# The influence of investment volatility on capital structure and cash holdings

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**Abstract**

Despite theoretical motivation, the relationship between investment volatility, capital structure, and cash levels is unstudied in the empirical literature. Our evidence suggests: i) firms with relatively high capital expenditure and acquisition investment volatility hold relatively higher levels of debt and lower levels of cash, ii) firms fund large capital expenditures and acquisitions by increasing debt or decreasing cash, iii) immediately after funding large investments firms reduce debt levels and increase cash holdings. Research and development investment volatility is related to lower debt levels and higher cash levels, and does not exhibit similar investment spike funding. Overall, our results are consistent with parts, but not all, of the DeAngelo, DeAngelo and Whited (2011) model.

Keywords: Capital structure, cash holding and investment volatility.

JEL Classification Codes: G32—Financing Policy.

# 1 Introduction

The theoretical and empirical academic literature regarding how firms finance their investment opportunities is large (for example Myers and Majluf (1984), Jensen (1986)). However, the relationship between investment volatility and financing is relatively unexplored. DeAngelo et al. (2011) create a dynamic capital structure model, where investment opportunities are not predictable but subject to shocks. Based on model simulations, firms with high shock volatility (relative to low shock volatility firms) have lower levels of debt, higher cash balances, and higher average debt issuance. In a related study, Elsas, Flannery and Garfinkel (2014) study how firms pay for very large investments and conclude that firms issue debt to fund large investments and subsequently pay off the debt with internal cash flows. Both papers empirically examine the influence of investment spikes (large investments) on financing, but to our knowledge there are no papers that test the cross-sectional relationship between investment volatility and financing.[1]

We follow DeAngelo et al. (2011) and define investment as capital expenditures plus acquisitions. However, because firms' policies may differ by investment types, we unbundle their definition and define investment as either capital expenditures or acquisitions and further define research and development as investment. We follow DeAngelo et al. (2011) and scale all investment measures by property, plant and equipment.

We use two methods to construct our variables of interest. First, we use the method of Kim and Sorensen (1986) and estimate the rolling five year standard deviation of investment. Second, we estimate the De Veirman and Levin (2015) conditional volatility measure and use it to construct investment spike variables (large investments). An investment spike occurs when actual investment growth is greater than predicted investment growth and when investment volatility is in the top tercile. The dependent variables are either the short and long-term book debt ratio or cash to total assets ratio. Whereas our investment spike variable is estimated from investment realizations from a conditional volatility estimation, DeAngelo et al. (2011) define investment spikes as investments that are two standard deviations from the two digit SIC code average. As the dependent variables in this study are bounded between zero and one, we test using the GLM (Generalized Linear Model)

[1] For example, investment volatility is not tested in Frank and Goyal (2009).

with logit link function proposed by Kieschnick and McCullough (2003) and used by Keefe and Yaghoubi (2015). We also follow Lemmon, Roberts and Zender (2008) and Flannery and Rangan (2006) and estimate a panel data model that controls for time invariant firm heterogeneity, and use panel GLM to test our hypotheses.

The first hypothesis is about the relationship between the investment volatility and a firm's debt and cash levels. Relative to the relationship between investment volatility and debt levels, our evidence indicates that high capital expenditure and acquisition volatility leads to higher debt levels. Relative to the relationship between investment volatility and cash levels, our estimation results indicate that high acquisition volatility leads to lower levels of cash, but that capital expenditure volatility does not affect cash levels. Our results are statistically significant and economically important. One standard deviation increase from the mean of capital expenditure plus acquisition investments volatility variable, leads to a 17.17% increase in the debt ratio and a 12.06% decrease in the cash level. All in all, our evidence does not support the DeAngelo et al. (2011) model prediction that firms with high investment volatility keep debt levels low and cash levels high. To our knowledge, we are the first to empirically test the relationship between financing and investment volatility.

The second hypothesis relates to how firms use debt and cash to fund large investments. We find a positive relationship between large investments and use of debt, and a negative relationship between large investments and cash levels. Our variable of interest is the investment spike variable defined earlier. Our evidence supports the ration that firms use debt and cash to fund large investments. Our results are statistically significant and economically important - our evidence suggests a 30.39% increase in the debt ratio and a 30.59% decrease in the cash level as a result of an investment spike (large investment). This finding supports the DeAngelo et al. (2011) model prediction and empirical tests that firms issue debt and use cash to fund large capital expenditure and acquisition investments. Unlike the first hypothesis, which has not been previously tested, our contribution relative to the second hypothesis is the use of a firm-level measure of investment spikes.

The third hypothesis is whether, after funding large investments, firms decrease debt levels and increase cash levels. Although rebuilding cash levels is not explicit in the model of DeAngelo et al. (2011), a plausible implication of their model is that firms rebuild their stock of cash after using cash stocks to fund large investments. For both cash and debt levels, our evidence suggests that one year after making large investments firms rebuild their debt and cash capacity by decreasing their debt levels and increasing their cash stocks. Our results are statistically significant and economically important - our evidence suggests a 10.76% decrease in the debt ratio and a 21.15% increase in the cash levels one year after the large investment. Overall, our findings support the DeAngelo et al. (2011) model prediction that firms decrease their debt level after the spike year. Our findings that firms increase cash levels after funding investments is novel.

Our evidence suggests firms' financial policies to support research and development investments differ from financial policies in support of capital expenditure and acquisition investments. Therefore, we discuss here our findings for all three hypotheses related to research and development. First, our evidence shows that higher research and development volatility leads to lower debt levels and higher cash levels. This result is statistically and economically important - a one standard deviation increase in research and development investment volatility leads to a 5.15% decrease in the debt ratio and a 10.40% increase in cash levels. Interestingly, unlike capital expenditure and acquisition volatility, this finding supports the DeAngelo et al. (2011) model prediction that firms with high investment volatility keep debt levels low and cash levels high. Second, our evidence indicates that research and development investment spikes are not important in explaining the level of cash or debt. However, one year after a large research and development investment, firms increase their debt capacity and cash stocks, which mirrors firms' behavior relative to capital expenditure and acquisition spikes. Our findings related to research and development investment volatility are novel.

We also evaluate if our findings are robust to a different measure of debt ratio, cash ratio, and spike measure. In particular, we test our hypotheses using the market short and long-term debt ratio, the ratio of cash over net assets, and a variable representing two consecutive investment spikes (large investments). We test our first hypothesis using the market debt ratio variable and our main results remain unchanged. Then we test all the three cash hypotheses using the ratio of cash over net assets and find that all the results remain unchanged. However, the result that research and development investment volatility leads to high cash levels is no longer statistically significant. We note that we estimate using a linear model. Lastly, using the two consecutive spike variables, we test our second hypothesis and all the main results remain unchanged.

This paper proceeds as follows: Section 2 reviews the literature and develops our hypotheses of the study. Section 3 reviews the data, constructs the variables, and reports the univariate statistics of the variables. Section 4 tests the hypotheses and discusses the results. Section 5 tests for robustness to other specifications and econometric methods. Section 6 provides concluding remarks.

## 2 Literature review and Hypothesis development

DeAngelo et al. (2011) create a dynamic model of capital structure where optimal investment requirements are not predictable. Specifically, the marginal productivity of capital is modeled as an auto-regressive (AR1) process, where the error term represents shocks to marginal productivity. These shocks imply that optimal investment is uncertain. The model suggests a firm's debt structure and cash levels are influenced by the need to fund uncertain investments. Using a Simulated Method of Moments (SMM), DeAngelo et al. (2011) show their model predicts that firms with higher versus lower standard deviation of investment shocks tend to have higher (lower) standard deviation of investment outlays, lower (higher) debt ratios, higher (lower) cash holdings, and higher (lower) deviation from target debt ratio. Essentially, a firm with uncertain future investment maintains financing capacity by keeping its debt ratio low and its cash level high.

DeAngelo et al. (2011) advance their dynamic model which implies firms with high investment shock volatility hold less debt. Intuitively, a firm with high investment shocks maintains low debt ratios to preserve debt capacity in order to fund uncertain investments. Although we cannot observe marginal productivity shocks in the DeAngelo et al. (2011) model, we can observe firm level investment volatility. To the extent that investment volatility is a proxy for marginal productivity shocks, firms with high investment volatility maintain lower debt ratios than would be optimal under a static trade-off model.

**Hypothesis 1a.** *Firms with high investment volatility have lower debt ratios, caeteris paribus.*

Opler, Pinkowitz, Stulz and Williamson (1999) state that firms set cash holding levels where the marginal benefits of holding cash are equal or greater than the marginal cost of it.[2] One of the benefits of cash holdings is having the option to finance investment opportunities using cash when other sources of financing are costly. Also, Kim, Kim and Woods (2011) find a positive relationship between a firm's cash holding level and investment opportunities. The model DeAngelo et al. (2011) advances that a higher fraction of investments in firms with high investment shock volatility are funded from cash balances, which implies:

**Hypothesis 1b.** *Firms with high investment volatility hold more cash, caeteris paribus.*

The model of DeAngelo et al. (2011) implies that firms temporarily diverge from their target capital structure to finance investments, where the difference between the target capital structure and the actual capital structure is the "transitory debt." DeAngelo et al. (2011) refer to large investments as investment spikes, and analyze debt issuances that associated with investment spikes for a sample of Compustat firms. Empirical tests show that investment spikes are accompanied by large debt issuances. In a related note, Denis and McKeon (2012) discuss how firms evaluate the financing of investment opportunities, and if there is a financing deficit they deviate from the target capital structure. They find that increases in the debt levels are primarily the result of the investment needs. In addition, Elsas et al. (2014) conclude that firms issue debt to fund large investments.

**Hypothesis 2a.** *Firms with large investments have higher debt ratios, caeteris paribus.*

The model of DeAngelo et al. (2011) implies firms with large uncertain investments have a higher beginning-of-year than end-of-year cash to assets ratio, indicating that such firms use cash to find large uncertain investments. Therefore, investment spikes are financed by a decrease in a firm's cash level, which implies:

[2]Examples of the drawbacks of holding cash are incremental taxes on interest income and lower rates of return.

**Hypothesis 2b.** *Firms with large investments have lower cash levels, caeteris paribus.*

The DeAngelo et al. (2011) model predicts firms fund large uncertain investments by issuing debt, after which, firms decrease their debt level back toward their target capital structure. In a related study, Elsas et al. (2014) conclude that firms issue debt to fund large investments and subsequently pay off the debt with internal cash flows. Both studies advance:

**Hypothesis 3a.** *After making large investments, firms decrease debt, caeteris paribus.*

The DeAngelo et al. (2011) model advances that firms hold cash to fund uncertain investments. Although not explicit in their model, a plausible implication is that after depleting cash stocks to fund a large investment, the firm will rebuild their stock of cash, which implies:

**Hypothesis 3b.** *After making large investments, firms increase cash, caeteris paribus.*

These hypotheses test the relationship between the volatility of investments and large realization of investment on debt and cash levels. Prior literature uses several investment definitions including capital expenditures ($Capx$), acquisitions ($Acq$), and the sum of capital expenditures and acquisitions ($Capx + Acq$). This paper contributes to the literature both in terms of the hypotheses tested and the range of our definitions of investment. To our knowledge, Hypotheses 1a, 1b and 3b have not been tested for any of these four investment volatilities. For some investment types some hypotheses have been tested. Hypothesis 2a has been empirically tested by DeAngelo et al. (2011) for large $Capx + Acq$ and by Elsas et al. (2014) for large $Capx$ and $Acq$, Hypothesis 2b has been empirically tested by DeAngelo et al. (2011) for large $Capx + Acq$, and Hypothesis 3a has been empirically tested by DeAngelo et al. (2011) for large $Capx + Acq$. Lastly, research and development expenditures ($R\&D$) has not been used as a measure of investment.

# 3 Sample, variable construction, and univariate statistics

## 3.1 Sample

To test these hypotheses we obtain annual data from 1974 through 2015 of the US corporations from the Compustat-CRSP Merged database. Following Bates, Kahle and Stulz (2009), we exclude financial firms, utilities, non-US firms and firms with missing or negative total assets or sales. We also follow Denis and Sibilkov (2010) and exclude firms with missing or negative cash. Following Kale and Shahrur (2007), all the variables are winsorized at 0.1% level in both tails of the distribution before calculating the summary statistics.

