THE EFFICIENCY OF INTERNAL CAPITAL MARKETS:

EVIDENCE FROM THE ANNUAL CAPITAL EXPENDITURE SURVEY

by

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Abstract

We empirically examine whether greater firm diversity results in the inefficient allocation of capital. Using both COMPUSTAT and the Annual Capital Expenditure Survey (ACES) we find firm diversity to be negatively related to the efficiency of investment. However once we distinguish between capital expenditure for structures and equipment, we find that while firms do inefficiently allocate capital for equipment, they efficiently allocate capital for structures. These results suggest that when the decision will have long-lasting repercussions, headquarters will, more often than not, make the correct choice.

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1. Introduction

In recent years, there has been a renewed focus on the internal capital markets of diversified firms. A number of papers have taken up the question of whether these markets are efficient. If frictions in external credit markets mean that positive net present value projects are not undertaken, then the ability of internal capital markets to finance these projects is of great interest. While theoretical studies are split on whether diversification can be "value creating," the majority of empirical investigations provide evidence that diversification is "value destroying" in the sense that firm resources often flow *from* high-performing efficient divisions *to* low-performing inefficient divisions.

In this paper, we take a fresh look at this issue by utilizing a new and unique dataset – the Census Bureau's Annual Capital Expenditure Survey (ACES). The availability of detailed segment-level capital expenditure data in the ACES enables us to take a closer and more critical look at the investment behavior of diversified firms. Our primary objective is to develop a better understanding of the nature of the inefficiency in investment, if any. In other words, does diversification always result in capital misallocation, or are there circumstances under which internal capital markets operate efficiently?

Theoretical arguments on the benefits of internal capital markets mainly focus on the inability of the external capital market to adequately fund profitable investment projects. Stein (1997) argues that if diversified firms are credit constrained, because of pronounced information and agency problems, the headquarters of a diversified firm is in a position to channel resources to their best use within a company.[1] For example, since one division's cash flow can be used for investment by another division, if headquarters can correctly pick, and

[1] Similar arguments are made by Li and Li (1996) and Matsusaka and Nanda (1998).

fund, those projects with the highest returns, diversification is value creating. An implication of this argument is that a division's investment is not dependent on its own cash flow, but is dependent on the cash flow of the firm. Lamont (1997) provides evidence for this type of investment interdependence in the oil industry. He documents that a decline in the cash flow of the oil divisions of petroleum firms led to a fall in the investment of the non-oil divisions. The key question in terms of value creation, however, is whether internal capital markets are efficient. Do company headquarters make the right decisions and correctly allocate their scarce resources?

Recent empirical evidence says that they do not. Shin and Stulz (1998) document that a segment's investment is impacted by a decline in the cash flow of other segments regardless of the value of its investment opportunities,[2] which is inconsistent with internal capital markets operating efficiently. Scharfstein (1998) examines capital allocation in a sample of 165 diversified firms and finds that divisions with high q tend to invest less than their stand-alone industry peers do, while divisions with low q tend to invest more than their stand-alone peers do. Further, there is evidence that diversified firms tend to have a lower Tobin's q, and trade at discounts relative to a portfolio of comparable stand-alone firms.[3] While these findings are widely accepted, the precise mechanism through which diversification reduces firm value is still unsettled.

Theoretical models of internal capital markets generally explain the inefficient allocation of capital within diversified firms in the context of agency cost or influence cost models. In these models, the hierarchical process of capital allocation leads to the inefficient allocation of funds due to the actions of self-interested divisional managers. For instance,

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[2] Moreover, they find that segment investment depends significantly more on their own cash flow than on the cash flow of the firm's other segments.

rent-seeking behavior by division managers leads to the subsidization of weaker divisions by stronger ones, or "socialism" in internal capital allocation (Scharfstein and Stein, 1998). These firms short-change their better performing divisions by over-investing in poor performers.

As Rajan, Servaes, and Zingales (RSZ, 2000) point out, however, it is often difficult to reconcile these models with the observed resource misallocation by diversified firms. For example, while empire building behavior on the part of CEOs can reasonably explain general overinvestment, it is not clear how this leads to firm resources systematically flowing from high *q* to low *q* divisions. RSZ (2000), instead, propose a model where internal power struggles distort firm decision-making. Division managers have the option of investing in "efficient" or "defensive" investment opportunities. Since the ex-post surplus generated by an efficient investment is available to all other divisions, if headquarters does not provide sufficient safeguards to allocate the surplus then the division manager has no incentive to invest efficiently. In this model, capital transfers to divisions with weak opportunities are optimal, because it leads to increased cooperation in joint production. A further implication is that division managers in highly diversified, relative to less diversified, firms tend to choose defensive investments over efficient investments leading to investment distortions, and therefore, less valuable firms.[4] Specifically, the model predicts a "U-shaped" relationship between diversity and efficient capital allocation. Thus, firms with very low, and very high, levels of diversity efficiently allocate capital. Using Compustat data from 1980 to 1993, RSZ

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[3] See Lang and Stulz (1994) and Berger and Ofek (1995).

