What is a Dollar Worth? The Market Value of Cash Holdings

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Abstract

This study investigates the market value of cash held by firms. In general, we estimate the value shareholders place on a marginal dollar of cash to be about $0.97. However, we find large cross-sectional differences consistent with existing theory. We document that the quality and volatility of the firm's investment opportunity set as well as the probability of financial distress and capital market access impact the value shareholders place on cash holdings. Firms with good growth options have their cash valued at a premium to those with poor growth prospects. Additionally, cash is valued less in firms with stable investment programs and those nearer to financial distress. Finally, we find that access to the capital markets affects shareholder's valuation of cash holdings, although the results are contrary to expectations. Overall, it appears that the investment opportunity set rather than the financing opportunity set of the firm affects the value that shareholders place on a firm's cash holdings.

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1. Introduction

A curious fact of financial markets is that some firms have cash holdings in excess of their market value. Management chooses to hold cash for various reasons, which in a perfect world, all maximize firm value. In their valuation of the firm, investors implicitly assign a value to these cash holdings based on their assessment of the probable use of the funds. An important question is: What value do investors place on the cash holdings of a firm? In this study, we investigate the value that investors assign to the liquid assets of a firm and examine what factors determine the market value of cash and marketable securities.[1]

While the liquid assets of firms have been explored in the financial economics literature, most of the studies have dealt with the level of cash holdings of corporations (see for instance, Opler, Pinkowitz, Stulz and Williamson (1999), Harford (1999), Mikkelson and Partch (2002), and Kim, Mauer, and Sherman (1998)). These studies examine why firms hold cash and what impact it has on their investment policies. For the most part, previous studies have tried to determine whether managers waste cash or use it for purposes that increase firm value. The other side of the debate is how investors perceive firms' cash holdings. To date, there has been no study empirically examining the value of cash as measured by shareholders.[2]

Traditionally, cash holdings are thought of as zero net present value (NPV) investments. As such, one dollar of cash should increase the market value of the firm by one dollar. In perfect capital markets, this result obtains; however, with imperfect capital markets, it may not. Given taxes and flotation costs, it may be costly to transfer cash in or out of the firm. These transaction costs are ultimately borne by the shareholders and should affect their valuation of cash. More importantly, it has been argued that there can be valuation effects of cash holdings because of their impact on investment policy.

Myers and Majluf (1984) argue that financial slack has value because it allows firms to take positive

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[1] We refer to liquid asset holdings, both cash and marketable securities, as cash holdings.

[2] A contemporaneous paper by Pinkowitz, Stulz and Williamson (2003) examines cash holdings internationally and using similar methodology assesses the value placed on cash holdings. However, their paper does not focus on the US, but examines investor protection and cash holdings around the world.

NPV opportunities they might otherwise forego due to the costs of external finance. Thus, a dollar of cash held by a firm may be valued at more than a dollar by its shareholders. On the other hand, Jensen (1986) argues that shareholders may want the firm to distribute its cash because free cash flow will be squandered. Harford (1999) provides support by showing that cash rich firms tend to make value decreasing acquisitions; hence, shareholders may value cash less than dollar for dollar. The implications of Myers and Majluf (1984) and Jensen (1986) are that cash can have both benefits and costs to shareholders. Financial slack creates value up to the point where a firm exhausts its positive NPV projects. After that, the costs of holding cash may exceed the benefits and cash could be valued less than dollar for dollar. The bottom line is that growth options, agency costs, and market frictions might impact the value shareholders place on a firm's liquidity. Accounting for these, it becomes an empirical question as to what value shareholders place on a firm's cash holdings and which factors determine that value.

Using a regression approach similar to Fama and French (1998) (hereafter, FF), we show that, on average, shareholders value a marginal dollar of cash at face value. Our estimates range from \$0.94 to \$0.97 with standard errors of roughly \$0.13. However, splitting the sample by firm characteristics, we find large cross-sectional differences in the value of cash. Our cross-sectional tests result in estimates of the marginal value of cash which range from \$0.27 to \$1.76. The main determinants of the value of liquidity are the growth options of the firm, the volatility of its investment opportunities, and the magnitude of stockholder-bondholder conflicts. Specifically, we find that firms with poor growth options, those with more predictable investment opportunities, and those nearer to financial distress have their cash valued at a significant discount to book value. We find that, controlling for growth options, access to the capital markets also impacts the value placed on cash; however, contrary to our expectations, unconstrained firms seem to have a higher cash value than constrained firms. Overall, it appears that the investment opportunity set, rather than the financing opportunity set of the firm is the primary driver for the value that shareholders place on a firm's cash holdings.

The evidence in this paper supports the contentions of both Myers and Majluf (1984) and Jensen (1986). Consistent with Myers and Majluf, shareholders place a premium on liquidity for firms with high growth options. This suggests that for some firms, increasing cash can be a positive NPV project. On the other hand, consistent with Jensen's (1986) assertion, in certain firms, shareholders value cash significantly less than dollar for dollar. Finally, we find support for the argument that stockholder-bondholder conflicts affect the value of cash holdings. Firms with higher probabilities of financial distress have their cash valued at significantly less than financially healthy firms.[3]

The results in this study contribute to the literature on firms' cash holdings by shedding light on investors' perceptions of the importance of firms' cash balances. It examines the determinants of investors' valuations of a dollar held by the firm, an aspect of cash holdings previously unaddressed empirically, and documents that the market values liquidity differently depending on firm characteristics. Overall, our results indicate that growth options and agency costs do, in fact, impact the value that shareholders place on liquidity and the impact can be quite large.

The rest of the paper is organized as follows. Section 2 motivates our analysis, presents a discussion of the market value of cash holdings and offers empirical predictions. Section 3 describes the data and methodology used in the study. Section 4 presents our main results, while we examine robustness in Section 5. Section 6 offers conclusions.

2. Cash Holdings and Firm Valuation

If capital markets are perfect, then cash held by the firm would be valued dollar for dollar by investors. Therefore, whether the firm pays out cash as dividends or holds on to it is irrelevant. If the firm pays out the dollar to investors, it could always raise cash when needed for positive NPV projects. However, if capital markets are imperfect or there are agency costs between managers and stockholders, or conflicts

[3] These results support Jensen and Meckling (1976), which shows that agency costs of debt can lead to lower firm values.

between stock and bondholders, then a dollar held by the firm may not be valued at a dollar by shareholders.

2.1. Costs and benefits to cash holdings

If capital markets are imperfect, holding cash may not simply be a zero NPV investment. Opler et al. (1999) discuss various motives for firms' cash holdings and describe the transaction and precautionary motives. The transaction motive for holding cash is based on Miller and Orr (1966) who argue that firms hold cash for daily transactions. Mulligan (1997) argues in favor of a transaction motive in which a firm's cash holdings are based on its activity, technological sophistication, and opportunity costs. Both papers argue that there are economies of scale in cash holdings.

Another reason firms may hold cash is the precautionary motive. In this case, firms hold cash in order to continue to invest in positive NPV projects during periods when external finance is costly. This situation is of particular importance to firms that have good investment opportunities but are unable to generate enough internal cash to take advantage of them. This implies a benefit to cash for firms that may be rationed out of the credit markets in times of tight credit. Opler et al. (1999) find support for the precautionary motive. In this paper, we do not address the transactions motive for cash holdings because in those models, the focus is the level of cash on hand, rather than marketable securities. Because we examine cash and marketable securities together, we cannot and do not make inferences regarding the transactions motive.

