Time Variation in the Marginal Value of Firms' Cash Holdings [1]

Michael O'Connor Keefe
Victoria University of Wellington
School of Economics and Finance
PO Box 600, Wellington 6140, NZ
michael.keefe@vuw.ac.nz

Robert Kieschnick
School of Management, SM 31
The University of Texas at Dallas
Richardson, TX 75083-0688
rkiesch@utdallas.edu

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Abstract

We decompose the effect of cross-sectional characteristics and macroeconomic variables on the changing market value of firm cash holdings. We find the market value of a $1 increase in cash holdings is (i) 25.6¢ higher for small firms that engage in R&D), (ii) 11.3¢ higher during economic expansions, and (iii) 25.3¢ higher for firms with relatively high CAPEX. Overall, our evidence suggests that high market values of cash are associated with investment opportunities and not precautionary savings.

Keywords: Cash, Financial Flexibility, Agency Costs, Macroeconomic Conditions

JEL Classification Codes: G32—Financing Policy, E32—Business Fluctuations, G14—Information and Market Efficiency

1 Introduction

Using several definitions of financially constrained firms, Faulkender and Wang (2006) find the marginal value of cash holdings are higher for financially constrained than unconstrained firms.[2] In a related paper, Bates, Kahle, and Stulz (2009) analyze time variation in the levels of cash holdings and attribute changing levels of cash holdings to cross-sectional changes in the firms composition (more volatile cash flows, smaller inventories and accounts receivables and increasing R&D intensity). We investigate whether the marginal value of firms' cash holdings changes over time and decompose time variation into cross-sectional and macroeconomic variables.

Bernanke and Gertler (1989) model the relationship between agency costs, net worth, and business fluctuations. Their model shows that in contracting economic states firm borrowing capacity declines; implying firms may be unable to finance even positive NPV (Net Present Value) projects during economic contractions. As a result, firms hold cash to fund projects during contracting economic states.[3] The survey evidence of Campello, Graham, and Harvey (2010) supports the idea that in contracting economic conditions firms are forced to bypass positive NPV projects. Specifically, Campello et al. (2010, page 472) write,

> During the financial crisis, 86% of constrained U.S. firms bypassed attractive investments due to difficulties in rasing external finance, compared to 44% of unconstrained firms that said the same. These numbers are mirrored in Europe and Asia.

The theoretical model of Bernanke and Gertler (1989) and the survey evidence of Campello et al. (2010) suggests that cash may have higher value during economic contractions.

Are some firms always financially constrained?[4] Because equity holders gain disproportionately from the upside of the project payoffs relative to lenders, debt financing of positive NPV projects

[2] In estimating the marginal value of cash, Faulkender and Wang (2006) control for both the level of cash and leverage.

[3] In our setting, a firm takes precaution by holding cash in case of unexpected macroeconomic contractions. Keynes (1936, pages 195-196) discusses for motives for holding cash: income, business, precautionary, and speculative.

[4] By financially constrained, we do not mean the firm can not obtain financing, rather it is difficult and costly for the firm to obtain financing. For example, a firm may be able receive funding from venture capitalists, private equity, or by issuing public equity.

with uncertain payoffs may be costly or not be available.[5] Consistent with this interpretation, Pinkowitz and Williamson (2007) show that the marginal value of cash is higher in growth industries such as computer software and positively related to investment. Brown and Petersen (2010) show that young firms use cash holdings to smooth R&D expenses. These studies imply that firms with projects with uncertain payoffs may hold cash as an ongoing (i.e. both in periods of economic expansion and contraction) strategy to fund capital investment and R&D.

What characterizes a financially constrained firm? Kaplan and Zingales (1997) find that cash flow, leverage, Q, dividends, and cash holdings all explain whether a firm is financially constrained. Almeida and Campello (2007) find that firm size, age, dividend payout, existence of a bond rating, financial slack (cash to lagged assets), and asset tangibility all explain whether a firm faces financing frictions. Whited and Wu (2006) construct an index of financial constraints that includes cash flow, dividend payout, leverage, total assets, industry sales growth, and firm sales growth. Using management comments in SEC filings, Hadlock and Pierce (2010) categorize firms into five levels of financial constraints. They test which variables explain management's perception of their level of constraint. Their results greatly reduce the number of variables associated with financially constrained firms to size and age.

We develop a model which shows the relationship between investment, economic growth, and firm value for a financially constrained firm. Our model predicts that the marginal value of cash for financially constrained firms increases with investment opportunities and economic growth. The positive relationship between investment and cash also implies that the market value of cash decreases during economic contractions. Figure 1 shows the estimated market value of an additional \$1 of cash from 1971 to 2009. The general upward trendline suggests that the marginal value of cash has increased due to changing firm characteristics. However, Figure 1 also shows substantial variation around the trendline with very high market values of cash during the early 1990s, around 2000, and most recently before the financial crisis. The value of cash appears to be positively associated with states of economic growth and negatively related to states of economic contraction.

[5] If a firm has a low bankruptcy risk due to other projects or collateral, then the firm can obtain debt financing by pledging those assets to finance the growth option. Consistent with this line of reasoning, Duchin (2010) finds that multidivision firms hold less cash than stand-alone firms.

Overall, Figure 1 suggests that the marginal value of cash generally increases between 1971 through 2009 and is positively associated with states of economic expansion.

Using a sample of U.S. firms from 1971-2009 and by extending the specification of Faulkender and Wang (2006), we decompose the effect of cross-sectional characteristics and macroeconomic variables on the changing market value of firm cash holdings. We find the marginal value of an increase of $1 in cash holdings is

i) 25.6¢ higher for firms in the smallest sales tercile that engage in R&D (relative to the smallest tercile firms that don't engage in R&D and all other firms),

ii) 11.3¢ higher during the top tercile of GDP growth (relative to the middle and bottom terciles of GDP growth),

iii) 25.3¢ higher for firms in the top tercile by year in investment intensity[6] (relative to the middle and bottom terciles of investment intensity), and

iv) unrelated to aggregate financial constraints as measured by the intensity of Seasoned Equity Offerings (SEOs) or the yield spread (Baa - Aaa bond yields).

In summary, we find that both cross-sectional changes in firm composition and time variation in macroeconomic variables affect the marginal value of firm cash holdings. Overall, our evidence suggests that high market values of cash are associated with investment opportunities and not precautionary savings.

Our study complements other studies that explore the relationship between investment and cash holdings. Simutin (2010) studies the relationship between excess cash holdings and market returns. He finds that firms with relatively high excess cash earn higher subsequent returns (on average) and invest more than firms with relatively low excess cash. Overall, he concludes that excess cash holdings are a proxy for growth options. We provide additional insights into his empirical findings. First, our model shows a positive relationship between firm value, cash, and economic growth for a financially constrained firm. Secondly, our empirical tests pinpoint the positive inter-relationship between the marginal value of cash, GDP growth, and firm characteristics related to

[6] We measure investment intensity as CAPEX (Capital Expenditures) to Total Assets.

financial constraints. Chung, Jung, and Park (2011) investigate the effect of changes in the cross-sectional characteristics on the market value of cash. We complement their findings by showing that time variation in the marginal value of cash is related to changes in the macroeconomy. Denis and Sibilkov (2010) show that financially constrained firms use cash to engage in value enhancing projects. We show that the value of cash is procyclical.

Our study also contributes to other strands of the cash literature. Fresard (2010) shows a positive affect of cash holdings on strategic market outcomes such as future market share. Our finding regarding the positive relationship between GDP growth, capital expenditure, and value is also supportive of firms strategically using cash to impact the product market through the channel of investment.

We proceeds as follows. Section 2 develops a model of the market value of cash for a financially constrained firm. Section 3 develops the hypotheses. Section 4 constructs the sample and defines the variables. Section 5 discusses the testing strategy and provides empirical results. Section 6 discusses possible alternative interpretations and conducts robustness tests. Section 7 concludes.

2 Financial Constraints and the Market Value of Cash

In this section, we model interaction of changes in cash and economic growth on firm value. We assume the firm is financially constrained and has a future investment opportunity.

2.1 Basic Set-up

We modify the continuous-investment model set-up of Tirole (2006, page 127) by adding declining returns to scale from the investment with next period cash flow proportional to economic growth. Specifically, we assume the cash flows generated from the project are a function of the investment as follows

$$\widetilde{CF}_{t+1}(I_t) = \widetilde{M}_{t+1} I_t^{\alpha}, \tag{1}$$

where $M > 0$ is the effect of macroeconomic conditions on the project cash flows and $I > 0$ the investment in the project. We further define the effect of macroeconomic conditions on the project cash flows as

$$\widetilde{M} = 1 + \beta\tilde{\gamma} \tag{2}$$

where $\tilde{\gamma}$ represents random economic growth and β represents the sensitivity of the product market to economic growth.

If the firm invests I at t, then the firm receives the realization of a random cash flows $\widetilde{CF}_{t+1}$ at $t+1$. If $\tilde{g}$ is the random perpetual growth rate of the cash flows after $t+1$, then the firm receives at $t+1$ the realization of $\widetilde{CF}_{t+1} = \widetilde{CF}_1(1+\tilde{g})$ implying the value of the investment at t is

$$V_t = -I_t + \frac{E_t[CF_{t+1}]}{r-g}, \tag{3}$$

where r is the risk adjusted required rate of return and $E_t[\tilde{g}] = g$.

2.2 Timeline and Assumptions

To focus on the effect of macroeconomic conditions on firm valuation, we model the value of firm based on the following timeline.

- At $t = 0$ the firm holds cash C_0, which it invests at the risk free rate r_f until $t = 1$.
- At $t = 1$ the firm:
  (a) Receives the realization of cash flow from $\widetilde{CF}_1$, and
  (b) Decides whether to invest (up to the stock of cash at $t = 1$) in a project.
- At $t = 2$ (Conditional on investing at $t = 1$) the firm:
  (a) Receives the realization of cash flow $\widetilde{CF}_2(I_1) = \widetilde{M}_2 I_1^{\alpha}$, and
  (b) The realized cash flow grows at a rate of g from $t = 2$ to infinity.

To focus the model on the relationship between financing constraints and economic growth, we make the following simplifying assumptions.

i) There are no taxes.

ii) The risk adjusted discount rate r is constant (risk preferences and the market price of risk do not change).

iii) All cash flows to the firm after $t = 1$ are due strictly to the investment at $t = 1$.

iv) Cash flows increase with the size of the investment, but at a decreasing rate. (We assume $0 < \alpha < 1$ which implies $\frac{\partial CF}{\partial I} > 0$ and $\frac{\partial^2 CF}{\partial^2 I} < 0$)

2.3 The Optimal Investment Decision without Financial Constraints

In a world without financial constraints, the firm would choose I to maximize the expected NPV of the project at $t = 1$. Let I^* denote the optimal choice of investment. The firm is financially constrained whenever $C_1 < I^*$.