[4] Wulf (2005) develops a model of influence activity and signal distortion by division managers in which headquarters relies both on private and public information from division managers in the ex-ante capital allocation process. Managers of large divisions, due to their influence on headquarters, are better able to distort private information. This model can be viewed in the context of the RSZ (2000) model, where the ability to influence equates with the power or strength of divisional managers.

(2000) find evidence consistent with their hypothesis. In that, to the extent that there is cross-subsidization (misallocation of capital) it is mainly found in large and well-diversified firms.

The focus of much of the existing empirical literature has, rightly, been on establishing whether or not diversification leads to the internal misallocation of capital. The question we ask in this paper, however, is slightly deeper. Does the *type* of investment matter for the efficiency of internal capital allocation?[5] In other words, are there circumstances under which headquarters will make the "correct" decision, or does diversity always result in a misallocation?

By using both the ACES data and the updated (1998-2004) COMPUSTAT segment-level data, we first reinforce the findings of RSZ (2000).[6] The efficiency of investment, as measured by the value of the firm, is negatively related to diversity. This result is robust across datasets and methods of segmentation. Further, since ACES differentiates between investment in equipment and in structures, we investigate whether the inefficiency is specific to a particular type of capital. Interestingly, we find that while diversity has a negative effect on the efficiency of investment in equipment, it has a positive effect on the efficiency of investment in structures. Implying that diversity is "value destroying" in equipment, but "value creating" in structures. This is intriguing because it says that when making bigger and longer-term decisions, headquarters are, in a sense, more careful, and, as a result, correctly allocate their resources.

The rest of the paper proceeds as follows. We discuss the data and empirical methodology in section 2. Section 3 documents the impact of diversity on the efficiency of

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[5] This, of course, requires that we first establish that diversification results in the inefficient capital allocation.
[6] While our results do differ slightly from RSZ (2000), as will be explained in section 3, this is mainly a function of the sample period.

internal capital allocation and firm value. In section 4, we offer a few possible explanations for the results. Section 5 concludes.

2. Data

Section 2.1 provides a discussion of the segment-level data. We present some basic summary statistics in section 2.2.

2.1. Segment-level data

Our segment data come from two sources. Balance sheet information is drawn from COMPUSTAT. Specifically, we rely on the updated segment-level data available since 1997. Prior to this time, the Statement of Financial Accounting Standards 14 (SFAS 14) only required public companies to break down their activities into major lines of business representing more that 10% of consolidated sales, profits, or assets. This segmentation, however, was not quite an accurate reflection of a firm's own internal organization of activities. In 1997, the Financial Accounting Standards Board (FASB) issued SFAS 131. SFAS 131 requires firms to break down lines of business segmentation based on operating segments.[7] As a result, the updated guidelines better aligns with management's own internal organization of business activities for the purposes of allocating capital.

We augment the balance-sheet data with segment-level capital expenditure data from the Annual Capital Expenditure Survey (ACES) available from the Census Bureau. The ACES data provides detailed and timely information on capital investment in new and used

[7] See Berger and Hann (2002).

structures and equipment by non-farm businesses. Among the data items collected are equipment and structures (new and used), capitalized software, and capital leases. The survey is based on a sample of approximately 46,000 companies with employees and 15,000 companies without employees. For employer firms, the data are collected at the firm and industry level, while for non-employer firms the data are collected only at the firm level. All data collected represent domestic operations. The micro data are confidential. To achieve comparability between the two datasets across the classification systems, we limit our sample to 1998-2004.[8]

In keeping with RSZ (2000), we exclude from our sample, firms with substantial activity in finance and insurance. That is, if the sum of capital expenditures reported by the finance and insurance divisions (1997 ICC 52) of a firm in a given year comprises more than 15% of the firm's total capital expenditures, then the firm is dropped from the sample for that year. We reason that finance and insurance companies rely much more on intangible assets than tangible assets in their operations. Since q is the inverse function of tangible assets, companies with disproportionately high intangible assets would have disproportionately high q values. Further, in regressions using the matched dataset between COMPUSTAT and ACES, we exclude firms that are mismatched by at least 15% in total firm capital expenditures. Among the many reasons for the mismatch[9] is that ACES covers domestic operations only, while COMPUSTAT covers worldwide operations.

