

The financing of uncertain future investments

Mona Yaghoubi¹

University of Canterbury

Department of Economics and Finance

Private Bag 4800, Christchurch 8140, NZ

Email: mona.yaghoubi@canterbury.ac.nz

Phone: 64 3 369 0311

Michael O'Connor Keefe

Victoria University of Wellington

School of Economics and Finance

PO Box 600, Wellington 6140, NZ

Email: michael.keefe@vuw.ac.nz

Phone: 64 4 463 5708

Current Draft: 17th December, 2021

¹The corresponding author is Mona Yaghoubi. Contact details for Mona are noted above. We thank participants at the Victoria University of Wellington Brown Bag seminar, Massey University seminar series, University of Canterbury seminar series, the 2016 European Financial Management Association Conference, the 2017 Financial Markets and Corporate Governance Conference, and the 2018 New Zealand Finance Colloquium. All remaining errors are our own.

The financing of uncertain future investments

Abstract

Purpose - This study investigates the effects of two important financing sources, debt and cash, on a firm's investment decisions and explores the intertemporal impact of this financing on future investment volatility.

Design/methodology/approach - We first report our results using ordinary least squares (OLS) estimation and then employ an instrumental variable (IV) strategy which addresses potential endogeneity that arises from future investment volatility on current capital structure and cash levels.

Findings - We find i) firms with low levels of debt or high levels of cash experience higher future investment volatility, and ii) the probability of large future investment increases with high cash levels. Our findings are economically important; for example, a one-standard-deviation increase from the mean of debt ratio implies an approximate 7.8% decrease in future investment volatility; and a one-standard-deviation increase from the mean of a firm's cash level leads to a 47% increase in the probability of a large investment in the next year.

Originality/value - The findings of this study help firms understand the impact of their present financing decisions on the plausibility of their future investments. This paper contributes to the literature by making both novel and confirmatory findings. We structure our paper to include confirmatory findings for two reasons. First, we use different methods to construct investment volatility and the related investment spike. Second, and more importantly, the hypotheses are interrelated and communicate how firms plan for and execute against uncertain future investments. Growth options are ephemeral, and the hypotheses structure provides a guideline for how a firm finances future growth options.

Keywords: Capital Structure, Cash Holding, Investment Volatility, and Investment Shock or Spike.

JEL Classification Codes: G31—Capital Budgeting, G32—Financing Policy.

1 Introduction

In corporate finance studies, a firm's ultimate goal is to maximize its shareholders' wealth, and managers as shareholders' agents fulfill this goal by investing in value-creating investment opportunities. The process starts with identifying, selecting and investing in future growth opportunities, which is possible when firms have accessible financing sources. Suppose a firm has limited funds, i.e. high debt level and small cash position; such a firm even in the case of high net present value (NPV) projects, will not be able to finance these opportunities and has to forgo the projects. Therefore, financing sources like debt and cash can affect the volatility of future investments.

The existing literature on investment and financing emphasizes agency issues (Myers and Majluf, 1984, Jensen, 1986). The agency issue indicates that managers tend to over-invest or under-invest in future growth opportunities in the presence of risky debt. A conflict of interests between managers and shareholders can lead to non-optimal resource allocation that does not necessarily maximize shareholders' value. Several other studies have examined the relationship between large investments (investment spikes) and debt level (Denis and McKeon, 2012, Dudley, 2012, Elsas, Flannery and Garfinkel, 2014), the relationship between debt priority structure and growth opportunities (Hackbarth and C. Mauer, 2012), and the relationship between acquisition valuation and capital structure considerations (Ang, Daher and Ismail, 2019). However, to our knowledge, there are no studies on the impact of financing sources on future investment volatility. In this study, we emphasize two significant financing factors and explore the intertemporal effect of firms' debt levels and cash holdings on their future investment volatility. The findings of this study will help firms understand the impact of their present financing decisions on the plausibility of their future investments.

To calculate firm-level investment volatility, we define investment as capital expenditures plus acquisitions costs. To measure investment volatility, we construct investment volatility using the difference between predicted and actual annual investment growth. Because we test the effect of debt levels and cash holdings on future investment volatility, our investment volatility variable is the five-year lead of the investment volatility measure. In robustness tests, we use an alternative method to construct investment volatility and estimate the rolling five-year standard deviation of scaled

investment. In addition, we use a three- and four-year lead of the investment volatility measure to test the relationship between current debt and cash policy and future investment volatility.

Closely related to investment volatility are investment spikes (large investments). Intuitively, firms with high investment volatility exhibit investment that diverges markedly from predicted investment. An investment spike occurs when actual investment growth is greater than predicted investment growth and when annual investment volatility is in the top tercile. Because our investment spike variable is estimated from realizations used to estimate conditional volatility, our investment spike is closely related to investment volatility.

We follow the literature and control for the size, working capital, turnover and retained earnings of a firm (Alstadsæter, Jacob and Michaely, 2017). Besides, to control for time-invariant firm heterogeneity, we use firm fixed effects, and to control for the effects of macroeconomic shocks on investment and investment volatility, we employ year dummies in our regressions. We first report our results using ordinary least squares (OLS) estimation, and then we follow Ambrosius and Cuecuecha (2016) and Bennett, Faria, Gwartney and Morales (2017) and employ an instrumental variable (IV) strategy and check for endogeneity concerns. The potential endogeneity arises from the effect of the future volatility of investment shocks on current capital structure and cash levels. For instance, if a manager is expecting high volatility in investment shocks, she or he may wish to maintain a low level of debt today to cover up potential future losses or take advantage of future opportunities by adjusting investments accordingly.

We first test the relationship between a firm's future investment volatility and current debt levels. Our evidence indicates that firms that hold low levels of debt experience higher future investment volatility. Then, we examine the relationship between a firm's future investment volatility and current cash levels. We show firms that hold high levels of cash experience higher future investment volatility. We find that a one-standard-deviation increase from the mean of our debt (cash) ratio leads to a 7.8% decrease (8.3% increase) in our investment volatility variable. To our knowledge, we are the first to empirically test the relationship between financing (both debt and cash holdings) and investment volatility as measured using capital expenditures plus acquisitions. Finally, we explore the effect of cash levels on future large investments, and find that holding high

cash levels may lead to large future investments. Our evidence suggests that one standard deviation increase in a firm's cash level leads to a 47% increase in the probability of large investments in the next year.

