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ABSTRACT

Firms must overcome agency and information asymmetry problems to make efficient corporate capital budgeting decisions; this is particularly true for firms with multiple units dispersed across geographic locations. Internal communication and coordination may therefore be crucial in reducing information asymmetry and achieving efficient resource allocation. We examine the relationship between corporate capital budgeting decisions and the degree of internal information sharing using a dataset of 342 U.S. firms from 1993 to 2002. Information sharing is measured by the internal linkages observed in firms' research and development (R&D) activities worldwide. The efficiency of a firm's capital budgeting decisions is measured by the deviation of the firm's estimated marginal q from the theoretical tax-adjusted benchmark. We observe a significant relationship between value-enhancing capital budgeting decisions and stronger internal linkages. Specifically, corporate over-investment is significantly reduced with better information sharing across units. All results are robust to firm- and industry–level controls.

1. INTRODUCTION

There are many reasons why firms may not invest at optimal levels. Firms with more agency and informational asymmetry problems, for example, make less efficient capital budgeting decisions (Durnev *et al.*, 2004; Greene *et al.*, 2009). Information asymmetry problems may be particularly acute for large multi-unit organizations, which are often geographically dispersed and managed with relative autonomy. With distance and organizational boundaries being significant barriers of information transfer (Kogut and Zander, 1992; Jaffe *et al*., 1993), under- or over-investment by the firm may result from inefficient communication and coordination across various units. On the one hand, if complementary assets inside the firm are not properly utilized, valuable investment opportunities may be overlooked. On the other hand, repetitive or inefficient investments may occur when managers are unaware of resources available in other parts of the organization.

Note that this is not only a problem of larger margins of error due to the lack of precise information; it can lead to consistent biases if managers do not take such communication inefficiency into consideration when making investment decisions. For example, in a multinational firm with horizontally diversified subsidiaries, managers who are unaware of resources available in other parts of the firm – and are not conscious of their unawareness – may consistently over-invest from the shareholder's perspective.

As market competition centers more and more on the development of intangible assets, the ability to combine and recombine existing knowledge represents the firms' key competitive advantage (Kogut and Zander, 1992; Henderson and Cockburn, 1994). When crucial resources within the firm become increasingly intangible, how to mobilize these resources may have a significant impact on managers' investment behavior. In this paper, we examine whether efficient corporate capital budgeting decisions are associated with intra-firm coordination and collaboration in developing intangible assets, after controlling for other relevant firm characteristics. We expect that, *ceteris paribus*, firms with more internal information sharing may make more efficient corporate budgeting decisions, particularly in organizations dispersed across many locations.

Efficiency of capital budgeting decisions is examined from the perspective of firm value maximization, using *marginal* Tobin's q, the ratio of the marginal change in market value to the contemporaneous marginal change in assets. Theoretically, with declining returns to investment, firms should continue to invest until the marginal return of any further investment approaches zero from above, i.e., when the marginal gain to the firm equals the marginal cost of investment. The deviation of a firm's estimated marginal q from the theoretical optimal value of marginal q can serve as a reverse indicator of the efficacy of a firm's capital budgeting decisions. We consider a firm under-investing if it stops investing when its estimated marginal q is still above the theoretical optimal level and a firm over-investing if it invests when its estimated marginal q is already below the theoretical optimal level.

Thus, we apply a two-stage empirical framework. In the first step we estimate marginal q for each firm as a coefficient in a regression. In the second stage we use the estimated marginal q's to form the dependent variable, the deviation of the estimated marginal q from the benchmark marginal q, which is then regressed on measures of internal information sharing and control variables. We examine the separate groups of under- and over-investing firms to investigate whether there is a consistent relationship between efficient capital budgeting and the presence of information sharing channels, and whether these relations are similar in the under- and over-investing samples.

We use four alternative measures of internal information sharing, utilizing information on firms' patenting activities. We admit that these measures are not perfect substitutes for each other, and that each measure incorporates more dimensions than internal information sharing, which as an intangible concept is intrinsically difficult to quantify. The purpose of using four alternatives is to identify consistent relationships not caused by a specific proxy. First, the self-citation ratio, defined as the percentage of forward citations that occur within the firm boundary, represents internalized knowledge transfers (Trajtenberg *et al*., 1997; Hall *et al*., 2002) and thus the degree to which firms take full advantage of their internal resources at various locations. Second, the non-local self-citation ratio reveals the percentage of self-citations to patents developed by researchers in other locations. Since information asymmetry problems are most challenging for multi-location firms, this ratio reflects the strength of internal communications channels across branches or subsidiaries. Third, having researchers from different parts of the world collaborate on the same project may signal the firm's strong inter-unit coordination and also promote future knowledge flows within the firm (Lahiri, 2003; Zhao, 2006; Alcácer and Zhao, 2007). Hence, we calculate the percentage of patents resulting from cross-regional collaborations and use it as a measure of internal linkages. Finally, we use the percentage of self-citations imposed by patent examiners to proxy for the lack of internal information sharing. While an inventor may choose not to cite a competitor's patents for strategic reasons, failing to cite the same firm's prior art is probably due to ineffective communication and coordination inside the firm. Therefore, we use the percentage of externally imposed self-citations to measure the information barriers in the organization, so this is a counter-measure of information sharing.

A sample of 342 U.S. manufacturing firms that filed patents during the period 1993 to 2002 is studied herein. To the extent that R&D may be one of the most centralized functions in a firm, internal coordination and communication may be particularly important to firms that engage actively in R&D. While our sample selection criterion may lead to an upward bias in the estimation of marginal q and the estimation of information sharing, we do not believe that these firms' capital budgeting decisions necessarily differ systematically from their non-R&D intensive peers. We will discuss this point further in the empirical section.

Our empirical results support the theoretical arguments. In general, more efficient capital budgeting decisions are associated with stronger internal linkages, and the effect is positively moderated by the number of locations where the firm has R&D activities. The rest of the paper proceeds as follows. In Section 2 we discuss the theoretical rationale for a relationship between efficient capital budgeting and internal information sharing. The measures of investment efficiency and internal coordination are outlined in Section 3. The data and econometric methods are described in Section 4. In Section 5 we present and analyze the empirical results and their implications. In Section 6 we present and analyze robustness tests using average Tobin's Q as the dependent variable. Section 7 concludes.

2. THEORETICAL ANALYSIS

2.1 Firm Organization and Informational Asymmetry

Firms that face agency and informational asymmetry problems make less-efficient capital budgeting decisions (Durnev *et al.,* 2004; Greene *et al.*, 2009) due to both intra-firm and inter-firm conditions. Internally, to make value-enhancing capital budgeting decisions, managers must possess sufficient information about the organization, and their interests must be aligned with those of the shareholders. Given that investors and management may have asymmetric information, complex corporate structures also may shield managers who pursue agency behavior. For example, managers could deliberately mis-invest to entrench themselves (Shleifer and Vishny, 1989), over-invest for empire building (Jensen, 1986; Morck and Yeung, 1992), or be excessively risk-averse to protect personal interests (John *et al.*, 2008).

Externally, to the extent that investors perceive there to be agency or informational asymmetry problems, financing might be priced at a premium (Myers and Majluf, 1984). The resultant liquidity constraint could cause a firm to reduce the scale of its investment activity (Himmelberg *et al*., 2002). Such concerns are particularly important for multi-unit firms, which tend to have more complex organizational structures and present greater agency and information asymmetry problems to managers and investors (e.g., Graham *et al*., 2002).

A notable difficulty in multi-unit firms is that not all information can be codified and transferred across units (Kogut and Zander, 1992; Szulanski, 1996). The difficulty can be significantly compounded if the units are located across distances, which could limit the interpersonal interactions needed for knowledge transfer and interpretation (Jaffe *et al*., 1993; Audretsch and Feldman, 1996). As a result, two types of inefficiencies may occur. First, when a decision is made at one location, the manager may be uninformed of the resources available in other parts of the firm. Fully aware of these information constraints, the manager has to choose an investment level based on an incomplete information set, which produces a larger variance around the optimal. The second inefficiency could arise from managers' ignorance or underestimation of such information barriers. That is, the manager may be uninformed of what is happening in other parts of the firm, and in addition also be unaware of the incompleteness of their information set. As a result, the manager may systematically over-invest in duplicative assets and under-invest in complementary assets.

While diversified firms in general face greater challenges in internal communication and coordination, some of them possess unique organizational capabilities that enable them to overcome such challenges and make more effective investment decisions. For example, multinational firms have long been recognized as a dispersed innovation network, with the capacity to assimilate, generate, and integrate knowledge on a global basis (Buckley and Casson, 1976; Bartlett and Ghoshal, 1990). Firms also frequently adjust their internal allocation of resources depending on the local environments. Desai *et al.* (2004) suggest that multinational firms appear to increase their internal borrowing in countries with underdeveloped capital markets or weak creditor rights. Feinberg and Gupta (2004) find evidence that U.S.-headquartered multinational firms respond to high risks in the host countries by increasing the extent of internal transactions among subsidiaries. These organizational features may explain why some multinational firms have stronger performance despite the challenges of coordinating subsidiaries. Thus, understanding the sources of firm heterogeneity is important to an analysis of organizational performance.