## 3.2 Variable Construction

### 3.2.1 Dependent variables

To test the relationship between investment volatility and capital structure, we construct both book and market debt ratios. In Section 4, we test using the book debt ratio and in the robustness section, we test using the market debt ratio. Our preferred measure is the book debt ratio because of possible simultaneity between market value and investment.[3]

In constructing our leverage measures, we address the Welch (2011) critique related to the treatment of non-financial liabilities. Welch (2011) states that by using financial debt over total assets ratio, researchers treat the non-financial liabilities as equity. To be consistent with DeAngelo et al. (2011), we use the total long plus short-term debt (financial-debt) in the numerator of our debt ratio measures, but we do not use the DeAngelo et al. (2011) debt ratio's denominator as they used the total assets. Following the Welch (2011) critique, we modify the denominator of our debt measures and use the below book and market debt ratios used by Rajan and Zingales (1995). For replication purposes, we use Compustat variable names in our definitions.

i) The short and long-term book debt ratio is the sum of short and long-term debt over the sum of common shareholders' equity, the total long-term debt and the total short-term debt.

$$BDR = \frac{dltt + dlc}{ceq + dltt + dlc}. \quad (1)$$

[3]Investment might affect both the market value of the equity and the need for the firm to issue more debt to fund the investment.

ii) The long-term market debt ratio is the sum of short and long-term debt divided by the sum of the long-term debt, short-term debt and the market value of equity.

$$MDR = \frac{dltt + dlc}{dltt + dlc + csho * prcc\_f}. \tag{2}$$

Note that both the numerator and the denominator exclude the non-financial liabilities.

To test the relationship between investment volatility and cash holdings, we construct a ratio of cash and short-term investments over total assets (DeAngelo et al., 2011, Bates et al., 2009, Almeida, Campello and Weisbach, 2004, DeAngelo, DeAngelo and Stulz, 2006).

$$Cash = \frac{che}{at}. \tag{3}$$

#### 3.2.2 Variables of Interest

We employ four measures of investment. First, we follow Guay (1999), Eisfeldt and Rampini (2006) and DeAngelo et al. (2011), who define a firm's investment as the sum of its capital expenditures plus acquisitions, $Inv = Capx + Acq$.[4] Second, we use the components of the aforementioned investment definition which are capital expenditure $Capx$ and acquisitions $Acq$ as the investment measures. Third, we use the research and development expenses $Xrd$ as a measure of investment following Brown and Petersen (2011). We follow DeAngelo et al. (2011) and scale our investment measures by property, plant and equipment.[5]

We employ two volatility estimation methods from the literature. For our first volatility estimation method, we follow the volatility estimation method of Kim and Sorensen (1986) and used by Keefe and Yaghoubi (2015). We estimate the ratio of the five years rolling standard deviation of $Inv$, $Capx$, $Acq$ and $Xrd$ to the five years rolling average of property, plant and equipment and construct $InvVol_{t-5,t}$, $CapxVol_{t-5,t}$, $AcqVol_{t-5,t}$ and $XrdVol_{t-5,t}$ investment volatility measures; where, for example, $InvVol_{t-5,t}$ is the investment volatility measure using $Inv$ as the investment

[4] Note that Compustat item capital expenditure $Capx$ excludes the acquisitions $Acq$.
[5] Except for research and development which is scaled by sales.

measure and the Kim and Sorensen (1986) estimation method. To denote five years as the length of the rolling window we use $(t-5,t)$ in the volatility measure.

To closely match the normal distribution of the investment volatility measures, we take the natural logarithm of the volatility measures. For example, the skewness and the kurtosis of $InvVol_{t-5,t}$ before taking the natural logarithm are 3.93 and 20.97, respectively. After taking the natural logarithm the skewness and the kurtosis decrease to 0.25 and 2.98, respectively.[6]

For our second investment volatility measure, we follow the De Veirman and Levin (2015) volatility estimation method and used by Keefe and Yaghoubi (2015) and Keefe and Tate (2013). To construct the De Veirman and Levin (2015) investment volatility measure, we estimate

$$\omega_{i,t} = \alpha_i + Year\beta_1 + \epsilon_{i,t} \tag{4}$$

where $\omega_{i,t}$ represents the first difference of an investment measure scaled by property, plant and equipment from $t-1$ to $t$ for firm $i$ and $Year$ is a matrix of year dummies. The residual $\epsilon_{i,t}$ represents the difference between the observed and the estimated investment growth of firm $i$ when controlling for time and firm's fixed effects. De Veirman and Levin (2015) show that $\hat{\sigma}_{i,t}$ is an unbiased estimator of the true conditional volatility

$$\hat{\sigma}_{i,t} = \sqrt{\pi/2} * |\hat{\epsilon}_{i,t}| \ , \tag{5}$$

where $\hat{\epsilon}_{i,t}$ is the estimated residual from Equation (4). We construct $InvVol_t$, $CapxVol_t$, $AcqVol_t$ and $XrdVol_t$ investment volatility measures. For example, $CapxVol_t$ is the investment volatility for year $t$ estimated using $Capx$ as the investment measure.

We construct our investment spike measure, using the De Veirman and Levin (2015) measure of volatility. For investment to be defined as a spike, it must meet two conditions. First, $\hat{\epsilon}_{i,t}$, which is estimated from Equation (4) must be positive. This implies that actual investment growth is greater than predicted investment growth from Equation (4). Second, the De Veirman and Levin (2015) measure of volatility $\hat{\sigma}_{i,t}$ in Equation (5) must be in the top tercile for each year.

[6] Note that the skewness and the kurtosis of a normal distribution is 0 and 3, respectively.

In summary, an investment spike occurs for those observations where $\hat{\sigma}_{i,t}$ is in the top tercile and where the deviation from predicted investment is positive. For example, $CapxSpike_{i,t}$ is set to one when actual capital expenditure growth is higher than predicted from Equation (4) and capital expenditure volatility from Equation (5) is in the highest tercile.

### 3.2.3 Control Variables

To control for variables that influence a firm's debt ratio, we follow Frank and Goyal (2009) and use the following control variables.

i) $MarketToBook$ is the proxy for a firm's growth opportunities and is the ratio of market value of asset to total assets.

ii) $Tangibility$ is the asset tangibility. The assets tangibility of a firm is the ratio of net property, plant, and equipment over book value of total assets.

iii) $FirmSize$ is a proxy for firms' size. It is the natural logarithm of total assets.

iv) $Profitability$ is the firm's operating income before depreciation divided by total assets.

v) $FirmAge$ is the number of years a firm has been listed in the Compustat.

vi) $LnRnD$ is the natural log of (1+ research and development expenses divided by revenue).

vii) $IndustLev$ is the ratio of median industry leverage ratio by SIC code to the total market debt ratio in each year.

viii) $CreditRating$ is an indicator variable, equals to one if S&P rates the debt as investment grade (BBB) debt and zero otherwise.

ix) $Inflation$ is the expected variation of CPI over the coming year.

We also control for cash flow volatility and follow Keefe and Yaghoubi (2015) and use:

x) $CFV_{t-5,t}$ is the natural log of a firm's cash flow volatility using a five-year window for years $t-5$ to $t$.

To control for variables that influence a firm's cash level, we follow Opler et al. (1999), Bates et al. (2009), and Pinkowitz and Williamson (2007) and use the following controls:

xi) $DPfirms$ is a dummy variable set to one if the firm pays a dividend in year $t$, and zero otherwise.

xii) $NWC$ is the working capital minus cash and marketable securities over total assets.

Lastly, we control for the investment variables that are used to construct our investment volatility measures.

xiii) *Acquisitions* is the natural logarithm of the ratio of acquisition spending to property, plant and equipment (ppegt).

xiv) *Capx* is the natural logarithm of the ratio of capital expenditure to property, plant and equipment (ppegt).

Because we already control for research and development using the Frank and Goyal (2009) measure, we do not add an additional control for research and development. To mitigate possible omitted variable bias we use all of the control variables in all tests.

### 3.3 Univariate Statistics

Table 1 reports summary statistics. The table reports that for most variables there are 146,668 firm-year observations. The mean of the book debt ratio $BDR$ is greater than the mean of the market debt ratio. This is consistent with the mean of market to book ratio $MtB$ being greater than one. In addition, Table 1 shows that on average the cash holding level of the sample firms is about 18% of the total assets, with a standard deviation of 0.22. The table also shows that on average 35.4% of the firm-year observations are the dividend paying firms and have been listed in Compustat for about 9 years.

insert Table 1

Table 2 reports the correlation coefficients between our volatility measures, $MarketToBook$ and our four investment measures. All the investment measures are positively correlated and among all of them *Capx* and *Inv* are highly correlated, with a correlation coefficient of 0.89. However, the correlation coefficient between *Capx* and *Acq* is only 0.22. This suggests *Capx* dominates the combined measure of investment used by DeAngelo et al. (2011). The correlation coefficients between $MarketToBook$ and *Inv*, *Capx* and *Acq* are small and negative, while the correlation between $Xrd$ and $MarketToBook$ ratio is small and positive. All the investment volatility measures as well as $MarketToBook$ are positively correlated. Also, all investment volatility and investment spike variables are positively correlated. The highest correlation coefficient of 0.83 is between $InvVol_{t-5,t}$ and $AcqVol_{t-5,t}$. This suggests most of the variation in the compound measure of investment is driven by acquisitions.

insert Table 2

# 4 Testing

## 4.1 Estimation approach

To test our hypotheses, we consider the fact that our dependent variables are proportional variables that are bounded between zero and one, which implies a nonlinear relationship between our dependent variables and explanatory variables. To address this issue, we follow Cook, Kieschnick and McCullough (2008) and use the following GLM (Generalized Linear Model):

$$E(Ratio_{i,t}|X_{i,t-1}, I) = G(\alpha_i + X_{i,t-1}\beta_1 + \beta_2 I + \epsilon_i) \quad (6)$$

where

- G(.) is the logistic link function,
- $Ratio_{i,t}$ is the book debt ratio $BDR$ for Hypotheses 1a, 2a and 3a; and is the cash ratio $Cash$ for Hypotheses 1b, 2b and 3b.
- $X_{i,t-1}$ is a matrix of lagged control variables listed in Section 3.2.3, and
- $I$ is the variable of interest. For Hypotheses 1a and 1b, $I$ is the lag of one of the investment volatility variables $InvVol_{t-5,t}$, $CapxVol_{t-5,t}$, $AcqVol_{t-5,t}$ and $XrdVol_{t-5,t}$; for Hypotheses

2a and 2b, $I$ is one of the the dummy spike variables $InvSpike_t$, $CapxSpike_t$, $AcqSpike_t$ and $XrdSpike_t$; for Hypotheses 3a and 3b, $I$ is the first lag and the first lead of one of the spike variables.

In addition to our cross-sectional regression, we follow Lemmon et al. (2008) and Flannery and Rangan (2006) and estimate a panel data model which controls for time invariant firm heterogeneity, implying identification comes through investment volatility variations within a firm over time. Because our dependent variables are proportional variables bounded between zero and one, we use the GLM panel data model as follows:

$$E(Ratio_{i,t}|X_{i,t-1}, I) = G(\alpha_i + X_{i,t-1}\beta_1 + \beta_2 I + \epsilon_{i,t}) \quad (7)$$

where

- G(.) is the logistic link function,
- $Ratio_{i,t}$ is the book debt ratio $BDR$ for Hypotheses 1a, 2a and 3a; and is cash ratio $Cash$ for Hypotheses 1b, 2b and 3b.
- $X_{i,t-1}$ is a matrix of lagged control variables listed in Section 3.2.3, and
- $I$ is the variable of interest. For Hypotheses 1a and 1b, $I$ is the lag of one of the investment volatility variables $InvVol_{t-5,t}$, $CapxVol_{t-5,t}$, $AcqVol_{t-5,t}$ and $XrdVol_{t-5,t}$; for Hypotheses 2a and 2b, $I$ is one of the the dummy investment spike variables $InvSpike_t$, $CapxSpike_t$, $AcqSpike_t$ and $XrdSpike_t$; for Hypotheses 3a and 3b, $I$ is the first lag and the first lead of one of the investment spike variables.

Table 3 through Table 8 report estimation results. In each table, Columns (1) to (4) report the estimation results of Equation (6) and Columns (5) to (8) report the estimation results of Equation (7), where the dependent variable is either book debt ratio $BDR$ or the cash to assets ratio $Cash$. In addition, Table 3 through Table 8 report that all the control variables are statistically significant with signs predicted from the literature.