In addition to these three original hypotheses, we perform two confirmatory tests. First, we re-examine the findings of DeAngelo, DeAngelo and Whited (2011) and Elsas et al. (2014) and, consistent with the literature, we find a negative and statistically significant relationship between future investment spike and firm's debt levels. Second, we re-examine the findings of DeAngelo et al. (2011), Denis and McKeon (2012) and Elsas et al. (2014) and investigate the relationship between investment spikes and a firm's current debt and cash levels. In line with the literature, our findings show a negative relationship between investment spikes and current cash levels and a positive and statistically significant relationship between investment spikes and debt levels.

Overall, our paper contributes to the literature by making both novel and confirmatory findings. We structure our paper to include confirmatory findings for two reasons. First, we use different methods to construct investment volatility and the related investment spike. Second, and more importantly, the hypotheses are inter-related and communicate how firms plan for and execute against uncertain future investments. Growth options are ephemeral, and the hypotheses structure provides a guideline for how a firm finances future growth options.

This paper proceeds as follows: Section 2 reviews the literature and develops the hypotheses of our 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 Hypotheses Development

In this section, we develop three testable hypotheses and discuss three confirmatory hypotheses based on the existing literature's theories and empirical findings related to corporate investments and uncertainty. Our hypotheses posit the financing of uncertain future investments and the effect of current debt and cash levels on the volatility of uncertain future investments.

Real options theory suggests that with an increase in uncertainty, the option value of waiting increases, resulting in delays in corporate investments (Pindyck, 1990, Dixit and Pindyck, 2012). In other words, firms invest in a project if the expected NPV of an investment is greater than the option value of waiting, where the expected NPV of an investment is negatively related to the opportunity cost of capital. That is, the availability of required funds for investment could affect the expected value of an investment.

Besides, agency theory advances that in the presence of risky debt, managers tend to under-invest or over-invest in future growth opportunities (Jensen and Meckling, 1976, Myers, 1977), and in the presence of agency cost of debt, the direct relationship between leverage and growth opportunities is negative (Billett, King and Mauer, 2007).²

The existing empirical literature is well-established on the negative relationship between the different measures of uncertainty and investment. For example Julio and Yook (2012), An, Chen, Luo and Zhang (2016), Gulen and Ion (2016) document the negative effect of political uncertainty on corporate investment; Yoon and Ratti (2011), Maghyereh and Abdoh (2020) investigate the relationship between oil price uncertainty and corporate investments; and Byrne and Davis (2004) show the negative effect of inflation uncertainty on corporate investment. Similarly, the effect of financial constraints on large investments has been studied (Whited, 2006). However, to our knowledge, the relationship between current debt and cash levels on the volatility of uncertain future investments is unexplored.

In a seminal study, 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 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 affect the need to fund uncertain future investments. Using simulated method of moments (SMM), DeAngelo et al. (2011) show their model predicts a negative relationship between future investment shocks and debt levels and a positive relationship between future investment shocks and cash levels.

²Growth comes from investment in NPV positive projects.

Their model advances that a firm with uncertain future investment maintains financing capacity by keeping its debt ratio low and its cash level high. Although we cannot observe the marginal productivity shocks in the DeAngelo et al. (2011) model, we can observe firm-level investment volatility. Following DeAngelo et al. (2011) and to the extent that investment volatility is a proxy for marginal productivity shocks, we conjecture that firms with high future investment volatility maintain lower debt ratios than would be optimal under a static trade-off model³ and higher cash levels,⁴ which implies the following:

Hypothesis 1. *There is a negative relationship between a firm's current level of debt and future investment volatility, ceteris paribus.*

Hypothesis 2. *There is a positive relationship between a firm's current level of cash and future investment volatility, ceteris 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 the following:

Hypothesis 3. *There is a positive relationship between a firm's large investment (investment spike) and the previous year's level of cash, ceteris paribus.*

In addition to these hypotheses, we perform some confirmatory testing on three related findings in the existing literature. We use different methods to construct investment volatility and the related investment spike.

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 are associated with investment

³Static trade-off theory states that the tax benefit of debt encourages firms to use more debt in their capital structure where the cost of bankruptcy trade-offs the tax benefit of debt.

⁴Opler, Pinkowitz, Stulz and Williamson (1999) state that firms set cash levels so that the marginal benefits of holding cash equal the marginal cost. Examples of the drawbacks of holding cash are incremental taxes on interest income and lower rates of return. One of the benefits of cash holdings is having the option to finance investment opportunities using cash when other sources of financing are costly. Likewise, Kim, Kim and Woods (2011) find a positive relationship between a firm's cash holding level and investment opportunities.

spikes. Empirical tests show that investment spikes are accompanied by large debt issuances.⁵ The model of DeAngelo et al. (2011) also finds 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 fund large uncertain investments. Therefore, we re-examine whether firms with large investments have higher debt ratios and lower cash levels.

Another prediction of the DeAngelo et al. (2011) model is that 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. Therefore, we re-examine whether firms decrease debt after making large investments.

Overall, Hypothesis 1 tests if low debt is maintained to fund future investment shocks; Hypothesis 2 tests if holding cash today is to fund future investment shocks; and Hypothesis 3 tests the relationship between cash levels and large realizations of investment.

This paper contributes to the literature both in terms of the hypotheses tested and the range of methods used to develop our investment volatility measures. To our knowledge, our hypotheses have not been tested before. For exposition purposes, we include the results of already tested hypotheses to stress the inter-connected nature of the related financing policies.

3 Sample, Variable Construction and Univariate Statistics

3.1 Sample

To test our hypotheses, we obtain annual data from 1974 through 2020 of 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. In addition, following Kale and Shahrur (2007), all the variables are winsorized at the 1% level in both tails

⁵Denis 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 investment needs. In addition, Elsas et al. (2014) conclude that firms issue debt to fund large investments.

of the distribution before calculating the summary statistics.⁶ To assist the reader, Table 1 of the Online Appendix provides Compustat and mathematical variable definitions, and Table 2 of the Online Appendix provides variables constructed using Compustat.⁷

3.2 Variable Construction

3.2.1 Investment volatility

To measure investment, 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, $Inv = Capx + Acq$.⁸ We follow DeAngelo et al. (2011) and scale our investment measure by total assets.