The main argument for firms maintaining financial flexibility is discussed in Myers and Majluf (1984) who contend that asymmetric information between investors and management makes external financing costly. Their study implies a positive value to financial slack for firms with good growth options. Without slack, firms may pass up positive NPV projects, leading to underinvestment. In some cases, a firm may desire to hold large cash balances which would be consistent with maximizing shareholder value. If cash enables firms to undertake projects which increase value, a dollar of cash held by the firm could have a value

greater than one dollar to investors. Mikkelson and Partch (2002) provide some evidence that cash holdings may be valuable to shareholders by looking at operating performance. They show that the five-year performance of cash rich firms is not significantly different from firms which are not cash rich.

Jensen (1986) argues that excess cash may induce managers to waste it on negative NPV projects. He asserts that it is better for management to pay out the cash in the form of dividends and use debt to finance future investments. Easterbrook (1984) claims that frequently going to the capital markets disciplines management and controls their wasteful behavior. Both studies argue that the capital markets can be used to control managerial opportunism. Harford (1999) provides support for Jensen's argument by showing that cash rich firms tend to make value decreasing acquisitions, and he documents a negative investor reaction to cash stockpiling. Furthermore, Blanchard, Lopez-de-Salinas, and Shleifer (1994) find that firms receiving cash windfalls spend that cash inefficiently.

Finally, Jensen and Meckling (1976) discuss the conflicts which may arise between stockholders and bondholders when risky debt is introduced into the firm. Since equity is a call option, shareholders prefer a riskier investment program. Cash holdings are risk-free and as such, shareholders may value liquidity at a discount. This is likely to be particularly prominent in firms where the risk of financial distress is high since the benefits of the cash may accrue mainly to bondholders.

In recent years, we have seen instances, such as Kirk Kerkorian's battle with Chrysler, where shareholders have gone to great lengths to force management to pay out what is perceived to be excess cash. If shareholders are concerned that management may spend cash inefficiently or that bondholders may obtain the benefits of the liquidity, the market might value the firm's cash at less than dollar for dollar.

The previous literature argues both sides of the debate on the need for cash. The evidence and theory indicates that firms should hold cash, but too much could be costly to shareholders. Overall, the main issue is whether the cash held by the firm will generate a higher return than if it were in the hands of shareholders. Shareholders assess what firms should do with its cash based on characteristics such as growth opportunities,

uncertainty in the arrival of investments, financial constraints, and stakeholder conflicts. It is important to know what value shareholders place on cash holdings and how they determine that value. We explore these issues in the following sections.

2.2 Predictions of the market value of cash holdings

Given the prior literature and discussion, it seems reasonable to expect cross-sectional differences in the market value of cash holdings. We hypothesize that the value shareholders place on the liquid assets of a firm will be a function of certain firm characteristics. Specifically, the value of cash should be related to: the investment opportunities of the firm, the predictability of those opportunities, the magnitude of stockholder-bondholder conflicts, and the firm's access to the capital markets.[4] The remainder of this section explains each hypothesis and its empirical predictions. These are all summarized in Table 1.

Investors would want firms with good investment opportunities to be able to take advantage of them. Myers and Majluf (1984) argue that financial slack is more valuable in firms with good investment opportunities, while Jensen's (1986) free cash flow argument relies on the fact that firms may have few good investment opportunities. Thus, the primary theoretical determinant of the value of cash holdings should be the investment opportunity set of the firm. We expect that shareholders of firms with a better investment set should place a greater value on the firm's liquid assets. This leads to our first hypothesis:

H1: Firms with greater growth opportunities should have higher values placed on their cash

Another factor which can affect the value of cash is the nature of the arrival of investment

[4] Additionally, there may be tax implications of holding cash. The decision of a firm to keep cash internally or distribute it to shareholders should be affected by the difference in marginal tax rates between the firm and investors. In prior versions, we evaluated the value of cash using an estimate of the marginal tax rate (see Graham (1996)). Using this approach, we found that cash appears to be valued more in firms with higher tax rates. Of course, this is likely because firms with higher tax rates are those which are growing and successful. We are do not test this further because we are unable to determine the effective tax rate of shareholder clienteles. Hence, we cannot measure the tax differential between shareholders and firms.

opportunities. For firms with relatively predictable investment outlays, it is easier to have the capital to undertake their investments. With stable capital expenditures, firms can budget internal cash for projects, or enter the capital markets ahead of time. On the other hand, firms with high volatility in their investment opportunities may need to hold cash to take advantage of investments when they arise. If projects arrive randomly, the delay in obtaining funds from the financial markets may cause some firms to forego investment. If such a firm attempts to access the markets in anticipation of an uncertain investment opportunity, the financing could be very costly due to information asymmetries. This is also consistent with a real option value to cash holdings. Option pricing theory shows that option values increase with the volatility of the underlying asset. In our case, the underlying asset is the investment program of the firm; hence, we expect cash to be less valuable for firms with more stable investment programs.

H2: Firms with greater predictability in their investment program should have lower values placed on their cash.

When the risk of financial distress is present, conflicts can arise between stockholders and bondholders. Jensen and Meckling (1976) were among the first to elaborate on the potential agency costs of risky debt, namely the chance for asset substitution. Because equity is a call option on the firm, shareholders prefer a riskier investment program than bondholders. Clearly no investment is less risky than cash. It is more likely that the benefit of cash holdings will accrue to bondholders rather than stockholders when the firm is near financial distress. As such, we expect shareholders to place a lower value on cash holdings in these firms.

H3: Firms with greater probability of financial distress conflicts have lower values placed on their cash.

If firms were able to easily obtain external funds, holding cash should not be terribly important.

However, we know that firms with limited or costly access to the capital markets might have to pass up positive NPV investments.[5] Therefore, shareholders would prefer these firms to hold cash and we would expect to see greater value placed on their cash holdings. The idea of constrained and unconstrained firms is covered extensively in studies such as Kaplan and Zingales (1997, 2000), Fazzari, Hubbard and Petersen (1998) and Hubbard (1998) which discuss the impact on financial constraints on investment. If constrained firms are unable to access the capital markets then they will be unable to take advantage of available investment opportunities. Therefore, controlling for growth opportunities, constrained firms should have a higher value of their cash holdings.

H4: Holding growth options constant, firms with less access to the capital markets should have higher values placed on their cash.

It is important to note that our predictions about the value investors assign to cash are not mutually exclusive across hypotheses. Additionally they are not mutually exclusive in terms of the proxies we use. Therefore, as seen in Table 1, some of the empirical measures are used to test more than one hypothesis. For instance, a lower value of cash holdings for dividend paying firms would be support either H1 or H4 depending on one's belief of whether dividends represent poor growth options, or greater capital market access. Alternatively, for some of our measures, we can cleanly distinguish among the different hypotheses. Leverage, for instance, is predicted to be negative in H3, but positive in H4.

3. Data and Methodology

Data come from the 2000 COMPUSTAT tapes (numbers in parentheses are COMPUSTAT data item numbers). Our analyses begin with all firm years from 1950 to 1999. Financial firms are deleted from the sample because of the unique role that cash plays for these types of firms. Utilities are also deleted because

[5] Costs of accessing the financial markets can be either explicit or implicit. Explicit costs include flotation costs and tax consequences. Implicit costs include asymmetric information, underpricing, and time.

they are regulated and should have a small differential between the cost of internal and external funds.

Market value of the firm's equity is calculated at fiscal year end as price multiplied by shares outstanding (54 * 199). Earnings are defined as earnings before extraordinary items plus interest, deferred tax credits, and investment tax credits (18 + 15 + 50 + 51). We define cash as cash plus marketable securities (1), while dividends are measured as common dividends paid (21). We also obtain data on total assets (6), net assets, which is defined as total assets less cash (6 - 1), EBIT (13), capital expenditures (128), taxes (16), and research and development expenses (46). When R&D is missing, we set it equal to zero.

