
Size	-0.0222***	-0.0219***	-0.0209***	-0.0208***
MB	0.0019***	0.0019***	0.0019***	0.0019***
AQ	0.1005***	0.1015***	0.0967***	0.0977***
Asset	0.0183***	0.0182***	0.0177***	0.0177***
Std_CFO	0.0348***	0.0354***	0.0355***	0.0361***
Std_Sales	0.0082***	0.0082***	0.0081***	0.0081***
OPCycle	0.0029***	0.0030***	0.0029***	0.0030***
PNEarn	0.0081***	0.0078***	0.0065***	0.0063***
Int_Capital	0.0151***	0.0141***	0.0146***	0.0138***
Int_Intangible	0.0034*	0.0034*	0.0037*	0.0037*
D_Intangible	-0.0006	-0.0006	-0.0005	-0.0005
Lev	0.0091***	0.0079***	0.0096***	0.0085***
Mom	-0.0077***	-0.0077***	-0.0080***	-0.0080***
Irisk	0.1020***	0.1016***	0.0990***	0.0986***
N	22,984	22,984	21,789	21,789
Adj. R-sq.	83.22%	83.23%	83.54%	83.55%

Note: The variables are defined as in Appendix 2. *t*-statistics are based on robust standard errors clustered at firm levels. *, **, and *** indicate the significance level at .10, .05, and .01, respectively.

6. Conclusions

Our study investigates whether investors incorporate the implications of abnormal cash holding on a firm's future performance into determining the cost of equity capital. We hypothesize that the cost of equity capital should be higher for firms reporting greater abnormal cash holdings if investors assimilate poor future performance and increased risk that implied by the current level of abnormal cash holdings. Using a composite measure of the implied cost of equity capital, we provide evidence that the cost of equity capital increases as the level of cash holdings deviates from the optimal level of cash holdings. Specifically, both insufficient and excess cash holdings increase the cost of equity capital, suggesting that investors fully recognize the performance inefficiency caused by any deviations from the optimal level of cash holdings. Further, we find that the signals from abnormal cash holdings have a greater influence on investors who face higher information asymmetry. Taken

together, these findings support Opler et al. (1999)'s static tradeoff theory of cash holdings that deviating from the optimal cash levels could lead to additional costs for firms.

This paper contributes to the extant literature in the following ways. First, our investigations reveal that both insufficient and excess cash holdings from their optimal levels play a significant role in determining the cost of equity capital. Prior studies show the link between abnormal cash holdings and future performance (Dittmar and Mahrt-Smith, 2007; Harford et al., 2008; Oler and Picconi, 2014). Complementing prior studies, we demonstrate that investors can incorporate the implications of abnormal cash holding in the process of the cost of equity capital. Second, our results are supportive of the static tradeoff theory of cash holdings (Opler et al., 1999). We find that a greater deviation from an optimal cash level could result in an operating inefficiency such as increased cost of equity capital. Finally, this study extends our understanding of the relative importance of insufficient and excess cash holdings for the valuation purpose. Our findings suggest that investors tend to regard insufficient cash holdings as more significant for the valuation objective than excess cash holdings.

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Appendix 1. Variable definitions in cash estimation.

Variable	Variable Explanation	Source
	Cash Variable	
Cash	Cash and cash equivalents divided by total assets less cash and cash equivalents (che/(at-che)).	COMPUSTAT
	Explanatory Variables	
Asset	Natural logarithm of total assets (log(at)).	COMPUSTAT
Working_Capital	Net working capital ((wcap-che)/(at-che)).	COMPUSTAT
Cap_Expenditure	Capital expenditures (aqc/(at-che)).	COMPUSTAT
Ind_Sigma	Average standard deviation of prior 20 years' cash flow ((oibdp-xint-txt-dvc)/(at-che)) calculated for each 2-digit SIC code industry.	COMPUSTAT
R&D	Research and development expense (xrd/at).	COMPUSTAT
Dividend	Dividend indicator which equals one if the firm paid dividends to common shareholders (dvc) over the prior year.	COMPUSTAT
Sales_Growth	Sales growth ((sale-lag_sale)/lag_sale).	COMPUSTAT
CFO	Cash flow from operations (oancf/(at-che)).	COMPUSTAT
Age	Natural logarithm of the number of years that the firm has been publicly traded (the difference between the firm's fiscal year and the date that the firm was included the CRSP).	CRSP
Foreign_Tax	Alternative tax cost of repatriating earnings ((pifo * the U.S. Statutory rate of 35%-txfo)/(at-che)).	COMPUSTAT

Appendix 2. Variable definitions in main analyses.