## 4.2 Hypotheses 1a and 1b - Effect of investment volatility on a firm's debt and cash levels.

Table 3 reports estimation results that test Hypothesis 1a, which posits that investment volatility implies low levels of debt. The intuition behind this hypothesis is that firms with high investment volatility keep debt levels low to maintain debt capacity to fund uncertain future investments. Table 3 shows:

- The coefficient associated with capital expenditure volatility $CapxVol_{t-5,t}$ is positive and statistically significant at less than the 1% level, which is opposite to the predicted relationship.
- The coefficient associated with acquisitions volatility $AcqVol_{t-5,t}$ is positive and statistically significant at less than the 1% level, which is opposite to the predicted relationship. We note that compound investment volatility $InvVol_{t-5,t}$, which is highly correlated with acquisition volatility, has the same sign and statistically significance.
- The coefficient associated with research and development volatility $XrdVol_{t-5,t}$ is negative and statistical significant at less than the 1% level, which is consistent with the predicted relationship.

Our evidence suggests that firms with high capital expenditures and acquisitions investment volatility do not keep debt levels low. Rather, high investment volatility appears to lead to higher debt levels. In contrast, firms with high research and development investment volatility use less debt. All in all, our evidence does not seem to support the DeAngelo et al. (2011) model prediction that firms with high investment volatility keep debt levels low.

insert Table 3

Table 4 reports estimation results test Hypothesis 1b, which advances that investment volatility implies high levels of cash. The intuition behind this hypothesis is firms with high investment volatility keep cash levels high to fund uncertain future investments. Table 4 shows:

- The coefficient associated with capital expenditure volatility $CapxVol_{t-5,t}$ is positive, but not statistically significant.

- The coefficient associated with acquisitions volatility $AcqVol_{t-5,t}$ is negative and statistically significant at less than the 1% level, which is opposite to the predicted relationship. We note that compound investment volatility $InvVol_{t-5,t}$, which is highly correlated with acquisitions, has the same sign and statistical significance.
- The coefficient associated with research and development volatility $XrdVol_{t-5,t}$ is positive and statistically significant at less than the 1% level, which is consistent with the predicted relationship.

Our estimation results testing with acquisition volatility are contrary, research and development volatility is in support and capital expenditure volatility is ambiguous relative to Hypothesis 1b. This evidence provides mixed support of the DeAngelo et al. (2011) model.

insert Table 4

## 4.3 Testing Hypotheses 2a and 2b - Effect of investment spikes on a firm's debt and cash levels.

Table 5 reports estimation results that test Hypothesis 2a, which proposes that an investment spike leads to higher levels of debt. The intuition behind this hypothesis is a firm's issue debt to fund large investments. Table 5 shows:

- The coefficient associated with capital expenditures spike is positive and statistically significant at less than the 1% level, which is consistent with the predicted relationship.
- The coefficient associated with the acquisitions spike is positive and statistically significant at less than the 1% level, which is consistent with the predicted relationship. We note that the compound investment spike $InvSpike_t$, which is highly correlated with acquisitions, has the same sign and statistical significance.
- The coefficient associated with research and development spike $XrdSpike_t$ is positive, but not statistically significant.

With the exception of research and development, our evidence supports using debt to fund large investments. All in all, our findings support the DeAngelo et al. (2011) model prediction that firms issue debt to fund large investments.

insert Table 5

Table 6 reports estimation results that test Hypothesis 2b, which posits that an investment spike implies lower levels of cash. The intuition behind this hypothesis is that firms use cash to fund large investments. Table 6 shows:

- The coefficient associated with capital expenditures spike $CapxSpike_t$ is negative and statistically significant at less than the 1% level, which is consistent with the predicted relationship.
- The coefficient associated with acquisitions spike $AcqSpike_t$ is negative and statistically significant at less than the 1% level, which is consistent with the predicted relationship. We note that compound investment spike $InvSpike_t$, which is highly correlated with acquisition, has the same sign and statistical significance.
- The coefficient associated with research and development spike $XrdSpike_t$ is negative, but not statistically significant.

With the exception of research and development, our evidence supports using cash to fund large investments. All in all, our findings support the DeAngelo et al. (2011) model prediction that firms use cash to fund large investments.

insert Table 6

### 4.4 Hypotheses 3a and 3b - The intertemporal effect of investment spikes on firm debt and cash levels.

Table 7 reports estimation results that test Hypothesis 3a, which advances that firms decrease debt levels after funding large investments. The intuition behind this hypothesis is that after large investments, firms decrease debt levels to maintain debt capacity to fund future investment. Table 7 shows:

- The coefficient associated with the lead of capital expenditures spike $CapxSpike_{t+1}$ is negative and statistically significant at less than the 1% level, which is consistent with the predicted relationship.
- The coefficient associated with acquisitions spike $AcqSpike_{t+1}$ is negative and statistically significant at less than the 1% level, which is consistent with the predicted relationship. We note that the compound investment spike $InvSpike_{t+1}$, which is highly correlated with acquisition, has the same sign and statistical significance.
- The coefficient associated with research and development spike $XrdSpike_{t+1}$ is negative and statistically significant at less than the 1% level, which is consistent with the predicted relationship.

Our evidence suggests that after large investments firms decrease their debt levels. All in all, our findings seem to support the DeAngelo et al. (2011) model prediction that firms decrease their debt level after the spike year.

insert Table 7

Table 8 reports estimation results that test Hypothesis 3b, which puts forward that firms increase cash levels after funding large investments. The intuition behind this hypothesis is that after large investments, firms rebuild cash stock to maintain cash capacity to fund future investment. Table 8 shows:

- The coefficient associated with the lead of capital expenditures spike $CapxSpike_{t+1}$ is positive and statistically significant at less than the 1% level, which is consistent with the predicted relationship.
- The coefficient associated with acquisitions spike $AcqSpike_{t+1}$ is positive and statistically significant at less than the 1% level, which is consistent with the predicted relationship. We note that the compound investment spike $InvSpike_{t+1}$, which is highly correlated with acquisition, has the same sign and statistical significance.

- The coefficient associated with research and development spike $XrdSpike_{t+1}$ is positive and statistically significant at less than the 1% level, which is consistent with the predicted relationship.

Our evidence suggests that after large investments firms rebuild their cash stock. Although not explicit in the model of DeAngelo et al. (2011), our evidence supports the plausible implication of their model that firms rebuild their stock of cash after depleting cash stocks to fund large investments.

insert Table 8

# 5 Discussion and Robustness

In this section we discuss the economic importance of our results, investigate if our findings are robust to alternative measures, and delve into why our findings diverge from the model predictions of DDD.

## 5.1 Economic Importance

Table 9 reports the predicted percentage change in dependent variables ($BDR$ and $Cash$) of our three Hypotheses using both cross-sectional and panel data models. The predicted percentage changes for Hypotheses 1a and 1b are the result of one standard deviation increase from the mean of the investment volatility variables, where other control variables are evaluated at their means. For example, to obtain the economic importance of $InvVol_{t-6,t-1}$, we estimate the change in the dependent variable ($BDR$) due to a one standard deviation increase in $InvVol_{t-6,t-1}$ using Equations (6) and (7). Predicted $BDR$ at the mean of $InvVol_{t-6,t-1}$ is 0.297 and at the mean plus one standard deviation of $InvVol_{t-6,t-1}$ is 0.348, implying a 17.17% increase in debt ratio as a result of one standard deviation increase in $InvVol_{t-6,t-1}$.[7] For Hypotheses 2a, 2b, 3a and 3b the predicted percentage changes are the result of the change in the dummy spike variables from zero to one, where other control variables are evaluated at their means. For example, the predicted

[7] $PercentageChange = \frac{0.348-0.297}{0.297} = +17.17\%$.

$BDR$ when $InvSpike = 0$ is 0.306 and when $InvSpike = 1$ is 0.399, implying a 30.39% increase in debt ratio as a result of a large investment spike.

insert Table 9

Table 9 shows a 17.17% increase in the debt ratio as a result of a one standard deviation increase from the mean of $InvVol_{t-6,t-1}$ which is mainly derived by $AcqVol_{t-6,t-1}$. The table also shows the economic importance is slightly lower using the panel data model. The second part of Table 9 reports the predicted percentage change in $Cash$ of Hypothesis 1b. For example, the table reports a 12.02% decrease in a firm's cash level as a result of a one standard deviation increase from the mean of $InvVol_{t-6,t-1}$. Like $BDR$ changes, the $Cash$ changes are mainly derived by $AcqVol_{t-6,t-1}$. Note that $Inv = Capx + Acq$.

## 5.2 Robustness to alternative measures

In this section, we test if our results are robust to alternative measures of the debt ratio, Table 10 summarizes these tests.

insert Table 10

### 5.2.1 Robustness using market debt ratios

To evaluate if our findings are robust to a different measure of debt ratio, we use the market short and long-term debt ratio constructed in Section 3.2. Panel A tests Hypothesis 1a using the short and long-term market debt ratio and reports the coefficients associated with our main investment volatility variables using both GLM and Panel GLM. Testing Hypotheses 1a, 2a and 3a using the market debt ratio, our main results remain qualitatively unchanged.

### 5.2.2 Robustness using an alternative cash ratio

We also follow Opler et al. (1999) and construct another cash ratio $Cash\_na = che/at - che$ where $che$ is cash and marketable securities and $at$ is total assets. Because our $Cash\_na$ variable is not bounded between zero and one, we can not use the GLM model. Therefore, we use the linear panel firm fixed-effect model. Panel B tests Hypotheses 1b, 2b and 3b and reports the coefficients associated with investment volatility. Re-testing our three cash hypotheses using $Cash\_na$, our main results remain qualitatively unchanged for Hypotheses 2b and 3b, and remain qualitatively unchanged for Hypothesis 1a using capital expenditure and acquisition volatility but not research and development volatility.

#### 5.2.3 Robustness using multiple investment spikes

In addition to our main investment spike variable that represents firms with large investments, we construct a two consecutive investment spikes variable that represents firms with two consecutive large investments. Panel C tests Hypotheses 2a and 2b using two consecutive spike variables. As can be seen in Panel D of Table 10, our main results remain qualitatively unchanged. The use of two investment spikes increases the magnitude of the coefficients associated with all the spike variables in Hypothesis 2a, and the coefficient associated with $CapxSpike$ in Hypothesis 2b.

### 5.3 Robustness – A re-examination of results related to Hypothesis 1

Relative to Hypothesis 1, we that firms with high investment volatility hold more debt and less cash. We expected the opposite results – firms with uncertain investment should maintain financing capacity by maintaining relatively low levels of debt and high levels of cash. This firm strategy is both intuitive and prudent. Why do we find the opposite result?

To further examine this question, we perform three robustness checks. First, we calculate the mean of each variable by firm over the sample period and then re-estimate our tests. Table 11 reports the results. Once again, we find that firms with relatively higher levels of investment volatility $InvVol$, $CapxVol$, and $AcqVol$ hold higher levels of debt and firms with higher levels of research and development volatility $XrdVol$ hold lower levels of debt. Also, we find that firms with relatively higher levels of investment acquisition volatility $AcqVol$ hold less cash and firms with higher levels of research and development volatility $XrdVol$ hold more cash. Thus, only for research and development volatility do we find results that are consistent with Hypothesis 1.

insert Table 11

Second, we investigate if our result is driven by correlated investment shocks. DeAngelo and Roll (2015) show that over long periods of time firm capital structure exhibits both high and low debt levels over protracted periods. DeAngelo and Roll (2015) attribute these high levels of debt to the need to fund investment. Consistent with the need to fund high levels of investment over an extended period is that investment volatility is also persistent over an extended period. Correlated investment shocks require firms to fund investment, which leads to plausibly lead to persistently high levels of debt and low levels of cash. Table 12 shows the correlation coefficients between the 5 year lag and the 5 year lead of investment volatility. Table 12 provides evidence that investment volatility is correlated. For example, the correlations coefficient between non-overlapping five year investment volatility is 0.36.

insert Table 12

The above evidence suggests our findings may be related to correlated investment shocks. To test if our results are in-part due to correlated investment shock, we re-estimate where the variable of interest is future investment volatility and the dependent variable is either the book debt ratio of cash holdings. Table 13 shows the results. Overall, the results support Hypothesis 1. We find that firms with high *future* investment volatility hold more debt and less cash – firms with *future* uncertain investment should maintain financing capacity by maintaining relatively low levels of debt and high levels of cash.

insert Table 13

# 6 Conclusion

The empirical literature on the relationship between firms' financing options and the volatility of investment is narrow. Prior literature uses several investment definitions including capital expenditures, acquisitions, and the sum of capital expenditures and acquisitions. Specifically, research and development expenditures have not been tested as a measure of investment. We also consider the non-linear relationship between our proportional dependent variables and the explanatory variables and use both a cross-sectional and panel GLM with logit link function. Thus, the paper contributes to the literature both in terms of the hypotheses tested and the range of our definition of investments.