To construct investment volatility measures, we follow the De Veirman and Levin (2018) volatility estimation method used by Keefe and Yaghoubi (2016) and Keefe and Tate (2013). To construct the De Veirman and Levin (2018) investment volatility measure, we estimate

$$\omega_{it} = \alpha_i + Year\beta + \epsilon_{it}, \quad (1)$$

where ω_{it} represents the first difference of the investment measure scaled by total assets from $t - 1$ to t for firm i and $Year$ is a matrix of year dummies. The residual $\hat{\epsilon}_{it}$ represents the difference between the observed and the estimated investment growth of firm i when controlling for time and firm fixed effects. De Veirman and Levin (2018) estimate conditional volatility as

$$\hat{\sigma}_{it} = \sqrt{\pi/2} * |\hat{\epsilon}_{it}|, \quad (2)$$

and show $\hat{\sigma}_{it}$ is an estimator of the conditional volatility (conditional at time t for firm i), where $\hat{\epsilon}_{it}$ is the estimated residual from Equation (1).

⁶By winsorizing at the 1% level, we modify the top and bottom 1% of data and match those values to the nearest extreme. This method reduces the effect of outliers.

⁷The Online Appendix can be found at <https://sites.google.com/site/mockeeefe/Data>.

⁸Note that Compustat item capital expenditure $Capx$ excludes the acquisitions Acq .

Because firms tend to slowly adjust their capital structure, we construct the five-year rolling average of $\hat{\sigma}_{it}$. To denote a five-year window, we use the subscript $t-5, t$. To closely match the normal distribution of the investment volatility measures, we take the natural logarithm of the investment volatility measure. $InvVol_DL_{t-5,t} = \ln(\frac{1}{5} \sum_{t-5}^t \hat{\sigma}_{it})$. Hypotheses 1 and 2 test the effect of the uncertain future investments' volatility on firms' debt and cash levels. Therefore, we use a five-year lead of the constructed investment volatility measure to represent the volatility of future investments. To denote the five-year lead, we use the subscript $t, t+5$. In our main results, we report results using $InvVol_DL_{t,t+5}$.

3.2.2 Investment spike

We construct our investment spike measure using the volatility estimation method of De Veirman and Levin (2018). For investment to be defined as a spike, it must meet two conditions. First, $\hat{\epsilon}_{it}$, which is estimated from Equation (1), must be positive. This implies that actual investment growth is greater than predicted investment growth from Equation (1). Second, the De Veirman and Levin (2018) measure of volatility $\hat{\sigma}_{it}$ in Equation (2) must be in the top tercile for each year.

$$InvSpike_DL_t = \begin{cases} 1, & \text{if } \hat{\epsilon}_{it} > 0 \text{ and } \hat{\sigma}_{it} > \hat{\sigma}_{2/3rank}. \\ 0, & \text{otherwise.} \end{cases} \quad (3)$$

In summary, an investment spike occurs for those observations where $\hat{\sigma}_{it}$ is in the top tercile and where the deviation from predicted investment is positive. $InvSpike_DL_t$ is set to one when actual investment growth is higher than predicted from Equation (1) and investment volatility from Equation (2) is in the highest tercile. This method of investment spike construction illustrates the close relationship between an investment spike and investment volatility. In addition, readers may refer to the Online Appendix for alternative volatility and spike measure used in the robustness section.

3.2.3 Variables of interest

To test the relationship between investment volatility and capital structure, we construct two book debt ratios. In Section 4, we test using the short and long-term book debt ratio and in the robustness section, we test using the total liabilities book debt ratio. We use book debt ratios as this study's debt measure because of possible simultaneity between market value and investment.⁹

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 the 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 total assets. Following the Welch (2011) critique, we modify the denominator of our debt measures and use the book debt ratio 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.

$$BDR = \frac{dltt + dlc}{ceq + dltt + dlc}. \quad (4)$$

- ii) We also follow Rajan and Zingales (1995) and Welch (2011) and construct the total liabilities debt ratio as the total liabilities divided by total assets.

$$BDR_lt = \frac{lt}{at}. \quad (5)$$

Note that in BDR , both the numerator and the denominator exclude the non-financial liabilities, and in BDR_lt , non-financial liabilities are categorized as debt.

⁹Investment might affect both the market value of the equity and the need for the firm to issue more debt to fund the investment.

To test the relationship between investment volatility and cash holdings, we construct two cash ratios. In Section 4, we test using cash scaled by total assets, and in the robustness section we test using cash scaled by net assets.

- i) The 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).

$$Cash_at = \frac{che}{at}. \quad (6)$$

- ii) The ratio of cash and short-term investments over net assets, where *che* is cash and marketable securities and *at* is total assets (Opler et al., 1999).

$$Cash = \frac{che}{at - che}. \quad (7)$$

In addition, to control for variables that influence a firm's investment, we follow the literature and control for size, working capital, turnover and retained earnings of a firm (Alstadsæter et al., 2017). Please see the Online Appendix for our control variables definition and construction.

3.2.4 Instrumental variables (IVs)

As the future volatility of investment shocks may affect the current capital structure and cash levels, we follow Ambrosius and Cuecuecha (2016) and Bennett et al. (2017) and employ an IV strategy to address the possible endogeneity concerns. Valid IVs must 1) be sufficiently correlated with debt or cash variables (variables suspected of being endogenous), and 2) be orthogonal to the second-stage error term.

For the first criterion, we use the Kleibergen-Paap rk LM under-identification test and the Kleibergen-Paap rk Wald F weak-identification test. The former test's null hypothesis is that the instruments are irrelevant, and the latter test's null hypothesis is that instruments are weak.¹⁰ For

¹⁰The Kleibergen-Paap rk LM under-identification test helps us to determine whether correlations between debt or cash variables (the endogenous variables) and the instruments are statistically different from zero.

the second criterion, we employ the Hansen J over-identification test, where the null hypothesis is that instruments are uncorrelated with the error term in the second-stage regression.

Therefore, the first step to find valid instruments is to find relevant variables. Leary and Roberts (2014) find that a firm's financial decisions are, to some extent, responses to peer firms' financial decisions and peer firms' characteristics. Therefore, we can consider peer firms' financial decisions and characteristics as possible instruments to a firm's cash or debt level. Following Leary and Roberts (2014), we define peer firms as all firms in the same industry year, where three-digit SIC codes represent industries.