To solve for the optimal investment, we find the expression for the NPV of the project at $t = 1$ and then solve for the firm's optimal choice of I. Because the investment is funded using cash, we re-write the investment choice as the amount of cash C that the firm invests at $t = 1$. Substituting (2) into (1) and C for I, we find

$$\begin{aligned} \widetilde{CF}_2(I_1) &= \widetilde{M} I_1^{\alpha} \\ &= (1 + \beta\tilde{\gamma})(C)^{\alpha}, \end{aligned} \tag{4}$$

which expresses the expected cash flow to the firm at $t = 2$. Letting $E[\tilde{\gamma}] = \gamma$, we find the expected value of the firm at $t = 1$ is

$$V_1 = E_1[V] = \frac{(1 + \beta\gamma)(C)^{\alpha}}{r - g}, \tag{5}$$

where g is the expected growth rate. Using (5), we express the NPV of the project at $t = 1$ as

$$\begin{aligned} NPV_1 &= PV_1 - I_1 \\ &= \frac{(1 + \beta\gamma)(C)^{\alpha}}{r - g} - C. \end{aligned} \tag{6}$$

In Appendix A, we solve for the C^* that maximizes (6) to find

$$C^* = \left(\frac{r-g}{\alpha(1+\beta\gamma)}\right)^{\frac{1}{\alpha-1}}. \tag{7}$$

Because C^* represents the optimal investment, the firm is financially constrained if $C_1 < C^*$.[7]

2.4 The Relationship between Cash, Investment and Economic Growth

Using this set-up, we analyze the effect of cash and economic growth on market valuations. We proceed by assuming the firm is financially constrained. First we find the firm's expected cash holdings at $t = 1$. Because the firm earns the risk free rate r_f on cash held from $t = 0$ until $t = 1$, the expected cash holdings at $t = 1$ is

$$\begin{aligned} \widetilde{C}_1 &= C_0(1+r_f) + \widetilde{CF}_1 \\ &= C_0 + r_f C_0 + \widetilde{CF}_1 \\ &= C_0 + \Delta\widetilde{C}, \end{aligned} \tag{8}$$

where $\Delta\widetilde{C} = r_f C_0 + \widetilde{CF}_1$. Substituting (8) into (5), we find

$$V_1 = E_1[V] = \frac{(1+\beta\gamma)(C_0+\Delta C)^{\alpha}}{r-g}, \tag{9}$$

which expresses the value of the firm in terms of both the level and changes in cash at $t = 2$.

To understand the relationship between the value of the firm and changes in cash, we take the partial derivative of (9) with respect to ΔC to find

$$\frac{\partial V_1}{\partial \Delta C} = \frac{\alpha(1+\beta\gamma)}{(r-g)(C_0+\Delta C)^{1-\alpha}}. \tag{10}$$

Because of the positive relationship between cash and investment, $\frac{\partial V_1}{\partial \Delta C} > 0$ if $\beta > 0$, $r > g$, and $|\Delta C| > C_0$.

[7] We show in Appendix A that (6) is concave in C.

To understand the relationship between the value of the firm, changes in cash,and both economic and firm growth, we take the cross-partial derivatives of (10) with respect to γ, g, and β to find

$$\frac{\partial V_1}{\partial \Delta C \partial \gamma} = \frac{\alpha\beta}{(r-g)(C_0+\Delta C)^{1-\alpha}} \tag{11}$$

and

$$\frac{\partial V_1}{\partial \Delta C \partial g} = \frac{\alpha(1+\beta\gamma)}{(r-g)^2(C_0+\Delta C)^{1-\alpha}} \tag{12}$$

and

$$\frac{\partial V_1}{\partial \Delta C \partial \beta} = \frac{\gamma(C_0+\Delta C)^{\alpha}}{r-g}. \tag{13}$$

All the cross partial derivatives in (11) through (13) are positive.[8] First, the interaction between the marginal value of cash and economic growth is positive, which is consistent with the value of cash increasing in periods of economic expansion (and decreasing in periods of economic contraction). We empirically test this insight later in the paper. Second, the interactions between the marginal value of cash and both β (the sensitivity of the investment to economic growth) and g (the expected growth rate in cash flow from the investment) are positive. For both levels and changes of cash, Pinkowitz and Williamson (2007) empirically supports these latter two implications.[9]

3 Development of the Propositions

Faulkender and Wang (2006) show that the value of holding a dollar of cash is higher for financially constrained than financially unconstrained firms. Using management comments in SEC filings, Hadlock and Pierce (2010) categorize firms into five levels of financial constraints. They test which variables explain management's perception of their level of constraints and compare their findings to measures previously used in the literature. Hadlock and Pierce (2010) results greatly reduce the number of variable associated with financially constrained firms to size and age. Consistent with age and size as measures of financial constraints, Brown and Petersen (2010) show that young

[8] As above, this holds when $\beta > 0$, $r > g$, and $|\Delta C| > C_0$

[9] Pinkowitz and Williamson (2007) find that risky industries such as computer software have the highest market value of cash and that firms with high sales growth have higher market values of cash.

firms use cash holdings to smooth R&D expenses. The evidence of these two studies implies the following proposition.

Proposition 1. *The market value of a dollar of cash is highest for small R&D intensive firms.*

Faulkender and Wang (2006) and Pinkowitz and Williamson (2007) both show that the market value of a firm's cash holdings varies with cross-sectional firm characteristics. Bates et al. (2009) show that from 1980 until 2006 the cross-sectional characteristics of listed firms changed. Brown, Fazzari, and Petersen (2009) and Brown and Petersen (2010) point to the increasing prevalence of R&D intensive firms and the associated importance of cash financing for these firms. The evidence of the linkage between firm characteristics and cash holdings combined with the changing nature of listed firms implies the following propositions:

Proposition 2. *The market value of a dollar of cash varies over time.*

Bernanke and Gertler (1989) model the relationship between agency costs, net worth, and business fluctuations. Because of agency costs, a firm uses collateral to borrow. In aggregate, the value of a borrowers collateral (i.e. net worth) is positively correlated with economic growth, implying borrowing capacity increases in economic expansions and declines in economic contractions. Hence, in contracting economic states firms may be unable to finance positive NPV projects. In contrast, a firm that holds cash during declining economic states may still be able to invest in the positive NPV project. From this perspective, cash serves to overcome the agency costs, implying the marginal value of cash should increase during economic contractions.

Riddick and Whited (2009) model the dynamic trade-off between the tax penalty of holding cash and the issuance costs associated with financing possible future investments. If a firm holds cash to maintain the flexibility to execute on an uncertain future growth option, then the market value of cash is positively correlated with the value of that growth option. To show the connection between macroeconomic growth and the value of an investment at a future state (i.e. growth option), we model in Section 2 a financially constrained firm with a stock of cash, whose value is based on a future investment opportunity. Equation (10) predicts that the value of the firm is positively associated with the interaction of the changes in cash and GDP growth.

Using cash as an ongoing strategy to fund projects suggests a positive relationship between the market value of cash and economic expansion. In contrast, using cash as a temporary strategy to fund projects during periods of economic contraction suggests a positive relationship between the market value of cash and economic contractions. Like the theory, our next proposition is ambiguous.

Proposition 3. *Changing macroeconomic conditions partially explain the market value of a dollar of cash holdings. The market value of firm cash holdings for financially constrained firms increases: i) during periods of economic expansion; or alternatively ii) during periods of economic contraction.*

Bates et al. (2009) find that increased use of R&D, increased earnings volatility, improved operational efficiency (lower Net Working Capital less Cash), and lower capital expenditure intensity are the main factors leading to firms holding more cash between 1980 and 2006. Ex-ante it is not clear if these cross-sectional changes affect the marginal value of holding cash. For example, engagement in R&D itself may not increase the marginal value of cash, but small firms that engage in R&D firms are likely financially constrained (due to their uncertain cash flows) and therefore have relatively high marginal values of cash. We formalized this idea in Proposition 1. Secondly, we don't have a theoretical basis to predict a relationship between the marginal value of cash and improved operational efficiency. Lastly, in Section 2 we model the relationship between changes in cash, investment, and firm value for a financially constrained firm. By (9) there is a positive relationship between the marginal value of cash and investment, which leads to the following proposition.

Proposition 4. *The market value of a dollar of cash increases with investment.*

4 Sample and Testing Specification

4.1 Sample

We construct our sample using data from the CRSP Compustat Annual, CRSP Monthly, Ken French Web Site, St. Louis Federal Reserve Economic Data (FRED), and SDC Platinum. Using the CRSP Compustat annual dataset, we drop (i) financials (6000<SIC<6999), (ii) utilities (4000<SIC<4999), (iii) firms with negative revenue (revt<0), and (iv) firms with negative assets (at<0).

Because firms use different fiscal years to report their financial results, we merge variables from other datasets by month and year. For example, to merge market variables with accounting data, we first construct rolling 12 month geometric returns and then merge by year and month (and by permno if firm specific) the (i) 12 month geometric rolling return of the Value Weighted CRSP index, (ii) 12 month geometric rolling returns of the Fama-French SMB, HML, and Excess Market Return, and (iii) 12 month rolling return of each firm from CRSP.

Because the dataset contains duplicate observations due to dual-class firms, we drop the lower share class. Specifically, each observation is unique by year, month, and permno, but not by year, month, and permco (or gvkey). Because we don't want to over-represent dual class firms, we drop the lower share class.[10] After dropping the share class, each observation is unique by year, month, and either permco, gvkey, or permno.

We next merge macroeconomic variables into the dataset. We merge yield spread by year and month. For GDP growth, we use quarterly data and then construct annual rolling quarterly GDP growth and merge by quarter and year into our dataset. Using SDC Platinum, we obtain Seasoned Equity Offerings (SEOs). We employ several filters. We drop all financials and utilities and then construct a measure of SEO activity by calendar year. We merge by year.

If a firm doesn't report a variable, Compustat codes the variable as missing. For example, if a firm fails to report R&D, Compustat codes the variable as missing. A standard convention is to set this variable to zero if missing. To avoid dropping observations, we change Compustat variables reported from missing to zero when Compustat records a value for cash and marketable securities. For example, if Compustat records R&D as missing, but reports a value for cash and marketable securities then we change R&D from missing to zero.

Table 1 provides variable definitions. We construct each variable as follows: (i) construct the variable (e.g. NA = at - che); (ii) deflate the variable using January 2001 CPI; and (iii) winsorize at 1% in both tails. We do not winsorize the market value of equity and use the nominal market

[10] Compustat reports the same accounting variables for both classes of firms. The returns in CRSP are almost identical.

value of equity to match to the Fama-French breakpoints. Our final sample consists of 113,995 firm years from 1971-2009, which includes 89,068 firm years from 1972-2001.[11]

4.2 Market Value of Cash Specification

To estimate the market value of a firm's cash holdings, Faulkender and Wang (2006, p. 1967) define the following specification:

$$\begin{aligned} r_{i,t} - R^B_{i,t} = \gamma_0 &+ \gamma_1 \frac{\Delta C_{i,t}}{M_{i,t-1}} + \gamma_2 \frac{\Delta E_{i,t}}{M_{i,t-1}} + \gamma_3 \frac{\Delta NA_{i,t}}{M_{i,t-1}} + \gamma_4 \frac{\Delta RD_{i,t}}{M_{i,t-1}} \\ &+ \gamma_5 \frac{\Delta I_{i,t}}{M_{i,t-1}} + \gamma_6 \frac{\Delta D_{i,t}}{M_{i,t-1}} + \gamma_7 \frac{C_{i,t-1}}{M_{i,t-1}} + \gamma_8 L_{i,t} + \gamma_9 \frac{NF_{i,t}}{M_{i,t-1}} \\ &+ \gamma_{10} \frac{C_{i,t-1}}{M_{i,t-1}} * \frac{\Delta C_{i,t}}{M_{i,t-1}} + \gamma_{11} * L_{i,t} \frac{\Delta C_{i,t}}{M_{i,t-1}} + \epsilon_{i,t} \end{aligned} \tag{14}$$

where

i) $M_{i,t}$ is the market value of equity in fiscal year t.

ii) $r_{i,t} - R^B_{i,t}$ is the return of firm $i's$ stock during fiscal year t less the return of the size and book to market matched 25 Fama-French portfolio.

iii) $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ is the change in cash holdings for firm i during fiscal year t scaled by the market value of equity in year $t-1$.

iv) $\frac{\Delta E_{i,t}}{M_{i,t-1}}$ is the change in earnings for firm i during fiscal year t scaled by market value of equity in year $t-1$. Earnings are equal to earnings before extraordinary items plus interest, deferred tax credits, and investment tax credits.

v) $\frac{\Delta NA_{i,t}}{M_{i,t-1}}$ is the change in total assets net of cash for firm i during fiscal year t scaled by market value of equity in year $t-1$.

vi) $\frac{\Delta RD_{i,t}}{M_{i,t-1}}$ is the change in research and development expenditures for firm i during fiscal year t scaled by market value of equity in year $t-1$. R&D expenditures are set to zero if missing.