In this study, we examine a particular dimension of firm heterogeneity: the efficiency of corporate budgeting decisions in multi-unit firms. Greene *et al.* (2009) observe that more efficient capital budgeting is strongly associated with multinationality, but do not provide an explanation for why this is the case. This paper intends to identify a specific mechanism behind the efficiency, *i.e.*, whether the efficiency of firms' capital budgeting decisions is associated with the coordination mechanisms that allow firms to alleviate agency or information asymmetry problems.

2.2 Mechanisms of Internal Information Sharing

In a large, dispersed organization, business units or divisions are often exposed to idiosyncratic challenges and opportunities in their respective industries or geographic locations. They often have their own agendas and interests, which may or may not be consistent with the firm's overall strategic goals. Firms therefore have reason to establish various formal and informal channels for internal coordination (Gupta and Govindarajan, 2000) to reduce coordination barriers and any related dissonance within the firm.

This is crucial for efficient corporate capital budgeting, which requires managers to use resources effectively at the organization level. Given the intangible nature of information sharing, it is almost impossible to capture the full spectrum of intra-firm communication and coordination. However, for firms that engage in active innovation, their patenting activities leave a valuable "paper trail" that can be used to examine the otherwise invisible internal linkages (Jaffe *et al*., 2000). Because many firms conduct simultaneously R&D in multiple locales, and innovation is increasingly important for marketplace competition, we believe that information sharing in firms' R&D activities may be a good representation of the overall levels of communication and coordination inside the corporation.

One mechanism of internal information sharing is knowledge flows inside the organization, especially across units or geographic locations. Hall *et al*. (2005) suggest that internalized knowledge transfers can lead to corporate competitive advantage and thus higher firm value. Firms with good coordination mechanisms should be able to identify and build on internal technologies better and faster than competitors. For example, Zhao (2006) suggests that the ability to integrate internal technologies enables multinational firms to appropriate value from R&D even in countries with weak intellectual property rights protection. Similar findings have been identified for firms conducting R&D in highly competitive technology clusters (Alcácer and Zhao, 2007).

The second mechanism that we identify is interpersonal collaboration. Despite the development of information technologies, knowledge spillovers remain locally constrained (Jaffe *et al*., 1993); even knowledge transfer inside the firm boundary has proved to be challenging without the right mechanisms in place (Kogut and Zander, 1992; Szulanski, 1996). Interpersonal relationships have long been considered an important mechanism of information sharing. Cockburn and Henderson (1998) use joint publications between scientists in pharmaceutical firms and researchers in publicly funded universities to measure the connectedness of firms to the external environment. Similarly, Lahiri (2003) uses co-patenting by semiconductor scientists as a measure of intra-firm linkages. Presumably, having researchers from different countries collaborate on the same project not only signals the firm's strong inter-unit coordination but also promotes future knowledge flows within the firm (Singh, 2008).

Based on the above discussion, we argue that collaboration and knowledge flow within firms can encourage communication and coordination, thus improving the effectiveness of corporate budgeting decisions in large organizations.[1] In the next section, we describe the empirical setup and the key variables used to test this relationship.

3. MODEL AND EMPIRICAL METHODOLOGY

3.1 Marginal *q*

Firms derive incremental value from each investment they make, and if the capital markets are well-informed, this change in firm assets should be reflected in contemporaneous changes in the firm's market value. Due to diminishing returns to investment, the firm eventually may have

[1] Note that in this study we focus on the effectiveness of corporate capital budgeting decisions, which often, but not always, contribute to overall firm performance and profitability. The link between internal coordination and profitability is less straightforward. For example, some firms may promote competition, rather than coordination, among subsidiaries with volume and performance-based incentives, which may lead to inefficient use of resources but better profitability. A more detailed study of unit-level capital budgeting decisions is beyond the scope of this paper.

a marginal investment project whose incremental value exactly equals the incremental cost. Optimally, the firm should stop right here.

Marginal *q* is defined as the ratio of the unanticipated incremental firm market value divided by the contemporaneous marginal investment. Therefore, the value-maximizing capital budgeting decision would yield a marginal *q* of 1.0: a positive (negative) deviation of a firm's estimated marginal *q* from 1.0 indicates under- (over-) investment. Of course, exogenous factors such as taxes may affect the capital budgeting process such that the optimal benchmark marginal *q* may differ from the theoretical benchmark of 1.0.

Note that this is a different concept from Tobin's Q (or average Q), which measures market perceptions of the firm's value. In the absence of agency problems, internal information sharing can have the direct effect of guiding firms to assess their existing assets before making investment decisions, thus avoiding under- or over-investment, but only has a secondary effect on the quality or profitability of an investment. Therefore, we believe that marginal *q* is a more appropriate measure of corporate capital budgeting for the purpose of this study. For robustness checks, we also examine the effect of internal information sharing on the estimated average Q.

The methodology to calculate marginal *q* was developed by Durnev *et al.* (2004) and was extended by Greene *et al.* (2009). The marginal *q* of firm *i* can be defined as:

$$\dot{q}_i = \frac{V_{i,t} - E_{t-1}V_{i,t}}{A_{i,t} - E_{t-1}A_{i,t}} = \frac{V_{i,t} - V_{i,t-1}\left(1 + \hat{r}_{i,t} - \hat{d}_{i,t}\right)}{A_{i,t} - A_{i,t-1}\left(1 + \hat{g}_{i,t} - \hat{\delta}_{i,t}\right)}, \qquad [1]$$

where $V_{i,t}$ is the market value of firm *i* at time *t*, and $A_{i,t}$ is the total assets of firm *i* at time *t*. E_{t-1} is the expectations operator, which uses all information available to the firm at time *t-1*. We substitute for the expectations operator using $\hat{r}_{i,t}$, the expected return from owning the firm and disbursements to investors; $\hat{d}_{i,t}$, the expected level of disbursements from the firm (dividends, share repurchases, and interest expenses); $\hat{g}_{i,t}$, the rate of expected expenditures on capital goods; and $\hat{\delta}_{j,t}$, the expected rate of depreciation of the firm's assets. See the appendix for details of how we estimate the firm's value (V) and assets (A).

Rearranging and simplifying [1], we derive the empirical specification as:

$$\frac{\Delta V_{i,t}}{A_{i,t-1}} = \beta_{0,i} + \beta_{1,i}\frac{\Delta A_{i,t}}{A_{i,t-1}} + \beta_{2,i}\frac{V_{i,t-1}}{A_{i,t-1}} + \beta_{3,i}\frac{D_{i,t-1}}{A_{i,t-1}} + \delta_t P_t + u_{i,t} \qquad [2]$$

where $D_{i,t\text{-}1}$ (or $d_{i,t}V_{i,t\text{-}1}$) is disbursements to investors, including dividends, share repurchases, and interest expenses. A series of year fixed effects, P_t, are also included to reflect cyclical economic factors that may affect all firms. The coefficient $\beta_{1,i}$ is firm i's marginal q.

Because all four coefficients in [2] may reflect firm heterogeneity, they are treated as random and estimated in the random coefficient model as $\hat{\beta}_j = \beta + v_{i,j}$, where i indicates firm (1…I), and j denotes the coefficient number (0…3). This yields an estimate and variance for each coefficient, $\hat{\beta}_j$, and a series of firm-specific estimates of each coefficient, $\hat{\beta}_{i,j}$. The estimated coefficients are then used to form the dependent variables for the second-round testing, which will be explained in Section 3.2.

Admittedly, the estimated marginal q (i.e., $\hat{\beta}_{1,i}$) is susceptible to noise in the data. For example, the change in investment may be misestimated due to accounting errors, and the change in firm value may reflect new information about prior investments. Moreover, while theory suggests that marginal q should be estimated using continuous time data in order to properly isolate the marginal investment made by a firm, the accounting data used to estimate marginal q is never continuous.

One caveat of marginal q calculation stems from tax considerations. As explained by Durnev *et al.* (2004), the marginal investor in a firm may face capital gains taxes, T_{CG}, upon selling shares in the firm, and personal income taxes, T_D, upon receiving dividends from the firm. Thus, instead of [1], the marginal q to such an investor should be $\frac{(1-T_{CG})(V_{i,t}-E_{t-1}V_{i,t})}{(1-T_d)(A_{i,t}-E_{t-1}A_{i,t})}$. Using this definition, we obtain [3], which is analogous to [2].

$$\frac{\Delta V_{i,t}}{A_{i,t-1}} = \beta_{0,i} + \dot{q}_{i,t}\frac{1-T_D}{1-T_{CG}}\frac{\Delta A_{i,t}}{A_{i,t-1}} + \beta_{2,i}\frac{V_{i,t-1}}{A_{i,t-1}} + \beta_{3,i}\frac{D_{i,t-1}}{A_{i,t-1}} + \delta_t P_t + u_{i,t} \qquad [3]$$

Thus, the estimated marginal $\hat{q}_i$ will be $\dot{q}_i \cdot \left(\frac{1-T_D}{1-T_{CG}}\right)$, the previous marginal q_i times the relevant tax factors.

Using representative tax rates from the 1990s, the personal tax on disbursements, T_D, is approximately 33%; and the effective personal gains tax rate, T_{CG}, is about 14% (or half of the statutory rate of 28%, assuming that the marginal investor is tax-exempt half the time). This implies that the estimated marginal q should be approximately 0.78 times the theoretical optimal value of 1.0.[2] The deviation of a firm's estimated marginal q from this benchmark value is used as an indicator of the efficiency of the firm's capital budgeting decisions. More generally, during this period the marginal investor would have faced effective tax rates such that $T_D \geq T_{CG} \geq 0$ and the upper bounds on T_D and T_{CG} were 33% and 28%, respectively, so a reasonable range of the tax adjustment would be from 0.78 to 1.00. Accordingly, we conduct all empirical tests using both estimated benchmark marginal q's, 0.78 and 1.00.

