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Institutional Investors, R&D Policy and Firm Stock Liquidity

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Abstract

This paper seeks to determine if institutional investors influence corporate research and development (R&D) investment policies. Specifically, this study tests whether institutional investors encourage R&D investment in firms with higher firm stock liquidity. Firm and year fixed effect regressions examining the effect of changes in institutional investor levels to subsequent changes in R&D investment levels are used. For robustness, difference-GMM regressions and regressions for different time periods are ran on the same relationship. I find that increased institutional ownership leads to increases in R&D investment, especially in firms with higher firm stock liquidity. Results support the assertion that the presence of institutional shareholders encourages management to invest in R&D for long-term benefits in lieu of short-term profits. Institutions have become the foremost power in U.S. stock ownership. The results in this paper indicate that institutional investors can deter management from investing in R&D at a sub-optimal level, thus benefiting all shareholders.

Keywords: institutional investors, R&D, managerial myopia, liquidity, herding, corporate finance, corporate governance, corporate investment

1. Introduction

In many firms, one of the most important financial decisions made by management executives is deciding how much the firm should invest in research and development (R&D). Generally, R&D investment is beneficial to shareholders. For example, Chan, Lakonishok, and Sougiannis (2001) provide evidence that the level and changes of R&D investment are positively associated with future returns. Still, the benefits of R&D investment may not be experienced by management or shareholders until after an extended period of time. Eberhart, Maxwell, and Siddique (2004) find that investors underreact to the benefits of R&D increases. They find evidence that firms experience abnormally positive stock returns for the 5-year period following an R&D increase. R&D investment is more likely to offer little or no return than comparable investments. Kothari, Laguerre and Leone (2002) demonstrate that the future benefits from R&D are far more uncertain than benefits from many other uses of funds such as investments in property, plant, and equipment.

The delayed impact of R&D on stock prices and the uncertain benefits of R&D investment may incentivize management to underinvest in R&D. Additionally, decreased investment in R&D may increase short-term earnings because R&D investment is expensed immediately while returns from successful R&D is usually realized in future years. Therefore, the nature of R&D investment and its returns may lead to the agency problem of a less than optimal investment in R&D (Porter, 1992). There is evidence that managers intentionally underinvest in R&D to meet an earnings target (Graham, Harvey, & Rajgopal, 2005), to facilitate a pending stock issuance (Bhojraj & Libby, 2005), to meet earnings-based compensation goals (Harter & Harikumar, 2004), and to beat analysts' earnings forecasts (Bhojraj, Hribar, Picconi, & McInnis, 2009).

Institutions own over 70% of the shares of U.S. corporations (Gaspar, Massa, Matos, Patgiri, & Rehman, 2013). This preponderant ownership level by institutions should present institutional investors the opportunity to influence corporate policies such as R&D investment. Institutional investors may help mitigate the potential problem of underinvestment in R&D or they may exacerbate it if institutional owners focus on short-term performance. The empirical evidence on this is mixed. Bange and De Bondt (1998) find that institutional investors encourage R&D while Samuel (2000) finds that institutional owners discourage R&D. Still,

institutional investors have been shown to be superior monitors because of their informational and cost advantages over other shareholders (Almazan, Hartzell, & Starks, 2005; Parrino, Sias, & Starks, 2003).

I examine the effect that institutions have on R&D. Then, I determine if firm stock liquidity alters the relationship between institutional investors and R&D investment.

Edmans (2009) creates a model which predicts that investors that hold a large proportion of a firm's shares (blockholders) can encourage managers to invest for long-run growth at the expense of current earnings as long as a firm has sufficient stock liquidity. In the Edmans' model, blockholders can encourage investment by influencing current stock prices to capture its long-term effect. The blockholders ability to exert this encouragement is positively related to the liquidity of the firm's common stock. An interesting aspect of this model which is pertinent to my paper is that it demonstrates that investors can add value to a firm even if they do not directly intervene in a firm's management.

Edmans' model could apply to institutional investors if institutional investors act in unison to affect investment policy. These actions do not even have to be coordinated as long as institutional investors tend to behave similarly. There is evidence that institutional investors sometimes act in near unison or "herd". Sias (2004) provides evidence that institutions garner information from each other's trades which results in herding. Institutional investors herd into and out of the same industries (Choi & Sias, 2009). Hsieh (2013) finds evidence of institutional investor herding in the Taiwan stock market. Institutional investors herd on dividend signals (Rubin & Smith, 2009) and into stocks with positive return momentum (Nofsinger & Sias, 1999).