[11] Faulkender and Wang (2006) sample from 1972-2001 consists of 82,187 firm years. Because we follow most of the same data filters, our larger sample may be due in part to winsorizing versus trimming the data.

vii) $\frac{\Delta D_{i,t}}{M_{i,t-1}}$ is the change in dividends for firm i during fiscal year t scaled by market value of equity in year $t-1$. Dividends are common stock dividends paid.

viii) $\frac{C_{i,t-1}}{M_{i,t-1}}$ is cash holdings plus marketable securities for firm i during fiscal year $t-1$ scaled by the market value of equity in year $t-1$.

ix) $L_{i,t}$ is total debt divided by the sum of total debt and the market value of equity.

x) $\frac{NF_{i,t}}{M_{i,t-1}}$ is net financing for firm i during fiscal year t scaled by the market value of equity in year $t-1$. Net financing is total equity issuance minus repurchases plus debt issuance minus debt redemption.

In specification (14), ΔX implies an unexpected change in a variable. Using three alternative specifications for unexpected changes in cash, Faulkender and Wang (2006) find the effect of actual changes (versus unexpected) are qualitatively similar (similar statistical significance and economic magnitude). Based on these findings, we use and denote ΔX as the actual changes throughout the rest of this paper.

Faulkender and Wang (2006) interact $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ with both $\frac{C_{i,t-1}}{M_{i,t-1}}$ and $L_{i,t}$ to and find the marginal value of cash (i) decreases with the level of cash ($\gamma_{10} < 0$), and (ii) decreases with leverage ($\gamma_{11} < 0$). In addition, they find that the value of \$1 of additional cash γ_1 is higher for financially constrained than unconstrained firms.[12] To test our propositions, we include additional explanatory varables in (14) and using the approach of Faulkender and Wang (2006) test for statistical significance of the interaction term.

We simplify the notation in (14) by defining β as

$$\begin{aligned}\beta(\cdot) &= \frac{\partial(r_{i,t} - R^B_{i,t})}{\partial(\Delta C_{i,t})} \\ &= \gamma_1 + \gamma_{10}\frac{C_{i,t-1}}{M_{i,t-1}} + \gamma_{11}L_{i,t}, \qquad (15)\end{aligned}$$

[12] Faulkender and Wang (2006) measure financial constraints using by payout ratio, firm size, bond rating, and commercial paper rating.

and then we re-writing (14) as

$$r_{i,t} - R^B_{i,t} = \alpha + \beta(\cdot)\frac{\Delta C_{i,t}}{M_{i,t-1}} + X\gamma + \epsilon_{i,t} \tag{16}$$

where γ is a column vector of the coefficients γ_2 through γ_9 in (14) and X represents the associated control variables.

As an alternative to (16), we also estimate:

$$r_{i,t} - R^{TBill}_t = \alpha + \beta(\cdot)\frac{\Delta C_{i,t}}{M_{i,t-1}} + FCTR\phi + X\gamma + \epsilon_{i,t} \tag{17}$$

where $FCTR$ are the Fama and French (1993) pricing factors $R^{VWCRSP}_t - R^{TBill}_t$, SMB_t, and HML_t and ϕ the column vector of associated coefficients. Using fixed effect panel regression with standard errors clustered by firm, we estimate (16) and (17). Table 3 shows the results. In columns (1) and (2), we estimate with $\beta(\cdot) = \gamma_1$ and in columns (3) through (6), we estimate with $\beta(\cdot) = \gamma_1 + \gamma_{10}\frac{C_{i,t-1}}{M_{i,t-1}} + \gamma_{11}L_{i,t}$. In columns (5) and (6) we include year dummies. Table 3 shows that the overall R^2 of the of specification (17) is over twice as large as specification (16). For example, the overall R^2 in column (5) is 0.082 and in column (6) is 0.199. Because of the large improvement in R^2, we use (17) as our baseline specification in the rest of the paper.[13]

5 Hypothesis Testing Results

5.1 The Effect of Size and R&D on the Marginal Value of Cash

To test Proposition 1, we estimate (17) by size and R&D subsample. In the subsample analysis, we let $\beta(\cdot) = \gamma_1 + \gamma_{10}\frac{C_{i,t-1}}{M_{i,t-1}} + \gamma_{11}L_{i,t}$. The variable of interest is $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ with associated coefficient γ_1. Using indicator variables, we then test for the statistical significance of the differences between subsample estimates of γ_1.

[13]The large improvement in R^2 is due to both a reduction in measurement error (the benchmark return is an estimate and therefore subject to measurement error) and the inclusion of the market return as an independent variable in (17). Faulkender and Wang (2006) note in a footnote that they obtain qualitatively the same marginal value of cash using either the benchmark portfolio approach or using pricing factors as in (17).

First, we assign each firm to size (by revenue) terciles by year and estimate (17) by size[14] Columns (1) and (2) of Table 4 show qualitatively large differences between $\hat{\gamma}_1$ for small and large firms (0.596 vs 0.267), which is consistent with small firms being financially constrained. To test if the difference between $\hat{\gamma}_1$ for small and large firm subsamples is statistically significant, we construct

i) $\textit{Small Dummy}_{i,t}$, which is set to one if firm i is in the smallest tercile in sales during fiscal year t, and

ii) $\frac{\Delta C_{i,t}}{M_{i,t-1}} * \textit{Small Dummy}_{i,t}$, which is the interaction of $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ and $\textit{Small Dummy}_{i,t}$ for firm i during fiscal year t.

Importantly, Column (3) of Table 4 shows the coefficient associated with the interaction $\frac{\Delta C_{i,t}}{M_{i,t-1}} * \textit{Small Dummy}_{i,t}$ is 0.214 and is significant at the 1% level. This result suggests that the marginal value of $1 of cash for firms in the smallest sales tercile is 21.4¢ higher than for firms in the largest sales tercile.

Second, we divide firms into ones that engage and do not engage in R&D. Columns (4) and (5) of Table 4 show qualitatively large differences between $\hat{\gamma}_1$ (0.742 vs 0.318) for firms that engage and don't engage in R&D, respectively. To test if the difference between the two estimates of $\hat{\gamma}_1$ is statistically significant, we construct

iii) $\textit{R\&D Dummy}_{i,t}$, which is set to one if firm i conducts R&D during fiscal year t, zero otherwise, and

iv) $\frac{\Delta C_{i,t}}{M_{i,t-1}} * \textit{R\&D Dummy}_{i,t}$, which is the interaction of $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ and $\textit{R\&D Dummy}_{i,t}$ for firm i during fiscal year t.

Interestingly, Column (6) of Table 4 shows that we fail to reject that both $\textit{R\&D Dummy}_{i,t}$ and $\frac{\Delta C_{i,t}}{M_{i,t-1}} * \textit{Small Dummy}_{i,t} * \textit{R\&D Dummy}_{i,t}$ are statistically different from zero, implying, engagement in R&D is not a sufficient condition for whether firm is financially constrained.

Lastly, we test the whether R&D and size have a joint effect on the marginal value of cash. To test the joint effect, we construct

[14]Note that our assignment method accomodates firms changing size tercile assignments over the sample period.

v) *Small Dummy*$_{i,t}$ * *R&D Dummy*$_{i,t}$, which is the interaction of *Small Dummy*$_{i,t}$ and *R&D Dummy*$_{i,t}$ for firm i during fiscal year t, and

vi) $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *Small Dummy*$_{i,t}$ * *R&D Dummy*$_{i,t}$, which is the triple interaction of $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ with *Small Dummy*$_{i,t}$ and *R&D Dummy*$_{i,t}$ for firm i during fiscal year t.

We include all the variables (i-vi) constructed above and estimate (17). Column (7) of Table 4 reports the results. In the presence of the triple interaction, the coefficient associated with $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *Small Dummy*$_{i,t}$ falls from 0.214 in Column (3) to 0.136 and is no longer statistically significant (at least at the 10% level). Most importantly, the coefficient associated with $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *Small Dummy*$_{i,t}$ * *R&D Dummy*$_{i,t}$ is 0.264 and is significant at the 5% level. These results suggests that the marginal value of \$1 of cash for firms in the smallest sales tercile is 13.6¢ higher than for firms in the largest sales tercile and 40¢ (13.6¢ + 26.4¢) higher for small firms that conduct R&D. Overall, these results provide both statistically and economically meaningful support of Proposition 1 – small firms that engage in R&D have higher marginal values of cash.

5.2 Does the Marginal Value of Cash Change over Time?

We test Proposition 2, using two approaches. First, we estimate our base specification by year and sub-sample and provide the results both graphically and in tabular format. Second, we include both year dummies and the interaction of the year dummies with $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ in the base specification. If the marginal value of cash changes over time, then these interactions should be statistically significant.

In our first approach, we set $\beta(\cdot) = \gamma_1 + \gamma_{10}\frac{C_{i,t-1}}{M_{i,t-1}} + \gamma_{11}L_{i,t}$ and estimate (17) by year from 1971-2009 and by subsample. We denote $\hat{\beta}_V(\cdot)$ as a column vector of the yearly estimates of γ_1 and use the subscript V to denote a vector of estimates. Table 5 shows $\hat{\gamma}_1$ and the corresponding t-statistic by year and subsample. The table also reports the means of $\hat{\gamma}_1$ and the associated t-statistic from 1971-2099.

Estimates of $\hat{\gamma}_1$ vary by both time and subsample. Consistent with the cross sectional analysis, firms from the smallest sales tercile that engage in R&D have the highest average marginal value of cash. Also, estimates of $\hat{\gamma}_1$ tend to be higher in periods of economic expansion and low during periods of economic decline. For example, during 2007 $\hat{\gamma}_1$ for each subsample is greater than one; yet during the financial crisis of 2008 the highest estimate of $\hat{\gamma}_1$ in any subsample is 0.61. To illustrate how the marginal value of cash varies over time, we plot in Figure 1 $\hat{\gamma}_1$ for the entire sample per year from 1971 to 2009. The figure shows a general upward trend with substantial variation around the trend. The highest marginal values of cash occur during the early 1990s, around 2000, and most recently before the financial crisis. Interestingly, the marginal value of cash appears to be positively related to states of economic growth and negatively related to states of economic decline. Overall, the figure shows the market value of cash trending upward from 1971-2009 and peaking during expanding economic states.

In our second approach, we investigate whether changes in the marginal value of cash are statistically significant. We construct the interaction of $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ with $\textit{Year Dummy}_{i,t}$ and estimate (17) with both $\textit{Year Dummy}_{i,t}$ and $\frac{\Delta C_{i,t}}{M_{i,t-1}} * \textit{Year Dummy}_{i,t}$. We reject that the coefficients associated with $\frac{\Delta C_{i,t}}{M_{i,t-1}} * \textit{Year Dummy}_{i,t}$ are jointly equal to zero at the 1% level of significance. In addition to joint signficance, many of the coefficients associated with $\frac{\Delta C_{i,t}}{M_{i,t-1}} * \textit{Year Dummy}_{i,t}$ are individually significant – six at the 1% level, eleven at the 5% level, and five at the 10% level. Overall, the statistical evidence supports Proposition 2 that the market value of cash changes over time.