3.2 Efficiency of Capital Budgeting and Internal Information Sharing

[2] It may not be realistic to gauge the impact from all possible biases. Durnev *et al.* (2004) used a non-linear technique to estimate this benchmark to be in the range 0.755-0.780, which is consistent with the back-of-the-envelope estimate detailed above and used herein.

We use four complementary measures to proxy for firms' internal information sharing. Because we emphasize the overall organizational capabilities of firms, each firm – including all its branches and subsidiaries – is treated as an integrated organization.

Our first measure is the self-citation ratio. Trajtenberg *et al*. (1997) proposed the self-citation measure, defined as "the percentage of citing patents issued to the same assignee as that of the originating patent," to measure the "fraction of the benefits captured by the original inventor." To capture information flows across locations, we also use the *non-local self-citation ratio*, a specific variation of the self-citation measure that tracks the percentage of cross-regional citations within the firm. Third, to capture the importance of interactions among researchers at multiple locations, we measure *cross-regional collaborations*, the extent of R&D collaborations across units or geographic locations. The fourth measure of internal information sharing is *examiner-imposed self-citations*. In a patent application, the inventors are required to report any prior art that the current patent is based on, and then the patent examiner – who is usually an expert in a certain technological area – would impose other citations that he/she believes appropriate. While an inventor may or may not cite a competitor's patents for strategic reasons (Alcácer and Gittelman, 2006), failing to cite the same firm's prior art is probably due to ineffective communication and coordination inside the firm. Inventors who have self-citations imposed by examiners are either (1) unaware of the internal knowledge stock or (2) unwilling to acknowledge the contribution from colleagues, which may reflect less than harmonious relationships among units. Hence, we calculate the percentage of self-citations that are imposed by patent examiners, and use it as a reverse measure of internal linkages.

There are two features about the four alternative measures that are worth discussion at this point. First, the four measures reflect information sharing from different perspectives, so they are imperfect alternatives and do not replicate each other. Self-citation ratios capture the result of information flow while cross-regional collaborations capture the process that may facilitate information flow. Meanwhile, examiner-imposed self-citations can be affected by the scope of the technologies and the patents' strategic role in the firm (Alcacer and Gittelman, 2006). As shown in the next section, these variables are correlated in the expected directions but the correlation ratios are not terribly high, which confirms our intuition. Second, these measures are based on patents and related information. Patentable technologies are among the most codified or least tacit part of the information set, and therefore easier to transfer across locations than other tacit knowledge. Hence, we may overestimate the true extent of knowledge sharing in firms that rely less on patents and other codified knowledge, which should make it more difficult for us to find statistical significance in our findings.

We use 0.78 and 1.00 as the benchmark marginal *q*'s, denoted herein as *h*, in the empirical tests in line with the discussion on tax implications presented earlier. Separate analyses are conducted on firms that under- and over-invest, depending on whether $(\hat{q}_i - h)$ is above or below zero; $(\hat{q}_i - h)^+$ and $(\hat{q}_i - h)^-$ are used as dependent variables in the two sub-samples, respectively. Thus, we examine the relation between the extent of under- or over-investment and the firm's inter-unit information sharing using a truncated regression:

$$\left.\begin{matrix}(\hat{q}_i - h)^+ \\ (\hat{q}_i - h)^-\end{matrix}\right\} = \alpha + \lambda X_i + \eta C_i + \omega I_{SIC} + \varepsilon_i \qquad [4]$$

where ***X*** represents the four alternative variables used to measure internal linkages, and ***C*** represents the firm-level control variables. I_{SIC} are industry fixed effects that capture each firm's primary two-digit SIC code. Finally, we assume that the disturbance term, ε_i, is normally distributed with zero mean and constant variance σ^2. As in Greene *et al.* (2009), we use a

Saxonhouse (1976) technique to weigh all observations by the inverse of the standard error associated with the estimate of marginal *q*, then use a weighted truncated regression model to conduct separate examinations of under- and over-investing firms using [4]. Since the truncated variance is between 0 and 1, the marginal effect of each variable may be smaller than that of the corresponding coefficient (Greene, 2003). Since *h* can assume either of two values, 0.78 or 1.00, we estimate [4] four times for each set of independent variables – i.e., for the under- and over-investing sub-samples defined relative to 0.78 and 1.00.

4. DATA AND VARIABLES

In this section, we report our sample and data sources, as well as variable construction. Details of the marginal *q* estimation procedure and dataset construction are reported in the appendix.

4.1 Data Sample and Sources

To estimate marginal *q* we must have reliable numbers on a firm's market value and assets. We use all data that can be matched across three datasets – CRSP/Compustat Merged Database (Compustat),[3] CRSP Daily Stocks Database (CRSP), and the U.S. Patent and Trademark Office (USPTO) – using the Directory of Corporate Affiliations (DCA) as a link when possible. Our sample period begins with 1993 because this is the first year for which DCA data is available in electronic format. Since the patent data end in 2006, and it may take years for a patent to go through the application pipeline, ending the sample period in 2001 should allow enough of an observation window for innovations to be captured by the patent data. Our marginal *q* estimates,

[3] The CRSP data are reported on a calendar year basis, and the Compustat data are reported on a fiscal year basis. To keep consistency across sources, if the firm's fiscal year ends in January-May (June-December), we use the data covering fiscal years 1992-2001(1993-2002).

which form the basis of the dependent variable in the second-stage regressions, are obtained using Compustat data from 1993-2002; and the independent variables in the second-stage regression, firm innovation and controls, are created using data for the years 1993-2001.

To obtain information on each firm's innovation activity, we first match company names in the Compustat data – which are typically parent companies – to the names in the DCA. The purpose is to rely on the affiliation information in the DCA to create a 'family tree' for each firm, so that the analyses are conducted at the organizational level, inclusive of all the branches, subsidiaries, and joint ventures in which the firm has a decisive stake. Next, we match the names of all family members to the patent assignees as documented by the USPTO. For those firms without a match in the DCA, we directly match the firm name from Compustat to the patent assignees as documented by the USPTO.

We acknowledge that firms with patenting activities may not represent all multi-unit firms, which potentially introduces two sources of selection bias to our analysis. First, given that R&D is likely to be one of the most centralized functions in a firm, internal coordination may be particularly important in R&D-intensive firms. Second, to the extent that R&D-intensive firms find it harder to raise external capital because they are more difficult for outsiders to understand and thus value properly, they are more likely to face liquidity constraints. So we may see more under-investing firms than we would in the general population of firms. However, despite having possibly higher measures of information sharing and of marginal q, we believe that these firms are not systematically different from other firms in terms of their reliance on internal coordination. In the semi-globalized world with significant differences across countries (Ghemawat, 2003), centralization is not always the optimal choice; the integration-responsiveness framework proposed by Bartlett and Ghoshal (1989) is still highly relevant to today's "high-tech" and "low-tech" firms alike. High-tech wireless telecommunications companies need location-specific investments catering to local customers, while low-tech manufacturers or retailers who count on standardization to achieve lower costs may find intra-firm coordination crucial to their competitiveness. That is, there is no evidence that firms engaged in patenting activities are special in the information-investment relationship we address in this paper.

Several sample filters are used to make sure that the firm's accounting data are stable, and that noisy and extreme values are excluded. Our results are robust to variations in the thresholds. First, we use only U.S.-headquartered, U.S.-incorporated manufacturing firms (i.e., SIC codes 2000-3999) for which five or more consecutive years of data are available from Compustat. When Compustat reports a value as 'insignificant' we set it to zero. To avoid duplication, we remove entries for preferred stock, class B stock, and the like by discarding entries whose CRSP CUSIP issue number begins with numbers other than 10 or 11.

Second, several criteria are applied to ensure that the equity market variables are reliable. We include only firms with tangible assets of at least $1 million to eliminate firms that may not have the financial means to pursue a coordinated R&D strategy. Meanwhile, we exclude all firm-year observations when a firm's stock was traded on fewer than 60 days per year (slightly above the first percentile of the distribution, or roughly one in every four trading days), share price was less than $1, and the estimated average Tobin's Q was above 5.0. Also excluded are firm-year observations in which the firm's value, total assets, or tangible assets changed by more than 300% in absolute value.

Finally, a firm is included in the sample if and only if it has at least three patents with the USPTO in a three-year period. Note that this step may introduce selection bias in the sense that not all manufacturing firms file patents. However, we decide to take this step for two reasons. First, innovative firms with significant intellectual assets are the ones facing the most serious coordination challenges. Second, most of the multi-unit firms in the Compustat data are large firms with multiple patents in the sample period, so the threshold is not too discriminating.

This yielded a dataset with 367 firms with estimates of marginal *q* ranging from -0.37 to 4.21. Since the extreme estimates of marginal *q* were both significantly different from the mean and difficult to interpret economically, we exclude from analysis all firms for which the estimated marginal *q* was more than two standard deviations away from the mean; this cost 22 observations.[4] We also included only those firms for which there were two or more other firms also in their industry as measured using the two-digit SIC industry code. The resultant dataset contains 342 manufacturing firms in 16 two-digit SIC industries.