Edmans conducts no empirical investigation of his theory in his paper. He does note that others have conducted empirical studies in which the findings are congruent with his theory. For example, P. M. Lee and O'Neill (2003) find that ownership concentration as proxied by blockholders that own more than 3% of a firm is positively related to R&D investment. Cronqvist and Fahlenbrach (2009) provide evidence that an increase in certain categories of blockholders leads to higher investment in R&D. These studies do not investigate the effect that liquidity has on the relationship between blockholders and R&D. My research is novel in that I look specifically at the effect that liquidity has on the relationship between institutional investors and subsequent R&D investment.

Edmans' theory leads to the hypothesis that institutional investors will encourage R&D investment more in firms with greater stock liquidity. In this theory, the managers of firms with high institutional ownership invest more in R&D to raise firm value because they realize that institutional owners will be able to discern the true value of the investments. High firm stock liquidity is an important aspect of the theory because it allows institutional investors to divest their shares if they discern that managers are not investing properly and thus offers the institutional investors an incentive to gather costly information required to monitor the firm effectively.

Bhide (1993) offers a countervailing argument to Edmans' theory about the relationship between blockholders and investment which I also expand to include institutional investors. Bhide does not provide extensive empirical evidence for his theory, instead relying on logic and specific examples. Bhide notes that U.S. regulations provide a wedge between investors and management, thus encouraging institutions to prefer dispersed arm's-length holdings over long-term concentrated holdings. The regulations that encourage institutions to disperse their holdings among firms that they have an arm's-length relationship include: pension and mutual funds are required to have diversified holdings, ERISA discourages pension managers from sitting on boards by holding them to a higher standard than other directors, insider-trading rules place special restrictions on investors that hold more than 10% of a company's stock or serve on its board.

These regulations increase the costs and reduce the benefits to institutional investors of monitoring management. Bhide asserts that higher liquidity allows large investors to divest their shares rather than expend resources to acquire the information necessary to monitor a firm effectively. He argues that since the large investors cannot sell their shares in firms with lower liquidity without accepting a significant discount, they prefer to expend effort to encourage management to invest more to enhance the value of their long-term investment. Bhide's argument provides the basis for my hypothesis that institutional investors will encourage R&D more in firms with low liquidity.

The essential difference between the Edmans (2009) theory and the argument in Bhide (1993) can be summarized as follows. Bhide asserts that blockholders increase firm value by monitoring, and since monitoring and divestment are mutually exclusive, liquidity decreases the propensity of blockholders to monitor. Edmans argues that blockholder loyalty to a firm that makes sound investment decisions at the expense of weak earnings allows the blockholder to increase firm value. Loyalty and divestment are again mutually exclusive, but the loyalty in the face of weaker earnings provides a particularly strong indicator of value which is strengthened if

the blockholder could have easily sold their shares. Paradoxically, the power of blockholder loyalty to add value depends on the ease of divestiture.

If institutional investors affect R&D investment more in firms with high stock liquidity, a logical inference is that they influence management through the threat of divestment. On the other hand, if they affect R&D investment more in firms with low liquidity, then they are more likely to influence management using tactics such as proxy votes and shareholder proposals.

My results indicate that an increase in institutional investor ownership leads to higher R&D investment. I also find that institutional investors positively influence R&D investment primarily in firms with high liquidity. This provides empirical support for my hypothesis based on the Edmans (2009) model which predicts that shareholders that lack control rights can help control managerial investment myopia in firms with high liquidity by gathering information about the fundamental value of investment policies and impounding them into stock prices.

I conclude that generally higher institutional investor ownership leads to higher R&D investment. I also find that this relationship strengthens as firm stock liquidity increases.

2. Literature Review

R&D investment is a vital component of success for many firms. The market appears to recognize the importance of R&D. Sundaram, John, and John (1996) find that R&D increase announcements are followed by an increase in stock price. Despite the benefits of R&D, management may underinvest because they are risk averse (Stein, 1988), or managing earnings (Stein, 1989), or concerned about earnings-related compensation (Bange & De Bondt, 1998). Also, concerns about hostile takeovers and influential investors' time horizons may incentivize managers to underinvest in R&D (Froot, Perold, & Stein, 1992) and (Stein, 1988). Conversely, managers may engage in empire building by overinvesting in R&D (Jensen, 1986).