5.3 The Effect of Macroeconomic Conditions on the Marginal Value of Cash

To test Proposition 3, we estimate (17) and set

$$\beta(\cdot) = \gamma_1 + \gamma_{10}\frac{C_{i,t-1}}{M_{i,t-1}} + \gamma_{11}L_{i,t} + \lambda MACRO, \tag{18}$$

where $MACRO$ represents the set of macroeconomic variables and λ the vector of associated coefficients. We follow Hadlock and Pierce (2010) who find yield spread, SEO (Seasoned Equity Offers) and GDP growth explain the probability a firm is financially constrained and construct the following $MACRO$ variables:

i) $\textit{Yield Spread}_t$ is yield of a Baa bond less the yield of a Aaa bond as of the month end of the fiscal year-end for firm i.

ii) *SEO Activity*$_t$ is the number of Seasoned Equity Offerings (SEOs) during year t divided by the number of firms in Compustat at the beginning of year t.

iii) *GDP Growth*$_t$ is the natural log of real GDP in fiscal year t less the natural log of real GDP in fiscal year $t-1$.

Higher *Yield Spread*$_t$ is associated with increased bankruptcy risk and higher costs of financing. Likewise, low SEO activity is associated with more difficulty in obtaining equity financing. We construct *GDP Growth*$_t$ quarterly and match to the quarter of the fiscal year-end of firm i. Almeida, Campello, and Weisbach (2004) use GDP growth to explain time variation in firm's propensity to save cash from generated cash flow.[15]

Panel A of Table 6 shows summary statistics for the macroeconomic variables. The mean *Yield Spread*$_t$ is 0.0118, the mean *GDP Growth*$_t$ growth is 0.0291, and the mean *SEO Activity*$_t$ is 0.0839. Panel B of Table 6 provides the pairwise correlations between the variables. *GDP Growth*$_t$ is strongly negatively correlated with *Yield Spread*$_t$. During periods of economic expansion there is a lower risk of default and hence *Yield Spread*$_t$ decreases. Likewise, *SEO Activity*$_t$ is modestly positively correlated with *GDP Growth*$_t$ and negatively correlated with *Yield Spread*$_t$.

Table 7 reports estimation results of (18) for each macroeconomic variable. The main variable of interest is the interaction of $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ with each macroeconomic variable. Column (1) reports results using the base specification and the yield spread variables. The interaction $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *Yield Spread*$_t$ is negative and significant at the 10% level. The negative coefficient implies that the marginal value of cash declines when aggregate credit risk increases (i.e. the yield spread increases) or equivalently the the marginal value of cash increases as credit risk declines. However, Column (4) shows that in the presence of the other macroeconomic variables, we fail to reject that $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *Yield Spread*$_t$ is equal to zero. Overall, the negative effect of *Yield Spread*$_t$ on the marginal value of cash is not robust to specification changes.

Column (2) of Table 7 reports results using the base specification and SEO variables. Interestingly, the coefficient associated with *SEO Activity*$_t$ is positive and significant at the 1% level,

[15] Almeida et al. (2004) estimate by year the sensitivity of cash levels to cash flow and then estimate the effect of macroeconomic variables in explaining that sensitivity. We estimate the effect of macroeconomic variables on the marginal value of cash in one step by including the macroeconomic variables in (18).

which is consistent with firms issuing equity during high market states. Columns (4), (6), and (7) show that *SEO Activity*$_t$ remains significant at the 1% level in specifications with the other macroeconomic variables. However, the coefficient associated with the interaction $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *SEO Activity*$_t$ is not statistically significant in any specification. One possible interpretation is that firms issue equity during high market states, build cash reserves and then use those cash reserves to fund future investments. This interpretation is consistent with the empirical findings of Brown and Petersen (2010).

Column (3) of Table 7 reports results using the base specification and GDP growth variables. Interestingly, the coefficient associated with *GDP Growth*$_t$ is statistically insignificant but the coefficient associated with the interaction $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *GDP Growth*$_t$ is positive and significant at the 5% level. Columns (4) shows that $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *GDP Growth*$_t$ remains signficant at the 5% level in specifications with the other macroeconomic variables. The positive and statistically significant coefficient associated with $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *GDP Growth*$_t$ supports the idea that the market value of cash is positively associated with investment opportunities as predicted in (11). To document the economic magnitude of changes in GDP, we construct

iv) *High GDP Dummy*$_{i,t}$, which is set to one if firm i is in the highest tercile of GDP growth, zero otherwise,

v) $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *High GDP Dummy*$_{i,t}$, which is the interaction of $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ with *High GDP Dummy*$_{i,t}$ for firm i,

vi) *Low GDP Dummy*$_{i,t}$, which is set to one if firm i is in the lowest tercile of GDP growth, zero otherwise, and

vii) $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *Low GDP Dummy*$_{i,t}$, which is the interaction of $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ with *Low GDP Dummy*$_{i,t}$ for firm i.

Column (5) of Table 7 reports results using the base specification and GDP high dummy variables. Consistent with the results using the continuous variable, the coefficient associated with *High GDP Dummy*$_{i,t}$ is statistically insignificant but the coefficient associated with the interaction $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *High GDP Dummy*$_{i,t}$ is positive and significant at the 10% level. The coefficient estimate of 0.119

implies that the marginal value of $1 of cash for firms in the highest GDP growth tercile is 12¢ higher than for firms in the lowest two GDP growth terciles. Column (6) shows that in the presence of the other macroeconomic variables the estimated economic impact drops from 12¢ to 10¢.

To estimate the economic impact relative to the middle GDP growth tercile, we include both *Low GDP Dummy*$_{i,t}$ and $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ $*$ *Low GDP Dummy*$_{i,t}$ in the Column (7) specification. The estimates, although not statistically significant are consistent with Column (6) results, and imply that the marginal value of $1 of cash (relative to the middle GDP growth tercile) is: 7.9¢ higher for firms in the highest GDP growth tercile and 6.3¢ lower than firms in the lowest GDP growth tercile. Relative to Proposition 3, which was agnostic regarding about the effect of macroeconomic conditions on the market value of cash, our evidence strongly suggests that the market value of cash is positively associated with GDP growth and is consistent with the value of cash increasing as the value of firm investments increase.

5.4 The Effect of Firm Characteristics on the Marginal Value of Cash

We next test whether these cross-sectional changes in firm characteristics effect the marginal value of holding cash. To test Proposition 4, we estimate (17) and set

$$\beta(\cdot) = \gamma_1 + \gamma_{10}\frac{C_{i,t-1}}{M_{i,t-1}} + \gamma_{11}L_{i,t} + \delta FIRM, \tag{19}$$

where $FIRM$ represents the firm cross-sectional explanatory variables. Rejection of the null hypothesis that the coefficients δ are equal to zero provides support for Proposition 4.

We use the variables identified by Bates et al. (2009) as a starting point for possible explanatory variables. In this section, we follow Bates et al. (2009) and construct the following variables.

i) *NWC to Assets*$_{i,t}$ is net working capital less cash divided by total assets.

ii) *CapExp to Assets*$_{i,t}$ is capital expense to total assets.

iii) *R&D to Sales*$_{i,t}$ is research and development expense divided by total sales. If research and development is missing in Compustat then *R&D to Sales*$_{i,t}$ is set to zero.

We proceed by investigating whether changes over the sample period in *NWC to Assets*$_{i,t}$, *CapExp to Assets*$_{i,t}$, and *R&D to Sales*$_{i,t}$ are related to time variation in the marginal value of cash. Table 8 shows the mean and median by year of *NWC to Assets*$_{i,t}$, *CapExp to Assets*$_{i,t}$, and *R&D to Sales*$_{i,t}$. The table shows that firm characteristics change dramatically over the period. Mean *NWC to Assets*$_{i,t}$ declines from 0.235 in 1971 to 0.042 in 2009; mean *CapExp to Assets*$_{i,t}$ declines from 0.059 to 0.037; mean *R&D to Sales*$_{i,t}$ increases from 0.011 in 1971 to 0.2171 in 2009. All three variables are skewed, but the R&D variable is extremely skewed – over the sample period most firms do not engage in R&D yet the mean *R&D to Sales*$_{i,t}$ over the entire sample is 0.124. Overall these summary statistics indicate that over the 1971-2009 period firms improve their working capital management, become less capital intensive, and become more reliant on R&D.

Table 9 reports estimation results of (19). In Column (1), we fail to reject that $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *NWC to Assets*$_{i,t}$ is equal to zero, implying that improvements in operational efficiency did not make cash more valuable. In Column (2), we reject at the 1% level that $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *CapExp to Assets*$_{i,t}$ is equal to zero, which supports Proposition 4 – the positive relationship between investment and the marginal value of cash. To document the economic magnitude of the joint effect of changes in cash and capital expenditure, we construct

iv) *High CAPEX Dummy*$_{i,t}$, which is set to one if firm i is in the highest tercile of CAPEX to Assets in year t, zero otherwise, and

v) $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *High CAPEX Dummy*$_{i,t}$, which is the interaction of $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ with *High CAPEX Dummy*$_{i,t}$ for firm i.

Column (3) shows that the coefficient associated with $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *CapExp to Assets*$_{i,t}$ is 0.235 and is significant at the 1% level, implying the marginal value of $1 of cash for the firms in the top tercile of CAPEX intensity is 23.5¢ higher than for firms in the lower two terciles of CAPEX intensity. In Section 5.1, we show the importance of the joint effect of size and R&D on the marginal value of $1 of cash.

5.5 Statistical Significance and Economic Magnitudes with Full Specification

In this section, we investigate whether our statistically significant cross-sectional and macroeconomic variables remain significant if we estimate (17) with firm and macroeconomic explanatory variables. In Section 5.1, we find that the marginal value of cash is relatively higher for small R&D firms. In Section 5.3, we find that marginal value of cash is relatively higher in expanding economic states. We find consistent results for both continuous and indicator variables, but use the indicator variables to interpret the economic magnitude. To determine if the effects remain in a specification with all the explanatory variables, we set

$$\beta(\cdot) = \gamma_1 + \gamma_{10} \frac{C_{i,t-1}}{M_{i,t-1}} + \gamma_{11} L_{i,t} + \lambda MACRO + \delta FIRM \tag{20}$$

and estimate (17) where $FIRM$ represents the variables associated size, R&D, and CAPEX and $MACRO$ represents GDP growth. Column (4) of Table 9 shows that all the variables remain statistically significant and maintain qualitatively the same economic magnitude from earlier estimates.

6 Robustness and Discussion of Results

Pinkowitz and Williamson (2007) show that the market value of cash varies by industry. In our fixed effects specifications, the effect of industry should be absorbed into the the intercept; however, to further check our results, we assign each firm to one of 49 Fama-French industry groups and construct dummy variables for each industry group. We include industry dummies and estimate (20) using random effects.[16] Column (5) of Table 9 shows our results remain qualitatively unchanged.

Do firms really use cash to invest? In an international survey of CFOs, Lins, Servaes, and Tufano (2010) find that firms use lines of credit (rather than cash) to exploit possible business opportunities. This point of view appears contrary to the relationship between the market value of cash and economic growth. We find that the positive relationship between the market value of cash and economic growth is strongest in small R&D intensive firms. These firms are unlikely to have access to line of credit financing.

