# Do Institutional Investors Alleviate Agency Costs in R&D Investment Decisions?

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**Abstract**

Research and development (R&D) investment is an important determinant of the future growth in revenue and earnings for many corporations. The amount of financial resources which are allocated to R&D is an important financial decision for those corporations and a key to survival for many of them. Since institutions own over 70% of U.S. public corporations, their effect on R&D decisions is important to the success of U.S. corporations.

This study tests whether institutional investors encourage R&D investment in firms with potential agency problems. Firm and year fixed effect regressions and difference-GMM regressions are used on data from CDA / Spectrum Compact Disclosure (1990 – 2005, the only years the data was available) to examine the effect of changes in institutional investor levels to subsequent changes in R&D investment levels. Increased institutional ownership leads to increased R&D investment and this relationship is stronger in firms more susceptible to agency problems. Agency-based free cash flow theory predicts that institutional investors will encourage R&D investment in firms with good investment opportunities, but they will not encourage R&D investment simply because a firm has higher free cash flow. My results support this prediction indicating that institutional investors help to control agency problems in R&D investment decisions. The results in this paper indicate that this may lead to a decrease in agency costs in R&D decisions, thus benefiting institutional and non-institutional shareholders.

**Keywords:** Institutional investors, R&D, Investment policy, Managerial myopia, Agency costs

## 1. Introduction

Corporate managers must decide how much of their company's budget should be dedicated to research and development (R&D). For many companies, this decision has a substantial impact on the future cash flows of the company. In most cases, shareholders should benefit from R&D investment. (Chan, Lakonishok, & Sougiannis, 2001) offer support to this view with their finding that higher and increased R&D investment is positively associated with future returns. Despite the apparent benefits of R&D, management may be hesitant to fully fund R&D investment because of uncertainties surrounding this type of investment. Investors underreact to R&D increases which leads to abnormally positive stock returns for the 5-year period following an R&D increase (Eberhart, Maxwell, & Siddique, 2004). Also, the benefits of R&D investment are far more uncertain than the benefits from many other investments (Kothari, Laguerre, & Leone, 2002).

The delayed and risky benefits of R&D can cause agency problems. Agency problems arise when managers act in their own interests at the expense of shareholders' interests. Underinvestment in R&D may be advantageous to management but not shareholders. Underinvestment may increase short-term earnings at the expense of long-term value because R&D investment is expensed immediately, but the payoff from R&D is rarely realized in the same accounting period as when the investment is made. Therefore, short-term earnings move inversely to R&D investment.

(Porter, 1992) argues that because U.S. institutional managers are measured on their short-term performance that they focus on short-term returns in their investments. This drives them to focus on near-term indicators that provide limited information like current earnings when valuing investments. Management reacts to this pressure by decreasing investment in R&D.

There is evidence that managers sometimes intentionally invest at less than the optimal level. (Graham, Harvey, & Rajgopal, 2005) interview executives and find out that approximately 80% of them would reduce R&D to meet an earnings target. (Bhojraj & Libby, 2005) conduct an experiment in which 89 experienced financial managers choose between projects where a conflict exists between near-term earnings and total cash flow. In the experiment, managers favor projects that will maximize short-term earnings over projects which will maximize total cash flows when increased capital market pressure resulting from a pending stock issuance is present. (Bhojraj, Hribar, Picconi, & McInnis, 2009) argue that dedicated earnings guiders engage in myopic R&D to beat analysts' forecasts. Additionally, they find that managers know they are underinvesting as evidenced by increased insider selling following underinvestment in R&D.

Although there is substantial evidence that management of some firms systematically underinvest, there is also evidence that managers do not methodically underinvest. (Cazier, 2011) follows CEOs throughout time and finds no evidence that they reduce spending on R&D as they near retirement, although he does find that older CEOs spend less on R&D in general.

Institutional investors may help mitigate the potential problem of underinvestment in R&D or they may exacerbate it. Institutional investors pool large sums of money which they then invest in various investments including equity. Common institutional investors include banks, insurance companies, mutual funds, investment advisors, pension funds, hedge funds and university endowments. Institutions own over 70% of the shares of U.S. corporations (Gaspar, Massa, Matos, Patgiri, & Rehman, 2013). There is evidence that influential shareholders can alleviate myopic R&D investment decisions. For example, (Tsao, Chang, & Koh, 2017) find that founding family ownership mitigates myopic R&D investment.

The empirical evidence on the relationship between institutional investors and R&D is mixed. (Aghion, Van Reenen, & Zingales, 2013) argue that institutional investors have a positive impact on R&D and its productivity by reducing the career risk faced by CEOs who invest in risky R&D projects. They find that CEOs are less likely to be fired after profit downturns resulting from such projects if institutional ownership is higher. In their study of large European companies, (Brossard, Lavigne, & Sakinç, 2013) find that firms with higher institutional ownership have higher R&D investments as long as the institutional investors are not seeking short-term profits. (Bange & De Bondt, 1998) find in a study of 100 firms with large R&D budgets that management is less likely to manage earnings by cutting R&D if institutional ownership is higher. Institutional investors help to mitigate managerial underinvestment caused by firm-specific risk (Panousi & Papanikolaou, 2012).