Some empirical evidence supports the view that managers sometimes underinvest to achieve short-term goals. This behavior is known as managerial myopia. M. Cheng, Subramanyam, and Zhang (2007) find that some firms manage earnings by underinvesting in R&D. Late career-stage CEOs manage earnings (Demers & Wang, 2010) and CEOs spend less on R&D near the end of their careers (Dechow & Sloan, 1991) indicating managerial myopia by CEOs that will not benefit from investments like R&D that may not pay off until the CEOs are no longer present. Others have found evidence that CEOs do not underinvest in R&D (Gibbons & Murphy, 1992; Cheng, 2004; Cazier, 2011).

Previous research has demonstrated that institutional investors can influence R&D investment. Aghion, Van Reenen, and Zingales (2013) find that institutional investors deter CEOs from being fired after profit downturns that result from R&D investment thus encouraging the investment. Le, Walters, and Kroll (2006) find that institutional investors influence R&D investment in technology and healthcare firms. Szewczyk, Tsetsekos, and Zantout (1996) argues that institutional investors are viewed by the market as effective monitors of R&D. Bushee (1998) finds that firms with higher institutional ownership are less likely to decrease R&D following a disappointing earnings report. In their study of large European companies, Brossard, Lavigne, and 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. They also provide evidence that if the institutional investors are seeking short-term profits, they have a negative effect on R&D.

Some studies have found that institutional owners do not influence R&D investment. For example, S. Lee (2012) finds no evidence that institutional owners have an effect on R&D investment in Korean manufacturing firms.

3. Hypotheses

Management can be influenced by institutional investors through various channels such as private negotiation, shareholder activism or dumping their shares which leads to a lower stock price. According to the CFOs surveyed in Graham et al. (2005), institutional investors are the most important marginal investors because they can influence stock price and access to capital. The influence of institutions is demonstrated by the fact that their shareholder proposals get more votes and a more positive stock price reaction (Gillan & Starks, 2000). The first part of my hypothesis is that institutional investors use their influence to encourage management to increase investment in R&D.

In a model proposed by Edmans (2009), investors with large holdings in a firm have strong incentives to monitor the firm. They use private information that they gather as a result of these incentives to make trading decisions. Therefore, they make trading decisions based on the fundamental value of the firm rather than current earnings. This encourages management to invest for the long-term rather than for short-term profits. Management can thus

avoid a depressed stock share price that results from large investors divesting their shares. In Edmans' model, the ability of blockholders to influence management is enhanced by high firm stock liquidity. Although Edmans' model is built upon the actions of blockholders, his model demonstrates how shareholders can influence management even if they do not have control rights. Therefore, institutional investors that demonstrate herding behavior because of similar motives can effectively act as blockholders. I test an extension of the Edmans' model by investigating if the ability of institutional investors to encourage higher R&D investment is enhanced by high stock liquidity.

According to Bhide (1993), greater liquidity allows large investors to divest their shares rather than expend costly resources to monitor management and encourage investment. An implication I have derived from this assertion is that high stock liquidity increases the incentives for institutional investors to divest their shares rather than expend costly effort encouraging higher R&D investment.

Although Edmans presented evidence of empirical research by others that is consistent with his model and Bhide provided logic and specific incidents that supported his model, the contradictory predictions that I derive from these two papers has not been directly tested to my knowledge. My application of the Edmans' model to institutional investors leads to hypothesis H1A and the predictions that I derive from Bhide's theory leads to hypothesis H1B.

H1A: Institutional investors will encourage higher R&D investment, especially as firm stock liquidity *increases*.

H1B: Institutional investors will encourage higher R&D investment, especially as firm stock liquidity *decreases*.

There is almost certainly an endogenous relationship between institutional investors and R&D investment policy. Therefore, I must show a causal relationship in which institutional ownership affects R&D investment policy in order to provide evidence for my hypotheses.

4. Data, Methods and Summary Statistics

4.1 Data

I compile yearly ownership data for institutional and insider ownership from CDA / Spectrum Compact Disclosure from 1990 to 2005. Utilities and financial firms are excluded because they are highly regulated. The ownership data and Compustat data are then merged. The final sample includes 10,668 firms and 79,890 firm-years. If a firm is missing data or is not present in the sample for enough firm-years to perform certain analysis, it is not used.