The 342 firms in the sample collectively generated 182,203 patents in the sample period, with annual patent output ranging from one to 2,865 for each firm. We rely on the front-page information on the patent applications to identify the detailed address of every single inventor. Following the innovation literature (e.g., Chung and Alcácer, 2002; Singh, 2008), a region is defined as a state in the U.S. or a country in the rest of the world. This generates 139 unique regions in our sample, including all 50 U.S. states, Washington D.C., Puerto Rico, and 85 foreign countries. The number of locations with R&D activities ranges from one to 55.

[4] 19 of these 22 observations were firms with high estimated marginal *q*'s (i.e., under-investing firms). It is unclear why we did not observe a symmetric distribution of outlier marginal *q*'s. We do not know if this reflects internal problems such as poorly functioning information sharing channels or external problems such as greater financial constraints. It may stem from our sample selection criterion whereby we include only firms with patenting activities during the time period, and high-tech firms tend to face bigger challenges in obtaining external financing.

4.2 Variables

We follow the Durnev *et al.* (2004) procedure to construct the dependent variable marginal q. On average, the mean estimated marginal q is 0.94, suggesting that firms over-invest relative to the theoretical benchmark marginal q, 1.0, but not the tax-adjusted benchmark marginal q, 0.78 (see Table 1). What interests us is the significant variation around the mean (from -0.16 to 2.19), which we try to explain using the degree of information sharing inside the firm.

To calculate the *self-citation ratio* for each patent in our sample, we pull out all the patents that have cited a focal patent after its grant date, and examine whether the assignees belong to the same firm. The ratio of self-citations to the total number of citations is considered the self-citation ratio of the focal patent, and is averaged at the firm level. Because we are interested in firms as integrated organizations, any citations among affiliated organizations are considered self-citations. Consistent with the literature, the average self-citation ratio in our sample is 14.0%, and the number drops to 2.4% if we only consider self-citations that occur across intra-firm units located in different regions (i.e., the *nonlocal self-citation ratio*).

Next, patents with inventors from at least two different regions are considered the result of cross-regional collaborations. We then divide the number of such patents by the total number of patents filed by each firm in each year. It turns out that 17.7% of the patents are the result of cross-regional collaborations, and despite significant cross-industry variations, this percentage generally increases over time.

The variable *examiner-imposed self-citations* is calculated for a reduced sample of patent citations. Because the information on examiner-imposed vs. inventor-listed citations was not available until January 1, 2001, patents granted before that date are removed from the sample. For each focal patent, we divide the number of examiner-imposed self-citations by the number of all self-citations. 48.0% of the citations are imposed by examiners. Examiner-imposed citations constitute a large percentage among self-citations as well as all citations, but the ratio of examiner-imposed self-citations has a much higher variance across firms.

We include a series of firm-level variables as controls. First, making sound investment decisions is particularly challenging when the firm's R&D activities are geographically dispersed. Therefore, we also count the number of regions where the firm has innovative activities.[5] Controlling for the number of regions is important for another reason. Since all our independent variables reflect aspects of cross-regional ties, they are likely to be correlated with the firm's geographic dispersion of operations. We want to make sure that the internal linkage variables do not just pick up the effects of globalization on market capitalization. For robustness checks, we also use the number of countries in which a firm has innovative activities in order to differentiate more cleanly between firms that conduct innovation at multiple places within an individual country and firms that conduct innovation in multiple countries.[6]

Second, firm size matters. Larger firms are likely to have greater internal financing capabilities, and thus are less constrained by capital when seeking valuable investment projects. However, larger firms tend to face more challenging coordination tasks. They also may have explored most of the profitable investment opportunities and are therefore more likely to over-invest (Jensen, 1986). Firm size is measured as the log of average property, plant, and equipment (PPE) over the time period. Because we are examining innovating firms, we also use the logarithm of the total number of patents that a firm filed in the past three years to reflect its

[5] Admittedly, the geographic dispersion of R&D may well be endogenous, determined by the firms' globalization strategies and their intrinsic organizational capabilities. Addressing the choice of organizational structure is beyond the scope of this paper.

[6] Since U.S. firms are not required to disclose overseas revenues or sales, it is not feasible to use accounting based measures to proxy accurately for a firm's multinationality.

overall innovation clout,[7] and use the average number of citations received by each patent to reflect the value of inventions in every sample firm.

Firms' financial conditions also may affect their budgeting decisions. Firms with high cash flow may be more prone to over-invest (Jensen, 1986), while firms with low cash flow may conserve resources for future usage (Himmelberg *et al.*, 2002). Cash flow is measured as the ratio of the sum of income before extraordinary items and depreciation and amortization to tangible assets. We also control for leverage, which is measured as the ratio of the sum of long-term debt and current liabilities to total assets. While highly leveraged firms may face greater financing constraints and have less leeway to invest because of the bankruptcy threat (Myers, 1977), they also may be subject to greater corporate governance oversight and therefore make more value enhancing investments (Jensen, 1986). In robustness tests we also use liquidity, the difference between current assets and current liabilities divided by tangible assets, to depict the firm's current financial standing.

Finally, we control for corporate industrial diversification. Diversified firms are more likely to be cash rich and have internal capital markets of their own (Stein, 1997). Yet, diversified firms are also more complex and present greater agency and information asymmetry problems to managers and investors.[8] Firm diversification is measured as the average number of different two-digit segments that are reported in Compustat Industry Segment Data (SSIC2). While this

[7] In additional robustness tests not reported herein we instead use a dummy for the top 5% of firms that have the largest stock of successful patents. The results are robust to this specification.

[8] Admittedly, diversification is not the only, or best, proxy for firm complexity. For example, Blanchard and Kremer (1997) construct a complexity index based on the input-output table across industries. However, this complexity index is estimated at the industry level and will be automatically dropped out when we add the industry dummy. We acknowledge our data constraints, which prevent us from constructing a complexity index to capture the firm heterogeneity we hope to examine in this paper.

measure is a noisy proxy of firm diversification, it remains the best choice available in many circumstances and is used widely in the literature (e.g., Linck *et al.*, 2008).

In addition, industry-specific characteristics may cause firms in certain industries to make more or less efficient capital budgeting decisions systematically. Two-digit industry fixed effects, S_{SIC}, are therefore included in our analysis of capital budgeting decisions. Moreover, macroeconomic factors may cause marginal q to be estimated with greater noise in some years. This concern is addressed through the use of year fixed effects and random coefficient estimation of marginal q. Table 1 lists the definitions and univariate statistics for the above-mentioned variables, and Table 2 reports the correlation matrix. In Table 3 we present the industry composition of firms in the dataset. The best-represented industry is “industrial and commercial machinery and computer equipment” (two-digit SIC code 35) with 52 firms.

5. RESULTS

It is unclear a priori whether information-sharing channels would have a symmetric effect on the efficiency of capital budgeting among under- and over-investing firms. Essentially, there are two possible mechanisms affecting the relationship between capital budgeting decisions and information sharing. On the one hand, the inefficiency in firms’ capital budgeting decisions may stem entirely from information asymmetry. In that case, we would observe a large margin of error with symmetry on the over- and under-investment sides, and a pooled analysis of all sample firms would be in order. On the other hand, the inefficiency may be due to managers not knowing their lack of information and behaving as if they knew. Then information sharing will significantly increase efficiency in the over-investing camp but not in the under-investing one. This asymmetric effect justifies separate analyses of the under- and over-investing firms.

In Table 4, we compare the main characteristics of over- and under-investing firms, and find that they are systematically different from each other. The over-investing firms are significantly larger in terms of assets, and they are more diversified geographically and industrially. We therefore decide to examine these two groups of firms separately.

The results of separate analyses of the efficiency of capital budgeting decisions of under- and over-investing firms are reported in Tables 5 and 6. If a particular measure of internal coordination has a symmetric effect on these two groups, then it would have opposite signs in the analyses (e.g., negative in Table 5 and positive in Table 6). However, if a particular measure has the same effect on all firms – for example, leading to lower levels of investment across the board – then it would have the same sign in both sub-samples and yet have different interpretations.

5.1 Impact of Internal Coordination and Communication

We first explore the connection between capital budgeting and overall self-citation ratios. We then zoom in on the self-citations that happen across geographic locations, and use *non-local self-citation ratio* as our key independent variable. Next, we examine the link between value-enhancing capital budgeting decisions and R&D collaborations among inventors from multiple regions as well as examiner-imposed self-citations. For each of our focal independent variables we run three sets of empirical tests vs. each of the two benchmark marginal q's, 0.78 and 1.00. In each set we examine (1) a baseline model using the focal variable, (2) an expanded version including also the number of locations with patenting activities, and (3) a fuller version in which we also control for the average citations received by each patent.[9] Results for the under-investment sample defined against the tax-adjusted benchmark marginal q's of 0.78 and 1.00 are

[9] We run all tests separately among under- and over-investing firms defined separately vs. the two benchmark marginal q's, 0.78 and 1.00. Thus, two rounds of tests, where each round includes two sets of three models, yield a total of twelve sets of results.

presented in Tables 5a and 5b, respectively; the comparable charts for the over-investment sample are presented in Tables 6a and 6b, respectively.