On the other hand, there is evidence that institutional investors are not effective monitors of R&D investment. (You, Chen, & Holder, 2010) demonstrate that institutional investors have no effect on R&D levels in American pharmaceutical firms. (Lee, 2012) finds no evidence that institutional owners have an effect on R&D investment in Korean manufacturing firms. (Brossard et al., 2013) also provide evidence that if the institutional investors are seeking short-term profits, they have a negative effect on R&D.

Still, institutional investors are generally believed to be more effective monitors of firm management than other investors. One reason for this is that the relative cost of monitoring and influencing management is higher for non-institutional shareholders than for institutions because costs are spread across fewer shares (Almazan, Hartzell, & Starks, 2005; Parrino, Sias, & Starks, 2003).

I examine the effect that institutions have on R&D and then analyze the effect that free cash flow and investment opportunities have on the relationship between institutional investors and R&D investment. I test a hypothesis that institutional investors will encourage R&D more in firms that are less prone to overinvestment problems. This hypothesis is derived from the work of (Jensen, 1986) which asserts that managers that put their interests above shareholders' interests will be more prone to overinvest if their firm has high free cash flow and poor investment opportunities. Jensen uses empirical evidence involving debt and acquisitions to support his theory. According to my hypothesis, institutional investors should encourage R&D investment primarily in firms that have good investment opportunities and not simply because a firm has high free cash flow (available funds). If institutional investors don't take investment opportunities into account when using their influence to convince management to increase R&D, then the relationship between institutional shareholders and R&D does not provide evidence of superior monitoring ability.

My results indicate that institutional investors encourage higher R&D investment in general. I find that institutional investors encourage R&D investment more as investment opportunities rise, but not as free cash flow rises. (Jensen, 1986) provides evidence that managers tend to overinvest if they have free cash flow even if they do not have adequate investment opportunities. He finds that debt helps to control this tendency. My results provide evidence that institutional investors help control managerial overinvestment by only encouraging higher R&D investment in firms that have adequate investment opportunities.

I conclude that, holding other factors constant, higher institutional investor ownership leads to higher R&D investment. I also find that this relationship strengthens as investment opportunities increase.

## 2. Hypotheses

(Shleifer & Vishny, 1986) and others have theorized that large investors are important monitors of firm management. Institutional investors can influence management R&D investment policy. This influence is reflected in the finding of (Graham et al., 2005) that CFOs view institutional investors as the most important marginal investors and institutional shareholders are important because they can lower stock price by herding out of a stock after an earnings miss or they can provide easier access to capital leading to a lower future cost of capital if they are pleased with firm management.

(Wahal & McConnell, 2000) find a positive relationship between institutional investors and R&D investment. They do not establish that institutional investors use their influence to persuade management to increase R&D investment. Given that the market generally rewards increased R&D investment and that institutional investors have been shown to effectively monitor management, I hypothesize that the influence of institutional investors will lead to higher R&D investment.

***H1***: Institutional investors will encourage higher R&D investment, after controlling for firm characteristics.

Agency costs are incurred by investors when a firm's management uses its superior knowledge of the firm's business activities to make decisions that benefit management at the expense of shareholders. Agency-based free cash flow theory ((Easterbrook, 1984) and (Jensen, 1986)) suggests that firms with higher free cash flow and poor growth opportunities have higher discretionary funds that can be misused by management.

If institutional investors are better monitors than other investors, agency-based theory implies that institutional investors will encourage R&D investment more in firms with good investment opportunities, but they will not encourage R&D investment more in firms with high free cash flow (unless the high free cash flow is accompanied by good investment opportunities). This leads to my final hypothesis.

***H2***: Institutional investors will encourage R&D investment more as investment opportunities increase. In the absence of increased investment opportunities, institutional investors will not encourage R&D investment more as free cash flow increases.

## 3. Data, Methods and Summary Statistics

### *3.1 Data*

I gather yearly institutional and insider ownership data from CDA / Spectrum Compact Disclosure for each year from 1990 to 2005. These are the only years that data was available. Financial firms and utilities are excluded because they are highly regulated by the government. The ownership data is then merged with Compustat data. The final sample includes 10,668 firms and 79,890 firm-years. Some firms are missing data or not present in the sample for enough firm-years to perform certain analysis. In such cases, these firms are not used.

Following (Bushee, 1998), I use R&D investment per share (adjusting for stock splits) as my primary measure of R&D investment. I also use R&D to assets as a measure of R&D investment for some of my robustness checks. Many others have used R&D to sales as a measure of R&D investment, but my sample includes numerous small firms with negligible sales. Therefore, results using R&D to sales as a dependent variable tend to be dominated by firms with the lowest sales figures. R&D investment per share is an effective measure to use in discerning if a firm increased or decreased R&D investment, but it does not provide a proper scale for use in linear regressions. Therefore, I use logit regressions in my analysis using a binary dependent variable which indicates either R&D increases or decreases. As in previous studies, missing values of R&D expenditures are assumed to be zero (e.g., (Coles, Daniel, & Naveen, 2006) and (Cheng, 2008)).

Since a variety of factors can jointly affect institutional ownership and investment levels, thus inducing a spurious correlation, several control variables must be used in my regressions. I start with the same control variables used by (Wahal & McConnell, 2000) in their study of the effects of institutional investors on R&D and capital investment with one exception; I substitute $q$ for the book-to-market ratio. Following (Dlugosz, Fahlenbrach, Gompers, & Metrick, 2006), I calculate the variable $q$ as the ratio of the market value of assets to the book value of assets where market value is calculated as the sum of the book value of assets and the market value of common stock less the book value of common stock and deferred taxes.