My primary measure of R&D investment, following Bushee (1998), is R&D investment per share (adjusting for stock splits). I also use R&D to assets for robustness checks. I declined to use R&D to sales as others have done because my sample includes numerous firms with low sales that tend to skew the results when this measure is used. R&D investment per share is useful in logit analysis based on R&D increases or decreases. It is not useful in linear regressions because it does not provide proper scale. Therefore, I use logit regressions with a binary dependent variable which denotes either R&D increases or decreases. Following S. Cheng (2008), missing values of R&D expenditures are assumed to be zero.

To isolate the relationship between institutional ownership and R&D investment, I use control variables in my regressions. I start with the same control variables used by Wahal and 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. I follow Dlugosz, Fahlenbrach, Gompers, and Metrick (2006) by calculating 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.

Total debt to total assets is used as a control because R&D competes with debt for funds. Earnings before interest and taxes (EBIT) scaled by total assets is used because earnings are a source of funds that are used for R&D. Insider percentage ownership and insider percentage ownership squared are used because insider owners have an influence on corporate policies (Morck, Shleifer, & Vishny, 1988). Firm size is controlled for by using log of sales as an independent control variable.

I add to the controls used by Wahal and McConnell (2000). R&D competes with capital expenditures for funds so capital expenditures scaled by assets is used as a control (Bushee, 1998). R&D investment changes as a firm matures so I use retained earnings to the book value of total equity as a proxy for firm life-cycle (DeAngelo, DeAngelo, & Stulz, 2006). Smaller firms are more likely to have cash flow problems that reduce funds available for R&D so I use the log of market capitalization of equity as a control (Jalilvand & Harris, 1984). The availability of free cash flow is important to R&D investment so I use free cash flow scaled by total assets as a

control (Bushee, 1998). Free cash flow is defined as net income plus depreciation and amortization minus capital expenditures.

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 (Changes in value 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.

In my analysis, I determine if liquidity has an effect on the relationship between institutional investors and R&D investment. Therefore, I use firm stock turnover as a proxy for liquidity as a control variable. Firm stock turnover is defined as the number of common shares traded in a year divided by common shares outstanding. The detailed definitions of all variables are shown in Table 1.

4.2 Methods

To prove my hypothesis, it is not enough to establish a relationship between institutional investors and R&D investment policy. I must demonstrate that institutional investors influence R&D investment policy. Therefore, I must establish causality and control for endogeneity in my methodology. Others have used two-stage least squares' regressions to overcome these problems, but I was unable to find instrumental variables that were statistically and conceptually sound for use with my sample.

Causality is established by running fixed effects regressions on changes in dependent variables from year t–1 to t on changes in independent variables from t–2 to t–1. Firm fixed effect regressions control for all stable characteristics of a firm including industry and unmeasured characteristics. The use of firm fixed effects and yearly dummy variables to control for time-varying omitted characteristics limit endogeneity problems. The yearly dummy variables and fixed effects create an effective intercept for each year. The intercepts in fixed effects regressions are an average value of the unobserved fixed effects for each firm. The yearly and fixed effects intercept values are not relevant to my results. Therefore, these values are not reported.

I use a difference generalized method of moments (GMM) methodology derived from the methodology of Holtz-Eakin, Newey, and Rosen (1988) for my robustness checks. This methodology reduces endogeneity problems. I also use methodology and validity tests developed by Arellano and Bond (1991). I use the Stata command xtabond2 which is described by its developer in Roodman (2009) in my analysis.

My sample includes a few time periods (a maximum of 16 years) and many firms (over 10,000). The difference GMM methodology is especially useful in such samples. Almeida, Campello, and Galvao (2010) assert that difference GMM conforms to theoretical expectations in regressions using sample data that contains firm-fixed effects and heteroskedasticity (such as mine).GMM is used by Brossard et al. (2013) to control for endogeneity and establish causality between institutional ownership and R&D investment changes.

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. The difference GMM robustness checks control for the likely endogenous relationship between R&D investment policy and institutional ownership. The difference GMM model is shown in model (1).

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

In this model, $Policy_{it}$ represents the change in the firm R&D investment policy. $Policy_{it-1}$ represents the change in firm payout composition 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 trends that affect all firms. Time-varying observation-specific errors are represented by ε_{it}. Time invariant firm-fixed effects are removed by the difference GMM methodology through the use of first-differences.