In evaluating the value of a dollar of cash held by a firm, it is important to control for other variables that may account for a firm's market value. To this end, we implement our tests by augmenting the valuation model from FF (1998). Since we are concerned with the value shareholders assign to cash, we examine regressions with market value of equity as the dependent variable. However, using market value can lead to problems with heteroscedasticity, so we deflate all variables by book value of assets. In this paper, we refer to X_t as the level of variable X in year t divided by the level of assets in year t. We use dX_t to indicate the change in the level of X from year t-2 to year t, divided by the book value of assets in year t $((X_{t-2} - X_t)/Assets_t)$. Similarly, dX_{t+2} indicates the change in the level of X from year t to year t+2, divided by the book value of assets in year t $((X_{t+2} - X_t)/Assets_t)$.

The main variables, described above, are abbreviated in the rest of the paper as: market value of the firm's equity (M); earnings (E); assets (A); net assets (NA); research and development expense (RD); interest expense (I); dividends (D); and cash and marketable securities (C). Following Shin and Stulz (2000) and FF (1998), we trim our observations at the 1% tails measured using the full sample. Because we require 2-year changes in some of the variables, our usable sample ends in 1997. Additionally, after data requirements, we have few firms prior to 1952 and thus eliminate the prior years. Lastly, we eliminate any firm year where the firm changed its fiscal year end sometime during the two years before or after the observation year. Our final sample is 9,844 firms representing 88,844 firm years from 1952 to 1997.

4. Summary statistics

The summary statistics for our sample of firms are shown in Table 2. We see that the ratio of market value of equity to book value of assets for the average firm is close to one. The mean for M_t is 0.96 while the median is 0.65. On average, firms earn about six cents for each dollar in assets, while they hold roughly ten percent of their assets in the form of cash and marketable securities. The median firm has 6.1% of its assets in cash. Additionally, the median change in cash holdings (dC_t and dC_{t+2}) is nearly zero, indicating that firms' cash holdings tend to be persistent, a result consistent with the findings in Opler et al. (1999).

Table 2 shows that firms' profitability has been increasing over time as the changes in earnings are slightly positive both at the mean and median. Additionally, the net assets of the average firm grow quite a bit over time. The standard deviation of net assets is also quite large, which may be surprising since one may expect that firms' asset bases would have been more stable. Changes in other aspects of the firms seem to be quite consistent. Both research and development expenditures and interest expenses are fairly stable, and not surprisingly, dividends also change relatively little through time.

Before we do a regression analysis of firms, we address the question of multicollinearity. Table 3 shows the correlation matrix for the variables of interest in determining the market value of a dollar held by the firm. The table shows that the correlation among the independent variables are relatively low. The only correlations potentially problematic are those between earnings and change in earnings, R&D and the change in R&D, and interest and the change in net assets. However, given the focus of our study, our main concern is whether the cash variables are highly correlated with the other independent variables. We see from the last three rows that only four of the 51 correlations are greater than 0.30 (in absolute value), and none are greater than 0.46. Due to the few large correlations, we believe that our cash variables will allow us to accurately measure the market value of cash holdings.

4.1. The market value of a dollar

The main emphasis of this paper is the market value of a dollar held by a firm. To directly test for this we use the regression model shown below:

$$\begin{aligned} M_{i,t} = {} & \alpha + \beta_1 E_{i,t} + \beta_2 dE_{i,t} + \beta_3 dE_{i,t+2} + \beta_4 dNA_{i,t} + \beta_5 dNA_{i,t+2} + \\ & \beta_6 RD_{i,t} + \beta_7 dRD_{i,t} + \beta_8 dRD_{i,t+2} + \beta_9 I_{i,t} + \beta_{10} dI_{i,t} + \beta_{11} dI_{i,t+2} + \\ & \beta_{12} D_{i,t} + \beta_{13} dD_{i,t} + \beta_{14} dD_{i,t+2} + \beta_{15} dM_{i,t+2} + \beta_{16} C_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (1)$$

In equation (1), we include only the current level of cash holdings. We also examine specifications which include the past and future two year changes in cash holdings ($dC_{i,t}$ and $dC_{i,t+2}$) as well. The regression specifications are similar to those in FF (1998), except that we use net assets and augment the model with cash holdings (see also Pinkowitz, Stulz and Williamson (2003)). In all our regressions, the dependent variable is M_t, the market value of equity deflated by assets. In the regression framework, β_{16}, the coefficient on cash holdings should serve as a measure of the market to book value of the marginal dollar. Because cash and marketable securities are carried on the books dollar for dollar, the coefficient should represent the market value shareholders place on an additional dollar of cash.

While this regression methodology allows us to estimate the market value of cash holdings, there are several potential problems that should be discussed. FF (1998) provide a thorough explanation of the econometric issues associated with their valuation model and indicate that some of the problems can be mitigated by estimating the models using the method of Fama and MacBeth (1973). Thus, all of our regressions use this methodology (hereafter FM), which involves running yearly cross-sectional regressions and using the series of coefficients to make our inferences. The coefficients reported in our tables are the mean of the cross-sectional regression coefficients, while the standard errors are also derived from the time series of coefficients. This method should lessen the impact of any survivor bias and/or serial correlation. Additionally, all variables are deflated by total assets to address the likely heteroscedasticity. However, there are additional issues unique to our specifications which must also be addressed.

Foremost is that we do not take a position on whether firms have an optimal level of cash holdings.

It may be that there is no optimum and firms simply accumulate cash when internal cash flows exceed investments, while drawing down cash when the reverse is true. Thus, cash holdings are mechanically determined by the flow of funds deficit and shareholders should not prefer one level of cash to another. On the other hand, firms may specifically target the level of their cash holdings and attempt to increase or decrease their cash balances when they stray from the target. Opler, et al (1999) find support for the idea that firms have target levels of cash, but at the same time, their results indicate that the flow of funds deficit also explains some of the changes in cash holdings.

If there is no optimal level of cash holdings, then our results should accurately reflect the market value of cash. Each dollar a firm obtains should have the same value to shareholders and the marginal value of a dollar would be independent of the level of cash holdings. However, if an optimal amount exists, our estimates of the market value of cash are conditional on where the firm is relative to its optimum. For firms below their target holdings, we would expect shareholders to value the marginal dollar higher than they would for firms above their target

Because of this issue, we examine an additional specification in an attempt to address this concern. While our first specification, shown in equation (1), uses only the contemporaneous level of cash holdings, the second also includes lag and lead two year changes in cash holdings. If a firm is either at its target or there is no target, past and future changes are less important to the current value placed on cash holdings and the first specification should provide us with a reasonable estimate of the market value of cash. However, if a target exists, but firms are not at it, changes in cash holdings are likely important because it controls for movements toward/away from the optimum. In this case, the second specification which controls for the changes in cash should be more valuable.

Ultimately though, our regressions make no attempt to explicitly specify where a firm is relative to an optimal level of cash holdings. Thus, the coefficients on cash have to be interpreted narrowly. For our point estimates to be valid, one of three assumptions must be made. Either there is no optimal level of cash

holdings for a firm; or there is an optimal level, but, on average, firms are at their target; or firms are away from their targets, but the coefficients on changes in cash control for this. In Tables 4-6, we assume one of the above is true, but are agnostic as to which one.

The first column in Table 4 uses the FM method of running cross-sectional regressions each year and using the time series of coefficients to generate inferences. The numbers in parentheses are the time-series standard errors and the adjusted R^2 is the average of the adjusted R^2s from the 46 cross-sectional regressions. The coefficients are similar to those found in previous studies and consistent with existing theory. Also, they are consistent across both specifications with a slight increase in explanatory power when changes in cash are included.