I use total debt to total assets because firms may forego R&D investment if funds are required to service debt. I include earnings before interest and taxes (EBIT) scaled by total assets because the availability of internally generated funds may have an impact on R&D investment decisions. I use insider percentage ownership and insider percentage ownership squared because insider owners are widely documented to have an effect on corporate policies and firm value (e.g. (Morck, Shleifer, & Vishny, 1988)). I also use log of sales as an independent control variable to control for firm size.

I add some control variables that were not used by (Wahal & McConnell, 2000). Capital expenditures scaled by assets is used to control for funds required for this use that are not available for R&D investment and for transition into a more mature firm life-cycle which requires a different investment mix (Bushee, 1998). I also use a proxy for firm life-cycle, retained earnings to the book value of total equity (DeAngelo, DeAngelo, & Stulz, 2006), because R&D investment may vary as a firm becomes more mature. I use the log of market capitalization of equity because smaller firms are more likely to suffer cash flow constraints that may limit cash available for R&D investment (Jalilvand & Harris, 1984). I use free cash flow scaled by total assets because firms with negative free cash flow may be forced to curtail R&D expenditures to preserve funds (Bushee, 1998). Free cash flow is defined as net income plus depreciation and amortization minus capital expenditures.

(Edmans, 2009) has hypothesized that stock liquidity is an important component of the effect that large investors can exert on investment policy. Therefore, firm stock turnover is used as a control for stock liquidity. Firm stock turnover is defined as the number of common shares traded in a year divided by common shares outstanding. Table 1 displays detailed definitions of all variables used in my analysis.

Table 1. Variable Definitions - R&D

| Variable | Description | Definition |
|---|---|---|
| Panel A: Summary Statistics and Correlation Table Variables | | |
| *N* | Number of Firms | The number of firms. |
| *Inst* | Institutional Ownership | The fraction of shares owned by institutional investors. |
| *R&D* | R&D Expenses | Research and development expenses divided by previous year's sales |
| *q* | Investment Opportunities | Market value of assets to the book value of assets |
| *MktCap* | Market Capitalization | The dollar market value of common stock in millions. |
| *LifeCycle* | Firm Life-cycle | The ratio of retained earnings to total equity. |
| *Liquidity* | Stock Turnover | Number of common shares traded in a year divided by common shares outstanding |
| *FCF* | Free Cash Flow | Net income plus depreciation and amortization minus capital expenditures scaled by total assets. |
| Panel B: Regression Dependent Variables (Measured as changes in values from year *t* – 1 to *t*.) | | |
| *R&D_Incr* | R&D Increase | Binary variable equal to one if there is an increase in R&D expenses per split-adjusted common share and zero otherwise. |
| *R&D_Decr* | R&D Decrease | Binary variable equal to one if there is a decrease in R&D expenses per split-adjusted common share and zero otherwise. |
| *R&D_Assets* | R&D to Assets | R&D expenses divided by previous year's total assets |
| Panel C: Regression Independent Variables (Measured as changes in values from year *t* – 2 to *t* - 1.) | | |
| *Inst* | Institutional Ownership | The fraction of shares owned by institutional investors. |
| *q* | Investment Opportunities | Market value of assets to the book value of assets |
| *Debt* | Debt Ratio | Debt to assets. |
| *ROA* | Return on Assets | Earnings before interest and taxes divided by total assets. |
| *Insider* | Insider Ownership | The fraction of shares owned by insiders. |
| *Insider2* | Insider Ownership Squared | The squared value of Insider. |
| *MktCap* | Market Capitalization | The dollar market value of common stock in millions. |
| *CapEx* | Capital Expenditures | Capital expenditures to total assets |
| *FCF* | Free Cash Flow | Net income plus depreciation and amortization minus capital expenditures scaled by total assets. |
| *Liquidity* | Stock Turnover | Number of common shares traded in a year divided by common shares outstanding |
| *LifeCycle* | Firm Life-cycle | The ratio of retained earnings to total equity. |
| *Revenue* | Revenue | The logarithm of firm revenue. |

*3.2 Methods*

The relationship between institutional investors and R&D investment is almost certainly endogenous and my hypotheses are contingent on institutional investors influencing R&D. Therefore, I must use a regression methodology which accounts for endogeneity and establishes causality. (Note 1)

I run regressions on changes in dependent variables from year $t-1$ to $t$ on changes in independent variables from $t-2$ to $t-1$ to establish causality. I use firm fixed effect regressions to control for all stable characteristics of a firm (including industry), whether measured or not. I use yearly dummy variables to control for time-varying omitted characteristics. Firm and year fixed effects alleviate endogeneity problems. Firm fixed effects regressions with yearly dummy variables effectively give a separate intercept to each year. Intercepts in fixed effects regressions are calculated as an average value of the unobserved fixed effects for each firm. This intercept and the yearly intercept values are not relevant to my analysis. Therefore, the intercept term and yearly dummy coefficients are not reported in my regression results.