The first hypothesis investigates if firms with higher investment volatility have lower debt levels and higher cash levels. Our results indicate that firms with high capital expenditure and acquisition volatility have higher debt levels and firms with high research and development expenditure have lower debt levels. In addition, our evidence suggests that firms with high acquisitions volatility hold less cash. Our results are economically important - we predict the percentage change in debt and cash ratios by one standard deviation increase from the mean of all four investment volatility variables. For example, our evidence suggests a 17.17% increase in the debt ratio and a 12.06% decrease in the cash level as a result of one standard deviation increase from the mean of capital expenditure plus acquisition volatility. All in all, our evidence does not support the model of DeAngelo et al. (2011) prediction that firms with high investment volatility have low debt levels and high cash levels.

The second hypothesis tests the effect of large investments on firms' debt and cash levels. The intuition behind this hypothesis is that firms issue debt and use their cash holdings to fund large investments. We construct investment spike variables using our four measures of investment. Our results are economically important - we predict the percentage change in debt and cash ratios by the change in the investment spike dummy variable from zero to one. For example, our evidence suggests a 30.39% increase in the debt ratio and a 30.59% decrease in the cash level as a result of an investment spike (large investment). Our evidence supports the prediction of the DeAngelo et al. (2011) model and the findings of Elsas et al. (2014) that firms finance their large investments by issuing debt and using their cash holdings.

The third hypothesis investigates if firms rebuild their debt capacity and cash stocks following the large investments. To test this hypothesis we use the first lead of the investment spike variables. Our results are economically important - we predict the percentage change in debt and cash ratios by the change in the lead of investment spike dummy variable from zero to one. For example, our evidence suggests a 10.76% decrease in the debt ratio and a 21.15% increase in the cash levels, one year after the large investment. Our evidence supports the prediction from the DeAngelo et al.

(2011) model and findings of Elsas et al. (2014) that firms decrease their debt level a year after the spike year. In addition, these firms rebuild their cash stock one year after funding large investments. Our findings that firms increase cash levels after funding investments is novel.

Our evidence suggests different firms' financial policies relative to research and development volatility. Our findings suggest that high research and development investment volatility is accompanied by lower debt and higher cash levels. Plausibly, research and development investment volatility may be a reasonable proxy for shocks to the marginal productivity of capital, the latent variable in the DeAngelo et al. (2011) model. In addition, our evidence suggests that a research and development spike is not an important determinant of a firm's debt and cash level. However, following a research and development investment spike, firms increase their debt capacity and cash levels. This supports the DeAngelo et al. (2011) model prediction.

# 7 Appendix

Variable Definitions
This table provides variable definitions. Column (1) provides the variable name. Column (2) defines the variable. Column (3) shows the variable construction using system variable names. Column (4) provides the data source.

| Variable | Definition | Construction | Data Sources |
|---|---|---|---|
| $MDR$ | The ratio of short plus long-term debt to short plus long-term debt plus common shareholder equity, (Rajan and Zingales, 1995). | $\frac{dltt+dlc}{dltt+dlc+csho*prcc\_f}$ | Compustat |
| $BDR$ | The ratio of short plus long-term debt to the sum of common shareholders' equity, the total long-term debt and the total short-term debt, (Rajan and Zingales, 1995). | $\frac{dltt+dlc}{dltt+dlc+ceq}$ | Compustat |
| $Cash$ | The ratio of cash and short-term investments over total assets, (DeAngelo et al., 2011, Bates et al., 2009, Almeida et al., 2004, DeAngelo et al., 2006). | $\frac{che}{at}$ | Compustat |
| $CFV_{t-5,t}$ | Natural logarithm of cash flow volatility. | See the (Keefe and Yaghoubi, 2015) paper | Compustat |
| $Tangibility$ | The assets tangibility of a firm is the ratio of(ppent) net property, plant, and equipment(at) toatal assets, (Lemmon et al., 2008) and (Frank and Goyal, 2009). | $\frac{ppenb}{at}$ | Compustat |
| $IndustLev$ | The median industry leverage of the sector a firm is classified by four-digit SIC code, (Frank and Goyal, 2009). | The median of $\frac{LT}{MVA}$ [8] | Compustat |
| $FirmSize$ | The proxy for a firm size. | $ln(at)$ | Compustat |
| $Profitability$ | Shows the profitability of a firm. | $\frac{oibdp}{at}$ | Compustat |
| $MarketToBook$ | The proxy for a firm's growth opportunities and is the ratio of market value of asset to total assets. | $\frac{MVA}{at}$ | Compustat |
| $Inflation$ | The expected change in the consumer price index (CPI) over the coming year, (Frank and Goyal, 2009). | $\frac{Forecast12Month-BasePeriod}{BasePeriod}$ | Livingston Survey |
| $LnRnD$ | The ratio of R&D expenses to sales of a firm, (Frank and Goyal, 2009). | $ln(1+\frac{xrd}{revt})$ | Compustat |

[8] Market value of assets ($MVA$) = debt in current liabilities ($dlc$) + long-term debt ($dltt$) + preferred stock ($pstkl$) + market value of equity ($csho*prcc-f$) - balance sheet deferred taxes and investment tax credit ($txditc$).

| Variable | Definition | Construction | Data Sources |
|---|---|---|---|
| $CreditRating$ | Indicator variable: One if a firm is listed as investment grade by S&P, and zero otherwise. | =1 if $SPLTICRM$ or $SPSDRM < 13$ | Compustat |
| $FirmAge$ | The number of years a firm has had data in Compustat. | fyear-First year in Compustat | Compustat |
| $DPfirms$ | A dummy variable set to one if a firm pays dividend in year $t$, and zero otherwise, (Opler et al., 1999) | =1 if $dvc \neq 0$ | Compustat |
| $Acquisitions$ | The ratio of acquisitions spending to the total assets, (Bates et al., 2009) | $\frac{aqc}{at}$ | Compustat |
| $Capx$ | The ratio of capital expenditure to the total assets, (Bates et al., 2009) | $\frac{capx}{at}$ | Compustat |
| $NWC$ | The working capital minus cash and marketable securities over total assets, (Bates et al., 2009) | $\frac{wcap-che}{at}$ | Compustat |
| $InvVol_{t-5,t}$ | The capital expenditures plus acquisitions investment volatility measure estimated using (Kim and Sorensen, 1986) method | SD of $Capx + Acq$ over the last five years divided by the five years moving average of *ppegt* | Compustat |
| $CapxVol_{t-5,t}$ | The capital expenditures investment volatility measure estimated using (Kim and Sorensen, 1986) method | SD of $Capx$ over the last five years divided by the five years moving average of *ppegt* | Compustat |
| $AcqVol_{t-5,t}$ | The acquisitions investment volatility measure estimated using (Kim and Sorensen, 1986) method | SD of $Acq$ over the last five years divided by the five years moving average of *ppegt* | Compustat |
| $XrdVol_{t-5,t}$ | The research and development investment volatility measure estimated using (Kim and Sorensen, 1986) method | SD of $Xrd$ over the last five years divided by the five years moving average of *ppegt* | Compustat |
| $InvSpike_t$ | An investment spike of $Capx + Acq$ | See Section3.2.2 | Compustat |
| $CapxSpike_t$ | An investment spike of $Capx$ | See Section3.2.2 | Compustat |
| $AcqSpike_t$ | An investment spike of $Acq$ | See Section3.2.2 | Compustat |
| $XrdSpike_t$ | An investment spike of $Xrd$ | See Section3.2.2 | Compustat |

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Table 1: Summary Statistics
This table shows summary statistics of variables of the study for non-financial and non-utility US companies from 1974-2015. All variables are winsorized at 0.1% level in both tails of the distribution before the summary statistics are calculated. The table reports the number of observations, mean, 25th percentile, median, 75th percentile and standard deviation. Appendix 7 defines the variables.

| Variable | N | mean | p25 | p50 | p75 | max | min | sd |
|---|---|---|---|---|---|---|---|---|
| $MDR$ | 146668 | 0.230 | 0.0195 | 0.157 | 0.376 | 0.877 | 0 | 0.236 |
| $BDR$ | 146668 | 0.291 | 0.0488 | 0.262 | 0.466 | 0.924 | 0 | 0.250 |
| $Cash$ | 146668 | 0.181 | 0.0274 | 0.0876 | 0.251 | 0.923 | 0.000325 | 0.219 |
| $Tangibility$ | 146455 | 0.276 | 0.103 | 0.222 | 0.390 | 0.894 | 0.00367 | 0.219 |
| $FirmSize$ | 146668 | 4.693 | 3.192 | 4.541 | 6.074 | 10.04 | 0.472 | 2.086 |
| $FirmAge$ | 146668 | 9.098 | 2 | 6 | 13 | 38 | 0 | 8.779 |
| $Profitability$ | 146342 | 0.0637 | 0.0314 | 0.114 | 0.176 | 0.404 | -0.993 | 0.218 |
| $MarketToBook$ | 142098 | 1.674 | 0.725 | 1.082 | 1.861 | 11.10 | 0.279 | 1.740 |
| $IndustLev$ | 146668 | 0.341 | 0.199 | 0.323 | 0.465 | 0.907 | 0.0104 | 0.175 |
| $RnD$ | 144689 | 0.0910 | 0 | 0 | 0.0500 | 2.202 | 0 | 0.300 |
| $Inflation$ | 146668 | 0.0437 | 0.0238 | 0.0379 | 0.0560 | 0.121 | 0.0166 | 0.0246 |
| $CreditRating$ | 146668 | 0.0683 | 0 | 0 | 0 | 1 | 0 | 0.252 |
| $NWC$ | 141986 | 0.459 | -0.0120 | 0.259 | 0.729 | 6.123 | -3.462 | 1.162 |
| $DPfirms$ | 146668 | 0.354 | 0 | 0 | 1 | 1 | 0 | 0.478 |
| $CFV_{t-5,t}$ | 95179 | 1.892 | 1.250 | 1.822 | 2.448 | 4.933 | -0.191 | 0.958 |
| $InvVol_{t-5,t}$ | 94914 | 2.265 | 1.474 | 2.206 | 2.999 | 5.377 | -0.422 | 1.154 |
| $InvSpike_t$ | 128897 | 0.136 | 0 | 0 | 0 | 1 | 0 | 0.342 |
| $CapxVol_{t-5,t}$ | 94914 | 1.669 | 1.021 | 1.662 | 2.323 | 3.981 | -0.766 | 0.961 |
| $CapxSpike_t$ | 128897 | 0.143 | 0 | 0 | 0 | 1 | 0 | 0.350 |
| $AqcVol_{t-5,t}$ | 54910 | 1.983 | 0.940 | 2.092 | 3.161 | 5.341 | -8.035 | 1.699 |
| $AqcSpike_t$ | 128897 | 0.123 | 0 | 0 | 0 | 1 | 0 | 0.329 |
| $XrdVol_{t-5,t}$ | 51370 | 1.076 | -0.261 | 1.083 | 2.458 | 5.140 | -6.791 | 1.908 |
| $XrdSpike_t$ | 128897 | 0.124 | 0 | 0 | 0 | 1 | 0 | 0.329 |

Table 2: Correlations

This table shows the pairwise correlation coefficients between investment, market to book and investment volatility variables. Appendix 7 defines the variables. Reference numbers in columns and rows refer to the variables associated with the pairwise correlation coefficients.