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

4.3 Summary Statistics

Table 2. Summary statistics

Panel A: All Firms								
Years	*N*	*Inst*	*R&D*	*q*	*MktCap*	*LifeCycle*	*Liquidity*	*FCF*
1990 - 1997	37 492	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	42 398	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	79 890	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	17 240	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	21 751	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	38 991	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)

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

Selected properties of firms included in my sample are displayed in Table 2. Panel A includes all firms and panel B includes only firm-years in which the firm made R&D investments. Statistics are shown for all years and for an early period, 1990–1997, and late period, 1998–2005. Means are shown with medians in parentheses below.

There are some notable patterns in the characteristics for all firms and for firms with R&D investment. Institutional investor percentage ownership increases over time. Institutional ownership for all firms and for firms that invest in R&D is quite similar. There is an increase from the first period to the next in R&D expenses to sales. There are a few firms with very large R&D to sales ratios. This skewness is indicated by the fact that the average R&D to sales ratio is much higher than the median R&D to sales ratio in all groups.

Firm size and *q* also increase over time in the sample. My life-cycle proxy, retained earnings to total equity, is higher for more mature firms. Overall, firms are less mature in the later time period. Firms with R&D expenses are less mature and have higher liquidity than firms without R&D expenses. Correlations for selected firm variables are displayed in Table 3.

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

Note. * indicates two-tailed significance at 5%.

5. The Effect of Institutional Owners and Firm Stock Liquidity on R&D Investment

Corporations invest in R&D because they believe the present value of the benefits from R&D exceed the present value of the costs. In others words, there is a long-term payoff overall. If R&D investment reduces current earnings, managers have an incentive to reduce R&D investment, thus engaging in managerial myopia. Wahal and McConnell (2000) posit that R&D spending decreases short-term earnings as R&D is expensed immediately, while benefits to earnings often don't occur for years. Therefore, I mirror their methods with my data to establish that R&D investment has a negative impact on short-term earnings.

I run firm fixed effect regressions using current year net income before extraordinary items divided by total assets from the previous year as the dependent variable. The only independent variable is current R&D expenditures divided by the previous year's sales. I run the regression for the entire sample, for years 1990–1997, and for years 1998–2005. The results (not shown in a table) are significantly negative coefficients in all three regressions with *t*-statistics of 8.58, 3.80 and 5.67 respectively. The regression is also run on a yearly basis. The yearly coefficients for the R&D variables are all negative with a minimum *t*-statistic of 2.10. The value for R^2 is over 0.05 for all but two of the years. The evidence supports the assertion of Wahal and McConnell (2000) that R&D investment reduces current earnings.

I use the following firm and year fixed effects logit model to ascertain the effect that institutional investors have on R&D investment.

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

$RDChg_{it}$ is a binary dependent variable which is set to one if there is an increase in R&D investment per share and to zero otherwise. In one robustness check, it is set to one if there is a decrease in R&D investment per share and zero otherwise. The independent variable ($Inst_{it-1}$) represents the effect of changes in institutional ownership percentage on R&D investment increases (or decreases in the robustness check) in the following year.

In model (2), $Year_t$ denotes yearly fixed effects, $Firm_i$ represents firm fixed effects, $Control_{it-1}$ is a vector of time-varying firm level control variables: *q*, debt, ROA, insider ownership, insider ownership squared, log of market capitalization, capital expenditures to assets, free cash flow to assets, stock turnover, retained equity to total equity, and log of revenue. The error term is ε_{it}.

Independent variables are measured as the change from year *t*–2 to year *t*–1. The dependent variable is measured on the change in R&D from year *t*–1 to year *t*. In the logit model, 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. Therefore, only firms that change policy on R&D investment increases are included in the analysis.

Table 4. Institutional ownership and R&D

	(1) All Firms	(2) All Firms	(3) No R&D Incr. in year *t* - 2	(4) R&D Incr. in year *t* - 2	(5) 1990 - 1997	(6) 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	18 434	18 215	6627	8630	4888	10 919
Number of Firms	2769	2757	1607	1814	1236	2126
Pseudo R-sqr.	0.04	0.05	0.06	0.07	0.04	0.06

Note. Absolute value of z statistics in parentheses. Significance Levels: * at 10%; ** at 5%; *** 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.