To address the possible endogeneity in testing Hypothesis 1, we construct the following IVs that explain a firm's debt level, but not the future investment volatility:

- i) Average of peer firms' debt ratio,

$$Peer_BDR = \frac{\sum BDR_{it}}{N - 1}, \quad (8)$$

- ii) Average of peer firms' property, plant and equipment over total assets,

$$Peer_PPE = \frac{\sum \frac{PPE_{it}}{at_{it}}}{N - 1}, \quad (9)$$

And, to address the possible endogeneity in testing Hypothesis 2, we construct the following IVs that explain a firm's cash level, but not future investment volatility:

- i) Average of peer firms' cash ratio,

$$Peer_Cash = \frac{\sum Cash_{it}}{N - 1}, \quad (10)$$

- ii) Average of peer firms' earnings before interest and taxes over total assets,

$$Peer_EBITDA = \frac{\sum \frac{EBITDA_{it}}{at_{it}}}{N - 1}, \quad (11)$$

where $Cash_{it}$ and BDR_{it} are constructed using Equations (6) and (4), and $N - 1$ is the number of firms in the same industry-year, excluding the i^{th} observation. In the robustness section, we follow Bennett et al. (2017) and show that there is no relationship between our IVs and the future investment volatility in the presence of our endogenous cash and debt ratio. These results, along with the Kleibergen-Paap rk LM identification test and the Hansen J over-identification test, indicate that our IVs are valid.

3.3 Univariate Statistics

Table 1 reports summary statistics. The table indicates that, on average, our sample firms 1) have about 29% debt and 71% equity in their capital structure, 2) have 18.1% of their total assets in the form of cash and marketable securities, 3) generated \$1.40 in sales for every dollar of assets and 4) net working capital is 0.4% of their total assets.

insert Table 1

Table 2 reports the correlation coefficients between our investment volatility, investment spike, investment measure and the components of investment measure $Capx$ and Acq . The investment measure is highly and positively correlated with its components $Capx$ and Acq , with a correlation coefficient of 0.89 between Inv and $Capx$. However, the correlation coefficient between $Capx$ and Acq is only 0.19. This suggests $Capx$ dominates the combined measure of investment used by DeAngelo et al. (2011). Also, the investment volatility and the investment spike variables are positively correlated with a correlation coefficient of 0.54.

insert Table 2

4 Testing

4.1 Estimation Approach

To test our Hypotheses 1 and 2, we follow Lemmon, Roberts and Zender (2008) and Flannery and Rangan (2006) and estimate a panel data model and include firm fixed effects which control

for firm invariant factors, implying identification comes through investment volatility variations within a firm over time. We also include a year dummy variable to control for macroeconomic and time-varying shocks to investment. Therefore, a plausible specification to test Hypotheses 1 and 2 is

$$InvVol_DL_{i,(t,t+5)} = \alpha + \beta_1 Ratio_{it} + \sum_n \beta_n Control_{it}^n + \eta_i + Year + \epsilon_{it}, \quad (12)$$

where $Ratio_{it}$ represents the variables of interest and is the book debt ratio (BDR_{it}) when testing Hypothesis 1 and the cash ratio ($Cash_{it}$) when testing Hypothesis 2. η_i is a firm fixed effect and $Year$ is a year dummy that controls for year fixed effects. We find qualitatively identical results when controlling for economic policy uncertainty (EPU) as defined by Anolick, Batten, Kinatader and Wagner (2021). $Control_{it}$ is a matrix of control variables, which are $Size$, $Turnover$, NWC and $REarnings$.

However, because of the possible endogeneity between $InvVol_DL_{i,(t,t+5)}$ and debt and cash levels, the estimated β_1 in Equation (12) is likely biased. Therefore, to estimate the effect of cash and debt levels on future investment volatility, we follow Ambrosius and Cuecuecha (2016) and Bennett et al. (2017) and employ IV estimation methods to address the possible endogeneity. We use the IVs constructed in Section 3.2.4. The first stage equation is

$$Ratio_{it} = \alpha_2 + \lambda IV_{sit} + \sum_n \beta_n Control_{it}^n + \eta_i + Year + \varphi_{it}, \quad (13)$$

and the second stage is

$$InvVol_DL_{i,(t,t+5)} = \alpha_3 + \beta_3 \widehat{Ratio}_{it} + \sum_n \beta_n Control_{it}^n + \eta_i + Year + \theta_{it}, \quad (14)$$

where, IV_{sit} represents $Peer_BDR$, and $Peer_PPE$ when testing Hypothesis 1, and $Peer_Cash$, and $Peer_EBITDA$ when testing Hypothesis 2. \widehat{Ratio}_{it} represents predicted BDR_{it} and $Cash_{it}$ from Equation (13). β_3 is an estimator of the effect of debt and cash levels on future investment volatility.

Because the dependent variable tested in Hypothesis 3 is a dummy variable, we follow the suggested specification by Wooldridge (2010) and used by Markarian and Michenaud (2019), and

employ a panel logit model with firm fixed effect to control for time-invariant firm heterogeneity, and year fixed effect to control for macroeconomic shocks. Wooldridge (2010) suggests using fixed-effects panel logit models for binary dependent variables with panel data because unlike the random effects models, the logit panel regression does not make assumptions about the relationship between the dependent variables and unobserved heterogeneity. We regress the *InvSpike_DL_t* dummy variable on the Hypothesis 3 variable of interest *Cash_{t-1}* and a set of control variables. Also, as a part of our confirmatory testing, we regress the investment spike on *BDR_{t-1}*. We estimate

$$Pr(InvSpike_DL_t = 1) = F(\alpha + \beta_1 Ratio_{i,t-1} + \sum_n \beta_n Control_{i,t-1}^n + \eta_i + Year), \quad (15)$$

where $F(z) = e^z / (1 + e^z)$ is the cumulative logistic distribution, *Ratio_{i,t-1}* is *Cash_{i,t-1}* i.e. the cash ratio in the previous year, when testing Hypothesis 3 and is *BDR_{i,t-1}* i.e. the book debt ratio in the previous year debt ratio in confirmatory testing. *Control_{i,t-1}* is a matrix of lagged control variables, which are *Size*, *Turnover*, *NWC* and *REarnings*. η_i is a firm fixed effect and *Year* is a year dummy that controls for year fixed effects.¹¹

4.2 Testing Hypotheses 1 and 2 – Future Investment Volatility and a Firm’s Current Debt and Cash Levels

insert Table 3

Table 3 shows the estimation result of Equation (12). Columns (1) and (2) report that the coefficients associated with the debt ratio (*BDR*) and the cash ratio (*Cash*) are statistically significant at the 1% level with the predicted signs. The table shows that firms with high future investment volatility keep their cash levels high and debt levels low. To address the potential endogeneity concerns associated with investment volatility and financing decisions, we also employ an IV approach to test Hypotheses 1 and 2.

insert Table 4

¹¹Stata does not provide a *xivlogit* command to test for the possible endogeneity in this hypothesis.