| Correlations | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| (1) $Inv$ | 1 | | | | | | | | | | | | | |
| (2) $Capx$ | 0.89 | 1 | | | | | | | | | | | | |
| (3) $Acq$ | 0.66 | 0.22 | 1 | | | | | | | | | | | |
| (4) $Xrd$ | 0.59 | 0.54 | 0.36 | 1 | | | | | | | | | | |
| (5) $MarketToBook$ | -0.03 | -0.03 | -0.01 | 0.04 | 1 | | | | | | | | | |
| (6) $InvVol_{t-5,t}$ | -0.07 | -0.12 | 0.04 | -0.06 | 0.23 | 1 | | | | | | | | |
| (7) $InvSpike_t$ | 0.05 | -0.03 | 0.15 | -0.02 | 0.08 | 0.31 | 1 | | | | | | | |
| (8) $CapxVol_{t-5,t}$ | -0.13 | -0.10 | -0.10 | -0.12 | 0.30 | 0.60 | 0.19 | 1 | | | | | | |
| (9) $CapxSpike_t$ | -0.03 | -0.02 | -0.02 | -0.04 | 0.17 | 0.20 | 0.36 | 0.34 | 1 | | | | | |
| (10) $AcaVol_{t-5,t}$ | -0.04 | -0.09 | 0.06 | -0.02 | 0.14 | 0.83 | 0.26 | 0.20 | 0.09 | 1 | | | | |
| (11) $AcqSpike_t$ | 0.05 | -0.04 | 0.16 | -0.01 | 0.01 | 0.22 | 0.68 | 0.08 | 0.09 | 0.25 | 1 | | | |
| (12) $XrdVol_{t-5,t}$ | -0.12 | -0.12 | -0.05 | 0.01 | 0.38 | 0.52 | 0.156 | 0.51 | 0.19 | 0.38 | 0.09 | 1 | | |
| (13) $XrdSpike_t$ | -0.03 | -0.05 | 0.01 | 0.00 | 0.18 | 0.22 | 0.23 | 0.23 | 0.24 | 0.16 | 0.15 | 0.38 | 1 | |
| (14) $CFV_{t-5,t}$ | -0.13 | -0.11 | -0.08 | -0.10 | 0.39 | 0.30 | 0.09 | 0.52 | 0.18 | 0.17 | 0.025 | 0.59 | 0.22 | 1 |

Table 3: Testing Hypothesis 1a

This table shows estimation results of Equation (6) using GLM with a logit link function and Equation (7) using panel GLM, where the short and long-term book debt ratio ($BDR$) is the dependent variable. All the RHS variables are in information set and are used in the lagged form. Columns (1) to (4) show the estimation results using the GLM and Columns (5) to (8) show the estimation results using panel GLM. The variables of interest are the investment volatility measured using several investment definitions including the sum of capital expenditures and acquisitions ($Capx + Acq$), capital expenditures ($Capx$), acquisitions ($Acq$) and research and development expenditures ($R\&D$). Section 3.2 defines the variables. Clustered standard errors by firms are shown in parentheses with 1%, 5% and 10% significance level denoted by ***, ** and *, respectively.

| VARIABLES | BDR | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | GLM | | | | Panel GLM | | | |
| $InvVol_{t-6,t-1}$ | 0.203*** | | | | 0.151*** | | | |
| | (0.0116) | | | | (0.00917) | | | |
| $CapxVol_{t-6,t-1}$ | | 0.0804*** | | | | 0.0483*** | | |
| | | (0.0146) | | | | (0.0111) | | |
| $AcqVol_{t-6,t-1}$ | | | 0.117*** | | | | 0.0868*** | |
| | | | (0.00859) | | | | (0.00657) | |
| $XrdVol_{t-6,t-1}$ | | | | -0.0401*** | | | | -0.0384*** |
| | | | | (0.0145) | | | | (0.0116) |
| $CFV_{t-6,t-1}$ | -0.222*** | -0.203*** | -0.193*** | -0.182*** | -0.148*** | -0.128*** | -0.129*** | -0.114*** |
| | (0.0154) | (0.0159) | (0.0153) | (0.0212) | (0.0118) | (0.0121) | (0.0116) | (0.0166) |
| $Acq_{t-1}$ | 0.0212*** | 0.0674*** | 0.0239*** | 0.0635*** | 0.0205*** | 0.0453*** | 0.0208*** | 0.0442*** |
| | (0.00427) | (0.00483) | (0.00426) | (0.00693) | (0.00307) | (0.00331) | (0.00303) | (0.00450) |
| $Capx_{t-1}$ | -0.0682*** | -0.0604*** | -0.0218 | -0.00256 | -0.0336*** | -0.0212* | -0.00580 | -0.000690 |
| | (0.0153) | (0.0155) | (0.0154) | (0.0235) | (0.0114) | (0.0116) | (0.0115) | (0.0174) |
| $RnD_{t-1}$ | -0.895*** | -0.995*** | -0.944*** | -0.422* | -0.595*** | -0.644*** | -0.618*** | -0.148 |
| | (0.261) | (0.273) | (0.268) | (0.232) | (0.201) | (0.206) | (0.206) | (0.175) |
| $Tangibility_{t-1}$ | 1.515*** | 1.224*** | 1.475*** | 1.060*** | 1.334*** | 1.116*** | 1.300*** | 1.160*** |
| | (0.0680) | (0.0646) | (0.0691) | (0.141) | (0.0637) | (0.0625) | (0.0642) | (0.118) |
| $FirmSize_{t-1}$ | 0.0613*** | 0.0684*** | 0.0575*** | 0.0559*** | 0.0649*** | 0.0698*** | 0.0624*** | 0.0531*** |
| | (0.00840) | (0.00864) | (0.00851) | (0.0118) | (0.00760) | (0.00779) | (0.00767) | (0.0108) |
| $FirmAge_{t-1}$ | -0.00423*** | -0.00549*** | -0.00516*** | -0.00276 | -0.00153 | -0.00223 | -0.00215 | 0.00122 |
| | (0.00157) | (0.00160) | (0.00157) | (0.00216) | (0.00152) | (0.00153) | (0.00151) | (0.00197) |
| $Profitability_{t-1}$ | -1.457*** | -1.485*** | -1.547*** | -1.404*** | -1.169*** | -1.176*** | -1.210*** | -1.030*** |
| | (0.120) | (0.119) | (0.121) | (0.154) | (0.104) | (0.104) | (0.105) | (0.132) |
| $MarketToBook_{t-1}$ | -0.0646*** | -0.0653*** | -0.0618*** | -0.0447*** | -0.0528*** | -0.0508*** | -0.0491*** | -0.0306** |
| | (0.0145) | (0.0145) | (0.0144) | (0.0169) | (0.0110) | (0.0110) | (0.0109) | (0.0127) |

| VARIABLES | BDR | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | | GLM | | | | Panel GLM | | |
| $IndustLev_{t-1}$ | 1.681*** | 1.643*** | 1.680*** | 1.515*** | 1.372*** | 1.346*** | 1.365*** | 1.307*** |
| | (0.0828) | (0.0840) | (0.0835) | (0.129) | (0.0640) | (0.0641) | (0.0641) | (0.0909) |
| $Inflation_{t-1}$ | 2.703*** | 1.302** | 2.379*** | 2.111*** | 0.991** | 0.183 | 0.904** | 0.863 |
| | (0.533) | (0.533) | (0.543) | (0.744) | (0.443) | (0.445) | (0.450) | (0.611) |
| $CreditRating_{t-1}$ | 0.186*** | 0.154*** | 0.161*** | 0.212*** | 0.203*** | 0.192*** | 0.193*** | 0.250*** |
| | (0.0372) | (0.0376) | (0.0373) | (0.0491) | (0.0298) | (0.0298) | (0.0297) | (0.0384) |
| Constant | -2.150*** | -1.478*** | -1.730*** | -1.309*** | -1.905*** | -1.427*** | -1.615*** | -1.466*** |
| | (0.0977) | (0.0925) | (0.0914) | (0.121) | (0.0789) | (0.0779) | (0.0755) | (0.103) |
| Observations | 25,079 | 25,079 | 25,079 | 13,639 | 25,079 | 25,079 | 25,079 | 13,639 |
| Number of gvkey | | | | | 5,428 | 5,428 | 5,428 | 3,091 |

Table 4: Testing Hypothesis 1b

This table shows estimation results of Equation (6) using GLM with a logit link function and Equation (7) using panel GLM, where the ratio of cash over total assets ($Cash$) is the dependent variable. All the RHS variables are in information set and are used in the lagged form. Columns (1) to (4) show the estimation results using the GLM and Columns (5) to (8) show the estimation results using panel GLM. The variables of interest are the investment volatility measured using several investment definitions including the sum of capital expenditures and acquisitions ($Capx + Acq$), capital expenditures ($Capx$), acquisitions ($Acq$) and research and development expenditures ($R\&D$). Section 3.2 defines the variables. Clustered standard errors by firms are shown in parentheses with 1%, 5% and 10% significance level denoted by ***, ** and *, respectively.

| VARIABLES | $Cash$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | GLM | | | | Panel GLM | | | |
| $InvVol_{t-6,t-1}$ | -0.123*** | | | | -0.0975*** | | | |
| | (0.0113) | | | | (0.00907) | | | |
| $CapxVol_{t-6,t-1}$ | | 0.0243 | | | | 0.00534 | | |
| | | (0.0165) | | | | (0.0136) | | |
| $AcqVol_{t-6,t-1}$ | | | -0.0868*** | | | | -0.0673*** | |
| | | | (0.00813) | | | | (0.00673) | |
| $XrdVol_{t-6,t-1}$ | | | | 0.0597*** | | | | 0.0515*** |
| | | | | (0.0143) | | | | (0.0119) |
| $CFV_{t-6,t-1}$ | 0.490*** | 0.470*** | 0.477*** | 0.429*** | 0.390*** | 0.375*** | 0.381*** | 0.357*** |
| | (0.0167) | (0.0175) | (0.0167) | (0.0203) | (0.0141) | (0.0146) | (0.0140) | (0.0177) |
| $Acq_{t-1}$ | -0.0459*** | -0.0760*** | -0.0418*** | -0.0726*** | -0.0417*** | -0.0588*** | -0.0389*** | -0.0593*** |
| | (0.00463) | (0.00470) | (0.00469) | (0.00564) | (0.00354) | (0.00348) | (0.00353) | (0.00434) |
| $Capx_{t-1}$ | 0.0116 | -0.0283* | -0.0118 | -0.0165 | -0.0125 | -0.0341** | -0.0286** | -0.0272* |
| | (0.0163) | (0.0170) | (0.0162) | (0.0195) | (0.0131) | (0.0136) | (0.0129) | (0.0160) |
| $RnD_{t-1}$ | 1.184*** | 1.221*** | 1.187*** | 0.879*** | 1.016*** | 1.030*** | 1.012*** | 0.792*** |
| | (0.131) | (0.137) | (0.133) | (0.113) | (0.109) | (0.112) | (0.111) | (0.105) |
| $Tangibility_{t-1}$ | -2.783*** | -2.552*** | -2.791*** | -2.655*** | -2.670*** | -2.480*** | -2.674*** | -2.784*** |
| | (0.0905) | (0.0869) | (0.0905) | (0.146) | (0.0831) | (0.0800) | (0.0837) | (0.141) |
| $FirmSize_{t-1}$ | 0.0476*** | 0.0471*** | 0.0488*** | 0.0718*** | 0.0245*** | 0.0219*** | 0.0257*** | 0.0531*** |
| | (0.00888) | (0.00905) | (0.00890) | (0.0110) | (0.00812) | (0.00825) | (0.00816) | (0.0100) |
| $FirmAge_{t-1}$ | -0.00143 | 3.03e-05 | -0.00103 | -0.00188 | -0.00149 | -0.000383 | -0.00113 | -0.00283 |
| | (0.00164) | (0.00167) | (0.00164) | (0.00197) | (0.00157) | (0.00162) | (0.00158) | (0.00197) |
| $Profitability_{t-1}$ | 0.395*** | 0.415*** | 0.422*** | 0.449*** | 0.357*** | 0.348*** | 0.370*** | 0.364*** |
| | (0.104) | (0.105) | (0.105) | (0.115) | (0.0915) | (0.0923) | (0.0924) | (0.103) |
| $MarketToBook_{t-1}$ | 0.0349*** | 0.0324*** | 0.0324*** | 0.0180** | 0.0275*** | 0.0256*** | 0.0252*** | 0.0132 |
| | (0.00840) | (0.00861) | (0.00848) | (0.00905) | (0.00772) | (0.00776) | (0.00781) | (0.00842) |