The important coefficient for this study is the 0.97 on cash holdings (C_t). It appears that shareholders value one dollar of cash at \$0.97 with a standard error of about \$0.124. When we include the changes in cash holdings in the second specification, we find a coefficient of \$0.94 with a similar standard error. The two regressions indicate that, on average, the market values a marginal dollar of cash at face value.

5. Market value of a dollar across firms

Table 4 includes all firms simultaneously, while the predictions discussed earlier and in the prior literature suggest there may be cross-sectional differences in the market value of cash. Thus, it is possible our inferences are muddled by including the full sample of firms. We attempt to examine our hypotheses by segmenting our sample by firm characteristics. In order to do this, we use a series of interactive dummy variables in our regressions. We again use the FM regression method. Each year, the cross-sectional regression takes the form of:

$$y_i = \sum_{j=1}^{J} \alpha_j \delta_j + \sum_{j=1}^{J} \gamma_j (\delta_j * c_i) + \sum_{k=1}^{K} \beta_k x_{k,i} + \varepsilon_{i,} \qquad (2)$$

where the $X_{k,i}$ variables are those from the regressions in Table 4, excluding cash. The cash variable is interacted with dummy variables indicated by the δ_js. The dummy variables serve to segment firms by a particular characteristic. In most cases, we segment firms into three categories: high, average, and low; hence J=3. For some characteristics such as dividends, and R&D expenses, we segment the firms into only two classes and thus J=2. To ensure we are capturing the value of cash for firms based on a specific characteristic rather than just the value of that characteristic, equation (2) includes separate intercepts for each group.

To determine the dummy variables, we rank the firms each year by the characteristic of interest and sort them into three groups. High (low) firms are those in the top (bottom) 20% of all firms in a given year, while average firms are those in the middle 60%. We then create a dummy variable to represent membership in one of the groups. Thus, δ_1 equals one for firms in the lowest quintile, and zero for all other firms. For example, when we examine whether growth options affect the value of cash, sales growth is one of the firm characteristics we use. In that case, δ_1 equals one for the lowest sales growth firms and δ_3 equals one for the highest sales growth firms. The estimated coefficients γ_1 and γ_3 represent the market value of cash for firms with low and high sales growth, respectively. An advantage of this specification is that we allow firms to switch groups from year to year.

Equation (2) is basically a constrained regression where we require that the coefficients on the control variables are the same across all types of firms. A benefit to this methodology is that we obtain greater efficiency in our estimates; however, it is possible that the constraints are unnecessarily restrictive. With no theory to guide us, we attempt to determine the robustness of our results by also examining separate regressions for each of the groups. Thus, we re-estimate the regressions of Table 4 using only the firms which fit a particular characteristic (i.e. high sales growth firms, or firms which pay dividends). This allows the coefficients on the control variables to vary across firm characteristics. While this estimation is less restrictive, using only a subset of the data means we are discarding information and sacrificing efficiency.

We report the results of these estimation methods in Table 5. The columns marked “full sample”

show the results of estimating equation (2), while the columns marked "subsample" include the results using only firms fitting the particular characteristic. To control for the issue of optimal cash holdings, regressions are run both including and excluding the lead and lag changes in cash. In all cases, the control variables are the same as those in Table 4. Because we are interested in the market value of a dollar held by the firm and for ease of presentation, we only report the interaction coefficients for high and low firms.[6] These correspond to γ_1 and γ_3 in equation (2).

5.1 Growth opportunities and market value of cash holdings

Our primary hypothesis is that firms with greater growth opportunities should have higher valuations on their cash holdings. The most widely used empirical measure of growth options is Tobin's Q or the market to book ratio. However, since this is essentially our dependent variable, segmenting firms by this measure could lead to spurious results. Thus, in Table 5, we examine growth opportunities using sales growth, dividends, R&D expenditures, and capital expenditures. While the use of sales growth is fairly obvious, dividends can also signal growth options because with unfunded positive NPV projects, shareholders should prefer the firm to reinvest earnings rather than pay them out. Lastly, firms which spend more on research and development (R&D) or capital expenditures may indicate that they have better growth opportunities than other firms.

Sales growth is defined as the one year growth rate in sales. Rather than segment firms on the level of R&D expenditures, we simply divide the sample into those firms which report nonzero R&D expenses and those which report zero expenses for the year. Capital expenditures are deflated by firm assets in order to normalize the levels for ranking purposes.

We find that in all four of our specifications, firms with higher sales growth have significantly larger coefficients on cash holdings. Additionally, in all regressions the low sales growth firms have cash valued

[6] The full regression results of each of the sub-samples are available from the authors.

at a significant discount to face value. These regressions seem to support both Myers and Majluf (1984) and Jensen (1986) which argue that the valuation of liquidity would be most affected by the growth opportunities of the firm. Our results suggest that for firms with good growth options, holding cash can be a positive NPV investment, while for firms with few growth options, the market values cash less than dollar for dollar. It is likely that this discount accounts for the probability that management may waste the cash on poor investments as suggested by Jensen.

The second set of regressions segments firms by whether or not they pay dividends.[7] It is always the case that firms which do not pay dividends have significantly higher coefficients on cash than firms which do pay dividends. If dividend paying firms have fewer growth options than non-payers, these results strongly support the sales growth evidence.

We also find that firms which report R&D expenses have higher valued cash holdings than those which do not. Additionally, the marginal value of liquid assets is always greater than $1.00 for firms which report research and development expenses. Lastly, we find that firms with high capital expenditures have their cash holdings valued significantly more than firms with low capital expenditures. Furthermore, like the prior evidence, the value of the marginal dollar of cash is significantly greater (less) than one dollar for the high (low) capital expenditure firms. While level of capital expenditures does not control for the quality of the investment opportunities, it seems to be the case that empirically, the more capital expenditures a firm makes, the greater its investment opportunity set is perceived.

The hypothesis that firms with greater growth options will have larger values placed on their liquidity seems to be firmly supported. The results of the sales growth, dividend, R&D, and capital expenditure regressions all suggest that cash can be a positive NPV investment for firms with good investment opportunities. Overall, the empirical evidence seems to strongly support the theoretical prediction of Myers

[7] Prior to 1962, almost all of the firms for which we have complete data pay dividends. Thus, the dividends tests are examined using the years 1962 and forward. We have a similar issue with the Altman Z-score and use only the years 1963 onward in those tests.

and Majluf (1984) that financial slack has value when firms have good growth options. Additionally, the magnitude of this value seems as though it can be considerable. Among all our proxies, the estimates for high growth firms range from $1.11 to $1.84.

5.2 Investment uncertainty and market value of cash holdings

The next two regressions examine our second hypothesis, which states that firms with lower volatility in their investment program should have lower valuations associated with their cash holdings. Empirically, we measure volatility of investment opportunities of a firm based on the standard deviation of either their capital expenditures or R&D expenses over our entire sample period.[8]

The full sample regressions show that there is no significant difference in the value of cash held by firms with high or low capital expenditure uncertainty. However, in subsample tests when we allow for separate estimates on the control variables, we do see a significant difference in the market value of liquidity. Our other proxy is the variability in research and development expenses. Using R&D uncertainty, we find significant differences between firms with high and low volatility. Additionally, firms with low uncertainty in R&D have a market value of cash that is significantly less than a dollar while those with high uncertainty show values that are significantly higher than a dollar for all regressions.

Overall the results seem to support the hypothesis regarding investment volatility and are consistent with option pricing theory. Firms with more predictable investments may be better able to plan for them by tapping the capital markets. On the other hand, firms with more uncertainty in the arrival of opportunities need to have cash on hand to take advantage of them; hence, investors place a higher value on their cash holdings.