Table 4 reports 2SLS estimation results of Equations (13) and (14). Columns (1) and (3) present the first-stage estimates with the short- and long-term book debt ratio (BDR) and the ratio of cash over total assets ($Cash$) as the dependent variables, respectively. Columns (1) and (3) instrument BDR with $Peer_BDR$, and $Peer_PPE$ and $Cash$ with $Peer_Cash$, and $Peer_EBITDA$. The excluded instruments are statistically significant at the 1% level with the predicted signs consistent with Leary and Roberts (2014).

Columns (2) and (4) report the second-stage estimates of Hypothesis 1 and Hypothesis 2, where $InvVol_DL_{t,t+5}$ is the dependent variable. Hypothesis 1 posits that firms maintain low debt levels to finance future investment shocks. The intuition behind this hypothesis is that firms with high future investment volatility keep debt levels low to maintain debt capacity to fund uncertain future investments. Likewise, Hypothesis 2 advances that firms with high future investment volatility keep current cash levels high to fund uncertain future investments.

Column (2) of Table 4 shows the coefficients associated with the debt variable (BDR) are negative and statistically significant at less than the 5% level, which is consistent with the predicted relationship. Our evidence suggests that firms keep their debt level low due to high future investment volatility. All in all, our evidence supports the DeAngelo et al. (2011) model's prediction that firms with productivity shocks that drive high future investment volatility keep current debt levels low.

Column (4) of Table 4 also shows the coefficients associated with the cash variable ($Cash$) is positive and statistically significant at less than the 10% level, which is consistent with the predicted relationship. Our result indicates that holding cash today is due to future investment shock, which is consistent with the DeAngelo et al. (2011) model.

Besides, Table 4 reports that the coefficients associated with $Size$ are negative and statistically significant, and the coefficient associated with $Turnover$ is positive and statistically significant, indicating that the smaller the firm, and the lower the ratio of sales over total assets, the higher the future investment volatility.

As discussed in Section 3.2.4, valid instruments must be 1) correlated with the IVs, and 2) orthogonal to the residuals in the second-stage equation. We use the Kleibergen-Paap rk LM

under-identification test and the Kleibergen-Paap rk Wald F weak-identification test for the first criterion and employ the Hansen J over-identification test for the orthogonality to the residuals criterion. Table 4 presents the results of these tests. The Kleibergen-Paap rk LM null hypothesis is that the endogenous regressors – BDR in Hypothesis 1 and $Cash$ in Hypothesis 2 – are not identified by the instruments. The Kleibergen-Paap rk Wald F tests if the excluded instruments are only weakly correlated with the endogenous regressors. The p -values and the statistics reported in Table 4 indicate that we reject both the under-identification and weak-identification null hypotheses. As for the orthogonality of the residuals, the Hansen J test null hypothesis is that the instruments are uncorrelated with the error term in the second-stage regression. Therefore, failing to reject the null hypothesis provides evidence of the validity of the instruments. As can be seen from the p -value and J -statistics reported in Table 4, we fail to reject the null hypothesis of the Hansen J test at the 1% significance level. All in all, our results provide evidence that our IVs are valid.

4.3 Testing Hypothesis 3 – Future Investment Spike and a Firm’s Cash Levels

Column (1) of Table 5 reports estimation results that test Hypothesis 3, where the dependent variable is $InvSpike_DL_t$ and cash ratio is used in lagged form to show the effect of cash on firms’ large future investments. Hypothesis 3 puts forward that firms rebuild their cash levels before funding large investments. The intuition behind this hypothesis is that firms rebuild their cash stock to maintain the capacity to fund future investment. Column (1) of Table 5 shows the coefficient associated with $Cash_{t-1}$ is positive and statistically significant at less than the 1% level, which is consistent with the predicted relationship. Our evidence suggests that before 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 to fund future large investments. In addition, our findings in Column (2) of Table 5 demonstrate an investment channel that helps explain the DeAngelo, Gonçalves and Stulz (2017) findings that over long periods of time firms decrease leverage from historical peaks while increasing cash balances.

insert Table 5

We also re-examine the findings of DeAngelo et al. (2011) and Elsas et al. (2014). Our confirmatory results are consistent with their findings. They find that firms decrease debt levels before funding large investments. For the discussion on confirmatory testing, please refer to the Online Appendix.

5 Discussion and Robustness

In this section, we discuss the economic importance of our results and investigate if our findings are robust to alternative measures of investment volatility, investment spike and debt and cash ratios.

5.1 Economic Importance

To show the economic importance of the *BDR* and *Cash* coefficients in Equation (14), we estimate the increase (decrease) in $InvVol_DL_{i,(t,t+5)}$ as a result of a one-standard-deviation increase in *BDR* and *Cash* from their means, where all the control variables are evaluated at their means. Likewise, to obtain the economic importance of the *BDR* and *Cash* coefficients in Equation 15, we calculate the percentage change in the probability of a firm having a large investment as a result of a one-standard-deviation increase in its debt and cash levels. The mean and standard deviations of the *BDR* and *Cash* variables are reported in Table 1.

Table 6 reports the percentage change predicted in the dependent variables ($InvVol_DL_{t,t+5}$, and $InvSpike_DL_t$) due to a one-standard-deviation increase from the mean of the cash and debt variables. Columns (1) and (2) of Table 6 report the predicted values of the dependent variables and Column (3) reports the percentage increase or decrease in the dependent variables. For example, the predicted value of $InvVol_DL_{t,t+5}$ at the mean of *BDR* is 1.67, and at the mean plus a one standard deviation of *BDR* is 1.54, implying a 7.8% decrease in $InvVol_DL_{t,t+5}$ as a result of a one-standard-deviation increase in *BDR*.¹²

As the $InvSpike_DL_t$ is a dummy variable and we use a panel logit model to test its relationship with debt and cash levels, the percentage changes in Table 6 represent the increased(decreased) probability of large investments. For example, Column (3) of Table 6 reports that a one-standard-

¹² $PercentageChange = \frac{1.54-1.67}{1.67} = -7.8\%$.

deviation increase in a firm's cash level leads to a 47.1% increase in the probability of large investments in the next year.

insert Table 6

5.2 Robustness

We perform a series of robustness tests discussed in the Online Appendix. We re-examine 1) Equation (15) using several lags of our debt and cash ratios to examine the intertemporal relationship between $InvSpike_DL_t$ and the debt and cash levels, 2) our main results using different measures of debt and cash ratios, and 3) whether our results are robust to alternative measures of investment volatility and investment spikes. As can be seen in the findings reported in the Online Appendix, our main results remain qualitatively unchanged.