[16] We need to use random effects because of perfect collinearity between the intercept and the industry dummies.

7 Conclusion

We develop and test four propositions related to the changing market value of cash. We find qualitatively large and statistically significant changes in the market value of cash over the 1971-2009. We attribute those changes to both cross-sectional firm characteristics and macroeconomic conditions. We contrast the idea holding cash for precautionary purposes rather from investment opportunities. Our evidence strongly supports that investors more highly value cash holdings of financially constrained firms in good economic states when the value of the underlying investment is high.

In the WSJ article *Corporate Cash Hoards Offer Hope*, Barley (2011) writes,

> Time to splash the cash? The corporate dash for liquidity that started in 2008 and accelerated in 2009 is starting to reverse. Spending on capital goods, advertising and software is rising. With consumers deleveraging and governments feeling the pinch, corporate spending is the key to recovery. And the conditions may favor an acceleration.

This practitioner viewpoint associates cash holdings with investment, implying investors value cash holdings by the related investment opportunities.

Throughout this paper, we have implicitly assumed that engagement in R&D is a proxy for cash flow uncertainty. Because a lender bears the risk of default but not the upside gain of an uncertain future cash flow, cash flow uncertainty makes debt financing either expensive or difficult to obtain. The intensity of this financial constraint is exacerbated if a firm does not have other pledgable assets or cash flows. Firm size represents a clear proxy for pledgable assets. Our finding of the joint effect of size and R&D on the market value of cash is consistent with this interpretation. Faulkender and Wang (2006) construct ten year moving average of industry cash flow volatility, which is a useful measure to explain changes in cash holdings. Because our research question is focused on the effect of the marginal value of $1 of cash on firm value, we need an annual measure of changes in cash flow volatility. A possible extension of the paper includes developing a firm cash flow volatility measure and testing the interaction of that measure with changes in cash holdings.

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Appendices

A Derivations

Derivation 1. *Derivation of the optimal investment choice.*

Taking the derivative of (6) with respect to C, we find

$$\begin{aligned}\frac{\partial NPV}{\partial C} &= \frac{\partial}{\partial C}\left\{\frac{(1+\beta\gamma)C^{\alpha}}{r-g} - C\right\} \\ &= \frac{\alpha(1+\beta\gamma)C^{\alpha-1}}{r-g} - 1. \end{aligned} \tag{21}$$

Setting (21) to zero and re-arranging, we find

$$\begin{aligned} 1 &= \frac{\alpha(1+\beta\gamma)C^{\alpha-1}}{r-g} \\ C^{\alpha-1} &= \frac{r-g}{\alpha(1+\beta\gamma)} \\ C^{*} &= \left\{\frac{r-g}{\alpha(1+\beta\gamma)}\right\}^{\frac{1}{\alpha-1}}. \end{aligned} \tag{22}$$

Taking the second derivative of (6) with respect to C, we find

$$\frac{\partial^2 NPV}{\partial C^2} = \frac{(\alpha-1)\alpha(1+\beta\gamma)C^{\alpha-2}}{r-g},$$

which is negative if $\alpha < 1$, $r > g$, and $\beta\gamma > -1$. Therefore, C^{*} is a maximum for plausible parameter values and decreasing returns to scale ($0 < \alpha < 1$).

Derivation 2. *Derivation of break-even investment.*

Solving for C where (6) equals zero, we find

$$\begin{aligned} NPV &= \frac{(1+\beta\gamma)C^{\alpha}}{r-g} - C = 0 \\ C &= \frac{(1+\beta\gamma)C^{\alpha}}{r-g} \\ C^{1-\alpha} &= \frac{(1+\beta\gamma)}{r-g} \\ C &= \left\{\frac{(1+\beta\gamma)}{r-g}\right\}^{\frac{1}{1-\alpha}} \end{aligned} \tag{23}$$

Derivation 3. *Derivation of the comparison of optimal investment to the break-even investment.*

Solving for conditions where the optimal investment (22) is less than the break even investment (23), we find

$$\begin{aligned}
\left\{\frac{r-g}{\alpha(1+\beta\gamma)}\right\}^{\frac{1}{\alpha-1}} &< \left\{\frac{(1+\beta\gamma)}{r-g}\right\}^{\frac{1}{1-\alpha}} \\
(r-g)^{\frac{1}{\alpha-1}}(r-g)^{\frac{1}{1-\alpha}} &< (1+\beta\gamma)^{\frac{1}{\alpha-1}}(1+\beta\gamma)^{\frac{1}{1-\alpha}}\frac{1}{\alpha^{\frac{1}{1-\alpha}}} \\
\frac{(r-g)^{\frac{1}{1-\alpha}}}{(r-g)^{\frac{1}{1-\alpha}}} &< \frac{(1+\beta\gamma)^{\frac{1}{1-\alpha}}}{(1+\beta\gamma)^{\frac{1}{1-\alpha}}}\frac{1}{\alpha^{\frac{1}{1-\alpha}}} \\
1 &< \frac{1}{\alpha^{\frac{1}{1-\alpha}}} \\
\alpha^{\frac{1}{1-\alpha}} &< 1 \\
\alpha &< 1. \qquad (24)
\end{aligned}$$

Assuming decreasing returns to scale ($0 < \alpha < 1$), (24) implies the optimal investment is less than the break-even investment. Because (6) is increasing in C up to C^*, the highest expected NPV choice for the firm is to invest cash up to C^*. Essentially, the financial cash constraint binds for $C < C^*$.

Note that in the case of increasing returns to scale where $\alpha > 1$, it is always beneficially to increase investment. In this sense, the firm is always financially constrained if increasing returns to scale are assumed.

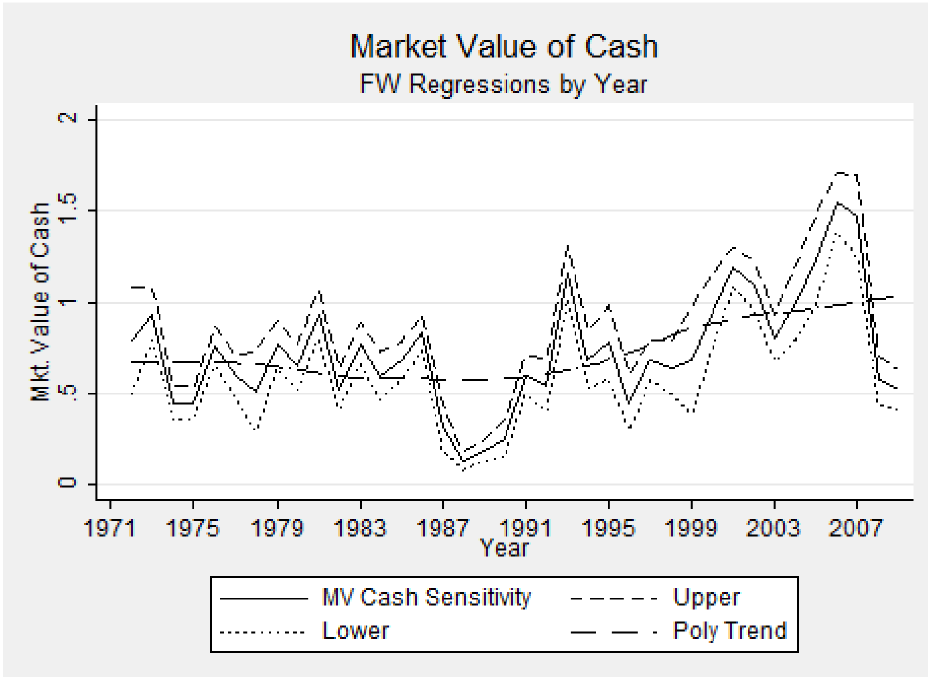

Figure 1: This figure plots the estimated market value of an additional $1 dollar of cash γ_1 from 1971-2009 from estimation results of Equation (14) by year. In addition, the figure plots the coefficient estimates plus and minus one estimated standard error by year. Also, the figure plots a kernel weighted local polynomial smoothing trend line.

Table 1: 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
$r_{i,t}$	12 month equity return of firm i at month t		CRSP
$R^B_{i,t}$	12 month equity return of the size and book to market matched portfolio B at month t. Portfolios are defined as the 25 Fama and French size and book to market portfolios.		Ken French Web Site
R_t^{VWCRSP}	12 month return of the CRSP value weighted portfolio at month t		CRSP
R_t^{TBill}	12 month return of the one month treasury bill at month t		
SMB_t	12 month return of the small minus big portfolio at month t	Ken French Web Site	
HML_t	12 month return of the high book to market minus the low book to market portfolios at month t	Ken French Web Site	
$C_{i,t}$	Cash plus marketable securities of firm i for the fiscal year t	CHE	Compustat
$E_{i,t}$	Earnings equals earnings before extraordinary items plus interest expense plus deferred tax credits plus investment tax credits of firm i for the fiscal year t	IB + XINT + TXDI + ITCI	Compustat
$NA_{i,t}$	Net assets equals total assets less cash holdings plus marketable securities of firm i for the fiscal year t	AT - CHE	Compustat
$RD_{i,t}$	Research and development of firm i for the fiscal year t	$RD_{i,t}$ is set to XRD or 0 if XRD is missing	Compustat
$I_{i,t}$	Interest expense of firm i for the fiscal year t	XINT	Compustat
$D_{i,t}$	Dividends of firm i for the fiscal year t	DVC	Compustat
$NF_{i,t}$	Net financing equals equity sales less equity repurchases plus long term debt issuance - long term debt reduction of firm i for the fiscal year t	SSTK - PRSTKC + DLTIS - DLTR	Compustat
$M_{i,t-1}$	Market value equity equals shares out times the stock price at fiscal year close of firm i for the fiscal year t	CSHPRI * PRCC_F	Compustat

Variable	Definition	Construction	Data Sources
$L_{i,t}$	Leverage is equal to total debt divided by the sum of total debt and the market value of equity of firm i for the fiscal year t	(DLTT + DLC) / (DLTT + DLC + MV Equity)	Compustat
$\textit{CF to Assets}_{i,t}$	Cash flow divided by total assets of firm i for the fiscal year t	(OIBDP - XINT - TXT - DVC) / AT	Compustat
$\textit{NWC to Assets}_{i,t}$	Net working capital less cash and marketable securities divided by total assets of firm i for the fiscal year t	(WCAP - CHE) / AT	Compustat
$\textit{CapExp to Assets}_{i,t}$	Capital expenditures divided by total assets of firm i for the fiscal year t	CAPX/AT	Compustat
$\textit{High CAPEX Dummy}_{i,t}$	Dummy set to one if firm i is in the highest tercile of CAPEX to Assets in year t, zero otherwise		Compustat
$\textit{R\&D to Sales}_{i,t}$	R&D to total revenue of firm i for the fiscal year t	XRD/REVT or 0 if XRD is missing	Compustat
$\textit{SEO Activity}_{t}$	SEO activity is the number of SEOs in the most recent calendar year divided by the beginning year number of firms in compustat		SDC Platinum and Compustat
$\textit{Yield Spread}_{t}$	Yield spread the is the difference between the Moody's Baa interest rate and the Aaa interest rate for the month that corresponds to fiscal year end		FRED
$\textit{GDP Growth}_{t}$	Change in log of real GDP between the most recent fiscal year and the immediately fiscal year.		FRED
$\textit{High GDP Dummy}_{i,t}$	Dummy set to one if firm i is in the highest tercile of GDP growth, zero otherwise		FRED
$\textit{Low GDP Dummy}_{i,t}$	Dummy set to one if firm i is in the lowest tercile of GDP growth, zero otherwise		FRED

Table 2: Summary Statistics

This table shows summary statistics from 1971-2008. The table reports the number of observations, mean, 25^{th} percentile, median, 75^{th} percentile, and standard deviation. Table 1 defines all variables.