2.2. Summary statistics

[8] The Appendix contains a detailed discussion about the datasets and the construction of the sample.
[9] The appendix contains a discussion of the mismatches between COMPUSTAT and ACES.

To test for the efficiency of internal capital allocation we need to construct measures of inter-segment transfers, diversity, and value. Because we base our empirical approach on RSZ (2000), we also rely on their variable definitions.[10] Specifically, we define transfers as the adjusted investment ratio of each segment. We use the median of Tobin's *q* of stand-alone firms operating in the segment's industry as a proxy for segment investment opportunities,[11] and define diversity (*DIVERSITY*) as the dispersion in weighted opportunities. We also construct four measures of value: the relative value added by allocation (*RV*), the absolute value added by allocation (*AV*), and two variations of the excess value measure introduced by Lang and Stulz (1994) (*EVQ* and *EVM*).

We also specify several control variables. Following Lang and Stulz (1994), and Berger and Ofek (1995) we construct two measures of corporate focus. The first is simply the number of segments (*SEGMENTS*), while the second measures focus by the Herfindahl index (*HERFINDAHL*) of segment asset size. Debt ratio (*DEBT*) is the (book) value of long-term debt divided by total assets, investment size (*INVSIZE*) is measured by the amount of the investment divided by total assets, and firm size (*SIZE*) is simply defined as the logarithm of firm sales. Finally, following Lang, et al (1991) we define free cash flow as operating income before depreciation minus interest expense, taxes, preferred dividends, and common dividends divided by total assets.

Table 1 presents some basic summary statistics comparing single-segment with multi-segment firms. The summary statistics reveal that firm size across the single segment and

[10] Detailed descriptions of all variables are included in the Appendix.
[11] The use of industry *q* as a proxy for investment opportunities has drawn criticism (see Villalonga, 2004, Campa and Kedia, 2002, Maksimovic and Phillips, 2002, Whited, 2001, and Chevalier, 2000). While we acknowledge that the approximation is not ideal, to be consistent with much of the existing literature, throughout the paper we use *q* as a proxy for opportunities.

multi segment first are relatively the same (6.5 versus 7.3). Tobin's q for single segment firms is significantly larger than those for multiple segment firms (7.1 versus 4.9).

3. Results

In this section, we test the proposition that diversity adversely affects a firm's value. We base our methodology on RSZ (2000). In section 3.1, we test for the effect of diversity on firm transfers. In section 3.2, we examine the effect of diversity on the value of the firm.

3.1. Segment transfers and diversity

We begin by assessing whether diversity in investment opportunities has any effect on the flow of firm transfers. In table 2, we present calculations of the segment investment ratio, the industry adjusted investment ratio, and the firm and industry adjusted investment ratio (our proxy for transfers) for both high-*q* and low-*q* industries. Looking at the investment ratio, we see that low *q* segments in diversified firms receive transfers, on average, while high *q* segments make them (-0.013 versus 0.054). Interestingly, after adjusting for the industry level of investment, we find that diversified firms actually invest *less* than single-segment firms in both high *q* and low *q* segments (-0.216 and -0.096, respectively). Even after further correcting for the average firm level of investment (-0.085 and -0.075) we find that stand-alone firms invest more. This is surprising since we expect investment to be increasing with diversification.[12]

[12] Models on both sides of the diversification debate predict increased investment with increased diversification. Supporters argue that diversification is efficiency improving because internal capital markets provide the

The critical issue, however, concerns the efficiency of these transfers. Just focusing on the differences, it is evident that diversified firms invest less as fraction of assets in segments with poor opportunities than in segments with good opportunities. Thus, we have some informal evidence against the Efficient Markets Hypothesis, which predicts that diversified firms should channel funds to segments with good opportunities.