While the link between efficient capital budgeting and self-citations is statistically insignificant among firms that under-invest (Tables 5a and 5b, Models 1-3), it is mostly significant among firms that over-invest (Tables 6a and 6b, Models 1-3), which suggests that repetitive, wasteful investment is reduced when there is greater information sharing within the firm. Non-local self-citations indicate the degree to which innovators within the firm build on technologies developed in other parts of the firm, and higher levels of non-local self-citations could indicate better information sharing. Our examination of over-investing firms reveals that capital budgeting decisions are more effective when a firm has higher levels of non-local self-citations (Tables 6a and 6b, Models 4-6). The result is stronger after we control for the number of locations in the firm.

As with the broad self-citation measure, non-local self-citation ratio has an insignificant impact on capital budgeting among under-investing firms (Tables 5a and 5b, Models 4-6). One possible explanation is that the geographically dispersed corporate units (e.g., subsidiaries) are more substitutes rather than complements for each other. When units are substitutes, better information sharing could reduce redundant investments. When units are complements, better information sharing may encourage value-enhancing investments to take advantage of the complementary resources scattered in the firm. We observe more support for the information sharing hypothesis.

Among firms that over-invest, interpersonal collaboration across regions turns out to be an effective means of reducing coordination costs and strengthening information sharing in geographically dispersed organizations (Tables 6a and 6b, Models 7-9). We find that firms make more value-enhancing capital budgeting decisions with higher proportion of R&D conducted in multi-location teams; this directly parallels the results reported earlier for the non-local self-citation ratio. We also find that among firms that under-invest, the efficiency of their capital budgeting decisions is inconsistently affected by multi-regional collaboration on patents. When we evaluate the efficiency of firm's capital budgeting decisions vs. the tax-adjusted benchmark marginal q of 0.78, we find that the efficiency is worsened by such multi-regional collaboration (Table 5a, Models 7-9) but we find no relationship when we evaluate efficient capital budgeting decisions vs. the no tax benchmark marginal q of 1.00 (Table 5b, Models 7-9). This result injects a degree of nuance into how we can interpret our results. It may be the case that extensive cross-regional collaborations, while facilitating information sharing within the firm, also inhibit the firm's integration into the local economy (Zhao and Islam, 2008). This limits the subsidiaries' access to local resources or local market opportunities, thus forgoing valuable investments that should have happened. Therefore, we see that the multi-region ratio is positive and statistically significant in nearly all tests, among both under- and over-investing firms.

Finally, as mentioned earlier, the percentage of self-citations imposed by patent examiners can be interpreted as a reverse measure of internal information sharing; it reveals the degree to which innovators are unaware of their colleagues' R&D activities. Of course, this is based on the assumption that the patent examiner knows exactly what should have been listed as prior art and acts objectively. Since this measure is available only for 2001-onwards, we examine a smaller number of firms in this set of regressions (307 vs. 342 in our other tests). This result is statistically significant in only four of the twelve cases we examine (Tables 5a, 5b, 6a, and 6b, Models 10-12). It shows that all firms invest less when they have higher levels of examiner-imposed self-citations. This results in less efficient capital budgeting decisions for under-investing firms and more efficient capital budgeting decisions for over-investing firms, which is counterintuitive. In other words, firms that under-invest leave good projects unexplored while firms that over-invest encounter speed bumps and invest less. One may argue that firms with high levels of examiner-imposed self-citations are not the most resourceful in organizing their global R&D activities, i.e., they are constrained in ways that are not fully captured by the variables in this study. Therefore, the unobserved resource constraints simultaneously drive up the examiner-imposed self-citations and suppress the overall level of investments.

5.2 Control Variables

While geographic dispersion could drive up coordination costs, there is evidence that multinational firms make more efficient capital budgeting decisions (Greene *et al.*, 2009) and have stronger managerial skills (Bloom and Van Reenen; 2007a, 2007b). Further, Brown and Medoff (1989) found that larger, more complex firms may be able to recruit and retain higher-quality employees. Thus, it is not surprising that we find no relationship between the efficiency of a firm's capital budgeting decisions and the number of locations where a firm conducts R&D. Also, we generally observe no relation between the efficacy of corporate capital budgeting decisions and firm size.

Firms that conduct more R&D may find information sharing more important to their budgeting decisions. On the other hand, they may face more information asymmetry between managers and investors, who find it difficult to evaluate effectively the intrinsic value of the firm's innovations. Such firms are also more likely to face liquidity constraints and have to rely on internal cash flows to finance investments. We find only limited evidence (Tables 5b and 6a) that firms make more effective capital budgeting decisions when they have more patents.

Firms may have widely cited patents because they (1) have the resources to engage in cutting-edge technologies, (2) are more visible, and (3) are more aggressive in defending their intellectual property, prompting other firms to cite their patents diligently. On the one hand, such patents may represent the successful completion of larger innovation projects that require greater managerial oversight. On the other hand, such projects could signal the presence of a large bureaucratic organization facing greater coordination challenges. We find significant evidence that among firms that under-invest, large citations are associated with worse capital budgeting decisions (Tables 5a and 5b).

Weaker capital budgeting decisions are consistently and significantly associated with leverage, regardless of whether the firm under- or over-invests (Tables 5a, 5b, and 6a). For firms that under-invest, leverage may lead to additional supervision by external monitors and thus exacerbate the under-investment situation. For firms that over-invest, high leverage may have resulted from excessive capital spending by the firm. While leverage may signal the presence of external monitors, higher levels of cash flow may make internal monitors more important. We find that capital budgeting decisions are weakly improved by higher cash flow (Tables 5a, 5b, and 6a). Investment efficiency and industrial diversification appear to be weakly related, mainly among under-investing firms. Among those firms that over-invest we do not observe a consistent relationship between efficient capital budgeting and industrial diversification. Other control variables were statistically insignificant in all tests.

5.3 Implications

Despite the obvious differences among the four alternative measures of information sharing, we find two consistent results. First, intra-firm information sharing helps improve firms' capital budgeting efficiency. Second, the effects are asymmetric between over- and under-investing firms. This is useful for us to tease out the specific mechanisms behind the data.

If the information barriers within firms make it difficult to make appropriate investment decisions, and the managers are aware of such difficulties, then a firm's investment level should be randomly distributed around the optimal level as the managers make their best bets. Accordingly, better information sharing should reduce the margin of error for both over- and under-investing firms in a symmetric fashion. Our empirical results do not support this scenario.

Instead, we find that better information sharing consistently reduces over-investment but has little effect on under-investment, which suggests that lack of information sharing led to inefficient investments in the firm. In other words, the managers either under-estimated intra-firm information barriers, or did not take them into consideration when making investment decisions. And because our study is focused on geographic diversification rather than industry diversification, most of the subsidiaries are horizontally differentiated.[10] In such circumstances, information barriers lead to more redundant investments than forgone opportunities.

6. AVERAGE Q – COMPLEMENTARY EVIDENCE

Unlike marginal q, average Tobin's Q, the ratio of firm market value to firm replacement value, reflects investors' valuation of the firm. Hayashi (1982) showed that with constant returns to scale and perfect competition, marginal q and average Q should be equal. If information sharing not only affects the quantity, but also raises the quality or profitability of the investments, then we would expect a positive association between intra-firm coordination and Tobin's Q.

We run four sets of tests of the following model

[10] We calculate the technological proximity across subsidiaries following Jaffe (1986), and find the mean distances within firms are much smaller than those across firms, even in the same industry.

$$Q_{it} = \alpha + \lambda X_{it} + \eta C_{it} + \omega I_{SIC} + \delta_t P_t + \varepsilon_{it} \quad [5]$$

where ***X*** represents the four alternative independent variables used to measure internal linkages, and ***C*** represents the firm-level control variables. I_{SIC} are industry fixed effects that capture each firm's primary two-digit SIC code, and P_t, a series of year fixed effects, are also included to reflect the economic environment. Finally, we assume that the disturbance term, ε_i, is normally distributed with zero mean and constant variance σ^2.

When we conducted our earlier tests where marginal *q* formed part of the dependent variable, the dependent variable was estimated over years *1…T* and independent variables were the average value per firm for the years *0…T-1*. Since average Q can be estimated directly for each year, we now can use *T* observations for each firm in estimating [5]. Our dataset of 342 firms contains 224 under-investing firms and 118 over-investing firms but we use simultaneously up to 2,663 observations on these 342 firms when examining variation in average Q, excluding only those observations for which we have missing data.

Our results from estimation of [5] are shown in Table 7. These results complement and mirror our earlier findings regarding marginal *q*: firm valuation is higher when firms engage in innovation activity that reflects stronger internal coordination and communication. Thus, average Q is significantly higher when firms cite their own patents, cite patents developed by colleagues in other locations, and develop patents with researchers in multiple locations. Similarly, average Q is significantly lower when examiner-imposed self-citations are higher. While the number of locations is not significantly associated with the marginal *q* measure, average Q seems to be higher when firms develop patents in more locations, a finding that is consistent with the Morck and Yeung (1991) finding that investors value multinationality if the firm possesses valuable intangible assets. Investors also attach a premium to firms that develop more widely cited patents, which proxy for firm-specific knowledge and intangible assets.