I use a difference generalized method of moments (GMM) methodology for my robustness checks (Holtz-Eakin, Newey, & Rosen, 1988). This methodology reduces endogeneity problems. I also use methodology and validity tests developed by (Arellano & Bond, 1991). I use the Stata command xtabond2 to implement this methodology for my analysis (Roodman, 2009). GMM is used by (Brossard et al., 2013) to control for endogeneity and establish causality between institutional ownership and R&D investment changes. (Almeida, Campello, & Galvao, 2010) find that difference GMM is effective in regressions using sample data that is similar to mine.

Since difference GMM uses lagged endogenous regressors as instruments, each firm's data loses one year in my analysis. Dependent variables rely on past realizations because current R&D investment policy is largely dependent on past R&D investment policy. Independent variables are assumed to be endogenous in difference GMM. My implementation of difference GMM controls for endogeneity in the relationship between R&D investment policy and institutional ownership. The difference GMM model (1) is shown below.

$$\Delta Policy_{it} = \Delta Policy_{it-1} + \Delta Inst_{it-1} + \beta \bullet \Delta Control_{it-1} + \Delta\varepsilon_{it} \quad (1)$$

In this model, $Policy_{it}$ represents the change in the firm R&D investment policy. $Policy_{it-1}$ represents the change in firm repurchase policy in the previous year. The independent variable $Inst_{it-1}$ represents the change in institutional ownership percentage in the previous year. $Control_{it-1}$ represents a vector of time-varying firm level control variables. Year dummies are included as control variables to remove time-related shocks that affect all firms. The $\varepsilon_{it}$ term represents a time-varying observation-specific error term. The difference GMM methodology uses first-differences thus removing the firm-fixed effects because they are time invariant.

(Roodman, 2009) argues that the Hansen-Sargan *J*-test and the Arellano-Bond test for second-order autocorrelation in differenced residuals should be used to validate the difference GMM model. I use both tests. In these tests, *p*-values of less than 0.10 indicate an invalid model.

*3.3 Summary Statistics*

Table 2 displays sample summary statistics. Panel A includes all firms and panel B includes only firm-years in which the firm made R&D investments. Statistics are shown for two time periods, 1990 – 1997 and 1998 – 2005, and for the total sample. Table 3 displays correlations for selected firm variables.

Table 2. Summary Statistics

| *Years* | *N* | *Inst* | *R&D* | *q* | *MktCap* | *LifeCycle* | *Liquidity* | *FCF* |
|---|---|---|---|---|---|---|---|---|
| | | | | Panel A: All Firms | | | | |
| 1990 - 1997 | 37492 | 28.9% | 1.155 | 2.81 | 2106 | -0.69 | 4.46 | -0.16 |
| | | (23.6%) | (0.000) | (1.85) | (163) | (0.29) | (0.64) | (0.01) |
| 1998 - 2005 | 42398 | 33.3% | 1.656 | 4.68 | 4891 | -0.53 | 4.80 | -0.39 |
| | | (25.8%) | (0.003) | (1.86) | (350) | (0.18) | (0.86) | (0.01) |
| Total | 79890 | 31.3% | 1.433 | 3.82 | 3603 | -0.61 | 4.64 | -0.28 |
| | | (24.6%) | (0.000) | (1.85) | (239) | (0.24) | (0.74) | (0.01) |
| | | | | Panel B: Firms with R&D Expenses | | | | |
| 1990 - 1997 | 17240 | 29.8% | 2.479 | 3.04 | 3007 | -1.75 | 6.88 | -0.11 |
| | | (24.1%) | (0.059) | (2.12) | (157) | (0.26) | (0.75) | (0.02) |
| 1998 - 2005 | 21751 | 33.3% | 3.197 | 3.97 | 6360 | -0.48 | 6.30 | -0.33 |
| | | (25.8%) | (0.096) | (2.23) | (317) | (0.01) | (1.01) | (-0.00) |
| Total | 38991 | 31.8% | 2.896 | 3.56 | 4894 | -1.04 | 6.55 | -0.24 |
| | | (24.9%) | (0.078) | (2.18) | (226) | (0.14) | (0.88) | (0.01) |

Means are shown on the first row and medians are shown in parentheses on the second row.

Table 3. Correlations

| | *R&D* | *Inst* | *q* | *MktCap* | *LifeCycle* | *Liquidity* |
|---|---|---|---|---|---|---|
| *Inst* | -0.0133* | | | | | |
| *q* | 0.0028 | -0.0135* | | | | |
| *MktCap* | -0.0049 | 0.0865* | -0.0019 | | | |
| *LifeCycle* | -0.0010 | 0.0013 | 0.0013 | 0.0009 | | |
| *Liquidity* | -0.0002 | -0.0009 | -0.0003 | -0.0008 | 0.0002 | |
| *FCF* | -0.0032 | 0.0232* | -0.4194* | 0.0023 | -0.0008 | 0.0000 |

* indicates two-tailed significance at 5%.

## 4. The Effect of Institutional Owners, Investment Opportunities and Cash Flow on R&D

It is generally assumed that corporate investment in R&D will have a long-term payoff in the aggregate. Otherwise, there would be no reason to make such investments. An essential component of arguing that a reduction in such investment is myopic in nature is an existence of a negative relationship between investment and short-term reported earnings. This link seems clear because, as noted in (Wahal & McConnell, 2000), accounting methods decrease short-term earnings as R&D spending is expensed immediately, but an increase in earnings from these investments may not occur for years. Nevertheless, I use a method similar to the one they used to show a negative relationship between investment spending and short-term earnings for my sample. Unsurprisingly, my results, which are omitted for conciseness, also demonstrate a strongly significant negative relationship between R&D investment and earnings for the entire sample and on a yearly basis. The evidence indicates that R&D expenditures reduce current reported earnings.