Variable	Obs.	Mean	25^{th} Percentile	Median	75^{th} Percentile	SD
$r_{i,t} - R_{i,t}^{B}$	113,995	0.0044	-0.3585	-0.0894	0.2151	0.6154
$r_{i,t} - R_{t}^{TBill}$	113,995	0.0988	-0.3060	-0.0111	0.3288	0.6585
$R_{t}^{VWCRSP} - R_{t}^{TBill}$	113,995	0.0672	-0.0466	0.0990	0.2033	0.1819
SMB_t	113,995	0.0223	-0.0470	0.0168	0.0822	0.1096
HML_t	113,995	0.0498	-0.0337	0.0479	0.1249	0.1349
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$	113,995	0.0065	-0.0364	0.0000	0.0369	0.3248
$\frac{\Delta E_{i,t}}{M_{i,t-1}}$	113,995	0.0240	-0.0374	0.0055	0.0469	0.6744
$\frac{\Delta NA_{i,t}}{M_{i,t-1}}$	113,995	-0.0379	-0.1036	0.0118	0.1221	1.4468
$\frac{\Delta RD_{i,t}}{M_{i,t-1}}$	113,995	-0.0018	0.0000	0.0000	0.0009	0.0595
$\frac{\Delta I_{i,t}}{M_{i,t-1}}$	113,995	-0.0031	-0.0036	0.0000	0.0049	0.1455
$\frac{\Delta D_{i,t}}{M_{i,t-1}}$	113,995	-0.0002	0.0000	0.0000	0.0003	0.0610
$\frac{C_{i,t-1}}{M_{i,t-1}}$	113,995	0.1946	0.0359	0.0960	0.2201	0.4414
$L_{i,t}$	113,995	0.3204	0.0410	0.2074	0.4810	0.3542
$\frac{NF_{i,t}}{M_{i,t-1}}$	113,995	0.0353	-0.0320	0.0006	0.0687	0.9849

Table 3: Baseline Regressions

This table shows estimation results of fixed effects panel regression of Equations (16) and (17). Columns (1), (3), and (5) show estimation results using $r_{i,t} - R^B_{i,t}$ the dependent variable. Columns (2), (4), and (6) show estimation results using $r_{i,t} - R^{TBill}_t$ as the dependent variable and include the pricing factors $R^{VWCRSP}_t - R^{TBill}_t$, HML_t, and SMB_t as additional independent variables. Columns (3) through (6) include the interactions $\frac{C_{i,t-1}}{M_{i,t-1}} * \frac{\Delta C_{i,t}}{M_{i,t-1}}$ and $L_{i,t} * \frac{\Delta C_{i,t}}{M_{i,t-1}}$. Column (6) includes year dummies. Clustered standard errors are shown in parentheses with 1%, 5%, and 10% levels of significance denoted by *, **, and ***, respectively.

Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$	0.251***	0.258***	0.463***	0.475***	0.453***	0.461***
	(0.037)	(0.039)	(0.060)	(0.062)	(0.059)	(0.060)
$\frac{\Delta E_{i,t}}{M_{i,t-1}}$	0.091***	0.088***	0.091***	0.088***	0.088***	0.087***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
$\frac{\Delta NA_{i,t}}{M_{i,t-1}}$	0.022***	0.023***	0.024***	0.026***	0.024***	0.026***
	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
$\frac{\Delta RD_{i,t}}{M_{i,t-1}}$	0.021	-0.000	0.006	-0.015	0.017	0.002
	(0.069)	(0.070)	(0.073)	(0.075)	(0.072)	(0.073)
$\frac{\Delta I_{i,t}}{M_{i,t-1}}$	0.112	0.110	0.158	0.158	0.152	0.153
	(0.108)	(0.112)	(0.121)	(0.125)	(0.118)	(0.122)
$\frac{\Delta D_{i,t}}{M_{i,t-1}}$	0.114***	0.104***	0.104***	0.094**	0.102***	0.095***
	(0.036)	(0.037)	(0.036)	(0.038)	(0.036)	(0.037)
$\frac{C_{i,t-1}}{M_{i,t-1}}$	0.239***	0.249***	0.222***	0.231***	0.212***	0.223***
	(0.033)	(0.034)	(0.030)	(0.031)	(0.029)	(0.030)
$L_{i,t}$	-0.644***	-0.611***	-0.636***	-0.603***	-0.719***	-0.701***
	(0.012)	(0.013)	(0.013)	(0.013)	(0.012)	(0.013)
$\frac{NF_{i,t}}{M_{i,t-1}}$	0.073***	0.071***	0.055***	0.053***	0.055***	0.054***
	(0.013)	(0.013)	(0.011)	(0.011)	(0.011)	(0.011)
$\frac{C_{i,t-1}}{M_{i,t-1}} * \frac{\Delta C_{i,t}}{M_{i,t-1}}$			-0.008**	-0.008**	-0.008**	-0.008**
			(0.003)	(0.004)	(0.003)	(0.003)
$L_{i,t} * \frac{\Delta C_{i,t}}{M_{i,t-1}}$			-0.270***	-0.275***	-0.264***	-0.266***
			(0.055)	(0.056)	(0.053)	(0.054)
$R^{VWCRSP}_t - R^{TBill}_t$		0.997***		0.991***		1.161***
		(0.011)		(0.012)		(0.020)
HML_t		0.166***		0.165***		0.179***
		(0.017)		(0.017)		(0.031)
SMB_t		1.104***		1.105***		1.080***
		(0.021)		(0.020)		(0.042)
Constant	0.159***	0.141***	0.159***	0.141***	0.238***	0.181***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.013)	(0.013)
Observations	113,995	113,995	113,995	113,995	113,995	113,995
Year Dummies					Yes	Yes
Number of firms	11,715	11,715	11,715	11,715	11,715	11,715
Within R^2	0.096	0.228	0.102	0.233	0.114	0.249
Between R^2	0.032	0.058	0.060	0.102	0.071	0.115
Overall R^2	0.062	0.173	0.074	0.188	0.082	0.199

Table 4: Regressions by Size and R&D

This table shows estimation results of Equation (17) using fixed effects regression. The dependent variable is $r_{i,t} - R_t^{TBill}$. Column (1) shows estimation results for firms in the lowest tercile of sales for each year. Column (2) shows estimation results for firms in the highest tercile of firm sales for each year. Column (3) shows estimation results for firms that engage in R&D. Column (4) shows estimation results for firms that do not engage in R&D. Column (5) shows estimation results for firms in the lowest sales tercile and that engage in R&D. Column (6) shows estimation results for firms in the highest sales tercile and that do not engage in R&D. Column (7) shows estimation results for firms in the highest and lowest sales terciles. Column (7) includes the additional explanatory variables: $Small\ Dummy_{i,t}$, $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * $Small\ Dummy_{i,t}$, $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * $R\&D\ Dummy_{i,t}$, $Small\ Dummy_{i,t}$ * $R\&D\ Dummy_{i,t}$, and $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * $Small\ Dummy_{i,t}$ * $R\&D\ Dummy_{i,t}$. Clustered standard errors are shown in parentheses with 1%, 5%, and 10% levels of significance denoted by *, **, and ***, respectively.

Explanatory Variable	SML (1)	LRG (2)	SML & LRG (3)	RD (4)	No RD (5)	ALL (6)	SML & LRG (7)
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$	0.596***	0.267***	0.266***	0.742***	0.318***	0.418***	0.207**
	-0.05	-0.084	-0.084	-0.076	-0.077	-0.077	-0.095
$\frac{\Delta E_{i,t}}{M_{i,t-1}}$	0.060***	0.155***	0.083***	0.107***	0.062***	0.088***	0.083***
	-0.018	-0.026	-0.019	-0.034	-0.013	-0.015	-0.019
$\frac{\Delta NA_{i,t}}{M_{i,t-1}}$	0.030***	0.020***	0.024***	0.056***	0.031***	0.025***	0.024***
	-0.01	-0.007	-0.007	-0.015	-0.005	-0.006	-0.006
$\frac{\Delta RD_{i,t}}{M_{i,t-1}}$	0.104	0.244	0.014	0.081	-0.489	0.001	0.026
	-0.09	-0.237	-0.083	-0.102	-0.36	-0.074	-0.086
$\frac{\Delta I_{i,t}}{M_{i,t-1}}$	0.097	0.071	0.155*	0.238*	-0.100**	0.166	0.144**
	-0.078	-0.075	-0.087	-0.129	-0.048	-0.117	-0.06
$\frac{\Delta D_{i,t}}{M_{i,t-1}}$	0.200***	0.162	0.176***	0.136*	0.095**	0.097***	0.182***
	-0.069	-0.14	-0.055	-0.078	-0.04	-0.037	-0.053
$\frac{C_{i,t-1}}{M_{i,t-1}}$	0.428***	0.151***	0.239***	0.388***	0.168***	0.222***	0.234***
	-0.043	-0.037	-0.032	-0.076	-0.027	-0.03	-0.034
$L_{i,t}$	-0.842***	-0.599***	-0.708***	-0.739***	-0.692***	-0.701***	-0.707***
	-0.024	-0.022	-0.017	-0.024	-0.015	-0.012	-0.017
$\frac{NF_{i,t}}{M_{i,t-1}}$	0.087***	-0.011	0.067***	0.083***	0.036***	0.054***	0.063***
	-0.022	-0.022	-0.017	-0.024	-0.012	-0.011	-0.016
$R_t^{VWCRSP} - R_t^{TBill}$	1.162***	1.119***	1.161***	1.214***	1.091***	1.160***	1.158***
	-0.045	-0.026	-0.025	-0.03	-0.026	-0.02	-0.025
HML_t	0.041	0.329***	0.201***	-0.133***	0.452***	0.179***	0.200***
	-0.063	-0.043	-0.038	-0.048	-0.037	-0.031	-0.038
SMB_t	1.615***	0.557***	1.034***	1.269***	0.874***	1.081***	1.038***
	-0.091	-0.054	-0.051	-0.067	-0.051	-0.042	-0.051

(Table 4 continued)

Explanatory Variable	SML (1)	LRG (2)	SML & LRG (3)	RD (4)	No RD (5)	ALL (6)	SML & LRG (7)
$\frac{C_{i,t-1}}{M_{i,t-1}} * \frac{\Delta C_{i,t}}{M_{i,t-1}}$	0	-0.019***	-0.006**	-0.041***	-0.004**	-0.007*	-0.003
	-0.001	-0.005	-0.003	-0.013	-0.002	-0.004	-0.003
$L_{i,t} * \frac{\Delta C_{i,t}}{M_{i,t-1}}$	-0.454***	-0.033	-0.215***	-0.498***	-0.174***	-0.241***	-0.151**
	-0.072	-0.075	-0.073	-0.083	-0.06	-0.058	-0.064
$Small\ Dummy_{i,t}$			0.027				0.021
			-0.025				-0.027
$\frac{\Delta C_{i,t}}{M_{i,t-1}} * Small\ Dummy_{i,t}$			0.214***				0.136
			-0.082				-0.086
$R\&D\ Dummy_{i,t}$						-0.01	-0.022
						-0.01	-0.014
$\frac{\Delta C_{i,t}}{M_{i,t-1}} * R\&D\ Dummy_{i,t}$						0.065	-0.004
						-0.078	-0.101
$Small\ Dummy_{i,t} * R\&D\ Dummy_{i,t}$							0.012
							-0.024
$\frac{\Delta C_{i,t}}{M_{i,t-1}} * Small\ Dummy_{i,t} * R\&D\ Dummy_{i,t}$							0.264**
							-0.122
Constant	-0.044	0.250***	0.131***	0.069***	0.271***	0.186***	0.143***
	-0.036	-0.016	-0.021	-0.02	-0.019	-0.014	-0.022
Observations	35,077	40,614	75,691	57,270	56,720	113,990	75,691
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of firms	6,511	3,653	9,741	6,321	6,872	11,715	9,741
Within R^2	0.274	0.268	0.245	0.291	0.242	0.249	0.247
Between R^2	0.127	0.159	0.096	0.159	0.094	0.114	0.097
Overall R^2	0.208	0.217	0.183	0.242	0.181	0.199	0.185

Table 5: Time Variation

This table shows γ_1 and the associated t-statistic from estimation results of Equation (17) by year and sample segments. The dependent variable is $r_{i,t} - R_t^{TBill}$. The t-statistic is estimated using robust standard errors. Column (1) shows the year. Columns (2) and (3) show results by year for the entire sample. Columns (4) and (5) show results by year for the smallest tercile of firms by sales. Columns (6) and (7) show results by year for the largest tercile of firms by sales. Columns (8) and (9) show results by year for the smallest tercile of firms that also conduct R&D. Columns (10) and (11) show results by year for the largest firms that do not conduct R&D.