One caveat is that the point estimates for the R&D uncertainty regressions are close to those found

[8] Here we are using look ahead information, but we do so in order to more correctly classify firms by the volatility of their investment programs. We are not attempting to create or examine any implementable strategy of identifying these types of firms ahead of time so this should not materially affect our results.

when using a dummy variable for whether firms have R&D. Thus, it may be the case that the uncertainty regression is really just indicating that the presence of R&D is what makes cash valuable. At the same time, it is possible our results on the option value of cash may actually be understated. In theory, how frequently investment opportunities arise is less important than how long the window for accepting the project remains open. It is likely that our measures of volatility are not great proxies for measuring whether investment opportunities are able to be delayed. While our results are supportive of the idea that higher volatility in the investment program makes liquidity more valuable, we may be understating the magnitude of the effect. Overall, our results seem to support the notion of a real options value inherent in cash holdings, but given the mixed results with capital expenditure volatility, support for H2 may not be too strong.

5.3 Financial distress and market value of cash holdings

Our third hypothesis is that firms with greater likelihood of financial distress should have lower valuations of their liquid assets because of agency costs between stockholders and bondholders. As proxies for the likelihood of financial distress, we use Altman's (1968) Z-score, the interest coverage ratio, and firm leverage. Additionally, firms close to financial distress are unlikely to make long-term investments in research and development; hence, R&D expenditures are also a proxy for financial distress.

We have already seen that firms with positive R&D expenses have greater values assigned to their cash. In the remainder of Table 5, we examine regressions using Z-score, TIE ratio, and leverage to segment firms. Firms with Z-scores of 3 or greater would be predicted to not enter bankruptcy while firms with a score of 1.80 or lower are likely to enter bankruptcy (Altman (1968)). We are concerned only with firms who have the possibility of financial distress and not necessarily those which are likely to enter bankruptcy; thus, we use a breakpoint of 3.0 to separate the firms.[9] We have only a handful of firms in 1962 with Z-scores below three, so we drop that year from the sample and examine the cross-sectional regressions from 1963

[9] We find similar results if we break the firms at 1.8 or if we segment the firms into quintiles each year.

forward. In all regressions, firms with Z-scores above three have cash values greater than those closer to financial distress. Further, for firms with scores below three, the coefficients are quite small, all are below 0.30. Since cash holdings are unlikely to benefit shareholders of firms which are likely to experience financial distress, this result is not surprising.

There is an additional factor to consider with the Z-score regressions. Despite the strong results, we may actually be underestimating the impact of financial distress because of a potential survivor bias. While the FM methodology allows firms to enter and leave the panel, because of the lag and lead differences in the regressions, we require a firm to have 5 years of consecutive data in order to enter the regression. For firms which are most likely to become financially distressed, this requirement may cause them to drop out of the sample. Hence, the lowest Z-score firms potentially under represent the riskiest firms.

The results of the Z-score regressions support the hypothesis that cash is less valuable when firms have a greater likelihood of financial distress. Additionally, the results from the R&D expenditures regressions support this idea since cash is more valuable for firms which made R&D investments. However, the interest coverage ratio and leverage regressions suggest little difference in the value of liquidity between firms with little debt and those that are highly levered. While the coefficients are in the right direction, they are at best only marginally significant. Nonetheless, overall, our results appear consistent with the arguments of Jensen and Meckling (1976). It appears that stockholder-bondholder conflicts might affect the value that shareholders place on the liquidity of the firm.

5.4 Capital market access and market value of cash holdings

We have seen that the value shareholders place on cash holdings varies based on the quality and volatility of the investment opportunity set as well as possible agency costs between stockholders and bondholders. All of these factors measure different aspects of how firms may spend cash once it is inside the firm. The remaining aspect of cash holdings which is important is the cost with which firms can obtain

liquidity. If firms could raise funds cheaply and easily, existing cash holdings should be less important. On the other hand, if market frictions impair certain firms from raising capital, we should see higher valuations on the cash of those firms. Our fourth hypothesis is that firms with less access to the capital markets should have higher values placed on their cash holdings. However, since growth options are a major determinant of the value of liquidity, we need to simultaneously control for the investment opportunity set of the firms.

Empirically, we utilize several proxies to determine which firms have access to the capital markets and which are financially constrained. First, firms which are small or do not pay dividends may have a high cost of external finance and limited access to the capital markets. Additionally, we expect that firms with low interest coverage ratios or high amounts of leverage will have less access. For more precise measures of financial constraints we examine a measure developed by Whited and Wu (2002) and also classify firms as constrained using the method in Almeida, Campello and Weisbach (2003).

We employ two different techniques to examine whether capital market access affects the value of cash. First we use regressions which include multiple interactions as shown in equation (3).

$$M_i = \sum_{h=1}^{H} \sum_{j=1}^{J} \alpha_{h,j} \delta_{h,j} + \gamma_{h,j} (\delta_{h,j} * c_i) + \sum_{k=1}^{K} \beta_k x_{k,i} + \varepsilon_i \qquad (3)$$

The interaction dummy variables are constructed on two dimensions rather than a single one. For instance, in examining whether firm size impacts the value of liquidity, we construct nine different dummy variables ($\delta_{h,j}$) which represent the intersection of breakpoints on sales growth and firm size. We first segment sales growth into thirds and within each tierce we sort those firms into high, average, and low capital market access. As before, high (low) access firms are those in the top (bottom) 20%, while average firms are the middle 60%.

In Table 6, the reported coefficient for large firms is the interaction coefficient on cash holdings for firms in both the largest group of size and the largest group of sales growth (i.e. $\gamma_{3,3}$). This is compared to

the coefficient for firms in the largest group of sales growth and the smallest group of size ($\gamma_{3,1}$). Using this method allows us to control for growth opportunities while estimating the model with all of our data. We refer to this method as "Dual Interactions".

Additionally, we study regressions where we estimate the model from equation (2), including individual intercepts, using only high growth firms. For this analysis, we first rank all firms into thirds of sales growth based on the prior year. We keep only the high growth firms and subsequently rank those firms on the basis of capital market access. In Table 6, this procedure is reported under the heading "Only High Growth". Similar to our prior analysis, for each procedure, we examine FM regressions both with and without the lag and lead change in cash holdings.

Our first set of regressions shows that cash is not more valuable in small, high growth firms than it is in large, high growth firms. In fact, we find that cash holdings in large firms are significantly more valuable than those in small firms. If smaller firms are less able to access the capital markets, then these results imply that cash is actually *more* valuable for firms where external finance is easy to acquire. Fazzari, Hubbard, and Petersen (1988) argue that dividend payout acts as a proxy for capital market access. When we segment our high growth firms on the basis of whether or not they pay a dividend, there does not appear to be any difference among the coefficients, either statistically or in economic terms. This is also the case when we use leverage as a proxy for capital market access. When we measure access using the interest coverage ratio, we see weak evidence that firms with more access to capital markets have a higher value on their cash holdings.

Whited and Wu (2003) has a model for measuring the level of financial constraint for a firm. For robustness, we use their model to calculate the degree of constraint for each firm in our sample. The results of this analysis show that firms with the lowest level of financial constraint have a significantly higher value placed on their cash holdings. This result is strongly supported regardless of the specification used.