The influence that institutional ownership changes have on R&D investment increases in the subsequent year is displayed in Table 4. The second regression provides evidence that increased institutional ownership leads to an increased probability that a firm will increase R&D investment in the ensuing year. This could be an artifact of a tendency of institutional investors to invest in companies that consistently increase their R&D investment. To control for this possibility, the next regression is run only on firms that did not increase R&D investment in year *t*–2. The results show that an increase in institutional investor ownership increases the probability of an R&D investment increase in the ensuing year, even if the firm did not increase R&D in the previous year. The final regression is run on firms that increased R&D in year *t*–2. The results indicate that institutional investors also encourage R&D investment increases in firms that had previously increased R&D. The fifth and sixth regressions show that higher institutional ownership leads to increased R&D in both the 1990–1997 and 1998–2005 time periods.

Increased institutional ownership leads to increased R&D investment. This result is not dependent on whether the firm previously increased their R&D investment or not.

Table 5. Institutional ownership, R&D, and stock liquidity

	(1) Low *Liquidity*	(2) Medium *Liquidity*	(3) High *Liquidity*
	R&D_Incr	*R&D_Incr*	*R&D_Incr*
Inst	-0.2674	0.2409	1.1890***
	(0.47)	(0.72)	(5.45)
q	-0.0656**	-0.0267	-0.0315***
	(2.02)	(1.46)	(2.60)
Debt	0.0463	-0.4591*	-0.8957***
	(0.68)	(1.76)	(3.13)
ROA	-0.1388	0.2399	0.4805**
	(0.51)	(1.17)	(2.24)
Insider	-0.3025	-0.4556	0.0283
	(0.43)	(0.74)	(0.04)
Insider2	0.2158	0.9333	-0.0420
	(0.24)	(1.10)	(0.05)
MktCap	0.5437***	0.6311***	0.6303***
	(4.31)	(6.77)	(9.05)
CapEx	0.5539	1.0343**	-0.3959
	(0.79)	(2.00)	(1.18)
FCF	0.5882***	0.1642	-0.0129
	(2.67)	(1.52)	(0.09)
Liquidity	0.1066	-0.0779	-0.0001
	(0.48)	(1.50)	(0.13)
LifeCycle	-0.0001	-0.0003	0.0002
	(0.16)	(0.38)	(0.43)
Revenue	0.1478	0.0440	0.0425
	(1.45)	(0.59)	(0.68)
Observations	3224	6166	5521
Number of Firms	741	1303	1127
Pseudo R-squared	0.03	0.04	0.09

Note. Absolute value of z statistics in parentheses. Significance Levels: * at 10%; ** at 5%; *** 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 *Liquidity* firms, respectively. The Low, Medium and High *Liquidity* groups include the lowest three, middle four, and highest three *Liquidity* deciles from year t - 1, respectively. Deciles are formed on a yearly basis.

I deduce from this result that institutional owners are also likely to discourage R&D cuts. To confirm this, I repeated the regressions in Table 4, but with R&D *decreases* as the binary dependent variable. The results, which are not displayed, mirror the results in Table 4 indicating that institutional owners strongly discourage cuts in R&D investment.

According to my hypothesis derived from a model proposed by Edmans (2009), institutional investors positive influence on subsequent R&D investment should primarily be concentrated in firms with high stock liquidity. According to my interpretation of Bhide (1993), this relationship should be stronger in firms with low stock liquidity. I test these predictions using firm stock turnover as a proxy for firm stock liquidity. I sort the sample of firms each year into liquidity deciles. I assign each firm-year to one of three groups. Firms in the bottom three deciles have low liquidity, those in the next four deciles have medium liquidity, and those in the highest three deciles have high liquidity.

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 per share increases (*R&D_Incr*) in the subsequent year. Regressions are run on the low liquidity, medium liquidity, and high liquidity groups separately based on which group a firm is in during year $t - 1$. Results are shown in Table 5.

The first and second regression, which includes only firms in the low and medium liquidity groups respectively, shows that institutional investors have no significant effect on R&D increases in these two groups. On the other

hand, the third regression shows that institutional investors encourage R&D increases in firms with high liquidity.