| VARIABLES | *Cash* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | | GLM | | | | Panel GLM | | |
| $IndustLev_{t-1}$ | -1.216*** | -1.219*** | -1.224*** | -1.058*** | -0.971*** | -0.959*** | -0.975*** | -0.826*** |
| | (0.0940) | (0.0951) | (0.0945) | (0.126) | (0.0738) | (0.0740) | (0.0740) | (0.0998) |
| $Inflation_{t-1}$ | -2.749*** | -2.212*** | -2.933*** | -4.852*** | -2.520*** | -2.133*** | -2.701*** | -4.084*** |
| | (0.715) | (0.716) | (0.724) | (0.957) | (0.575) | (0.578) | (0.584) | (0.819) |
| $NWC_{t-1}$ | -0.196*** | -0.194*** | -0.197*** | -0.140*** | -0.148*** | -0.145*** | -0.148*** | -0.108*** |
| | (0.0165) | (0.0162) | (0.0164) | (0.0184) | (0.0129) | (0.0126) | (0.0128) | (0.0148) |
| $DPfirms_{t-1}$ | -0.123*** | -0.0930*** | -0.111*** | -0.169*** | -0.124*** | -0.106*** | -0.117*** | -0.159*** |
| | (0.0306) | (0.0313) | (0.0306) | (0.0391) | (0.0249) | (0.0253) | (0.0250) | (0.0316) |
| $CreditRating_{t-1}$ | -0.298*** | -0.274*** | -0.289*** | -0.319*** | -0.240*** | -0.232*** | -0.237*** | -0.262*** |
| | (0.0433) | (0.0437) | (0.0434) | (0.0542) | (0.0420) | (0.0425) | (0.0425) | (0.0578) |
| Constant | -1.778*** | -2.396*** | -1.940*** | -2.249*** | -1.659*** | -2.071*** | -1.789*** | -2.024*** |
| | (0.100) | (0.0986) | (0.0952) | (0.120) | (0.0863) | (0.0866) | (0.0826) | (0.106) |
| Observations | 24,556 | 24,556 | 24,556 | 13,470 | 24,556 | 24,556 | 24,556 | 13,470 |
| Number of gvkey | | | | | 5,353 | 5,353 | 5,353 | 3,079 |

Table 5: Testing Hypothesis 2a

This table shows estimation results of Equation (6) using GLM with a logit link function and Equation (7) using panel GLM, where the short and long-term book debt ratio ($BDR$) is the dependent variable. All the RHS variables are in information set and are used in the lagged form. Columns (1) to (4) show the estimation results using the GLM and Columns (5) to (8) show the estimation results using panel GLM. The variables of interest are the investment spikes measured using several investment definitions including the sum of capital expenditures and acquisitions ($Capx + Acq$), capital expenditures ($Capx$), acquisitions ($Acq$) and research and development expenditures ($R\&D$). Section 3.2 defines the variables. Clustered standard errors by states are shown in parentheses with 1%, 5% and 10% significance level denoted by ***, ** and *, respectively.

| VARIABLES | $BDR$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | GLM | | | | Panel GLM | | | |
| $InvSpike_t$ | 0.409*** | | | | 0.326*** | | | |
| | (0.0200) | | | | (0.0145) | | | |
| $CapxSpike_t$ | | 0.0980*** | | | | 0.0591*** | | |
| | | (0.0226) | | | | (0.0178) | | |
| $AqcSpike_t$ | | | 0.294*** | | | | 0.245*** | |
| | | | (0.0177) | | | | (0.0129) | |
| $XrdSpike_t$ | | | | 0.0102 | | | | 0.0132 |
| | | | | (0.0305) | | | | (0.0219) |
| $CFV_{t-6,t-1}$ | -0.189*** | -0.182*** | -0.184*** | -0.179*** | -0.126*** | -0.116*** | -0.122*** | -0.115*** |
| | (0.0153) | (0.0154) | (0.0153) | (0.0153) | (0.0116) | (0.0117) | (0.0116) | (0.0116) |
| $Acq_{t-1}$ | 0.0740*** | 0.0694*** | 0.0754*** | 0.0703*** | 0.0540*** | 0.0459*** | 0.0551*** | 0.0464*** |
| | (0.00497) | (0.00487) | (0.00505) | (0.00488) | (0.00347) | (0.00333) | (0.00354) | (0.00332) |
| $Capx_{t-1}$ | -0.0167 | -0.0156 | -0.0161 | -0.0154 | 0.00132 | 0.00147 | -0.000618 | -0.000225 |
| | (0.0154) | (0.0154) | (0.0154) | (0.0154) | (0.0116) | (0.0117) | (0.0116) | (0.0116) |
| $RnD_{t-1}$ | -0.944*** | -1.016*** | -0.966*** | -1.030*** | -0.616*** | -0.650*** | -0.629*** | -0.655*** |
| | (0.266) | (0.274) | (0.268) | (0.278) | (0.205) | (0.207) | (0.206) | (0.208) |
| $Tangibility_{t-1}$ | 1.335*** | 1.234*** | 1.316*** | 1.230*** | 1.206*** | 1.123*** | 1.183*** | 1.115*** |
| | (0.0651) | (0.0649) | (0.0652) | (0.0652) | (0.0629) | (0.0628) | (0.0629) | (0.0630) |
| $FirmSize_{t-1}$ | 0.0625*** | 0.0630*** | 0.0602*** | 0.0617*** | 0.0700*** | 0.0670*** | 0.0674*** | 0.0661*** |
| | (0.00850) | (0.00853) | (0.00851) | (0.00854) | (0.00775) | (0.00774) | (0.00773) | (0.00775) |
| $FirmAge_{t-1}$ | -0.00594*** | -0.00642*** | -0.00580*** | -0.00639*** | -0.00283* | -0.00294* | -0.00252* | -0.00293* |
| | (0.00158) | (0.00158) | (0.00158) | (0.00159) | (0.00151) | (0.00151) | (0.00151) | (0.00152) |
| $Profitability_{t-1}$ | -1.629*** | -1.554*** | -1.628*** | -1.549*** | -1.300*** | -1.207*** | -1.290*** | -1.195*** |
| | (0.120) | (0.120) | (0.121) | (0.120) | (0.106) | (0.105) | (0.106) | (0.105) |
| $MarketToBook_{t-1}$ | -0.0738*** | -0.0653*** | -0.0689*** | -0.0623*** | -0.0615*** | -0.0510*** | -0.0563*** | -0.0488*** |
| | (0.0146) | (0.0145) | (0.0146) | (0.0145) | (0.0112) | (0.0110) | (0.0112) | (0.0110) |

| VARIABLES | | | | *BDR* | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | | GLM | | | | Panel GLM | | |
| $IndustLev_{t-1}$ | 1.666*** | 1.648*** | 1.673*** | 1.652*** | 1.373*** | 1.346*** | 1.378*** | 1.344*** |
| | (0.0839) | (0.0841) | (0.0842) | (0.0840) | (0.0641) | (0.0640) | (0.0642) | (0.0639) |
| $Inflation_{t-1}$ | 1.416*** | 1.248** | 1.256** | 1.219** | 0.272 | 0.153 | 0.253 | 0.161 |
| | (0.532) | (0.534) | (0.536) | (0.536) | (0.444) | (0.446) | (0.446) | (0.446) |
| $CreditRating_{t-1}$ | 0.146*** | 0.143*** | 0.147*** | 0.140*** | 0.185*** | 0.188*** | 0.189*** | 0.187*** |
| | (0.0374) | (0.0376) | (0.0376) | (0.0376) | (0.0295) | (0.0298) | (0.0297) | (0.0298) |
| Constant | -1.288*** | -1.242*** | -1.274*** | -1.230*** | -1.321*** | -1.295*** | -1.317*** | -1.291*** |
| | (0.0854) | (0.0853) | (0.0856) | (0.0854) | (0.0726) | (0.0725) | (0.0726) | (0.0726) |
| Observations | 25,079 | 25,079 | 25,079 | 25,079 | 25,079 | 25,079 | 25,079 | 25,079 |
| Number of gvkey | | | | | 5,428 | 5,428 | 5,428 | 5,428 |

Table 6: Testing Hypothesis 2b

This table shows estimation results of Equation (6) using GLM with a logit link function and Equation (7) using panel GLM, where the ratio of cash over total assets ($Cash$) is the dependent variable. All the RHS variables are in information set and are used in the lagged form. Columns (1) to (4) show the estimation results using the GLM and Columns (5) to (8) show the estimation results using panel GLM. The variables of interest are the investment spikes measured using several investment definitions including the sum of capital expenditures and acquisitions ($Capx + Acq$), capital expenditures ($Capx$), acquisitions ($Acq$) and research and development expenditures ($R\&D$). Section 3.2 defines the variables. Clustered standard errors by states are shown in parentheses with 1%, 5% and 10% significance level denoted by ***, ** and *, respectively.

| VARIABLES | $Cash$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | GLM | | | | Panel GLM | | | |
| $InvSpike_t$ | -0.402*** | | | | -0.351*** | | | |
| | (0.0222) | | | | (0.0175) | | | |
| $CapxSpike_t$ | | -0.148*** | | | | -0.151*** | | |
| | | (0.0247) | | | | (0.0201) | | |
| $AqcSpike_t$ | | | -0.341*** | | | | -0.300*** | |
| | | | (0.0192) | | | | (0.0150) | |
| $XrdSpike_t$ | | | | -0.0105 | | | | -0.0407* |
| | | | | (0.0272) | | | | (0.0221) |
| $CFV_{t-6,t-1}$ | 0.479*** | 0.481*** | 0.475*** | 0.477*** | 0.380*** | 0.380*** | 0.379*** | 0.377*** |
| | (0.0166) | (0.0169) | (0.0166) | (0.0169) | (0.0139) | (0.0141) | (0.0140) | (0.0141) |
| $Acq_{t-1}$ | -0.0791*** | -0.0735*** | -0.0808*** | -0.0751*** | -0.0667*** | -0.0570*** | -0.0686*** | -0.0585*** |
| | (0.00469) | (0.00470) | (0.00474) | (0.00469) | (0.00354) | (0.00344) | (0.00359) | (0.00346) |
| $Capx_{t-1}$ | -0.0172 | -0.0184 | -0.0162 | -0.0162 | -0.0348*** | -0.0372*** | -0.0327** | -0.0319** |
| | (0.0161) | (0.0163) | (0.0162) | (0.0162) | (0.0129) | (0.0130) | (0.0128) | (0.0129) |
| $RnD_{t-1}$ | 1.186*** | 1.217*** | 1.189*** | 1.220*** | 1.012*** | 1.029*** | 1.014*** | 1.032*** |
| | (0.133) | (0.135) | (0.133) | (0.136) | (0.111) | (0.112) | (0.111) | (0.112) |
| $Tangibility_{t-1}$ | -2.682*** | -2.570*** | -2.672*** | -2.556*** | -2.621*** | -2.523*** | -2.598*** | -2.495*** |
| | (0.0883) | (0.0876) | (0.0880) | (0.0880) | (0.0816) | (0.0808) | (0.0812) | (0.0806) |
| $FirmSize_{t-1}$ | 0.0455*** | 0.0437*** | 0.0478*** | 0.0457*** | 0.0186** | 0.0191** | 0.0212** | 0.0209** |
| | (0.00893) | (0.00899) | (0.00895) | (0.00903) | (0.00822) | (0.00819) | (0.00825) | (0.00821) |
| $FirmAge_{t-1}$ | -0.000568 | -0.000229 | -0.000802 | -0.000210 | -0.000607 | -0.000392 | -0.000848 | -0.000269 |
| | (0.00164) | (0.00166) | (0.00165) | (0.00167) | (0.00158) | (0.00159) | (0.00159) | (0.00160) |
| $Profitability_{t-1}$ | 0.476*** | 0.423*** | 0.472*** | 0.406*** | 0.435*** | 0.380*** | 0.429*** | 0.354*** |
| | (0.105) | (0.105) | (0.104) | (0.105) | (0.0926) | (0.0923) | (0.0925) | (0.0923) |
| $MarketToBook_{t-1}$ | 0.0433*** | 0.0386*** | 0.0391*** | 0.0339*** | 0.0359*** | 0.0318*** | 0.0315*** | 0.0274*** |
| | (0.00852) | (0.00857) | (0.00848) | (0.00855) | (0.00781) | (0.00779) | (0.00785) | (0.00772) |