A second, potentially related robustness test is based on Wurgler (2000). Wurgler estimates a country's investment elasticity by measuring the sensitivity of investment to value-added across industries. An analogous measure in our context would reveal how swiftly capital flows to the correct unit within a firm. Unfortunately, to obtain the firm-level estimates of elasticity, we need unit-level data which we do not have. Instead, we create a measure similar to Wurgler's between-year component of investment elasticity by regressing the growth in firm assets on the growth in firm value over the years.

As we have only 5-10 observations per firm, our estimated investment elasticities are very noisy; just 24 of the 343 estimated elasticities are statistically significant. We find that among those firms with negative investment elasticities, firms respond better to market value changes when they have higher self-citation ratios and lower levels of examiner-imposed self-citations; this is consistent with the results reported in Tables 5a and 6. Unfortunately, the other results are mostly insignificant, which is probably due to the small numbers of observations used in the first stage estimation of the elasticity.

7. CONCLUSION

Firms are increasingly conducting business on a global basis and developing resources at different geographic locations. The additional agency and information asymmetry problems arising from such organizational structures often make it difficult for managers to make efficient corporate capital budgeting decisions. We focus on firm heterogeneity in the degree of internal information sharing, and examine whether the efficiency of corporate capital budgeting decisions is associated with stronger internal linkages.

Using marginal Tobin's *q* to measure the efficiency of corporate capital budgeting decisions and four alternative variables to measure firms' internal information sharing, we find consistent evidence that firms with (1) higher internal citations, (2) frequent citations across subsidiaries, (3) extensive use of inter-unit collaborations, and (4) smaller percentage of examiner-imposed self-citations are more likely to avoid inefficient investments from the corporation's perspective. In addition, by linking the same variables to average Tobin's Q, we find that better internal coordination is also positively associated with the overall valuation of the R&D active firms in our sample.

This study contributes to the economics and finance literature by looking into the firm and identifying the sources of heterogeneity in firms' capital investment efficiency (Greene *et al*., 2009). Specifically, efficiency in capital investment not only depends on the external environment for information (Durnev *et al*., 2004), but also relates to internal coordination and information sharing. Our study also contributes to the management literature by showing that intra-firm coordination is important not only for certain strategic goals such as corporate innovation (Singh, 2008), but also for the overall financial performance of firms.

Admittedly, there may be other factors in firms' capital budgeting decisions that cannot be fully incorporated into this study. For future research, it would be interesting to have a closer look at the benefits and costs of strong internal linkages, and analyze whether firms with different strategic imperatives or cost structures would choose specific levels of inter-unit integration, which, in turn, affects the efficiency of corporate budgeting. Another promising avenue to explore is the nature of relationships among the divisions and subsidiaries in the firm. Hansen (2002) suggests that a proper understanding of effective inter-unit knowledge sharing in a multi-unit firm should take into consideration relatedness in knowledge content among business units. For instance, if investment inefficiencies are due to managers' ignorance of internal coordination problems, then managers in a horizontally diversified firm may be more likely to make poor investments while such managers in a vertically diversified firm may under-invest, missing opportunities that reside in complementary assets within the firm. Understanding the nature of firm diversification will help us disentangle the specific mechanisms underlying the inefficiencies and thus provide better insights for practitioners.

8. APPENDIX

When estimating marginal q, the terms $V_{i,t}$ and $A_{i,t}$ are rewritten as:

$$V_{i,t} = P_t(CS_{i,t} + PS_{i,t} + LTD_{i,t} + SD_{i,t} - STA_{i,t}) \quad \text{[A1]}$$

$$A_{i,t} \equiv K_{i,t} + INV_{i,t} + P_t STA_{i,t}, \quad \text{[A2]}$$

where

$CS_{i,t}$ = the market value of the outstanding common shares, estimated as the number of common shares outstanding (CRSP's SHROUT) multiplied by the end of fiscal year price (CRSP's PRC).

$PS_{i,t}$ = the estimated market value of preferred shares outstanding (Compustat's Data19) over the Moody's Baa preferred dividend yield.[11]

$LTD_{i,t}$ = estimated market value of long-term debt (Data9).

$SD_{i,t}$ = book value of short-term debt, estimated as debt in current liabilities (Data34), the total amount of short-term notes and the current portion of long-term debt that is due in one year, less the total amount of short-term notes (Data206).

[11] These data are available online at http://research.stlouisfed.org/fred/data/irates/baa.

$STA_{i,t}$ = book value of short-term assets (Data4). $STA_{i,t}$ is included in the estimation of firm assets, $A_{i,t}$, in order to reflect the possibility of corporate spin-offs or divestitures.

P_t = inflation adjustment using the GDP deflator.[12]

$K_{i,t}$ = estimated market value of property, plant, and equipment, which is calculated using current and historical data on capital spending (Data7).

INV = estimated market value of inventories, calculated using total inventory (Data3) and LIFO reserve (Data240). When a firm uses FIFO accounting, inventory is Data3. However, when a firm uses LIFO accounting, inventory is Data3 + Data240.

In [3] we estimate $D_{i,t\text{-}1}$, disbursements to investors, as the product $d_{i,t}V_{i,t\text{-}1}$, with d capturing total cash disbursements, which are estimated as the sum of cash dividends on common and preferred stock (Data21 and Data19), purchases of common and preferred stock (Data115),[13] and interest expense (Data15).

The market value of property, plant, and equipment (PP&E) is calculated using a recursive algorithm because historical cost accounting does not adjust properly for inflation. All PP&E figures are converted to 1983 dollars,[14] and we assume straight-line depreciation of 10% per annum. PP&E in year $t+1$ is PP&E from year t less 10% depreciation plus current capital spending, denoted $\Delta X_{i,t+1}$, which is deflated to 1983 dollars. We convert the data to 1983 dollars using π_t, the fractional change in the seasonally adjusted producer price index (PPI) for finished goods published by the U.S. Department of Labor, Bureau of Labor Statistics.[15] More generally, we use the recursive equation:

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[12] These data are available online at http://research.stlouisfed.org/fred/data/ppi/ppifgs.
[13] This is to capture share repurchases.
[14] If the first observation for a firm is a different year, we use that as the firm's base year instead.

[15] These data are available online at http://research.stlouisfed.org/fred/data/ppi/ppifgs.

$$K_{i,t+1} = (1-\delta)K_{i,t} + \frac{\Delta X_{i,t+1}}{\prod_{\tau=0}^{t+1}(1+\pi_{\tau})}. \quad [A3]$$

When fewer than ten years of historical observations are available per firm, we begin the calculation with the first available year of data. We exclude all firms for which we are unable to obtain at least five historical observations. This procedure is necessary because historical cost accounting can cause firm valuations of PP&E to be inaccurate if simple deflators are used to adjust for inflation.

Average Q is estimated as $Q_{it} \equiv \frac{V_{it}}{A_{it}}$.

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Table 1: Descriptive Statistics

This table reports the definitions, and mean, standard deviation, median, minimum, and maximum values for all variables.

Variable	Definition	Mean (S.D.)	Median	Min	Max	# Obs
Dependent Variables						
Marginal *q*	A coefficient in the regression of the change in market value of a firm on an unexpected change in the stock of capital goods (with all variables scaled by the lagged value of the firm's stock of capital goods) and year fixed effects using annual data from 1993 through 2002. The firm's value and tangible assets are defined using [A1] and [A2], respectively. Assets are calculated as the sum of the market value of property, plant, and equipment, as defined using the recursive formula [A3], inventory, and short-term assets.	0.94 (0.38)	0.93	-0.16	2.19	342
Average Q	The ratio of firm market value to replacement value of assets, using the formulas [A1] and [A2].	1.00 (0.65)	0.82	0.11	3.66	342
Independent Variables						
Self-citation ratio	Percentage of citations on a patent that occur within the same firm	0.14 (0.11)	0.11	0.00	0.61	342
Nonlocal-self-citation ratio	Percentage of nonlocal citations that are self-citations	0.02 (0.04)	0.01	0.00	0.31	342
Multi-region ratio	Percentage of patents that are the result of multi-region collaborations	0.18 (0.13)	0.16	0.00	0.81	342
Self-examiner ratio	Percentage of self-citations that are imposed by patent examiners	0.48 (0.27)	0.46	0.00	1.00	307
Locations	Average number of locations where the firm produces patents	7.47 (8.57)	4.00	1.00	50.33	342

Control Variables						
Patents	Log average number of patents filed in the preceding three years	3.59 (1.64)	3.41	1.10	8.24	342
Average citations	Average number of citations received by each patent	5.81 (3.67)	4.67	0.52	22.28	342
PPE	The log of average annual property, plant, and equipment (PP&E), US$mn; estimated using the recursive formula [A3]	6.00 (1.92)	6.02	0.70	11.16	342
Leverage	Average ratio of the sum of long-term debt and current liabilities to total assets	0.24 (0.14)	0.24	0.00	0.95	342
Cash flow	Average ratio of the sum of income before extraordinary items and depreciation and amortization to tangible assets, where tangible assets are estimated using [A2]	0.14 (0.13)	0.14	-0.80	1.05	342
Diversification	The average number of 2-digit SIC codes in which the firm operates	1.70 (0.84)	1.44	1.00	5.67	342

Table 2: Correlations of Variables

This table reports the correlations of all variables. Refer to Table 1 for variable numbering and descriptive statistics.