Table 6. R&D and stock liquidity (GMM)

	(1) All Firms *R&D_Assets*	(2) Low *Liquidity* *R&D_Assets*	(3) High *Liquidity* *R&D_Assets*
Inst	0.0744**	0.0275	0.0713*
	(2.02)	(0.39)	(1.85)
R&D_Assets	0.2364**	-0.0375	0.1785**
	(2.43)	(0.20)	(2.12)
q	0.0392***	0.0431*	0.0268***
	(2.73)	(1.80)	(3.89)
Debt	-0.0442	0.0301	0.0395
	(0.29)	(1.19)	(0.29)
ROA	0.1129	0.0697**	-0.1460
	(1.21)	(2.13)	(1.58)
Insider	0.9170*	-0.1522	0.7406
	(1.72)	(0.46)	(1.54)
Insider2	-1.6853**	0.4782	-1.3710**
	(2.15)	(1.00)	(2.02)
MktCap	-0.1634**	-0.2276*	-0.1101**
	(2.49)	(1.70)	(2.25)
CapEx	-0.0658	0.9977*	0.0609
	(0.30)	(1.81)	(0.31)
FCF	-0.0575	-0.0324	0.0387
	(0.61)	(0.90)	(0.48)
Liquidity	0.0000	-0.0083	0.0000
	(0.13)	(0.12)	(0.05)
LifeCycle	0.0000	0.0000	-0.0000
	(0.22)	(0.03)	(0.02)
Revenue	0.0074	-0.0313	0.0506*
	(0.21)	(1.08)	(1.82)
Observations	14 341	5987	8354
Firms	3127	1931	2276
Chi2 (*p*-value)	0.000	0.000	0.000
J p-value	0.343	0.862	0.307
AR(2) *p*-value	0.610	0.129	0.958
Inst lag limits	None	3	None
R&D lag limit	3	None	3

Note. Robust z stats in parentheses. Significance Levels: * at 10%; ** at 5%; *** at 1%.

This table reports estimates generated by difference GMM of changes (from year *t* - 1 to *t*) in R&D expenditures divided by assets (*R&D_Assets*). All independent variable values are changes from year *t* - 2 to *t* - 1. Regressions (2) and (3) include only Low and High *Liquidity* firms (the lowest and highest five deciles from year t - 1), 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.

I use the Arellano and Bond (1991) difference linear GMM dynamic panel data methodology for robustness. I use changes in R&D to assets as my dependent variable with this method because difference GMM is a linear method. The results are shown in Table 6. The results indicate that a rise in institutional investors leads to a rise in R&D, especially for firms with high stock liquidity. There is no support for the assertion that institutional investors encourage R&D investment in firms with low stock liquidity.

My results are consistent with the hypothesis derived from the (Edmans, 2009) model which predicts that institutional investors will encourage R&D in firms with high stock liquidity. The hypothesis derived from the arguments of Bhide (1993) is not supported.

6. Discussion

Institutional investors are the majority shareholders of U.S. corporations overall. Institutional shareholders demonstrate influence over an important corporate policy, the amount of investment that should be dedicated to research and development (R&D). I find that institutional investors generally encourage higher R&D investment.

I expand a model that Edmans (2009) proposes about the effect of blockholders on long-term investment. In his model, blockholders make their trading decisions based on the fundamental value of the firm rather than current earnings. The superior monitoring ability of blockholders enables them to discern the benefit of the firm investing for the long-term to enhance firm value. Management, which is cognizant of the large shareholders' ability to determine the firm's true value, is thus encouraged to invest for the long-term rather than for short-term profits. Management can thus avoid a depressed stock share price that results from the blockholders divesting their shares if management chooses to invest at a sub-optimal level. I argue that if institutional investors herd, they can have an impact similar to the one predicted of blockholders in this model.

A prediction of the Edmans (2009) model is that the ability of large shareholders to encourage higher investment is enhanced by higher firm stock liquidity because the higher liquidity heightens the threat of divestment. I find that higher firm stock liquidity enhances the ability of institutional investors to use their influence to persuade management to increase their investment in R&D. Thus, my results support the (Edmans, 2009) model. Institutional investor increases precede increases in research and development (R&D) investment overall and specifically in firms with higher stock liquidity.

This study is limited to U.S. listed stocks and thus is only directly applicable to U.S. firms and the institutional investors that invest in them. Further research is required to see if the findings here can be expanded to include firms from other countries. Increased R&D investment is often seen as an advantageous goal for growing firms and national economies. The results of this study indicate that corporate and national policy makers would be well-advised to consider the potential positive impact of a combination of institutional investors and firm stock liquidity on company and economic performance.

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