We next test the main implications of RSZ's (2000) model of internal capital allocation, by examining the relationship between diversity and the efficiency of transfers between divisions. The model is very precise in that it makes clear that it is not opportunities that matter, so much as size-weighted opportunities. We, therefore, place segments into one of four categories, depending on whether segment asset-weighted opportunities are above, or below the firm average, and whether segment *q* is above, or below the firm average. For each category, we calculate the weighted sum of transfers across segments. This is the dependent variable. The explanatory variables include diversity and the inverse of average *q*, which, following RSZ (2000), proxies for investment opportunities. Further, the regressions include a constant, a proxy for firm size, firm fixed effects, and calendar-year dummies.[13] For each of the four sub-samples, we estimate the following with OLS:[14]

$$Transfers_{it} = \alpha + \beta_1 InverseQ_{it} + \beta_2 Diversity_{it} + \beta_3 Size_{it} + \delta_1 FirmD + \delta_2 YearD + \varepsilon \quad (1)$$

Table 3, panel A, summarizes the results. If the model's predictions are correct, the coefficient on diversity should be negative in columns 1 and 3, and positive in columns 2 and

opportunity to fund profitable projects that single-segment firms, due to external financing constraints, cannot. On the other hand, if headquarters is not careful, this re-allocation is simply an inefficient overinvestment.

[13] The firm fixed effects control for unobserved heterogeneity, such as cross-sectional differences in organizational structure or segment reporting, provided these firm characteristics are (fairly) stable over time.

4. If, on the other hand, the Efficient Markets Hypothesis is true, it should be the case that the coefficient on diversity is positive in columns 1 and 2, and negative in columns 3 and 4. From the point of view of either theory, the estimation results are problematic. With the exception of the results in column 2, we find that diversity has a positive (and significant) effect on transfers regardless of segment opportunities, size-weighted or otherwise. This holds across both the COMPUSTAT and ACES datasets. This implies that, on average, an increase in diversity results in increasing flows of capital to all segments, which is inconsistent with both theories.

Even if we control for differences in firm focus, as measured by the Herfindahl index for segment size, variation in investment opportunities across segments, and variation in size across segments, the coefficient on diversity remains positive (and significant). These results are presented in table 3, panels B, C, and D. In fact, the Herfindahl index is positive in only two of the four equations, and in only of these two cases, does it have the "right" sign. For instance, column 1 predicts that as firms increase focus, transfers move out of segments with above average opportunities. The coefficient of variation of investment opportunities and size, on the other hand, are never significant.

There are two possible reasons why our results deviate from RSZ (2000). First, our sample period differs. Their sample begins in 1979 and ends in 1993. Our sample begins in 1998 and ends in 2004. In addition to being much shorter, our sample covers the end of a major investment boom in the U.S. economy. Doms (2004) finds that much of this "overinvestment" was led primarily by increases in IT investment. Thus, internal transfers to fund investment, regardless of opportunities, were increasing for all firms during this period.

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[14] If a firm does not a have a segment in a particular group, we drop the observation.

Second, our firm universe differs. Because we construct one consistent firm universe from both COMPUSTAT and ACES, we do not include a significant number of firms that RSZ (2000) include in their sample. We test for this by repeating the exercise above with the complete COMPUSTAT universe of firms. The results are available upon request.

3.2. The efficiency of transfers

We have, thus far established that firm transfers, regardless of investment opportunities, increase with diversity. It is also true, however, that this tells us nothing of the efficiency of the internal capital market. It could be that the net effect of these transfers is positive. In fact, this really is the key question – does diversification decrease value?

To determine whether inefficiencies in the internal allocation of capital lead to a reduction in firm value we examine how the value of a firm is affected by its diversity and size. Moreover, we are interested in the source of this inefficiency, if any. In addition to a measure of firm value and diversity, our regressions include a measure of the availability of investment opportunities, firm fixed effects, and calendar year dummies. We, thus, estimate the following equation with OLS:

$$Value_{it} = \alpha + \beta_1 InverseQ_{it} + \beta_2 Diversity_{it} + \beta_3 Size_{it} + \delta_1 FirmD + \delta_2 YearD + \varepsilon \qquad (2)$$

We consider four different measures of $Value_{it}$ (relative value (*RV*), added value (*AV*), excess value using segment *q* (*EVQ*), and excess value using the market-to-sales ratio (*EVM*)) over firm *i* and calendar year *t*. The calculated standard errors are robust to heteroskedasticity and autocorrelation (HAC standard errors). The regression results using relative value (*RV*), added value (*AV*), and excess value (*EVQ* and *EVM*) as measures of investment efficiency are presented in tables 2, 3, and 4, respectively. It is important to note that the dependent variables represent the *efficiency* of investment. A negative coefficient on diversity, therefore, implies that increasing diversity is associated with less efficient internal capital allocation decisions. The results in column 1, of tables 2 and 3 are based on COMPUSTAT, while the results in columns 2-4 are based on the ACES. Specifically, in column 2, our measures of firm capital are based on total capital expenditures, while in columns 3 and 4 we limit attention to expenditures on equipment and expenditures on structures, respectively.