I investigate the influence that institutional investors have on R&D investment by estimating the following firm and year fixed effects logit model (2).

$$RDChg_{it} = Year_t + Firm_i + Inst_{it-1} + \beta \bullet Control_{it-1} + \varepsilon_{it} \quad (2)$$

The dependent variable $RDChg_{it}$ is a binary variable set to either zero or one. In most of my analysis, it is set to one if there is an increase in R&D investment per share and to zero if not. In a robustness check, it is set to one if there is a decrease in R&D investment per share and to zero if not. The independent variable of interest ($Inst_{it-1}$) represents the effect of changes in institutional ownership percentage on changes in R&D investment in the following year.

In model (2), $Year_t$ represents year fixed effects, $Firm_i$ represents firm fixed effects, $Control_{it-1}$ represents a vector of time-varying firm level control variables, and $\varepsilon_{it}$ is the error term. The dependent variable is calculated on the change in R&D from year $t$ - 1 to year $t$. The independent variables are measured as the change from year $t$ – 2 to year $t$ – 1. The logit model drops firms from the regression that never have a change in the dependent variable. This means that when the dependent variable is an R&D increase binary variable, firms that increase their R&D investment in every year of the sample and firms that don't increase their R&D investment in any year of the sample are dropped from the regression. I consider this an advantage to the model since only firms that change R&D policy are included in regression samples.

Table 4. Institutional Ownership and R&D

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | All Firms | All Firms | No R&D Incr. in year *t* - 2 | R&D Incr. in year *t* - 2 | 1990 - 1997 | 1998 - 2005 |
| | *R&D_Incr* | *R&D_Incr* | *R&D_Incr* | *R&D_Incr* | *R&D_Incr* | *R&D_Incr* |
| *Inst* | | 0.8576*** | 0.8496*** | 0.6722*** | 0.8601*** | 0.8353*** |
| | | (5.54) | (3.13) | (2.95) | (2.73) | (4.30) |
| *q* | -0.0406*** | -0.0374*** | -0.0366*** | -0.0470*** | -0.0797*** | -0.0290*** |
| | (4.97) | (4.64) | (2.94) | (3.23) | (3.17) | (3.46) |
| *Debt* | -0.0920 | -0.0807 | 0.1262 | -0.5816** | -0.7951** | -0.0231 |
| | (1.18) | (1.04) | (1.10) | (2.39) | (2.27) | (0.33) |
| *ROA* | 0.1942* | 0.1969* | -0.0509 | 0.1756 | 0.8265** | 0.1590 |
| | (1.84) | (1.85) | (0.40) | (0.75) | (2.30) | (1.36) |
| *Insider* | -0.1552 | -0.1622 | -0.6080 | 0.8499 | -0.8434 | 0.5605 |
| | (0.46) | (0.48) | (1.12) | (1.57) | (1.36) | (1.28) |
| *Insider2* | 0.3269 | 0.3213 | 1.0153 | -0.7765 | 1.2460* | -0.7551 |
| | (0.74) | (0.72) | (1.39) | (1.10) | (1.66) | (1.24) |
| *MktCap* | 0.6717*** | 0.6324*** | 0.6192*** | 0.6859*** | 0.5291*** | 0.5797*** |
| | (15.48) | (14.48) | (9.16) | (9.06) | (4.93) | (11.33) |
| *CapEx* | 0.2181 | 0.1729 | 0.1679 | -0.0410 | -0.2828 | 0.5615* |
| | (0.96) | (0.76) | (0.47) | (0.12) | (0.67) | (1.77) |
| *FCF* | 0.1560** | 0.1637*** | 0.1714* | 0.3113** | 0.5970** | 0.1402** |
| | (2.54) | (2.59) | (1.89) | (2.27) | (2.46) | (2.04) |
| *Liquidity* | -0.0001 | -0.0001 | -0.0001 | 0.0188 | -0.0001 | 0.0215* |
| | (0.24) | (0.23) | (0.18) | (0.98) | (0.13) | (1.65) |
| *LifeCycle* | 0.0001 | 0.0001 | 0.0001 | -0.0025** | 0.0001 | 0.0001 |
| | (0.66) | (0.64) | (0.91) | (2.21) | (0.21) | (0.78) |
| *Revenue* | 0.0912** | 0.0849** | 0.0272 | 0.2382*** | -0.0477 | 0.0572 |
| | (2.47) | (2.30) | (0.53) | (3.37) | (0.57) | (1.27) |
| Observations | 18434 | 18215 | 6627 | 8630 | 4888 | 10919 |
| Number of Firms | 2769 | 2757 | 1607 | 1814 | 1236 | 2126 |
| Pseudo R-sqr. | 0.04 | 0.05 | 0.06 | 0.07 | 0.04 | 0.06 |

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

This table reports estimates of firm and year fixed effect logit regressions of increases (from year *t* - 1 to *t*) in R&D expenditures (*R&D_Incr*). All independent variable values are calculated as changes in that independent variable from year *t* - 2 to *t* - 1. Regressions (1) and (2) include all firms. Regression (3) includes only firms that had no R&D increase in year *t* - 2 and regression (4) includes only firms that had an R&D increase in year *t* - 2. Regression (5) includes the years from 1990 to 1997. Regression (6) includes the years from 1998 to 2005.