Additionally, Almeida, Campello and Weisbach (2003) develop a measure of the cash flow sensitivity of cash and use it to examine financial constraint. The idea is that constrained firms will have a higher cash

flow sensitivity than unconstrained firms since these firms are more dependent on cash flows for investment. Using this approach, we find that unconstrained firms have a higher value of cash holdings than constrained firms, although the results are at best marginally significant. We take this approach a bit further by looking at firms that are significantly constrained, but do not find any different results.[10]

Overall, the results suggest that the value shareholders place on liquidity is affected by the firm's access to the capital markets. However, contrary to our hypothesis, the results suggest that cash is more valuable for firms which are less financially constrained. It appears that cash is less valuable in the firms where it is most needed.

The results of Table 6 seem to contradict common beliefs about market access and the value of liquidity. The first possible explanation for this is that our empirical measures of constraint may be flawed. While we examine many proxies for financial constraint, the fact is that the current literature has not been able to settle on a specific measure which adequately describes the firm's degree of financial constraint.

Second, it may be that shareholders view a firm's access to the capital markets as a determining factor regarding whether the firm will be able to take advantage of investment opportunities. If the investment decision is linked to the financing decision, then we probably should see unconstrained firms having greater value associated with cash. While economists often think of investments as a scalable project, in reality, there is often a minimum investment needed. If a firm's current cash resources are insufficient to finance a good project, an unconstrained firm can go to the capital markets to make up the deficit. However, if a firm is constrained and its cash is insufficient to take the project, it will be forced to forego the project. Perhaps shareholders consider the probability of taking any investment in the valuation of a firm's cash holdings. Therefore, they might, in fact, put a higher value on the cash of those high-growth firms that are more likely to make investments.

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[10] Our implementation of ACW's (2003) technique defines firms to be financially constrained if the sensitivity of the change in cash to cash flow is estimated to be positive. We define firms to be significantly constrained if the estimated sensitivity is positive and significant at the 10% level.

This explanation is formalized in Cleary, Povel and Raith (2003) which argues that there is a U-shape in the investment of financially constrained firms and asymmetric information plays a more important role in these firms. If constrained firms are unable to access the capital markets then they will be unable to take advantage of available investment opportunities. Therefore, keeping growth opportunities constant, unconstrained firms could have a higher value assigned to their cash holdings. These firms have good investment opportunities and are able to take advantage of them while the constrained firms are not.

Regardless, the empirical results dealing with constrained firms seems contrary to expectation. While the area of financial constraint is a hot topic in the literature, our results indicate that the valuation effects of constraint need to be further examined.

5.5 Summary of the market value cash holdings

Our results suggest that there are cross-sectional differences in the valuation associated with cash holdings. It appears that firms with greater growth opportunities or more volatile investment programs have their liquid assets valued at a premium to face value. Additionally, it seems that firms which are likely to face financial distress have a significant discount placed on the value of their cash holdings. Also, while capital market access appears to matter, the results go in the opposite direction to what one may expect. Cash holdings in unconstrained firms appear more valuable than cash in a constrained firm.

6. Robustness

While our results appear consistent using different empirical proxies, we use several other techniques to determine their robustness. Most checks can be classified into two groups: those which test the robustness of the regression specification, and those which check the robustness of our cross-sectional classifications.

In our main regressions, to separately value the cash component from the rest of the firm, we control for the change in net assets rather than total assets so as not to capture cash in both variables. However

separating out the cash may cause difficulties with the earnings variables, especially when we include the past and future changes in cash holdings. The potential problem is that earnings are just a combination of cash earnings and accruals. To confirm that this issue does not materially affect our estimates, we run all regressions substituting the earnings variables with accruals. Doing so allows us to focus solely on the cash component. These results are similar and suggest that isolating the cash component does not cause specification problems.[11]

Similarly, deflating all variables by assets can be an issue since assets include cash. We repeat all our analyses deflating by net assets and find qualitatively similar results. While the magnitudes of the cash coefficients tend to increase, the inferences regarding the cross-sectional differences remain the same.

Additionally, while we use two year lag and lead changes in our independent variables to be consistent with prior literature, we also examine our results if we use one year lag and lead changes. Our main results are unaffected by this change.

Finally, we reexamine all our results using different measures for our dependent variable. First, we use the market to book ratio, defined as (market value of equity + book value of debt) / assets. We also examine regressions where the market value of equity is determined at the end of the fiscal year using prices from CRSP rather than COMPUSTAT. Lastly, we try to control for the fact that cash holdings for the firm might not be known by investors as of the fiscal year end due to a reporting delay. We reexamine our main results using the market value of equity measured either 3 months or 6 months after the end of the fiscal year. Our results are similar with these measures, and our inferences are unchanged. Despite all these different specifications of the dependent variable, the estimates on the value of cash for the full sample still range from \$0.87 to \$1.11 with standard errors around \$0.12

In addition to testing the robustness of our specification, we also employ several measures to

[11]The results tend to show that the coefficient on cash holdings is higher than that reported when the earnings variables are included. This is to be expected because in such a specification the cash variable also contains earnings information that is not captured by the accruals. The results are available upon request.

determine the robustness of our cross-sectional selection process. In our primary results, we group firms into the lowest 20%, middle 60% and top 20% for the respective variable. We also examine regressions which simply segment firms into quintiles. Additionally, we analyze specifications which use continuous interaction variables. In both cases, we draw similar inferences as those reported in the tables. While we report results of estimating equation (2) using separate intercepts for each group, we also examine the equation using a common intercept and find similar results.

In the investigation of the impact of growth opportunities on the value of cash holdings, our main proxy is the one year growth in firm sales. We also estimate regressions using the three-year geometric average of sales growth and find similar results. Another potential concern is that our sales growth results are hard-wired because our dependent variable is market capitalization deflated by assets which some argue is itself a measure of growth options. By ranking firms individually, we may simply be sorting firms into "winners" and "losers". To address this concern, we also examine regressions where we sort firms by industry characteristics. Firms are sorted each year based on the median sales growth for their 2 digit SIC code. While this procedure introduces more noise into the estimates, the results are qualitatively similar and suggest that the sales growth results are not spurious.

Given the surprising results we find when examining capital market access, we examine one additional empirical proxy. Due to their regulation, utilities tend to have fewer information asymmetries than industrial firms. Hence, we examine whether the value of cash differs across these two types of firms. Overall, the results are mixed. Estimations including both types of firms simultaneously reveal no differences, while estimations on subsamples indicate that cash is slightly less valuable for utilities. If anything, the utility results only strengthen the idea that more work needs to be done examining the interaction between cash holdings and financial constraint.

7. Conclusions

In this study we show that, on average, the market value of a dollar held by a firm is approximately one dollar. However, we also find substantial cross-sectional differences in the market value of cash. We show that firms with good growth opportunities have a higher premium placed on each dollar relative to firms with poor growth options. We also find that firms which are likely to face financial distress have their cash valued at a substantial discount to one dollar. Additionally, we find support for the idea that firms with greater uncertainty in their investment program have greater valuations placed on their liquid assets. Finally, we find evidence that access to the capital markets impacts the value of cash holdings, but the results are contrary to our expectations. Cash appears more valuable in unconstrained firms.

Our results suggest that, on average, shareholders believe the benefits of liquidity are balanced against the potential agency problems associated with it. Our cross-sectional tests provide support for the financial slack arguments of both Myers and Majluf (1984) and Jensen (1986). Overall, it appears that the investment opportunity set rather than the financing opportunity set of the firm has the greatest impact on the value that shareholders place on a firm's cash holdings.

Future research should further examine the impact that financial constraint has on a firm's cash policies and the impact of agency costs on the value of cash holdings. Theoretical models of the value shareholders place on the liquid assets of constrained and unconstrained firms would be very useful to increasing our understanding in this area.

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Table 1
Summary of Hypotheses and Predictions

The sign in parentheses in the final column indicates the predicted relationship on the value of cash holdings that the empirical proxy should have.