	Entire Sample		Smallest Tercile		Largest Tercile		Smallest R&D		Largest No R&D	
Year	γ_1	t-statistic	γ_1	t-statistic	γ_1	t-statistic	γ_1	t-statistic	γ_1	t-statistic
1971	1.26	4.97	1.03	2.07	1.25	3.13	0.86	1.29	1.22	2.64
1972	0.79	2.70	0.77	1.98	1.24	2.42	0.13	0.19	0.52	0.71
1973	0.93	6.51	0.83	4.10	1.29	5.04	1.07	2.20	1.41	2.62
1974	0.45	4.72	0.36	1.84	0.31	1.89	0.27	0.77	0.42	2.28
1975	0.45	5.14	0.46	3.24	0.50	2.61	0.44	2.21	0.48	2.10
1976	0.76	7.10	0.64	3.70	0.66	3.03	1.03	3.08	0.47	1.26
1977	0.60	5.16	0.74	3.95	0.04	0.23	0.94	1.84	0.17	0.54
1978	0.51	2.31	1.73	3.91	0.64	1.86	1.97	3.20	0.83	1.75
1979	0.77	5.85	0.42	1.89	0.83	3.53	1.28	2.56	0.72	2.62
1980	0.65	5.15	0.99	3.94	0.17	0.65	1.50	2.96	-0.25	-0.66
1981	0.93	6.93	1.29	5.57	0.53	2.23	1.40	3.12	0.88	3.32
1982	0.52	4.64	0.48	2.31	0.39	1.45	0.87	3.76	0.35	0.97
1983	0.77	6.94	0.74	4.15	0.73	4.39	0.66	1.97	0.58	2.12
1984	0.60	4.60	1.18	6.72	0.17	0.93	1.85	4.69	0.31	1.52
1985	0.68	6.52	0.61	2.77	0.54	3.27	1.36	2.88	0.43	1.91
1986	0.83	8.56	0.97	5.07	0.61	3.02	1.09	3.15	0.40	1.21
1987	0.31	2.46	0.20	1.12	0.15	0.47	0.20	1.00	-0.29	-0.82
1988	0.13	2.58	0.21	2.66	-0.01	-0.05	0.80	2.91	-0.12	-0.62
1989	0.19	3.22	0.36	3.24	0.10	1.60	1.12	4.01	-0.10	-0.94
1990	0.25	2.52	0.49	2.59	0.12	0.96	0.16	0.60	-0.12	-0.86
1991	0.60	5.66	0.75	3.85	0.21	1.04	0.44	2.55	-0.19	-0.89
1992	0.55	3.70	0.62	2.97	0.44	1.19	0.85	3.09	-0.17	-0.84
1993	1.16	7.87	1.20	5.24	1.42	3.59	1.43	3.47	1.09	2.03
1994	0.69	4.33	1.12	4.74	0.43	1.89	1.13	3.66	0.03	0.15
1995	0.78	3.86	0.82	2.94	1.96	6.23	1.57	3.57	1.56	4.93
1996	0.45	2.97	0.22	1.42	0.60	2.46	0.28	1.19	0.29	1.12
1997	0.68	6.06	0.76	5.34	0.57	2.33	1.13	4.48	0.43	1.40
1998	0.64	4.51	0.56	4.15	1.27	3.24	0.57	2.24	1.51	3.01
1999	0.68	2.34	1.07	6.18	1.71	2.82	0.92	3.67	1.33	2.41
2000	0.95	4.58	0.78	3.00	1.48	2.91	0.59	1.78	1.38	2.70
2001	1.19	10.76	1.10	7.15	0.95	3.40	1.29	5.90	0.98	2.58
2002	1.10	8.31	1.62	8.02	0.60	2.76	1.76	6.63	0.20	0.52
2003	0.81	6.31	0.82	3.47	1.51	3.75	0.87	3.51	1.02	2.19
2004	1.00	4.88	1.33	4.97	1.68	5.66	1.20	4.05	0.84	2.00
2005	1.24	4.99	1.12	3.31	1.67	4.55	1.61	4.03	1.93	3.68
2006	1.55	9.59	1.63	7.37	1.58	5.47	1.45	4.77	1.69	4.34
2007	1.47	6.50	1.26	5.00	2.11	3.08	1.62	5.60	3.31	3.36
2008	0.57	4.16	0.65	5.79	0.46	1.73	0.70	5.24	0.43	1.00
2009	0.52	4.68	0.57	4.64	0.30	0.70	0.61	5.39	-0.18	-0.46
Mean	0.74	5.25	0.83	4.01	0.80	2.60	1.00	3.16	0.66	1.51

Table 6: Macroeconomic Variable Summary Statistics

Panel A shows summary statistics for $\textit{Yield Spread}_t$, $\textit{GDP Growth}_t$, and $\textit{SEO Activity}_t$ from 1971-2009. Panel B shows the pairwise correlations between $\textit{Yield Spread}_t$, $\textit{GDP Growth}_t$, and $\textit{SEO Activity}_t$.

Panel A: Summary Statistics						
Variable	Obs.	Mean	25^{th} Percentile	Median	75^{th} Percentile	SD
$\textit{Yield Spread}_t$	39	0.0118	0.0080	0.0108	0.0132	0.0056
$\textit{GDP Growth}_t$	39	0.0291	0.0126	0.0289	0.0432	0.0232
$\textit{SEO Activity}_t$	39	0.0839	0.0424	0.0816	0.1086	0.0481

Panel B: Correlations			
	$\textit{Yield Spread}_t$	$\textit{GDP Growth}_t$	$\textit{SEO Activity}_t$
$\textit{Yield Spread}_t$	1		
$\textit{GDP Growth}_t$	-0.656	1	
$\textit{SEO Activity}_t$	-0.243	0.229	1

Table 7: Changes in Economic Conditions

Columns (1) through (7) show estimation results of Equation (17) using fixed effects regression with controls for changing macroeconomic conditions. The dependent variable is $r_{i,t} - R_t^{TBill}$. All columns include the intereacation with $\frac{\Delta C_{i,t}}{M_{i,t-1}}$ and the variable of interest. Column (1) includes the *Yield Spread$_t$*, Column (2) includes *SEO Activity$_t$*, and Column (3) includes *GDP Growth$_t$*. Column (4) includes all the macroeconomic variables included in Columns (1) through (3). Column (5) includes *High GDP Dummy$_{i,t}$* and Column (6) adds includes the other macroeconomic variables. Column (7) includes *Low GDP Dummy$_{i,t}$*. Clustered standard errors are shown in parentheses with 1%, 5%, and 10% levels of significance denoted by *, **, and ***, respectively.

Explanatory Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$	0.559***	0.462***	0.374***	0.323**	0.435***	0.511***	0.494***
	-0.082	-0.119	-0.067	-0.156	-0.062	-0.149	-0.147
$\frac{\Delta E_{i,t}}{M_{i,t-1}}$	0.086***	0.087***	0.084***	0.084***	0.085***	0.085***	0.084***
	-0.015	-0.015	-0.014	-0.014	-0.014	-0.014	-0.014
$\frac{\Delta NA_{i,t}}{M_{i,t-1}}$	0.026***	0.026***	0.029***	0.029***	0.028***	0.028***	0.028***
	-0.007	-0.007	-0.006	-0.006	-0.006	-0.006	-0.006
$\frac{\Delta RD_{i,t}}{M_{i,t-1}}$	0.003	0.004	0.015	0.015	0	0.004	0.006
	-0.073	-0.073	-0.071	-0.07	-0.072	-0.071	-0.071
$\frac{\Delta I_{i,t}}{M_{i,t-1}}$	0.141	0.152	0.089	0.089	0.134	0.127	0.115
	-0.114	-0.12	-0.08	-0.079	-0.109	-0.104	-0.093
$\frac{\Delta D_{i,t}}{M_{i,t-1}}$	0.094**	0.095***	0.091**	0.092**	0.093**	0.093**	0.094**
	-0.038	-0.037	-0.038	-0.038	-0.037	-0.038	-0.038
$\frac{C_{i,t-1}}{M_{i,t-1}}$	0.224***	0.222***	0.231***	0.230***	0.228***	0.229***	0.231***
	-0.03	-0.031	-0.029	-0.03	-0.029	-0.029	-0.029
$L_{i,t}$	-0.701***	-0.700***	-0.699***	-0.698***	-0.699***	-0.699***	-0.699***
	-0.013	-0.012	-0.012	-0.012	-0.013	-0.012	-0.012
$\frac{NF_{i,t}}{M_{i,t-1}}$	0.053***	0.054***	0.051***	0.051***	0.051***	0.051***	0.050***
	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011
$R_t^{VWCRSP} - R_t^{TBill}$	1.164***	1.160***	1.160***	1.161***	1.159***	1.162***	1.158***
	-0.022	-0.02	-0.021	-0.022	-0.02	-0.022	-0.022
HML_t	0.180***	0.178***	0.178***	0.181***	0.175***	0.177***	0.175***
	-0.031	-0.031	-0.031	-0.031	-0.032	-0.032	-0.032
SMB_t	1.077***	1.079***	1.078***	1.076***	1.082***	1.079***	1.074***
	-0.043	-0.042	-0.043	-0.043	-0.042	-0.043	-0.044
$\frac{C_{i,t-1}}{M_{i,t-1}} * \frac{\Delta C_{i,t}}{M_{i,t-1}}$	-0.009***	-0.008**	-0.009***	-0.009***	-0.009***	-0.009***	-0.009***
	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003
$L_{i,t} * \frac{\Delta C_{i,t}}{M_{i,t-1}}$	-0.257***	-0.267***	-0.266***	-0.260***	-0.262***	-0.261***	-0.258***

(Table 7 continued)

Explanatory Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	-0.056	-0.064	-0.053	-0.065	-0.055	-0.065	-0.065
$Yield\ Spread_t$	0.351			0.692		0.242	0.409
	-0.803			-0.911		-0.813	-0.828
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * $Yield\ Spread_t$	-9.100*			1.215		-5.383	-3.301
	-5.189			-5.23		-5.096	-4.755
$SEO\ Activity_t$		0.735***		0.818***		0.793***	0.793***
		-0.11		-0.119		-0.12	-0.12
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * $SEO\ Activity_t$		-0.015		0.33		-0.15	0.108
		-0.838		-0.84		-0.831	-0.757
$GDP\ Growth_t$			0.001	0.157			
			-0.204	-0.207			
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * $GDP\ Growth_t$			3.494**	3.736**			
			-1.468	-1.506			
$High\ GDP\ Dummy_{i,t}$					-0.006	-0.004	-0.006
					-0.006	-0.006	-0.007
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * $High\ GDP\ Dummy_{i,t}$					0.119*	0.103*	0.079
					-0.064	-0.062	-0.064
$Low\ GDP\ Dummy_{i,t}$							-0.012
							-0.008
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * $Low\ GDP\ Dummy_{i,t}$							-0.063
							-0.058
Constant	0.176***	0.017	0.178***	-0.01	0.183***	0.003	0.009
	-0.016	-0.016	-0.014	-0.028	-0.014	-0.026	-0.027
Observations	113,995	113,995	113,995	113,995	113,995	113,995	113,995
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of firms	11,715	11,715	11,715	11,715	11,715	11,715	11,715
Within R^2	0.249	0.249	0.250	0.250	0.250	0.250	0.250
Between R^2	0.118	0.115	0.114	0.114	0.120	0.121	0.118
Overall R^2	0.199	0.199	0.200	0.200	0.200	0.200	0.200

Table 8: Time Variation in Cross Sectional Characteristics
This table shows the mean and median by year for *NWC to Assets*$_{i,t}$, *CapExp to Assets*$_{i,t}$, and *R&D to Sales*$_{i,t}$. Table 1 provides variable definitions.