Table 4 reports results on the influence that changes in institutional ownership have on R&D investment per share increases in the subsequent year. The first regression uses only control variables as independent variables.

The second regression shows that an increase in institutional ownership leads to an increased probability that a firm will increase R&D investment in the ensuing year. This result could simply be a byproduct of a tendency of institutional investors to invest more in firms that regularly increase their investment in R&D. To control for this possibility, the third regression is run only on firms that did not increase R&D investment in year $t$ – 2. The third regression indicates that an increase in institutional investor ownership has a positive effect on the probability of an R&D investment increase even if the firm did not increase R&D investment in the year preceding the increase in institutional ownership. The fourth regression is run only on firms that increased R&D investment in year $t$ – 2. The evidence indicates that institutional investors encourage R&D investment increases in this group as well. Regressions 5 and 6 provide evidence that higher institutional ownership results in increased R&D for two separate time periods: 1990 – 1997 and 1998 – 2005.

The results in Table 4 indicate that institutional owners encourage R&D increases. A logical inference from this result is that institutional owners will discourage R&D decreases. To verify this, I ran regressions identical to those in Table 4, but with the binary dependent variable set to one if there is a *decrease* in R&D investment. The results, which are not displayed in a table, are virtually a mirror image of the results in Table 4 with strong statistical significance indicating that institutional owners strongly discourage cuts in R&D investment.

Institutional investors use their influence to persuade management to raise R&D investment. This holds true whether or not the firm increased their R&D investment in the previous year.

According to agency-based theory, institutional investors will encourage R&D investment more in firms with good investment opportunities, but they will not encourage R&D investment more in firms with high free cash flow (unless the high free cash flow is accompanied by good investment opportunities).

I test this prediction using $q$ as a proxy for investment opportunities. I sort the sample of firms each year into investment opportunity deciles. I assign each firm-year to one of three groups. Firms in the bottom three deciles (Low $q$) have poor investment opportunities, those in the next four deciles (Medium $q$) have moderate investment opportunities, and those in the highest three deciles (high $q$) have good investment opportunities.

The median R&D to sales ratio for firm-years in which the firm made an R&D investment in the low, medium, and high $q$ groups are 2.75%, 5.66% and 16.70% respectively. The percentage of firm-years in which the firm made an R&D investment in the low, medium, and high $q$ groups are 34%, 49% and 65% respectively. Thus, firms with higher $q$'s (and better investment opportunities) are unsurprisingly prone to invest more and more often in R&D.

I run regressions using the firm and year fixed effects logit model (2) that shows the effect that changes in institutional ownership have on R&D investment increases in the subsequent year. Regressions are run on the low, medium, and high $q$ groups separately based on which group a firm is in during year $t$ – 1. The results are shown in Table 5.

Table 5. Institutional Ownership, R&D, and Investment Opportunities

| | (1) | (2) | (3) |
|---|---|---|---|
| | Low *q* | Medium *q* | High *q* |
| | *R&D_Incr* | *R&D_Incr* | *R&D_Incr* |
| *Inst* | 0.3045 | 0.7199** | 0.7077*** |
| | (0.77) | (2.54) | (2.64) |
| *q* | -0.1544 | -0.1929*** | -0.0359*** |
| | (1.49) | (3.54) | (3.77) |
| *Debt* | 0.0290 | 0.1851 | -0.6954*** |
| | (0.10) | (1.05) | (3.13) |
| *ROA* | 1.0324** | 0.6358** | 0.2255 |
| | (2.24) | (2.18) | (1.38) |
| *Insider* | 0.5603 | -0.6163 | -0.7136 |
| | (0.66) | (1.06) | (1.15) |
| *Insider2* | 0.1019 | 0.5233 | 1.1121 |
| | (0.09) | (0.70) | (1.31) |
| *MktCap* | 0.2639** | 0.8201*** | 0.6156*** |
| | (2.53) | (6.24) | (7.93) |
| *CapEx* | 0.6142 | 0.0936 | -0.1428 |
| | (1.01) | (0.17) | (0.44) |
| *FCF* | 0.2224 | 0.1549 | 0.0788 |
| | (1.49) | (1.12) | (0.63) |
| *Liquidity* | 0.0224 | 0.0296 | -0.0082 |
| | (0.64) | (1.27) | (0.40) |
| *LifeCycle* | 0.0046* | -0.0008 | 0.0001 |
| | (1.89) | (1.37) | (0.74) |
| *Revenue* | 0.1569 | -0.1148 | 0.0238 |
| | (1.23) | (1.09) | (0.48) |
| Observations | 3019 | 6272 | 5507 |
| Number of Firms | 676 | 1312 | 1108 |
| Pseudo R-squared | 0.03 | 0.05 | 0.05 |

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

This table reports estimates of firm and year fixed effect logit regressions of increases (from year *t* - 1 to *t*) in R&D expenditures (*R&D_Incr*). All independent variable values are calculated as changes in that independent variable from year *t* - 2 to *t* - 1. Sample firms used in regressions (1), (2), and (3) include only Low, Medium and High *q* firms, respectively. The Low, Medium and High *q* groups include the lowest three, middle four, and highest three *Liquidity* deciles from year *t* - 1, respectively. Deciles are formed on a yearly basis.