Hypothesis	Prediction of value of cash	Empirical proxies (Sign)
H1: Growth Options	Greater growth options makes cash more valuable	Sales growth (+) Dividends (-) R&D expenditures (+) Capital Expenditures (+)
H2: Predictability of Investment Opportunities	Greater predictability makes cash less valuable	Standard deviation of capital expenditures (+) Standard deviation of R&D (+)
H3: Probability of Financial Distress	Greater probability of distress makes cash less valuable	Altman's Z-score (+) R&D expenditures (+) Interest Coverage Ratio (+) Leverage (-)
H4: Capital Market Access	Holding growth options constant, financial constraint makes cash more valuable	Firm size (+) Dividends (-) Interest Coverage Ratio (-) Leverage (+) Whited and Wu (2003) (+) Almeida, Campello and Weisbach (2003) (+)

Table 2
Summary Statistics

Compustat variable numbers are in parentheses. X_t is the level of variable X in year t divided by the level of assets in year t. dX_t is the change in the level of X from year t-2 to year t divided by assets in year t $((X_{t-2} - X_t)/A_t)$. dX_{t+2} is the change in the level of X from year t+2 to year t divided by assets in year t $((X_{t+2} - X_t)/A_t)$. M is market value of equity (54*199). E is earnings defined as earnings before extraordinary items + interest + income statement deferred tax credits + investment tax credits (18 + 15 + 50 + 51). NA is net assets, which is defined as assets - cash (6 - 1). RD is research and development expense (46). When R&D is missing, it is set to zero. I is interest expense (15). D is common dividends (21). C is cash and marketable securities (1). The sample includes 9,844 firms representing 88,844 firm years from 1952-1997.

Variable	Mean	1st Quartile	Median	3rd Quartile	Standard Deviation
M_t	0.955	0.366	0.652	1.169	0.992
E_t	0.058	0.044	0.077	0.106	0.111
dE_t	0.010	-0.014	0.017	0.045	0.111
dE_{t+2}	0.016	-0.020	0.018	0.058	0.139
dNA_t	0.153	0.034	0.160	0.299	0.271
dNA_{t+2}	0.249	0.003	0.159	0.365	0.524
RD_t	0.020	0.000	0.000	0.019	0.045
dRD_t	0.004	0.000	0.000	0.002	0.022
dRD_{t+2}	0.006	0.000	0.000	0.002	0.033
I_t	0.023	0.009	0.019	0.032	0.020
dI_t	0.003	-0.002	0.002	0.009	0.017
dI_{t+2}	0.007	-0.002	0.002	0.012	0.025
D_t	0.012	0.000	0.006	0.020	0.017
dD_t	0.002	0.000	0.000	0.004	0.007
dD_{t+2}	0.002	0.000	0.000	0.004	0.008
dM_{t+2}	0.285	-0.139	0.071	0.400	1.390
C_t	0.104	0.026	0.061	0.137	0.120
dC_t	0.015	-0.017	0.005	0.041	0.103
dC_{t+2}	0.026	-0.022	0.004	0.044	0.164

Table 3
Correlation Matrix

Compustat variable numbers are in parentheses. X_t is the level of variable X in year t divided by the level of assets in year t. dX_t is the change in the level of X from year t-2 to year t divided by assets in year t $((X_{t-2} - X_t)/A_t)$. dX_{t+2} is the change in the level of X from year t+2 to year t divided by assets in year t $((X_{t+2} - X_t)/A_t)$. M is market value of equity (54*199). E is earnings defined as earnings before extraordinary items + interest + income statement deferred tax credits + investment tax credits (18 + 15 + 50 + 51). NA is net assets, which is defined as assets - cash (6 - 1). RD is research and development expense (46). When R&D is missing, it is set to zero. I is interest expense (15). D is common dividends (21). C is cash and marketable securities (1). The sample includes 9,844 firms representing 89,596 firm years from 1952-1997.

	M_t	E_t	dE_t	dE_{t+2}	dNA_t	dNA_{t+2}	RD_t	dRD_t	dRD_{t+2}	I_t	dI_t	dI_{t+2}	D_t	dD_t	dD_{t+2}	dM_{t+2}	C_t	dC_t
E_t	0.009																	
dE_t	0.093	0.597																
dE_{t+2}	-0.015	-0.266	-0.253															
dNA_t	0.169	0.253	0.143	-0.098														
dNA_{t+2}	0.215	0.128	0.136	0.171	0.169													
RD_t	0.291	-0.289	-0.084	0.015	-0.033	-0.020												
dRD_t	0.204	-0.065	-0.135	-0.015	0.166	0.031	0.528											
dRD_{t+2}	0.242	0.055	0.092	-0.110	0.064	0.165	0.227	0.155										
I_t	-0.296	-0.124	-0.050	0.019	-0.162	-0.098	-0.109	-0.102	-0.082									
dI_t	-0.074	0.016	-0.033	-0.009	0.452	-0.014	-0.045	0.036	-0.017	0.293								
dI_{t+2}	0.074	0.026	0.054	0.008	0.235	0.581	-0.034	0.017	0.044	-0.124	0.014							
D_t	0.137	0.268	0.030	0.016	-0.007	-0.038	-0.129	-0.054	-0.053	-0.323	-0.027	-0.051						
dD_t	0.137	0.205	0.102	-0.001	0.139	0.051	-0.041	-0.001	-0.001	-0.165	-0.004	0.034	0.450					
dD_{t+2}	0.127	0.182	0.103	0.130	0.033	0.125	-0.044	-0.009	0.007	-0.150	-0.049	-0.006	0.208	0.194				
dM_{t+2}	0.076	-0.011	0.032	0.208	0.004	0.325	0.128	0.073	0.197	-0.035	-0.019	0.029	-0.009	0.028	0.116			
C_t	0.348	-0.079	0.009	-0.018	-0.092	0.074	0.297	0.179	0.174	-0.325	-0.105	-0.009	0.039	0.044	0.059	0.168		
dC_t	0.178	0.162	0.128	-0.067	0.007	0.133	0.020	0.121	0.126	-0.113	-0.025	0.047	-0.025	0.042	0.072	0.042	0.461	
dC_{t+2}	0.142	0.010	0.048	0.137	0.053	0.143	0.115	0.079	0.187	-0.015	-0.001	0.044	-0.044	-0.007	0.050	0.395	-0.032	-0.068

Table 4
Regression Results for Market Value of the Firm

Compustat variable numbers are in parentheses. X_t is the level of variable X in year t divided by the level of assets in year t. dX_t is the change in the level of X from year t-2 to year t divided by total assets in year t $((X_{t-2} - X_t)/A_t)$. dX_{t+2} is the change in the level of X from year t+2 to year t divided by assets in year t $((X_{t+2} - X_t)/A_t)$. M is market value of equity (54*199). E is earnings defined as earnings before extraordinary items + interest + income statement deferred tax credits + investment tax credits (18 + 15 + 50 + 51). NA is net assets, which is defined as assets - cash (6 - 1). RD is research and development expense (46). When R&D is missing, it is set to zero. I is interest expense (15). D is common dividends (21). C is cash and marketable securities (1). The dependent variable for the regressions is M_t. All regressions are run using the methodology of Fama and MacBeth. Each year cross-sectional regressions are run and the reported coefficients are the means of the time series of regression coefficients. The standard errors reported are from the time series of regression coefficients as well. The reported R^2 are the average of the R^2s from the cross-sectional regressions.