6 Conclusion

Planning to execute an investment plan is one of the most important financial strategies of a firm. Growth options are ephemeral, and a firm must be positioned to quickly execute these options at the appropriate time. Our paper shows how firms manage their debt and cash levels to execute on these options. The empirical literature on the relationship between firms' financing options and the volatility of investment is narrow. We address this gap in the literature and empirically test theoretically motivated hypotheses.

Our first two hypotheses investigate if firms with higher future investment volatility have lower debt levels and higher cash levels. Considering the possible endogeneity between the investment volatility and cash and debt levels, we employ an instrumental variable strategy and predict the percentage change in investment volatility from a one-standard-deviation increase from the mean of the debt and cash variables. Our results are statistically significant and economically important. Our evidence shows firms hold cash and maintain low debt to fund uncertain future investment opportunities.

Our third hypothesis investigates the relationship between cash holdings and future investment spikes. We test if firms try to re-build their cash stock one year before large investment to fund their future large investment (investment spikes). We find firms with high cash levels are more likely to have a large investment in the next year. Our results are statistically significant and economically important.

Our paper provides practical guidance on how a firm should plan a financing program. Our results indicate that, on average, due to a five-year future investment volatility window, firms decrease their debt levels by 7.8% and increase their cash levels by 8.3%. Therefore, firms should anticipate their future financing needs and accordingly decrease their debt levels and increase their cash stocks. Also, our results indicate that firms benefit from having approximately a one year of planning time horizon before a large investment. This anticipation helps them to decrease their debt levels and increase their cash stock, which increases the probability of being able to fund a large investment. We note our results are based on US data from 1974 to 2020. These results may differ in countries with different financial systems and laws.

References

- Almeida, H., Campello, M. and Weisbach, M. S. (2004), ‘The cash flow sensitivity of cash’, *The Journal of Finance* **59**(4), 1777–1804.
- Alstadsæter, A., Jacob, M. and Michaely, R. (2017), ‘Do dividend taxes affect corporate investment?’, *Journal of Public Economics* **151**, 74–83.
- Ambrosius, C. and Cuenquecha, A. (2016), ‘Remittances and the use of formal and informal financial services’, *World Development* **77**, 80–98.
- An, H., Chen, Y., Luo, D. and Zhang, T. (2016), ‘Political uncertainty and corporate investment: evidence from china’, *Journal of Corporate Finance* **36**, 174–189.
- Ang, J., Daher, M. and Ismail, A. (2019), ‘How do firms value debt capacity? evidence from mergers and acquisitions’, *Journal of Banking & Finance* **98**, 95–107.
- Anolick, N., Batten, J., Kinateder, H. and Wagner, N. (2021), ‘Time for gift giving: abnormal share repurchase returns and uncertainty’, *Journal of Corporate Finance* **66**, 101787.
- Bates, T. W., Kahle, K. M. and Stulz, R. M. (2009), ‘Why do U.S. firms hold so much more cash than they used to?’, *Journal of Finance* **64**(5), 1985–2021.
- Bennett, D., Faria, H., Gwartney, J. and Morales, D. (2017), ‘Economic institutions and comparative economic development: a post-colonial perspective’, *World Development* **96**, 503–519.
- Billett, M., King, T. D. and Mauer, D. (2007), ‘Growth opportunities and the choice of leverage, debt maturity, and covenants’, *The Journal of Finance* **62**(2), 697–730.
- Byrne, J. and Davis, E. (2004), ‘Permanent and temporary inflation uncertainty and investment in the united states’, *Economics Letters* **85**(2), 271–277.
- De Veirman, E. and Levin, A. (2018), ‘Cyclical changes in firm volatility’, *Journal of Money, Credit and Banking* **50**(2-3), 317–349.
- DeAngelo, H., DeAngelo, L. and Stulz, R. M. (2006), ‘Dividend policy and the earned/contributed capital mix: a test of the life-cycle theory’, *Journal of Financial Economics* **81**(2), 227–254.
- DeAngelo, H., DeAngelo, L. and Whited, T. M. (2011), ‘Capital structure dynamics and transitory debt’, *Journal of Financial Economics* **99**(2), 235–261.
- DeAngelo, H., Gonçalves, A. and Stulz, R. (2017), ‘Corporate deleveraging and financial flexibility’, *The Review of Financial Studies* **31**(8), 3122–3174.
- Denis, D. J. and Sibilkov, V. (2010), ‘Financial constraints, investment, and the value of cash holdings’, *Review of Financial Studies* **23**(1), 247–269.
- Denis, D. and McKeon, S. (2012), ‘Debt financing and financial flexibility evidence from proactive leverage increases’, *Review of Financial Studies* **25**(6), 1897–1929.
- Dixit, R. and Pindyck, R. (2012), *Investment under uncertainty*, Princeton university press.