Variable	Variable Explanation	Source
	Cost of Equity Capital	
R_MPEG	Implied cost of equity capital following MPEG Model (Easton, 2004)	COMPUSTAT and I/B/E/S
R_OJN	Implied cost of equity capital following OJN Model (Ohlson and Juettner-Nauroth, 2005)	COMPUSTAT and I/B/E/S
R_CT	Implied cost of equity capital following CT Model (Claus and Thomas, 2001)	COMPUSTAT and I/B/E/S
R_GLS	Implied cost of equity capital following GLS Model (Gebhardt et al., 2001)	COMPUSTAT and I/B/E/S
R_MN	Mean value of *R_MPEG*, *R_OJN*, *R_CT*, and *R_GLS*	COMPUSTAT and I/B/E/S
	Cash Variables	
Cash	Cash and cash equivalents divided by total assets less cash and cash equivalents (che/(at-che)).	COMPUSTAT
Target cash	We estimate coefficients from 5-year rolling regressions, based on equation (1), ending in the prior year to the estimation year. For 2013, we use data from the year 2008 to the year 2012 for coefficient estimation. We, then, multiply these calculated coefficients (from previous five years) and financial information (from current year) to determine target cash. This target cash is a proxy for optimal cash.	COMPUSTAT and CRSP
Cash_Diff	The difference between cash and target cash.	COMPUSTAT and CRSP
Abs_Cash_Diff	The absolute value of *Cash_Diff*.	COMPUSTAT and CRSP
Insufficient_Cash	The absolute value of *Cash_Diff* if *Cash_Diff* is negative, 0 otherwise. This variable measures the degree of cash insufficiency from optimal cash.	COMPUSTAT and CRSP
Excess_Cash	The value of *Cash_Diff* if *Cash_Diff* is positive, 0 otherwise. This variable measures the degree of cash excessiveness from optimal cash.	COMPUSTAT and CRSP

Appendix 2. Variable definitions in main analyses.

	Other Explanatory Variables	
Beta	Market model's beta calculated using a regression of daily stock returns (ret) on the value-weighted market return over 250 trading days with minimum 200 trading days ending at the end of the fiscal year.	CRSP
Size	Natural logarithm of the market value of equity at the end of the fiscal year (log(prcc_f*csho)).	COMPUSTAT
MB	Market-to-Book ratio calculated as the ratio of the market value of equity to the book value of equity at the end of the fiscal year (prcc_f*csho/ceq).	COMPUSTAT
AQ	Accrual Quality calculated, using the modification of Dechow and Dichev (2002) model, as standard deviation of residuals from firm-specific regressions of total current accruals on the current-, lag-, lead-period cash flow from operations, changes in revenues and property, plant, and equipment over 10 years from year t to t-9.	COMPUSTAT
Asset	Natural logarithm of total assets (log(at)).	COMPUSTAT
Std_CFO	The standard deviation of cash flow from operation (oancf/at) over 10 years from year t to t-9.	COMPUSTAT
Std_Sales	The standard deviation of sales (sale/at) over 10 years from year t to t-9.	COMPUSTAT
OPCycle	Operating cycle calculated as logarithm of the sum of days taken in selling and days taken in recovering cash (log(365*rect/sale+365*invt/cogs)).	COMPUSTAT
PNEarn	Proportion of Negative Earnings (xi) over the 10 years from year t to t-9.	COMPUSTAT
Int_Capital	Capital intensity calculated as the ratio of the net book value of Property, Plant, and Equipment to total assets (ppent/at).	COMPUSTAT
Int_Intangible	Intangibles intensity calculated as the sum of R&D expense and advertising expense, deflated by sales ((xrd+xad)/sale).	COMPUSTAT
D_Intangible	Intangibles indicator which equals one if *Int_Intangible*=0, and 0 otherwise	COMPUSTAT
Lev	Leverage calculated as the ratio of the total senior securities to total assets ((lct+dltt+pstkl)/at).	COMPUSTAT
Mom	Momentum calculated as the logarithm of 1+ the compounded returns (ret) over the previous 12 months.	CRSP
Irisk	Idiosyncratic risk calculated as the standard deviation of market model residuals for days (-250, -50)	CRSP