		NWC to Assets$_{i,t}$		*CapExp to Assets*$_{i,t}$		*R&D to Sales*$_{i,t}$	
Year	Obs.	Mean	Median	Mean	Median	Mean	Median
1971	1,497	0.2346	0.2440	0.0595	0.0477	0.0112	0.0000
1972	1,562	0.2376	0.2484	0.0629	0.0508	0.0107	0.0010
1973	1,628	0.2349	0.2456	0.0682	0.0552	0.0101	0.0006
1974	2,073	0.2373	0.2545	0.0726	0.0562	0.0101	0.0002
1975	2,601	0.2374	0.2535	0.0675	0.0495	0.0120	0.0000
1976	2,389	0.2341	0.2500	0.0705	0.0521	0.0122	0.0000
1977	2,288	0.2328	0.2500	0.0780	0.0610	0.0130	0.0000
1978	2,386	0.2326	0.2482	0.0814	0.0639	0.0114	0.0000
1979	2,545	0.2242	0.2420	0.0841	0.0669	0.0134	0.0000
1980	2,638	0.2144	0.2301	0.0862	0.0684	0.0135	0.0000
1981	2,591	0.2011	0.2120	0.0883	0.0653	0.0180	0.0000
1982	2,643	0.1825	0.1959	0.0840	0.0610	0.0251	0.0000
1983	2,874	0.1662	0.1785	0.0744	0.0544	0.0405	0.0000
1984	2,856	0.1635	0.1759	0.0830	0.0635	0.0406	0.0000
1985	2,970	0.1505	0.1676	0.0779	0.0570	0.0506	0.0000
1986	3,053	0.1420	0.1540	0.0709	0.0507	0.0645	0.0000
1987	3,031	0.1394	0.1476	0.0672	0.0492	0.0707	0.0000
1988	3,107	0.1397	0.1428	0.0647	0.0480	0.0853	0.0000
1989	3,212	0.1308	0.1318	0.0650	0.0464	0.0843	0.0000
1990	3,212	0.1240	0.1274	0.0642	0.0455	0.0826	0.0000
1991	3,194	0.1192	0.1252	0.0563	0.0391	0.0848	0.0000
1992	3,135	0.1306	0.1301	0.0582	0.0417	0.1043	0.0000
1993	3,229	0.1270	0.1246	0.0610	0.0432	0.1241	0.0000
1994	3,407	0.1242	0.1240	0.0651	0.0466	0.1521	0.0000
1995	3,672	0.1226	0.1229	0.0670	0.0471	0.1393	0.0000
1996	3,866	0.1214	0.1146	0.0676	0.0473	0.1471	0.0000
1997	3,939	0.1124	0.1088	0.0673	0.0461	0.1610	0.0000
1998	4,028	0.1008	0.0928	0.0672	0.0462	0.1879	0.0025
1999	3,867	0.0941	0.0880	0.0583	0.0413	0.1861	0.0017
2000	3,640	0.0865	0.0787	0.0589	0.0400	0.2053	0.0020
2001	3,432	0.0608	0.0562	0.0530	0.0344	0.2444	0.0059
2002	3,433	0.0483	0.0414	0.0441	0.0293	0.2660	0.0104
2003	3,201	0.0584	0.0473	0.0408	0.0263	0.2509	0.0107
2004	3,050	0.0634	0.0490	0.0442	0.0273	0.2553	0.0105
2005	2,888	0.0615	0.0537	0.0472	0.0293	0.2497	0.0094
2006	2,835	0.0584	0.0514	0.0499	0.0300	0.2697	0.0091
2007	2,741	0.0548	0.0495	0.0502	0.0295	0.2715	0.0097
2008	2,672	0.0473	0.0489	0.0546	0.0326	0.2486	0.0085
2009	2,610	0.0424	0.0461	0.0368	0.0223	0.2171	0.0085
Total	113,995	0.1321	0.1314	0.0640	0.0447	0.1244	0.0003

Table 9: Firm Characteristics

This table shows estimation results of Equation (17) using fixed effects regression with controls. The dependent variable is $r_{i,t} - R_t^{TBill}$. Column (1) includes $NWC\ to\ Assets_{i,t}$ and $\frac{\Delta C_{i,t}}{M_{i,t-1}} * NWC\ to\ Assets_{i,t}$. Column (2) includes $CapExp\ to\ Assets_{i,t}$ and $\frac{\Delta C_{i,t}}{M_{i,t-1}} * CapExp\ to\ Assets_{i,t}$. Column (3) includes $High\ CAPEX\ Dummy_{i,t}$ and $\frac{\Delta C_{i,t}}{M_{i,t-1}} * High\ CAPEX\ Dummy_{i,t}$. Column (4) includes statistically significant variables of interest from Tables 4 and 7. Column (5) includes industry dummies for the 49 Fama-French Industry Groups and uses random effects estimation. Clustered standard errors are shown in parentheses with 1%, 5%, and 10% levels of significance denoted by *, **, and ***, respectively.

Explanatory Variable	(1)	(2)	(3)	(4)	(5)
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$	0.466***	0.415***	0.422***	0.308***	0.360***
	-0.056	-0.065	-0.062	-0.088	-0.082
$\frac{\Delta E_{i,t}}{M_{i,t-1}}$	0.087***	0.086***	0.085***	0.084***	0.082***
	-0.015	-0.015	-0.015	-0.014	-0.013
$\frac{\Delta NA_{i,t}}{M_{i,t-1}}$	0.026***	0.026***	0.026***	0.029***	0.031***
	-0.006	-0.007	-0.007	-0.005	-0.006
$\frac{\Delta RD_{i,t}}{M_{i,t-1}}$	0.005	-0.002	0.001	0.014	0.023
	-0.07	-0.072	-0.072	-0.073	-0.07
$\frac{\Delta I_{i,t}}{M_{i,t-1}}$	0.144	0.152	0.144	0.115	0.137*
	-0.102	-0.121	-0.117	-0.08	-0.074
$\frac{\Delta D_{i,t}}{M_{i,t-1}}$	0.094**	0.095**	0.096**	0.098**	0.095**
	-0.038	-0.037	-0.038	-0.039	-0.038
$\frac{C_{i,t-1}}{M_{i,t-1}}$	0.223***	0.225***	0.226***	0.234***	0.192***
	-0.031	-0.03	-0.03	-0.029	-0.02
$L_{i,t}$	-0.698***	-0.699***	-0.702***	-0.700***	-0.461***
	-0.013	-0.013	-0.013	-0.012	-0.007
$\frac{NF_{i,t}}{M_{i,t-1}}$	0.053***	0.053***	0.053***	0.046***	0.01
	-0.011	-0.011	-0.011	-0.011	-0.009
$R_t^{VWCRSP} - R_t^{TBill}$	1.161***	1.161***	1.160***	1.156***	1.174***
	-0.02	-0.02	-0.02	-0.02	-0.019
HML_t	0.179***	0.179***	0.180***	0.175***	0.180***
	-0.031	-0.031	-0.031	-0.031	-0.031
SMB_t	1.080***	1.079***	1.081***	1.084***	1.078***
	-0.042	-0.042	-0.042	-0.042	-0.042
$\frac{C_{i,t-1}}{M_{i,t-1}} * \frac{\Delta C_{i,t}}{M_{i,t-1}}$	-0.009**	-0.007**	-0.007**	-0.006*	-0.008***
	-0.004	-0.003	-0.003	-0.003	-0.003
$L_{i,t} * \frac{\Delta C_{i,t}}{M_{i,t-1}}$	-0.270***	-0.258***	-0.255***	-0.188***	-0.239***
	-0.05	-0.054	-0.053	-0.059	-0.055
$NWC\ to\ Assets_{i,t}$	0.026				
	-0.023				
$\frac{\Delta C_{i,t}}{M_{i,t-1}} * NWC\ to\ Assets_{i,t}$	-0.068				
	-0.15				
$CapExp\ to\ Assets_{i,t}$		0.026			
		-0.051			
$\frac{\Delta C_{i,t}}{M_{i,t-1}} * CapExp\ to\ Assets_{i,t}$		1.185***			
		-0.327			
$High\ CAPEX\ Dummy_{i,t}$			-0.013**	-0.013**	0.014***

(Table 9 continued)

Explanatory Variable	(1)	(2)	(3)	(4)	(5)
			-0.005	-0.005	-0.004
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *High CAPEX Dummy*$_{i,t}$			0.235***	0.253***	0.277***
			-0.051	-0.05	-0.049
High GDP Dummy$_{i,t}$				-0.006	-0.005
				-0.006	-0.006
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *High GDP Dummy*$_{i,t}$				0.113**	0.117**
				-0.05	-0.049
Small Dummy$_{i,t}$				-0.025**	-0.095***
				-0.012	-0.007
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *Small Dummy*$_{i,t}$				-0.009	-0.012
				-0.067	-0.063
R&D Dummy$_{i,t}$				-0.017*	-0.038***
				-0.01	-0.005
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *R&D Dummy*$_{i,t}$				0.014	0.019
				-0.086	-0.086
Small Dummy$_{i,t}$ * *R&D Dummy*$_{i,t}$				0.026*	0.024***
				-0.015	-0.009
$\frac{\Delta C_{i,t}}{M_{i,t-1}}$ * *Small Dummy*$_{i,t}$ * *R&D Dummy*$_{i,t}$				0.256**	0.213**
				-0.106	-0.105
Constant	0.174***	0.178***	0.186***	0.202***	0.228***
	-0.015	-0.014	-0.013	-0.015	-0.033
Observations	113,995	113,995	113,995	113,990	113,990
Year Dummies	Yes	Yes	Yes	Yes	Yes
Industry Dummies	No	No	No	No	Yes
Number of firms	11,715	11,715	11,715	11,715	11,715
Within R^2	0.249	0.25	0.25	0.252	0.245
Between R^2	0.116	0.113	0.115	0.122	0.213
Overall R^2	0.199	0.2	0.2	0.203	0.228