- Dudley, E. (2012), ‘Capital structure and large investment projects’, *Journal of Corporate Finance* **18**(5), 1168–1192.
- Eisfeldt, A. L. and Rampini, A. A. (2006), ‘Capital reallocation and liquidity’, *Journal of Monetary Economics* **53**(3), 369–399.
- Elsas, R., Flannery, M. J. and Garfinkel, J. A. (2014), ‘Financing major investments: Information about capital structure decisions’, *Review of Finance* **18**(4), 1341–1386.
- Flannery, M. J. and Rangan, K. P. (2006), ‘Partial adjustment toward target capital structures’, *Journal of Financial Economics* **79**(3), 469–506.
- Guay, W. R. (1999), ‘The sensitivity of CEO wealth to equity risk: An analysis of the magnitude and determinants’, *Journal of Financial Economics* **53**(1), 43–71.
- Gulen, H. and Ion, M. (2016), ‘Policy uncertainty and corporate investment’, *The Review of Financial Studies* **29**(3), 523–564.
- Hackbarth, D. and C. Mauer, D. (2012), ‘Optimal priority structure, capital structure, and investment’, *Review of Financial Studies* **25**(3), 747–796.
- Jensen, M. (1986), ‘Agency costs of free cash flow, corporate finance, and takeovers’, *American Economic Review* **76**(2), 323–329.
- Jensen, M. and Meckling, W. (1976), ‘Theory of the firm: managerial behavior, agency costs and ownership structure’, *Journal of financial economics* **3**(4), 305–360.
- Julio, B. and Yook, Y. (2012), ‘Political uncertainty and corporate investment cycles’, *The Journal of Finance* **67**(1), 45–83.
- Kale, J. R. and Shahrur, H. (2007), ‘Corporate capital structure and the characteristics of suppliers and customers’, *Journal of Financial Economics* **83**(2), 321–365.
- Keefe, M. O. and Tate, J. (2013), ‘Is the relationship between investment and conditional cash flow volatility ambiguous, asymmetric or both?’, *Accounting & Finance* **53**(4), 913–947.
- Keefe, M. and Yaghoubi, M. (2016), ‘The influence of cash flow volatility on capital structure and the use of debt of different maturities’, *Journal of Corporate Finance* **38**, 18–36.
- Kim, J., Kim, H. and Woods, D. (2011), ‘Determinants of corporate cash-holding levels: An empirical examination of the restaurant industry’, *International Journal of Hospitality Management* **30**(3), 568–574.
- Leary, M. T. and Roberts, M. R. (2014), ‘Do peer firms affect corporate financial policy?’, *The Journal of Finance* **69**(1), 139–178.
- Lemmon, M. L., Roberts, M. R. and Zender, J. F. (2008), ‘Back to the beginning: Persistence and the cross-section of corporate capital structure’, *Journal of Finance* **63**(4), 1575–1608.
- Maghyreh, A. and Abdoh, H. (2020), ‘Asymmetric effects of oil price uncertainty on corporate investment’, *Energy Economics* **86**, 104622.

- Markarian, G. and Michenaud, S. (2019), ‘Corporate investment and earnings surprises’, *The European Journal of Finance* **25**(16), 1485–1509.
- Myers, S. C. (1977), ‘Determinants of corporate borrowing’, *Journal of Financial Economics* **5**(2), 147–175.
- Myers, S. C. and Majluf, N. S. (1984), ‘Corporate financing and investment decisions when firms have information that investors do not have’, *Journal of Financial Economics* **13**(2), 187–221.
- Opler, T., Pinkowitz, L., Stulz, R. and Williamson, R. (1999), ‘The determinants and implications of corporate cash holdings’, *Journal of Financial Economics* **52**(1), 3–46.
- Pindyck, R. (1990), ‘Irreversibility, uncertainty, and investment’, *National Bureau of Economic Research Cambridge, USA* .
- Rajan, R. G. and Zingales, L. (1995), ‘What do we know about capital structure? Some evidence from international data’, *The Journal of Finance* **50**(5), 1421–1460.
- Welch, I. (2011), ‘Two common problems in capital structure research: The financial-debt-to-asset ratio and issuing activity versus leverage changes’, *International Review of Finance* **11**(1), 1–17.
- Whited, T. (2006), ‘External finance constraints and the intertemporal pattern of intermittent investment’, *Journal of Financial Economics* **81**(3), 467–502.
- Wooldridge, J. (2010), *Econometric analysis of cross section and panel data*, MIT press.
- Yoon, K. and Ratti, R. (2011), ‘Energy price uncertainty, energy intensity and firm investment’, *Energy Economics* **33**(1), 67–78.

Table 1: Summary statistics

This table shows summary statistics of variables of the study for non-financial and non-utility US companies from 1974 to 2020. All variables are winsorized at the 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. Table 2 of Online appendix defines the variables.

Variable	N	mean	p25	p50	p75	max	min	sd
<i>BDR</i>	158806	0.293	0.049	0.264	0.470	0.926	0	0.252
<i>Cash</i>	158806	0.188	0.028	0.091	0.261	0.938	0.000	0.227
<i>FirmSize</i>	158806	4.822	3.271	4.656	6.258	10.23	0.509	2.137
<i>NWC</i>	153484	0.406	-0.023	0.240	0.704	6.009	-4.454	1.217
<i>Turnover</i>	141027	1.375	0.709	1.212	1.799	5.391	0	0.983
<i>REarnings</i>	139820	-0.224	-0.164	0.184	0.412	0.961	-8.851	1.450
<i>Acq</i>	158806	0.017	0	0	0.002	0.280	-0.002	0.0481
<i>Capx</i>	157347	0.060	0.020	0.041	0.077	0.336	0	0.062
<i>InvVol_DL_{t-5,t}</i>	93530	2.851	2.100	2.727	3.502	5.308	0.987	1.002
<i>InvSpike_DL_t</i>	140920	0.141	0	0	0	1	0	0.348

Table 2: Correlations

This table shows the pairwise correlation coefficients between investment and investment volatility variables. The appendix 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)
(1) <i>Inv</i>	1					
(2) <i>Capx</i>	0.891	1				
(3) <i>Acq</i>	0.614	0.188	1			
(4) <i>InvSpike_DL_t</i>	0.054	-0.005	0.125	1		
(5) <i>InvVol_DL_{t-5,t}</i>	0.019	-0.031	0.096	0.542	1	
(6) <i>InvVol_DL_{t,t+5}</i>	-0.036	-0.037	-0.013	0.075	0.199	1

Table 3: Testing Hypotheses 1 and 2 – OLS estimation

This table shows OLS estimation results of Hypotheses 1 and 2 where the $InvVol_DL_{t,t+5}$ is the dependent variable and short- and long-term book debt ratio (BDR) and the ratio of cash over total assets ($Cash$) are the variables of interest. Section 3.2 defines the variables. Clustered standard errors by firm are shown in parentheses with 1%, 5% and 10% significance level denoted by ***, ** and *, respectively.