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1. Marginal *q*	1.00											
2. Average Q	0.07	1.00										
3. Self-citation ratio	0.03	0.19	1.00									
4. Nonlocal-self-citation ratio	-0.01	0.05	0.55	1.00								
5. Multi-region ratio	-0.06	0.14	0.09	0.16	1.00							
6. Self-examiner ratio	-0.04	-0.03	-0.14	-0.10	-0.02	1.00						
7. Locations	-0.20	0.13	0.19	0.27	0.18	0.05	1.00					
8. Patents	-0.18	0.11	0.18	0.23	0.05	0.01	0.85	1.00				
9. Average citations	0.12	0.12	0.04	0.07	-0.06	-0.11	-0.01	0.07	1.00			
10. PPE	-0.32	0.02	0.13	0.21	0.18	-0.03	0.64	0.65	-0.24	1.00		
11. Leverage	-0.02	-0.13	0.04	0.13	0.03	-0.06	-0.02	-0.04	-0.11	0.20	1.00	
12. Cash flow	-0.02	0.20	0.03	0.06	0.08	0.03	0.06	0.09	0.11	-0.03	-0.22	1.00
13. Diversification	-0.21	-0.19	0.02	0.08	-0.05	0.06	0.25	0.22	-0.15	0.40	0.15	-0.06

Table 3: Industry composition of firms in dataset

This table reports the number of firms in our dataset in each two-digit SIC code classification. We exclude from analysis all industries in which we obtain estimated marginal q's for fewer than three firms.

Two-digit SIC code	Industry name	Number of firms	Mean estimated marginal q
20	Food and kindred products	15	0.87
22	Textile mill products	6	1.00
25	Furniture and fixtures	8	0.86
26	Paper and allied products	19	0.88
27	Printing, publishing and allied industries	7	0.71
28	Chemicals and allied products	49	0.92
29	Petroleum refining and related industries	10	0.75
30	Rubber and miscellaneous plastics products	12	1.04
32	Stone, clay, glass, and concrete products	6	0.90
33	Primary metal industries	12	0.71
34	Fabricated metal products, except machinery and transportation equipment	18	0.80
35	Industrial and commercial machinery and computer equipment	52	0.96
36	Electronic and other electrical equipment and components, except computer equipment	44	0.97
37	Transportation equipment	33	0.97
38	Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks	44	1.08
39	Miscellaneous manufacturing industries	7	0.98

Table 4: Descriptive statistics for under- and over-investing firms

This table describes the basic characteristics of firms that under- or over-invest. The table reports means, with standard deviations in parentheses.

	Firms for which $\hat{q}_i > 0.78$	Firms for which $\hat{q}_i \leq 0.78$	T-test of the means	Firms for which $\hat{q}_i > 1.00$	Firms for which $\hat{q}_i \leq 1.00$	T-test of the means
Marginal *q*	1.14	0.55	23.77***	1.29	0.69	22.56***
	(0.28)	(0.18)		(0.25)	(0.22)	
Locations	7.00	8.37	-1.34	5.76	8.66	-3.34***
	(8.04)	(9.48)		(6.45)	(9.62)	
PPE	5.75	6.45	-3.28***	5.49	6.35	-4.17***
	(1.91)	(1.85)		(1.90)	(1.85)	
Diversification	1.63	1.83	-1.98**	1.59	1.78	-2.06**
	(0.78)	(0.93)		(0.75)	(0.89)	

Table 5a: Analyses among under-investing firms of the relationship between effective capital budgeting decisions and information sharing within a firm

The dependent variable, $(\hat{q}_i - 0.78)$, measures the efficiency of a firm's corporate capital budgeting decisions relative to the tax-adjusted theoretical benchmark marginal q, as reported in Section 3.1 We include in this sample only those firms that under-invest (i.e., $\hat{q}_i > 0.78$). Refer to Table 1 for variable definitions. We include industry fixed effects for all industries in which there are at least three firms; the intercept and industry fixed effects are not reported. *** denotes significance at the 1% level; ** at the 5% level; and * at the 10% level.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
	MLE	MLE	MLE									
Self-citation ratio	1.08	1.27	1.57									
	(1.51)	(1.46)	(1.27)									
Non-local self-citation ratio				-1.64	-1.33	-1.40						
				(5.22)	(5.01)	(4.25)						
Multi-region ratio							2.34**	2.79***	2.35**			
							(0.99)	(1.03)	(1.03)			
Examiner-imposed self-citation ratio										1.14**	1.12**	1.31***
										(0.53)	(0.53)	(0.49)
Locations		-0.05	-0.05		-0.04	-0.04		-0.06*	-0.07*		-0.02	-0.02
		(0.04)	(0.03)		(0.04)	(0.03)		(0.04)	(0.04)		(0.03)	(0.03)
Patents	-0.04	0.12	0.08	-0.02	0.10	0.10	0.06	0.27	0.28	-0.06	0.02	-0.04
	(0.14)	(0.18)	(0.16)	(0.14)	(0.18)	(0.17)	(0.13)	(0.18)	(0.18)	(0.13)	(0.17)	(0.17)
Average citations			0.15***			0.14***			0.12***			0.15***
			(0.04)			(0.04)			(0.03)			(0.05)
PPE	0.12	0.14	0.19	0.07	0.07	0.14	-0.03	-0.04	0.05	0.10	0.10	0.15
	(0.15)	(0.15)	(0.13)	(0.16)	(0.15)	(0.14)	(0.14)	(0.13)	(0.13)	(0.15)	(0.15)	(0.14)
Leverage	1.79*	1.82*	1.85**	2.21**	2.19**	2.17**	1.64*	1.66*	1.96**	2.53**	2.61**	2.40***
	(1.00)	(0.97)	(0.85)	(1.04)	(1.01)	(0.89)	(0.91)	(0.88)	(0.86)	(1.02)	(1.02)	(0.89)
Cash flow	0.34	0.33	1.24	0.52	0.54	1.49**	0.20	0.15	0.97	2.95*	3.07*	2.19
	(0.82)	(0.80)	(0.76)	(0.76)	(0.74)	(0.73)	(0.70)	(0.68)	(0.73)	(1.57)	(1.60)	(1.33)
Diversification	-1.12***	-1.02***	-0.95***	-0.91***	-0.86***	-0.93***	-0.80***	-0.65**	-0.77***	-1.06***	-1.01***	-0.96***
	(0.33)	(0.32)	(0.28)	(0.32)	(0.31)	(0.27)	(0.28)	(0.26)	(0.27)	(0.31)	(0.30)	(0.27)
Log likelihood	-65.72	-64.92	-55.09	-64.18	-63.75	-55.76	-61.53	-59.52	-52.85	-51.97	-51.62	-46.41
Number of Obs.	224	224	224	224	224	224	224	224	224	202	202	202
Scale factors for marginal effects	0.32	0.33	0.35	0.31	0.32	0.34	0.35	0.36	0.36	0.34	0.35	0.36

Table 5b: Analyses among under-investing firms of the relationship between effective capital budgeting decisions and information sharing within a firm

The dependent variable, $(\hat{q}_i - 1.00)$, measures the efficiency of a firm's corporate capital budgeting decisions relative to the tax-adjusted theoretical benchmark marginal *q*, as reported in Section 3.1 We include in this sample only those firms that under-invest (i.e., $\hat{q}_i > 1.00$). Refer to Table 1 for variable definitions. We include industry fixed effects for all industries in which there are at least three firms; the intercept and industry fixed effects are not reported. *** denotes significance at the 1% level; ** at the 5% level; and * at the 10% level.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
	MLE	MLE	MLE									
Self-citation ratio	2.41	2.24	2.22									
	(1.68)	(1.58)	(1.46)									
Non-local self-citation ratio				-2.31	-2.17	-2.94						
				(6.73)	(6.41)	(5.69)						
Multi-region ratio							2.06	2.23	1.97			
							(1.45)	(1.41)	(1.36)			
Examiner-imposed self-citation ratio										0.53	0.47	0.75
										(0.71)	(0.72)	(0.72)
Locations		-0.03	-0.04		-0.03	-0.03		-0.07	-0.07		-0.02	-0.02
		(0.04)	(0.04)		(0.04)	(0.04)		(0.05)	(0.05)		(0.05)	(0.05)
Patents	-0.27*	-0.18	-0.15	-0.23		-0.11	-0.17	0.02	0.02	-0.26	-0.19	-0.22
	(0.15)	(.18)	(0.17)	(0.16)		(0.18)	(0.16)	(0.21)	(0.20)	(0.18)	(0.23)	(0.23)
Average citations			0.06*			0.06			0.05			0.11*
			(0.03)			(0.04)			(0.04)			(0.07)
PPE	0.01	0.02	0.05	0.01	0.01	0.05	-0.06	-0.01	0.04	0.02	0.03	0.07
	(0.16)	(0.15)	(0.14)	(0.15)	(0.15)	(0.14)	(0.17)	(0.15)	(0.15)	(0.19)	(0.20)	(0.19)
Leverage	1.33	1.14	1.10	1.43	1.30	1.33	1.70	1.29	1.30	2.61*	2.65*	2.61**
	(1.11)	(1.04)	(0.97)	(1.15)	(1.10)	(1.03)	(1.23)	(1.08)	(1.03)	(1.36)	(1.36)	(1.31)
Cash flow	0.32	0.29	0.56	0.62	0.58	0.89	0.05	0.002	0.31	1.96*	1.97*	1.36
	(0.76)	(0.70)	(0.64)	(0.72)	(0.68)	(0.63)	(0.83)	(0.76)	(0.73)	(1.18)	(1.17)	(1.09)
Diversification	-0.36	-0.33	-0.33	-0.42	-0.39	-0.39	-0.36	-0.25	-0.29	-0.52	-0.50	-0.47
	(0.31)	(0.30)	(0.28)	(0.31)	(0.31)	(0.29)	(0.34)	(0.31)	(0.30)	(0.36)	(0.39)	(0.37)
Log likelihood	-70.94	-70.88	-69.21	-72.435	-72.44	-70.81	-70.94	-70.06	-68.96	-62.07	-61.96	-60.62
Number of Obs.	145	145	145	145	145	145	145	145	145	130	130	130
Scale factors for marginal effects	0.29	0.31	0.33	0.29	0.30	0.32	0.27	0.30	0.32	0.27	0.27	0.28