The first regression indicates that for firms with poor investment opportunities, there is not a significant relationship between institutional ownership changes and the probability of an R&D increase in the following year. The second and third regressions indicate that institutional investors encourage R&D investment increases in firms with moderate and good investment opportunities. These results are consistent with agency-based theory. Institutional investors appear to only use their influence to persuade management to increase R&D when sufficient investment opportunities exist.

Agency-based theory also predicts that institutional investors will not encourage higher R&D simply because high free cash flow increases the amount of discretionary cash that is available to management. I test this prediction by assigning each firm-year to one of three groups: low cash flow (bottom three deciles), moderate cash flow (middle four deciles), and high cash flow (top three deciles). Once again, I use the firm and year fixed effects logit model (2). The results are shown in Table 6.

Table 6. Institutional Ownership, R&D, and Free Cash Flow

| | (1) | (2) | (3) |
|---|---|---|---|
| | Low *FCF* | Medium *FCF* | High *FCF* |
| | *R&D_Incr* | *R&D_Incr* | *R&D_Incr* |
| *Inst* | 0.6301* | 0.7130** | 0.2497 |
| | (1.84) | (2.45) | (0.78) |
| *q* | -0.0273*** | -0.0413* | -0.0292 |
| | (2.62) | (1.75) | (0.92) |
| *Debt* | 0.0424 | -0.6562* | -0.3594 |
| | (0.63) | (1.92) | (0.89) |
| *ROA* | 0.3599** | -0.2821 | -0.7376** |
| | (2.39) | (0.76) | (2.09) |
| *Insider* | 0.2562 | -0.1966 | -0.2641 |
| | (0.36) | (0.31) | (0.39) |
| *Insider2* | -0.5947 | 0.5828 | 0.0960 |
| | (0.64) | (0.71) | (0.10) |
| *MktCap* | 0.5052*** | 0.6855*** | 0.4233*** |
| | (6.78) | (6.68) | (3.34) |
| *CapEx* | 0.3918 | 0.3994 | 0.6130 |
| | (1.12) | (0.84) | (0.73) |
| *FCF* | 0.1237 | 0.0297 | 0.0732 |
| | (1.24) | (0.33) | (0.86) |
| *Liquidity* | -0.0001 | -0.0095 | -0.0271 |
| | (0.17) | (0.43) | (0.93) |
| *LifeCycle* | -0.0000 | 0.0005 | -0.0007 |
| | (0.17) | (0.40) | (0.76) |
| *Revenue* | -0.0831* | 0.0474 | 0.3471** |
| | (1.75) | (0.40) | (2.00) |
| Observations | 3341 | 5458 | 4877 |
| Number of Firms | 828 | 1245 | 967 |
| Pseudo R-squared | 0.09 | 0.04 | 0.03 |

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

This table reports estimates of firm and year fixed effect logit regressions of increases (from year *t* - 1 to *t*) in R&D expenditures (*R&D_Incr*). All independent variable values are calculated as changes in that independent variable from year *t* - 2 to *t* - 1. Sample firms used in regressions (1), (2), and (3) include only Low, Medium and High *FCF* firms, respectively. The Low, Medium and High *FCF* groups include the lowest three, middle four, and highest three *Liquidity* deciles from year *t* - 1, respectively. Deciles are formed on a yearly basis.

The median R&D to sales ratio for firm-years in which the firm made an R&D investment in the low, medium, and high free cash flow groups are 24.34%, 4.27% and 5.87% respectively. The percentage of firm-years in which the firm made an R&D investment in the low, medium, and high *FCF* groups are 56%, 43% and 50% respectively. Thus, firms with the lowest free cash flow to asset ratios are prone to invest more and more often in R&D than the other two groups.

The first and second regressions show that institutional investors have a positive effect on R&D investment in firms with low and medium free cash flow rates. The third regression indicates that institutional investors do not have a significant effect on R&D investment in firms with high free cash flow. The pattern indicates that institutional investors' encouragement of R&D investment does not increase as firm free cash flow rises. In fact, it wanes in the highest free cash flow firms.

For robustness, I use the (Arellano & Bond, 1991) difference linear GMM dynamic panel data methodology to obtain the results displayed in Table 7. This methodology alleviates endogeneity problems. Difference GMM is a linear method so I use changes in R&D to assets as my dependent variable when using this method. The results indicate that a rise in institutional investors leads to a rise in R&D investment, Regressions 3 and 4 indicate that an increase in institutional investors leads to increased R&D in firms with good investment opportunities and low free cash flow, respectively. Institutional investors have no significant effect on R&D in firms with poor investment opportunities (regression 2) or high free cash flow (regression 5).

The evidence indicates that an increase in institutional investors leads to an increase in R&D investment, especially in firms with good investment opportunities. Institutional investors do not encourage R&D investment in firms with high free cash flow. Therefore, institutional investors help to control agency problems by encouraging management to invest more in R&D in firms because good investment opportunities exist, but not simply because cash is available.