Variables	Hypothesis 1	Hypothesis 2
	(1)	(2)
	$InvVol_DL_{t,t+5}$	$InvVol_DL_{t,t+5}$
BDR_t	-0.289*** (0.037)	
$Cash_t$		0.370*** (0.050)
$Size_t$	-0.179*** (0.013)	-0.186*** (0.013)
NWC_t	0.009 (0.009)	0.023** (0.009)
$Turnover_t$	0.041*** (0.010)	0.051*** (0.010)
$REarnings_t$	0.022** (0.010)	0.0304*** (0.010)
Constant	2.339*** (0.051)	2.204*** (0.051)
Observations	65,928	65,928
R^2	0.051	0.051
Number of firms	6,141	6,141
Year effect	Yes	Yes
Firm effect	Yes	Yes

Table 4: Testing Hypotheses 1 and 2 – 2SLS estimation

This table shows 2SLS estimation results where BDR and $Cash$ are treated as endogenous. 2SLS simultaneously solves the stage 1 equation $Ratio_{it} = \alpha_2 + \lambda IV s_{it} + \sum_n \beta_n Control_{it}^n + Year + \alpha_i + \varphi_{it}$, and the stage 2 equation $InvVol_DL_{i,(t,t+5)} = \alpha_3 + \beta_3 \widehat{Ratio}_{it} + \sum_n \beta_n Control_{it}^n + Year + \alpha_i + \eta_{it}$. $Ratio$ represents $Cash$ and BDR . The excluded instruments of BDR_t are $Peer_BDR$ and $Peer_PPE$, and the excluded instruments of $Cash_t$ are $Peer_Cash$ and $Peer_EBITDA$. Hansen J test is the over-identification test. Kleibergen-Paap rk is the under-identification test. Kleibergen-Paap rk Wald F is the weak-identification test. Section 3.2 defines the variables. Clustered standard errors by firm are shown in parentheses with 1%, 5% and 10% significance level denoted by ***, ** and *, respectively.

Variables	Hypothesis 1		Hypothesis 2	
	(1)	(2)	(3)	(4)
	1st Stage BDR_t	2nd Stage $InvVol_DL_{t,t+5}$	1st Stage $Cash_t$	2nd Stage $InvVol_DL_{t,t+5}$
\widehat{BDR}_t		-0.481** (0.191)		
\widehat{Cash}_t				0.514* (0.303)
$Peer_BDR_t$	0.457*** (0.0172)			
$Peer_PPE_t$	-0.101*** (0.0255)			
$Peer_Cash_t$			0.405*** (0.0208)	
$Peer_EBITDA_t$			0.0907*** (0.0117)	
$Size_t$	0.0393*** (0.00283)	-0.162*** (0.0154)	-0.0161*** (0.00209)	-0.183*** (0.0138)
NWC_t	-0.0260*** (0.00206)	0.00645 (0.0103)	-0.0149*** (0.00202)	0.0243** (0.0100)
$Turnover_t$	-0.0144*** (0.00236)	0.0406*** (0.0105)	-0.0172*** (0.00187)	0.0524*** (0.0110)
$REarnings_t$	-0.0364*** (0.00258)	0.0130 (0.0123)	0.00733*** (0.00187)	0.0294*** (0.00984)
Observations	64,418	64,418	64,949	64,949
R^2		0.051		0.050
Number of firms	5,473	5,473	5,506	5,506
Year effect	Yes	Yes	Yes	Yes
Firm effect	Yes	Yes	Yes	Yes
F -stat	352.750	17.410	203.89	15.310
Hansen J statistic		3.266		0.241
Hansen J p -value		0.071		0.623
Kleibergen-Paap rk LM statistic		249.240		229.808
Kleibergen-Paap rk LM p -value		0.000		0.000
Kleibergen-Paap rk Wald F statistic		352.754		203.885

Table 5: Testing Hypothesis 3 and the three confirmatory hypotheses

This table shows estimation results of testing Equation (15) in Columns (1) and (2), and confirmatory testing in Columns (3) and (4). $InvSpike_DL_t$ is the dependent dummy variable, and the cash and debt ratios are the variables of interest. Column (1) reports Hypotheses 3 testing and Columns (3) to (4) report the three confirmatory hypotheses testing. Section 3.2 defines the variables. Clustered standard errors by firm are shown in parentheses with 1%, 5% and 10% significance level denoted by ***, ** and *, respectively.

Variables	Hypothesis 3		Confirmatory Hypotheses	
	(1)	(2)	(3)	(4)
	$InvSpike_DL_t$	$InvSpike_DL_t$	$InvSpike_DL_t$	$InvSpike_DL_t$
$Cash_{t-1}$	3.187*** (0.089)			
BDR_{t-1}		-2.234*** (0.069)		
$Cash_t$			-2.369*** (0.096)	
BDR_t				1.362*** (0.059)
$Size_{t-1}$	-0.449*** (0.018)	-0.396*** (0.017)	-0.561*** (0.018)	-0.563*** (0.017)
NWC_{t-1}	0.150*** (0.016)	0.038** (0.016)	0.088*** (0.016)	0.116*** (0.016)
$Turnover_{t-1}$	0.351*** (0.019)	0.281*** (0.019)	0.277*** (0.018)	0.314*** (0.018)
$REarnings_{t-1}$	0.111*** (0.016)	0.050*** (0.016)	0.130*** (0.016)	0.166*** (0.016)
Year effect	Yes	Yes	Yes	Yes
Firm effect	Yes	Yes	Yes	Yes
Observations	97,648	97,648	97,648	97,648
Number of firms	6,849	6,849	6,849	6,849

Table 6: Economic importance

This table reports the predicted percentage change in $InvVol_DL_{t,t+5}$ and $InvSpike_DL_t$ using a panel regression with firm and year fixed effects. The predicted percentage changes are the result of a one-standard-deviation increase from the mean of debt and cash variables BDR and $Cash$, where other control variables are evaluated at their means.

	(1)	(2)	(3)
	Predicted at mean	Predicted at mean+1SD	% Δ
Panel A - Hypotheses 1 and 2 – $InvVol_DL_{t,t+5}$			
\widehat{BDR}_t	1.67	1.54	-7.8%
\widehat{Cash}_t	1.69	1.83	8.3%
Panel B - Hypothesis 3 – $InvSpike_DL_t$			
$Cash_{t-1}$	0.17	0.25	47.1%
Panel C - Confirmatory Hypotheses – $InvSpike_DL_t$			
BDR_{t-1}	0.06	0.04	-33.3%
$Cash_t$	0.04	0.03	-25.0%
BDR_t	0.09	0.12	33.3%