Table 6a: Analyses among over-investing firms of the relationship between effective capital budgeting decisions and information sharing within a firm

The dependent variable, $(\hat{q}_i - 0.78)$, measures the efficiency of a firm's corporate capital budgeting decisions relative to the tax-adjusted theoretical benchmark marginal q, as reported in Section 3.1 We include in this sample only those firms that over-invest (i.e., $\hat{q}_i < 0.78$). Refer to Table 1 for variable definitions. We include industry fixed effects for all industries in which there are at least three firms; the intercept and industry fixed effects are not reported. *** denotes significance at the 1% level; ** at the 5% level; and * at the 10% level.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
	MLE	MLE	MLE									
Self-citation ratio	0.69***	0.67***	0.61**									
	(0.24)	(0.24)	(0.25)									
Non-local self-citation ratio				2.21	2.82*	2.75*						
				(1.44)	(1.52)	(1.62)						
Multi-region ratio							0.29**	0.30***	0.36**			
							(0.12)	(0.12)	(0.17)			
Examiner-imposed self-citation ratio										0.15	0.14	0.23**
										(0.10)	(0.11)	(0.11)
Locations		-0.003	-0.004		-0.02***	-0.02***		-0.006	-0.007		-0.002	-0.001
		(0.005)	(0.005)		(0.008)	(0.008)		(0.005)	(0.005)		(0.006)	(0.006)
Patents	0.01	0.03	0.03	0.13***	0.20***	0.20***	0.01	0.05	0.05	0.002	0.01	-0.008
	(0.02)	(0.04)	(0.04)	(0.02)	(0.04)	(0.04)	(0.02)	(0.04)	(0.04)	(0.03)	(0.05)	(0.05)
Average citations			0.004			0.001			-0.002			0.01**
			(0.004)			(0.006)			(0.005)			(0.004)
PPE	0.01	0.003	0.007	-0.13***	-0.12***	-0.11***	0.03	0.02	0.02	0.01	0.01	0.03
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Leverage	-0.13	-0.14	-0.21	-0.96**	-0.77**	-0.78**	-0.56**	-0.61**	-0.63**	-0.37	-0.36	-0.48*
	(0.23)	(0.23)	(0.24)	(0.41)	(0.38)	(0.38)	(0.26)	(0.27)	(0.27)	(0.27)	(0.26)	(0.27)
Cash flow	0.45**	0.53**	0.54**	1.52***	1.60***	1.59***	0.30	0.44*	0.40	0.57**	0.59**	0.62**
	(0.21)	(0.24)	(0.238)	(0.33)	(0.30)	(0.31)	(0.23)	(0.25)	(0.26)	(0.28)	(0.29)	(0.30)
Diversification	-0.08***	-0.07***	-0.07***	-0.01	0.001	0.002	-0.06**	-0.05*	-0.05*	-0.05*	-0.05	-0.04
	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Log likelihood	72.54	72.74	73.33	50.07	50.70	50.71	71.37	72.14	72.24	51.58	51.63	54.26
Number of Obs.	118	118	118	118	118	118	118	118	118	105	105	105
Scale factors for marginal effects	1.00	1.00	1.00	0.90	0.91	0.91	1.00	1.00	1.00	0.93	0.93	0.94

Table 6b: Analyses among over-investing firms of the relationship between effective capital budgeting decisions and information sharing within a firm

The dependent variable, $(\hat{q}_i - 1.00)$, measures the efficiency of a firm's corporate capital budgeting decisions relative to the tax-adjusted theoretical benchmark marginal q, as reported in Section 3.1 We include in this sample only those firms that over-invest (i.e., $\hat{q}_i < 1.00$). Refer to Table 1 for variable definitions. We include industry fixed effects for all industries in which there are at least three firms; the intercept and industry fixed effects are not reported. *** denotes significance at the 1% level; ** at the 5% level; and * at the 10% level.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
	MLE	MLE	MLE									
Self-citation ratio	0.66	0.67*	0.67*									
	(0.41)	(0.41)	(0.41)									
Non-local self-citation ratio				2.96*	3.24**	3.27**						
				(1.57)	(1.61)	(1.62)						
Multi-region ratio							0.54*	0.60**	0.63**			
							(0.30)	(0.31)	(0.32)			
Examiner-imposed self-citation ratio										-0.08	-0.09	-0.09
										(0.17)	(0.17)	(0.17)
Locations		-0.01	-0.01		-0.01	-0.01		-0.01	-0.01		-0.004	-0.004
		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)
Patents	-0.02	0.004	0.003	-0.02	0.01	0.01	-0.01	0.02	0.03	-0.09**	-0.07	-0.07
	(0.04)	(0.05)	(0.05)	(0.04)	(0.05)	(0.05)	(0.04)	(0.05)	(0.05)	(0.04)	(0.05)	(0.06)
Average citations			0.001			-0.001			-0.004			-0.002
			(0.01)			(0.01)			(0.01)			(0.01)
PPE	-0.03	-0.02	-0.02	-0.04	-0.03	-0.03	-0.03	-0.02	-0.02	0.02	0.03	0.03
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
Leverage	-0.18	-0.22	-0.22	-0.16	-0.21	-0.21	-0.31	-0.38	-0.39	-0.24	-0.27	-0.26
	(0.34)	(0.34)	(0.35)	(0.34)	(0.34)	(0.34)	(0.35)	(0.36)	(0.36)	(0.36)	(0.36)	(0.36)
Cash flow	0.03	0.05	0.06	-0.04	-0.01	-0.01	-0.07	-0.05	-0.07	0.12	0.13	0.13
	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)	(0.33)	(0.33)	(0.33)
Diversification	0.04	0.04	0.04	0.04	0.05	0.05	0.03	0.04	0.04	-0.04	-0.04	-0.04
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Log likelihood	14.28	14.64	14.65	15.06	15.71	15.72	14.60	15.31	15.41	27.95	28.10	28.11
Number of Obs.	197	197	197	197	197	197	197	197	197	177	177	177
Scale factors for marginal effects	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.48	0.48	0.48

Table 7: Analyses of the relationship between average Tobin's Q and information sharing within a firm

The dependent variable, Q_i, proxies for the stock market's valuation of the firm. As defined in Table 1, average Q is the ratio of firm market value to firm replacement value. We include in the sample all firms, irrespective of whether they can be classified as under- or over-investors based on their estimated marginal q's. Refer to Table 1 for variable definitions. We include industry fixed effects for all industries in which there are at least three firms; the intercept and industry fixed effects are not reported. *** denotes significance at the 1% level; ** at the 5% level; and * at the 10% level.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Self-citation ratio	0.24**	0.20*	0.19*									
	(0.11)	(0.10)	(0.10)									
Non-local self-citation ratio				0.64**	0.49*	0.48*						
				(0.26)	(0.26)	(0.26)						
Multi-region ratio							0.16**	0.03	0.03			
							(0.07)	(0.08)	(0.08)			
Examiner-imposed self-citation ratio										-0.12*	-0.10*	-0.09
										(0.06)	(0.06)	(0.06)
Locations		0.02***	0.02***		0.02***	0.02***		0.02***	0.02***		0.02***	0.02***
		(0.003)	(0.003)		(0.003)	(0.003)		(0.002)	(0.003)		(0.003)	(0.003)
Patents	0.06***	-0.02	-0.02	0.06***	-0.02	-0.02	0.06***	-0.02	-0.02	0.08***	-0.006	-0.01
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Average citations			0.004			0.0002			-0.0003			0.001
			(0.003)			(0.0003)			(0.001)			(0.004)
PPE	-0.02*	-0.05***	-0.05***	-0.03**	-0.06***	-0.06***	-0.02*	-0.05***	-0.05***	-0.03	-0.07***	-0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Leverage	0.002	0.04	0.04	-0.01	0.03	0.03	-0.002	0.05	0.05	-0.02	0.004	0.005
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.13)	(0.13)	(0.13)
Cash flow	0.96***	0.92***	0.91***	0.97**	0.92***	0.92***	0.97***	0.93***	0.93***	1.14***	1.07***	1.07***
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.12)	(0.12)	(0.12)
Diversification	-0.04**	-0.05**	-0.05***	-0.04**	-0.05***	-0.05***	-0.04**	-0.05***	-0.05***	-0.04*	-0.05**	-0.05**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
R^2	0.20	0.22	0.22	0.20	0.22	0.22	0.20	0.22	0.22	0.21	0.23	0.23
Number of Obs.	2223	2223	2223	2204	2204	2204	2272	2272	2272	1627	1627	1627