| VARIABLES | *Cash* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | GLM | | | | Panel GLM | | | |
| $IndustLev_{t-1}$ | -1.224*** | -1.213*** | -1.233*** | -1.219*** | -0.984*** | -0.963*** | -0.992*** | -0.966*** |
| | (0.0943) | (0.0949) | (0.0945) | (0.0950) | (0.0738) | (0.0739) | (0.0740) | (0.0740) |
| $Inflation_{t-1}$ | -2.217*** | -2.162*** | -2.135*** | -2.159*** | -2.184*** | -2.066*** | -2.218*** | -2.099*** |
| | (0.713) | (0.715) | (0.713) | (0.717) | (0.574) | (0.576) | (0.578) | (0.577) |
| $NWC_{t-1}$ | -0.193*** | -0.192*** | -0.194*** | -0.193*** | -0.144*** | -0.144*** | -0.146*** | -0.145*** |
| | (0.0162) | (0.0163) | (0.0162) | (0.0162) | (0.0125) | (0.0126) | (0.0125) | (0.0126) |
| $DPfirms_{t-1}$ | -0.103*** | -0.100*** | -0.0984*** | -0.0978*** | -0.105*** | -0.107*** | -0.105*** | -0.109*** |
| | (0.0308) | (0.0310) | (0.0309) | (0.0310) | (0.0252) | (0.0252) | (0.0252) | (0.0253) |
| $CreditRating_{t-1}$ | -0.286*** | -0.282*** | -0.288*** | -0.278*** | -0.233*** | -0.236*** | -0.237*** | -0.232*** |
| | (0.0436) | (0.0438) | (0.0437) | (0.0438) | (0.0423) | (0.0427) | (0.0427) | (0.0426) |
| Constant | -2.275*** | -2.315*** | -2.272*** | -2.328*** | -2.017*** | -2.043*** | -2.015*** | -2.049*** |
| | (0.0905) | (0.0912) | (0.0907) | (0.0918) | (0.0788) | (0.0790) | (0.0790) | (0.0794) |
| Observations | 24,556 | 24,556 | 24,556 | 24,556 | 24,556 | 24,556 | 24,556 | 24,556 |
| Number of gvkey | | | | | 5,353 | 5,353 | 5,353 | 5,353 |

Table 7: Testing Hypothesis 3a

This table shows estimation results of Equation (6) using GLM with a logit link function and Equation (7) using panel GLM, where the short and long-term book debt ratio ($BDR$) is the dependent variable. All the RHS variables are in information set and are used in the lagged form. Columns (1) to (4) show the estimation results using the GLM and Columns (5) to (8) show the estimation results using panel GLM. The variables of interest are the lag and leads of investment spikes measured using several investment definitions including the sum of capital expenditures and acquisitions ($Capx + Acq$), capital expenditures ($Capx$), acquisitions ($Acq$) and research and development expenditures ($R\&D$). Section 3.2 defines the variables. Clustered standard errors by states are shown in parentheses with 1%, 5% and 10% significance level denoted by ***, ** and *, respectively.

| VARIABLES | $BDR$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | GLM | | | | Panel GLM | | | |
| $InvSpike_{t-1}$ | 0.165*** | | | | 0.142*** | | | |
| | (0.0182) | | | | (0.0137) | | | |
| $InvSpike_{t}$ | 0.425*** | | | | 0.326*** | | | |
| | (0.0207) | | | | (0.0156) | | | |
| $InvSpike_{t+1}$ | -0.161*** | | | | -0.211*** | | | |
| | (0.0205) | | | | (0.0161) | | | |
| $CapxSpike_{t-1}$ | | 0.162*** | | | | 0.106*** | | |
| | | (0.0235) | | | | (0.0183) | | |
| $CapxSpike_{t}$ | | 0.104*** | | | | 0.0655*** | | |
| | | (0.0223) | | | | (0.0182) | | |
| $CapxSpike_{t+1}$ | | -0.143*** | | | | -0.138*** | | |
| | | (0.0246) | | | | (0.0191) | | |
| $AcqSpike_{t-1}$ | | | -0.0349* | | | | -0.000863 | |
| | | | (0.0186) | | | | (0.0131) | |
| $AqcSpike_{t}$ | | | 0.291*** | | | | 0.224*** | |
| | | | (0.0183) | | | | (0.0138) | |
| $AcqSpike_{t+1}$ | | | -0.175*** | | | | -0.199*** | |
| | | | (0.0170) | | | | (0.0128) | |
| $XrdSpike_{t-1}$ | | | | 0.0322 | | | | 0.0315 |
| | | | | (0.0287) | | | | (0.0204) |
| $XrdSpike_{t}$ | | | | 0.0273 | | | | 0.0189 |
| | | | | (0.0268) | | | | (0.0208) |
| $XrdSpike_{t+1}$ | | | | -0.105*** | | | | -0.100*** |
| | | | | (0.0260) | | | | (0.0209) |
| $CFV_{t-6,t-1}$ | -0.207*** | -0.195*** | -0.196*** | -0.191*** | -0.137*** | -0.126*** | -0.129*** | -0.123*** |
| | (0.0153) | (0.0155) | (0.0153) | (0.0153) | (0.0116) | (0.0118) | (0.0116) | (0.0116) |

| VARIABLES | | | | $BDR$ | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | GLM | | | | Panel GLM | | | |
| $Acq_{t-1}$ | 0.0532*** | 0.0677*** | 0.0833*** | 0.0694*** | 0.0341*** | 0.0449*** | 0.0549*** | 0.0457*** |
| | (0.00567) | (0.00479) | (0.00641) | (0.00483) | (0.00394) | (0.00328) | (0.00438) | (0.00328) |
| $Capx_{t-1}$ | -0.0299* | -0.0530*** | -0.0236 | -0.0205 | -0.0111 | -0.0265** | -0.00442 | -0.00209 |
| | (0.0156) | (0.0173) | (0.0157) | (0.0157) | (0.0116) | (0.0128) | (0.0116) | (0.0116) |
| $RnD_{t-1}$ | -1.121*** | -1.171*** | -1.136*** | -1.201*** | -0.790*** | -0.816*** | -0.812*** | -0.842*** |
| | (0.304) | (0.309) | (0.305) | (0.327) | (0.228) | (0.230) | (0.230) | (0.240) |
| $Tangibility_{t-1}$ | 1.278*** | 1.200*** | 1.279*** | 1.211*** | 1.148*** | 1.092*** | 1.134*** | 1.096*** |
| | (0.0657) | (0.0652) | (0.0661) | (0.0657) | (0.0628) | (0.0628) | (0.0630) | (0.0632) |
| $FirmSize_{t-1}$ | 0.0641*** | 0.0653*** | 0.0615*** | 0.0626*** | 0.0673*** | 0.0667*** | 0.0660*** | 0.0656*** |
| | (0.00854) | (0.00857) | (0.00857) | (0.00861) | (0.00770) | (0.00771) | (0.00769) | (0.00774) |
| $FirmAge_{t-1}$ | -0.00616*** | -0.00650*** | -0.00572*** | -0.00590*** | -0.00348** | -0.00343** | -0.00294** | -0.00276* |
| | (0.00157) | (0.00157) | (0.00158) | (0.00159) | (0.00150) | (0.00150) | (0.00150) | (0.00153) |
| $Profitability_{t-1}$ | -1.477*** | -1.411*** | -1.491*** | -1.443*** | -1.167*** | -1.113*** | -1.163*** | -1.125*** |
| | (0.120) | (0.120) | (0.120) | (0.120) | (0.103) | (0.102) | (0.103) | (0.103) |
| $MarketToBook_{t-1}$ | -0.0728*** | -0.0649*** | -0.0669*** | -0.0619*** | -0.0575*** | -0.0475*** | -0.0503*** | -0.0444*** |
| | (0.0146) | (0.0145) | (0.0146) | (0.0145) | (0.0112) | (0.0110) | (0.0111) | (0.0109) |
| $IndustLev_{t-1}$ | 1.635*** | 1.621*** | 1.644*** | 1.620*** | 1.350*** | 1.333*** | 1.351*** | 1.325*** |
| | (0.0855) | (0.0855) | (0.0857) | (0.0854) | (0.0640) | (0.0641) | (0.0640) | (0.0642) |
| $Inflation_{t-1}$ | 1.180** | 1.346** | 1.479*** | 1.233** | 0.102 | 0.292 | 0.349 | 0.254 |
| | (0.531) | (0.533) | (0.541) | (0.535) | (0.439) | (0.440) | (0.443) | (0.442) |
| $CreditRating_{t-1}$ | 0.148*** | 0.144*** | 0.145*** | 0.140*** | 0.194*** | 0.194*** | 0.192*** | 0.191*** |
| | (0.0371) | (0.0373) | (0.0373) | (0.0373) | (0.0295) | (0.0298) | (0.0296) | (0.0298) |
| Constant | -1.385*** | -1.355*** | -1.243*** | -1.252*** | -1.399*** | -1.378*** | -1.301*** | -1.312*** |
| | (0.0883) | (0.0889) | (0.0883) | (0.0863) | (0.0737) | (0.0744) | (0.0737) | (0.0729) |
| Observations | 24,642 | 24,642 | 24,642 | 24,642 | 24,642 | 24,642 | 24,642 | 24,642 |
| Number of gvkey | | | | | 5,312 | 5,312 | 5,312 | 5,312 |

Table 8: Testing Hypothesis 3b

This table shows estimation results of Equation (6) using GLM with a logit link function and Equation (7) using panel GLM, where the cash to total assets ($Cash$) is the dependent variable. All the RHS variables are in information set and are used in the lagged form. Columns (1) to (4) show the estimation results using the GLM and Columns (5) to (8) show the estimation results using panel GLM. The variables of interest are the lag and leads of investment spikes measured using several investment definitions including the sum of capital expenditures and acquisitions ($Capx + Acq$), capital expenditures ($Capx$), acquisitions ($Acq$) and research and development expenditures ($R\&D$). Section 3.2 defines the variables. Clustered standard errors by states are shown in parentheses with 1%, 5% and 10% significance level denoted by ***, ** and *, respectively.

| VARIABLES | | | | $Cash$ | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | GLM | | | | Panel GLM | | | |
| $InvSpike_{t-1}$ | -0.0916*** | | | | -0.103*** | | | |
| | (0.0207) | | | | (0.0161) | | | |
| $InvSpike_{t}$ | -0.398*** | | | | -0.326*** | | | |
| | (0.0234) | | | | (0.0185) | | | |
| $InvSpike_{t+1}$ | 0.215*** | | | | 0.242*** | | | |
| | (0.0210) | | | | (0.0164) | | | |
| $CapxSpike_{t-1}$ | | -0.0772*** | | | | -0.0717*** | | |
| | | (0.0264) | | | | (0.0207) | | |
| $CapxSpike_{t}$ | | -0.156*** | | | | -0.151*** | | |
| | | (0.0245) | | | | (0.0206) | | |
| $CapxSpike_{t+1}$ | | 0.164*** | | | | 0.139*** | | |
| | | (0.0252) | | | | (0.0211) | | |
| $AcqSpike_{t-1}$ | | | 0.0585*** | | | | 0.0121 | |
| | | | (0.0211) | | | | (0.0154) | |
| $AqcSpike_{t}$ | | | -0.325*** | | | | -0.263*** | |
| | | | (0.0201) | | | | (0.0158) | |
| $AcqSpike_{t+1}$ | | | 0.195*** | | | | 0.217*** | |
| | | | (0.0184) | | | | (0.0147) | |
| $XrdSpike_{t-1}$ | | | | 0.0336 | | | | 0.00730 |
| | | | | (0.0255) | | | | (0.0211) |
| $XrdSpike_{t}$ | | | | -0.0644*** | | | | -0.0658*** |
| | | | | (0.0244) | | | | (0.0209) |
| $XrdSpike_{t+1}$ | | | | 0.170*** | | | | 0.163*** |
| | | | | (0.0248) | | | | (0.0220) |
| $CFV_{t-6,t-1}$ | 0.491*** | 0.487*** | 0.486*** | 0.483*** | 0.385*** | 0.384*** | 0.383*** | 0.380*** |
| | (0.0168) | (0.0170) | (0.0168) | (0.0170) | (0.0140) | (0.0142) | (0.0141) | (0.0142) |