Fama MacBeth	Levels - M_t	Levels - M_t
Intercept	0.27 (0.053)	0.27 (0.052)
E_t	3.59 (0.767)	3.40 (0.744)
dE_t	-0.13 (0.253)	-0.26 (0.261)
dE_{t+2}	1.03 (0.299)	0.86 (0.264)
dNA_t	0.65 (0.048)	0.67 (0.049)
dNA_{t+2}	0.29 (0.036)	0.31 (0.040)
RD_t	5.27 (0.530)	5.19 (0.525)
dRD_t	0.74 (0.886)	0.70 (0.870)
dRD_{t+2}	3.90 (0.559)	3.68 (0.558)
I_t	-6.79 (0.567)	-6.64 (0.581)
dI_t	-4.07 (1.101)	-4.76 (1.151)
dI_{t+2}	-5.18 (0.977)	-5.52 (1.070)
D_t	6.81 (0.729)	7.44 (0.699)
dD_t	4.57 (0.708)	4.50 (0.713)
dD_{t+2}	8.75 (0.993)	8.55 (0.973)
dM_{t+2}	-0.12 (0.048)	-0.14 (0.049)
C_t	**0.97** **(0.124)**	**0.94** **(0.130)**
dC_t		0.36 (0.070)
dC_{t+2}		0.61 (0.094)
N	46	46
Adjusted R^2	0.4730	0.4831

Table 5
Interacted Cash Coefficients - Various Regressions

All regressions are run using the methodology of Fama and MacBeth. Each year cross-sectional regressions are run and the reported coefficients are the means of the time series of regression coefficients. The standard errors, in parentheses, are computed from the time series of regression coefficients. Coefficients are shown which are the interaction between cash to assets and a dummy variable indicating firm characteristics. The dummy variables take the value of 1 if the firm has that characteristic in that year. Lowest and Highest refer to quintiles of the variable. Quintiles are re-ranked each year from 1952-1997. Regressions are run both including and excluding individual intercepts for each quintile as noted in the table heading. Subsample means that the regression is estimated using only the firms which have the particular characteristic noted. *, **, and *** indicate that the coefficient is larger than the other category at the 10, 5, and 1 percent levels respectively.

Regression includes change in lead and lag cash	No		Yes	
	Full Sample	Subsample	Full Sample	Subsample
Sales Growth				
Lowest Sales Growth	0.27	0.66	0.29	0.75
	(0.111)	(0.100)	(0.126)	(0.112)
Highest Sales Growth	1.34***	1.14***	1.30***	1.11***
	(0.205)	(0.152)	(0.216)	(0.184)
Dividend Policy (1962 on)				
Dividend Paying	0.96	0.78	0.91	0.65
	(0.074)	(0.066)	(0.083)	(0.071)
No Dividends	1.21**	1.19***	1.16**	1.20***
	(0.133)	(0.129)	(0.129)	(0.114)
Research and Development Expenditures				
Zero R&D expenditures	0.77	0.74	0.73	0.70
	(0.118)	(0.110)	(0.124)	(0.119)
Nonzero R&D expenditures	1.84***	1.76***	1.79***	1.54***
	(0.166)	(0.201)	(0.172)	(0.180)
Capital Expenditures				
Lowest capital expenditures	0.51	0.75	0.46	0.73
	(0.098)	(0.092)	(0.106)	(0.086)
Highest capital expenditures	1.55***	1.36***	1.52***	1.32***
	(0.210)	(0.203)	(0.219)	(0.252)
Capital Expenditure Uncertainty				
Lowest Capital Expenditure Volatility	0.80	0.77	0.74	0.65
	(0.111)	(0.103)	(0.111)	(0.105)
Highest Capital Expenditure Volatility	0.86	1.07**	0.83	1.17**
	(0.174)	(0.152)	(0.185)	(0.203)
Research and Development Uncertainty				
Lowest R&D Volatility	0.72	0.81	0.67	0.78
	(0.114)	(0.087)	(0.121)	(0.096)
Highest R&D Volatility	1.76***	1.54***	1.75***	1.58***
	(0.178)	(0.185)	(0.188)	(0.198)
Altman's Z-Score (1963 on)				
Less than 3.0	0.23	0.25	0.26	0.28
	(0.083)	(0.079)	(0.122)	(0.124)
Higher than 3.0	1.60***	1.50***	1.58***	1.41***
	(0.102)	(0.100)	(0.099)	(0.100)
Interest Coverage Ratio (TIE ratio)				
Lowest (positive) TIE	0.54	0.54	0.49	0.35
	(0.104)	(0.089)	(0.109)	(0.096)
Highest (positive) TIE	0.82*	0.62	0.70	0.63
	(0.153)	(0.161)	(0.157)	(0.160)
Leverage				
Lowest leverage (nonzero)	0.85	0.74	0.77	0.50
	(0.152)	(0.186)	(0.154)	(0.183)
Highest leverage	0.51*	0.49	0.48*	0.51
	(0.168)	(0.132)	(0.181)	(0.150)

Table 6
Interacted Cash Coefficients - Capital Market Access For High Growth Firms

All regressions are run using the methodology of Fama and MacBeth. Each year cross-sectional regressions are run and the reported coefficients are the means of the time series of regression coefficients. The standard errors, in parentheses, are computed from the time series of regression coefficients. Dual Interactions indicates that the regression is estimated using the full sample of data and the coefficient is the interaction between cash to assets and a dummy variable indicating firms with the highest sales growth and the noted characteristic. The dummy variables take the value of 1 if the firm has that characteristic in a particular year. Only High Growth means that the regression is estimated using only the subset of firms which were in the highest quintile of sales growth each year. Lowest and Highest refer to quintiles of the variable. Quintiles are re-ranked each year from 1962-1997. *, **, and *** indicate that the coefficient is larger than the other category at the 10, 5, and 1 percent levels respectively.

Regression Includes Changes in Lead and Lag Cash	Dual Interactions		Only High Growth	
	No	Yes	No	Yes
Large Firms	2.13***	2.03 ***	1.92***	1.81***
	(0.354)	(0.357)	(0.331)	(0.336)
Small Firms	0.65	0.63	0.43	0.44
	(0.229)	(0.246)	(0.222)	(0.246)
Dividend Paying	1.47	1.42	1.28	1.26
	(0.157)	(0.155)	(0.148)	(0.207)
No Dividends	1.64	1.60	1.33	1.21
	(0.179)	(0.192)	(0.186)	(0.154)
Lowest (positive) TIE	0.71	0.67*	0.66*	0.67*
	(0.309)	(0.214)	(0.180)	(0.244)
Highest (positive) TIE	1.16	1.11	1.13	1.11
	(0.273)	(0.283)	(0.254)	(0.275)
Lowest leverage (nonzero)	1.04	0.98	0.97	0.95
	(0.220)	(0.231)	(0.222)	(0.276)
Highest leverage	0.71	0.66	0.59	0.61
	(0.226)	(0.230)	(0.263)	(0.276)
Highest Financial Constraint (WW)	0.78	0.77	0.53	0.56
	(0.270)	(0.287)	(0.279)	(0.296)
Lowest Financial Constraint (WW)	2.19 ***	2.11***	2.02***	1.93***
	(0.241)	(0.245)	(0.227)	(0.245)
Constrained (ACW)	1.13*	1.14	0.92*	0.94*
	(0.197)	(0.205)	(0.173)	(0.198)
Unconstrained (ACW)	1.48	1.44	1.27	1.24
	(0.197)	(0.204)	(0.174)	(0.185)
Significantly Constrained (ACW)	0.98	0.92*	0.90	0.81
	(0.308)	(0.305)	(0.284)	(0.280)
Significantly Unconstrained (ACW)	1.39	1.36	1.17	1.17
	(0.175)	(0.188)	(0.154)	(0.175)