Table 7. R&D, Investment Opportunities and Free Cash Flow (GMM)

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | All Firms | Low *q* | High *q* | Low *CashFlow* | High *CashFlow* |
| | *R&D_Assets* | *R&D_Assets* | *R&D_Assets* | *R&D_Assets* | *R&D_Assets* |
| *Inst* | 0.0744** | 0.0098 | 0.0679* | 0.1319** | 0.0177 |
| | (2.02) | (0.50) | (1.84) | (2.31) | (1.27) |
| *R&D_Assets* | 0.2364** | 0.0416 | 0.2505** | 0.1845* | 0.1843*** |
| | (2.43) | (0.33) | (2.48) | (1.93) | (3.09) |
| *q* | 0.0392*** | 0.0271 | 0.0401*** | 0.0404** | 0.0149*** |
| | (2.73) | (1.44) | (2.65) | (2.37) | (4.47) |
| *Debt* | -0.0442 | 0.0574* | 0.0011 | 0.1759 | 0.0745 |
| | (0.29) | (1.83) | (0.02) | (1.29) | (1.17) |
| *ROA* | 0.1129 | 0.2186* | 0.1417* | 0.0939 | -0.0200 |
| | (1.21) | (1.72) | (1.76) | (1.01) | (0.75) |
| *Insider* | 0.9170* | -0.1224 | 1.0092** | 0.4731 | 0.1663 |
| | (1.72) | (0.42) | (2.52) | (1.11) | (1.10) |
| *Insider2* | -1.6853** | 0.0528 | -1.7979*** | -1.0685 | -0.2886 |
| | (2.15) | (0.13) | (2.65) | (1.49) | (1.17) |
| *MktCap* | -0.1634** | -0.0502* | -0.1706*** | -0.1673** | -0.0371** |
| | (2.49) | (1.72) | (3.11) | (2.29) | (2.07) |
| *CapEx* | -0.0658 | 0.0911 | -0.1571 | 0.0591 | -0.0631 |
| | (0.30) | (0.53) | (0.89) | (0.27) | (0.54) |
| *FCF* | -0.0575 | -0.0517 | -0.1097 | -0.0388 | -0.0034 |
| | (0.61) | (1.32) | (1.13) | (0.43) | (0.37) |
| *Liquidity* | 0.0000 | 0.0000 | -0.0000 | -0.0000 | -0.0037 |
| | (0.13) | (0.72) | (0.59) | (0.68) | (1.06) |
| *LifeCycle* | 0.0000 | -0.0001 | -0.0001 | -0.0003 | -0.0000 |
| | (0.22) | (1.08) | (0.71) | (0.56) | (1.18) |
| *Revenue* | 0.0074 | 0.0033 | 0.0361 | -0.0223 | -0.0025 |
| | (0.21) | (0.06) | (1.27) | (0.77) | (0.11) |
| Observations | 14341 | 5966 | 9045 | 6231 | 8110 |
| Number of Firms | 3127 | 1867 | 2409 | 2355 | 2228 |
| Chi2 (*p*-value) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| *J p*-value | 0.343 | 0.505 | 0.181 | 0.673 | 0.247 |
| AR(2) *p*-value | 0.610 | 0.349 | 0.431 | 0.520 | 0.164 |
| *Inst* lag limits | None | None | None | None | None |
| *R&D* lag limits | 3 | None | None | 3 | 3 |

Robust z stats in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

This table reports estimates generated by difference GMM of changes (from year $t$ - 1 to $t$) in R&D expenditures divided assets (*R&D_Assets*). Independent variable values are changes from year $t$ - 2 to $t$ - 1. Regressions (1) and (2) include only Low and High *q* firms (the lowest and highest five deciles from year t - 1), respectively. Regressions (3) and (4) include only Low and High *CashFlow* firms, respectively. Deciles are formed on a yearly basis. *J* is the Hansen-Sargan test of overidentifying restrictions. AR(2) is the Arellano-Bond test of second-order autocorrelation in the errors. Independent variables *Inst* and *R&D_Assets* are instrumented using GMM-type instrument lags. The maximum available lags which produce a valid model are used.

**5. Summary**

Research and development (R&D) investment is an important determinant of the future growth in revenue and earnings for many corporations. The amount of financial resources which are allocated to R&D is an important financial decision for those corporations and a key to survival for many of them. Since institutions own over 70% of U.S. public corporations, their effect on R&D decisions is important to the success of U.S. corporations.

I find that companies with higher institutional investor ownership, holding other factors constant, invest more in R&D than companies with lower institutional ownership. I find that an increase in institutional ownership leads to an increase in R&D investment.

Firms with higher free cash flow and poor growth opportunities are susceptible to agency problems because they have higher discretionary funds that can be misused by management. Agency-based free cash flow theory predicts that if institutional investors are better monitors than other investors, they will encourage R&D investment in firms with good investment opportunities, but they will not encourage R&D investment simply because a firm has higher free cash flow. My results support this prediction indicating that institutional investors help to control agency problems in R&D investment decisions.

Institutional investor increases precede increases in research and development (R&D) investment overall and specifically in firms with lower free cash flow and better investment opportunities. Institutional investors effectively encourage management to pursue long-term R&D investment policies that are beneficial to all shareholders. Institutional investors appear to control agency problems in R&D decisions. Further research into how institutional investors affect agency problems is warranted.

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## Notes

Note 1. Note 1. I attempted two-stage least squares’ (instrumental variables) regressions but was unable to come up with instrumental variables which were statistically and conceptually sound.