| VARIABLES | *Cash* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | GLM | | | | Panel GLM | | | |
| $Acq_{t-1}$ | -0.0692*** | -0.0736*** | -0.0932*** | -0.0761*** | -0.0512*** | -0.0565*** | -0.0696*** | -0.0583*** |
| | (0.00568) | (0.00472) | (0.00633) | (0.00471) | (0.00410) | (0.00344) | (0.00452) | (0.00346) |
| $Capx_{t-1}$ | -0.00873 | 0.000263 | -0.0112 | -0.0162 | -0.0230* | -0.0162 | -0.0279** | -0.0313** |
| | (0.0168) | (0.0190) | (0.0166) | (0.0169) | (0.0132) | (0.0149) | (0.0130) | (0.0133) |
| $RnD_{t-1}$ | 1.248*** | 1.263*** | 1.238*** | 1.218*** | 1.071*** | 1.076*** | 1.068*** | 1.057*** |
| | (0.141) | (0.141) | (0.139) | (0.141) | (0.110) | (0.109) | (0.109) | (0.109) |
| $Tangibility_{t-1}$ | -2.615*** | -2.552*** | -2.644*** | -2.534*** | -2.534*** | -2.499*** | -2.544*** | -2.468*** |
| | (0.0894) | (0.0887) | (0.0891) | (0.0896) | (0.0816) | (0.0814) | (0.0814) | (0.0817) |
| $FirmSize_{t-1}$ | 0.0438*** | 0.0431*** | 0.0461*** | 0.0467*** | 0.0190** | 0.0199** | 0.0202** | 0.0240*** |
| | (0.00902) | (0.00907) | (0.00901) | (0.00915) | (0.00825) | (0.00825) | (0.00827) | (0.00832) |
| $FirmAge_{t-1}$ | -0.000319 | -3.92e-05 | -0.000671 | -0.000852 | 0.000127 | 0.000146 | -0.000216 | -0.000802 |
| | (0.00166) | (0.00167) | (0.00166) | (0.00168) | (0.00160) | (0.00161) | (0.00160) | (0.00162) |
| $Profitability_{t-1}$ | 0.411*** | 0.382*** | 0.416*** | 0.372*** | 0.377*** | 0.358*** | 0.373*** | 0.335*** |
| | (0.106) | (0.106) | (0.105) | (0.105) | (0.0905) | (0.0900) | (0.0908) | (0.0897) |
| $MarketToBook_{t-1}$ | 0.0395*** | 0.0356*** | 0.0346*** | 0.0309*** | 0.0316*** | 0.0289*** | 0.0266*** | 0.0231*** |
| | (0.00874) | (0.00874) | (0.00866) | (0.00866) | (0.00798) | (0.00793) | (0.00799) | (0.00780) |
| $IndustLev_{t-1}$ | -1.204*** | -1.194*** | -1.209*** | -1.172*** | -0.962*** | -0.947*** | -0.962*** | -0.929*** |
| | (0.0954) | (0.0957) | (0.0955) | (0.0955) | (0.0738) | (0.0741) | (0.0742) | (0.0742) |
| $Inflation_{t-1}$ | -2.025*** | -2.092*** | -2.411*** | -2.179*** | -1.877*** | -1.966*** | -2.171*** | -2.027*** |
| | (0.721) | (0.723) | (0.728) | (0.722) | (0.577) | (0.581) | (0.581) | (0.579) |
| $NWC_{t-1}$ | -0.196*** | -0.197*** | -0.197*** | -0.197*** | -0.145*** | -0.148*** | -0.147*** | -0.148*** |
| | (0.0165) | (0.0165) | (0.0165) | (0.0166) | (0.0127) | (0.0129) | (0.0128) | (0.0129) |
| $DPfirms_{t-1}$ | -0.0998*** | -0.102*** | -0.100*** | -0.0979*** | -0.105*** | -0.112*** | -0.109*** | -0.111*** |
| | (0.0311) | (0.0313) | (0.0310) | (0.0312) | (0.0253) | (0.0253) | (0.0254) | (0.0253) |
| $CreditRating_{t-1}$ | -0.278*** | -0.274*** | -0.276*** | -0.276*** | -0.231*** | -0.233*** | -0.230*** | -0.233*** |
| | (0.0439) | (0.0441) | (0.0439) | (0.0440) | (0.0427) | (0.0431) | (0.0430) | (0.0431) |
| Constant | -2.265*** | -2.286*** | -2.355*** | -2.357*** | -1.992*** | -2.015*** | -2.069*** | -2.082*** |
| | (0.0932) | (0.0951) | (0.0931) | (0.0936) | (0.0800) | (0.0812) | (0.0804) | (0.0803) |
| Observations | 24,136 | 24,136 | 24,136 | 24,136 | 24,136 | 24,136 | 24,136 | 24,136 |
| Number of gvkey | | | | | 5,240 | 5,240 | 5,240 | 5,240 |

Table 9: Economic importance

This table reports the predicted percentage change in $BDR$ and $Cash$ of all three hypotheses of this study using GLM and panel GLM. For Hypotheses 1a and 1b the predicted percentage changes are the result of one standard deviation increase from the mean of the investment volatility variables, for Hypotheses 2a, 2b, 3a and 3b the predicted percentage changes are the result of the change in the dummy spike variables from zero to one, where other control variables are evaluated at their means.

| | $\Delta BDR\%$ | | | | $\Delta Cash\%$ | | | |
|---|---|---|---|---|---|---|---|---|
| | $Inv$ | $Capx$ | $Acq$ | $Xrd$ | $Inv$ | $Capx$ | $Acq$ | $Xrd$ |
| | Hypothesis 1a $Vol_{t-6,t-1}$ | | | | Hypothesis 1b $Vol_{t-6,t-1}$ | | | |
| GLM | 17.17% | 5.30% | 14.24% | -5.15% | -12.06% | 1.74% | -12.36% | 10.40% |
| Panel | 12.16% | 3.01% | 10.15% | -4.96% | -9.25% | 0.00% | -9.71% | 8.59% |
| | Hypothesis 2a $Spike_t$ | | | | Hypothesis 2b $Spike_t$ | | | |
| GLM | 30.39% | 6.65% | 21.17% | 0.63% | -30.59% | -12.58% | -26.76% | -0.92% |
| Panel | 23.36% | 3.95% | 17.39% | 0.91% | -27.45% | -12.79% | -23.58% | -3.59% |
| | Hypothesis 3a $Spike_{t+1}$ | | | | Hypothesis 3b $Spike_{t+1}$ | | | |
| GLM | -10.76% | -9.52% | -11.32% | -7.01% | 21.15% | 15.75% | 19.66% | 16.67% |
| Panel | -13.72% | -8.92% | -12.99% | -6.46% | 23.62% | 12.75% | 21.70% | 15.84% |

Table 10: Robustness

This table summarizes the robustness testing of Section 5 using alternative measure of the debt ratio, the cash ratio and the spike measure. Panel A tests Hypothesis 1a using the short and long-term market debt ratio and reports the coefficients associated with our investment volatility using both GLM and Panel GLM. Panel B tests Hypotheses 1b, 2b and 3b and reports the coefficients associated with these hypotheses investment volatility and linear firm-fixed effect model. Panel D tests Hypotheses 2a and 2b using two consecutive spike variables that represent firms with two consecutive spikes (large investments).

Panel A: Hypothesis 1a Robustness using market debt ratio

| | | $InvVol_{t-6,t-1}$ | $CapxVol_{t-6,t-1}$ | $AcqVol_{t-6,t-1}$ | $XrdVol_{t-6,t-1}$ |
|---|---|---|---|---|---|
| MDR | GLM | 0.194*** | 0.0942*** | 0.1000*** | -0.0362** |
| | Panel GLM | 0.151*** | 0.0532*** | 0.0787*** | -0.0504*** |

Panel B: Hypotheses 1b, 2b and 3b Robustness using cash over net assets and firm-fixed effect model

| | | | | | |
|---|---|---|---|---|---|
| $Cash\_na$ | Hypothesis1b | $InvVol_{t-6,t-1}$ | $CapxVol_{t-6,t-1}$ | $AcqVol_{t-6,t-1}$ | $XrdVol_{t-6,t-1}$ |
| | | -0.0174*** | 0.00426 | -0.0127*** | -0.00248 |
| $Cash\_na$ | Hypothesis2b | $InvSpike_t$ | $CapxSpike_t$ | $AcqSpike_t$ | $XrdSpike_t$ |
| | | -0.0723*** | -0.0465*** | -0.0585*** | -0.0265*** |
| $Cash\_na$ | Hypothesis3b | $InvSpike_{t+1}$ | $CapxSpike_{t+1}$ | $AcqSpike_{t+1}$ | $XrdSpike_{t+1}$ |
| | | 0.0718*** | 0.0328*** | 0.0598*** | 0.0617*** |

Panel C: Hypotheses 2a and 2b Robustness using two consecutive spikes variable

| | | $ConsInvSpike$ | $ConsCapxSpike$ | $ConsAcqSpike$ | $ConsXrdSpike$ |
|---|---|---|---|---|---|
| $BDR$ | GLM | 0.512*** | 0.183*** | 0.323*** | 0.00642 |
| | Panel GLM | 0.379*** | 0.0942** | 0.250*** | 0.0102 |
| $Cash$ | GLM | -0.384*** | -0.181*** | -0.296*** | -0.0200 |
| | Panel GLM | -0.285*** | -0.150*** | -0.233*** | -0.0339 |

Table 11: Robustness

This table summarizes results with one observation per firm. For each firm, variables are averaged over the entire sample period so that there is one observation for each firm. Mona – note the specifications that are tested.

| Investment Volatility Variables | $BDR$ | $Cash$ |
|---|---|---|
| $InvVol$ | 0.227*** | -0.0683*** |
| | (0.0172) | (0.0160) |
| $CapxVol$ | 0.144*** | 0.0276 |
| | (0.0235) | (0.0233) |
| $AqcVol$ | 0.101*** | -0.0278** |
| | (0.0147) | (0.0127) |
| $XrdVol$ | -0.0514*** | 0.0491*** |
| | (0.0157) | (0.0137) |

Table 12: Correlations

This table shows the pairwise correlation coefficients between 5 years lag and 5 years lead of investment volatility. Appendix 7 defines the variables. Reference numbers in columns and rows refer to the variables associated with the pairwise correlation coefficients.

| Correlations | | | |
|---|---|---|---|
| Variables | (1) | (2) | (3) |
| (1) $InvVol_{t-10,t-6}$ | 1 | | |
| (2) $InvVol_{t-5,t}$ | 0.34 | 1 | |
| (3) $InvVol_{t,t+4}$ | 0.26 | 0.35 | 1 |

Table 13: Testing Hypothesis 1a and 1b using future investment volatility

This table shows estimation results of Equations (6) using GLM with a logit link function and Equation (7) using panel GLM, where the short and long-term book debt ratio ($BDR$) and the ratio of cash over total assets ($Cash$) are the dependent variables. Columns (1) to (4) show the estimation results using the GLM and Columns (5) to (8) show the estimation results using panel GLM. The variables of interest are the investment volatility measured using several investment definitions including the sum of capital expenditures and acquisitions ($Capx + Acq$), capital expenditures ($Capx$), acquisitions ($Acq$) and research and development expenditures ($R\&D$). Section 3.2 defines the variables. Clustered standard errors by firms are shown in parentheses with 1%, 5% and 10% significance level denoted by ***, ** and *, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | GLM | | | | Panel GLM | | | |
| | $BDR$ | | | | | | | |
| $InvVol_{t,t+4}$ | -0.0145 | | | | -0.0438*** | | | |
| | (0.0120) | | | | (0.00947) | | | |
| $InvCapx_{t,t+4}$ | | -0.0195 | | | | -0.0217 | | |
| | | (0.0170) | | | | (0.0133) | | |
| $InvAqc_{t,t+4}$ | | | -0.0118 | | | | -0.0290*** | |
| | | | (0.00938) | | | | (0.00694) | |
| $InvXrd_{t,t+4}$ | | | | -0.0478*** | | | | -0.0645*** |
| | | | | (0.0173) | | | | (0.0130) |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | GLM | | | | Panel GLM | | | |
| | $Cash$ | | | | | | | |
| $InvVol_{t,t+4}$ | -0.00144 | | | | 0.0169 | | | |
| | (0.0131) | | | | (0.0104) | | | |
| $InvCapx_{t,t+4}$ | | 0.0557*** | | | | 0.0309* | | |
| | | (0.0206) | | | | (0.0163) | | |
| $InvAqc_{t,t+4}$ | | | -0.00564 | | | | 0.00737 | |
| | | | (0.0104) | | | | (0.00825) | |
| $InvXrd_{t,t+4}$ | | | | 0.0621*** | | | | 0.0454*** |
| | | | | (0.0185) | | | | (0.0151) |