If we focus on the overall efficiency of internal capital allocation (columns 1 and 2 of tables 2 and 3, and both columns of table 4) it is clear that increased diversity means decreased efficiency. This reinforces the empirical findings of RSZ (2000). While they worried that perhaps their data did not accurately reflect the true segmentation of a firm, we find that their results are quite robust. All estimated coefficients on diversity are negative and, with the exception of the excess value (market-to-sales) regression, significant. Moreover, whether we use COMPUSTAT or the ACES data, the estimates are nearly identical. In addition, we find that, in general, size negatively (though not always significantly) impacts efficiency, which is consistent with the model developed by Wulf (2005).

While these estimates confirm that greater firm diversity results in the inefficient internal allocation of capital, that is all they tell us. By using the ACES data, however, we can get a better idea about the source of this measured inefficiency. Columns 3 and 4 of tables 2 and 3 present the results for the efficiency of investment in equipment and structures.

In these regressions, we measure value in terms of the allocation of structures and equipment. Interestingly, we find that, while diversity is negatively related to equipment investment, it is positively related to structure investment. This implies that the measured inefficiency in total capital allocation is primarily driven by investment in equipment. To summarize the findings to this point, the efficiency of investment, as measured by the value of the firm, is negatively related to diversity. This misallocation of resources does not apply to all types of capital, however. While equipment is inefficiently allocated across divisions, structures are not.

If we assume equipment is relatively more segment-specific then structures, which is reasonable, these results are consistent with RSZ (2000). In their model, divisions prefer "defensive" to "efficient" investments as diversity increases. A defensive investment offers lower returns, but has an advantage over the efficient investment in that it is less likely to be poached by another division. Clearly, more specific investments are easier to protect.[15] Headquarters is well aware of the impact of diversity on incentives, and reallocates resources across divisions in an effort to reduce the disparity in investment opportunities. Thus, the ultimate impact of increased diversity is that it forces headquarters to misallocate resources from high to low resource-weighted divisions.

It should be noted, however, that at extremely high levels of diversity this equalization mechanism breaks down. The opportunity cost of reallocation is greater than the gain from improved incentives. We should expect then, that firms with very low and very high levels of diversity are relatively more efficient then firms in the middle of the diversity spectrum. If our supposition about the specificity of investment holds true, then it should be the case that firms on either end of the diversity spectrum are intensive in structure-

[15] In this case, the excess specialization associated with the segment-specific project results in returns that are lower relative to those offered by the general project. See Shleifer and Vishny (1989) for more details.

investment. Figure 1 graphs the percent of investment in structures as a function of the level of firm diversity. The "u-shaped" relationship further reinforces the finding that inefficient capital expenditure is being driven by firms with high capital expenditures in equipment.

4. Interpretation of Results

Understanding exactly what happens during the process of internal capital allocation is a difficult question to answer. We believe, however, that some important lessons can be learned from the results presented in this paper. Our findings support the argument made by RSZ (2000). In their model, inefficiencies in resource allocation are driven by differences in resources and investment opportunities across the firm. We find evidence that this inefficiency takes the form of equipment-investment. The question then arises as to why diversified firms inefficiently allocate funds for equipment, but efficiently allocate funds for structures. We have made the claim that this is due to the relative specificity of equipment versus structures. In this section, we discuss some additional possibilities.

4.1. Duration and financing

There are many lines of reasoning in the managerial incentive literature as to why we observe distortions in investment decisions. Below we briefly summarize a few of these arguments, and then discuss their relevance, or lack of, to our empirical findings.

Duration One obvious difference between structures and equipment is that structures are the result of long-term decisions. For instance, Del Boca et al. (2005) establish that while there are significant time-to-build effects for structures, there is none for equipment.[16] Thus, is it possible for differences in the duration of structure-investment, relative to equipment-investment, to explain why diversified firms efficiently allocate structures but not equipment? In other words, why do diversified firms follow a socialism strategy in the short-run, but not the long-run?

The managerial incentive literature provides a variety of arguments as to why long-run investment decisions are subject to significant distortions. Most prominent are arguments that center on short-term managerial objectives and imperfect information.[17] In these models, when managers have private information regarding their decisions, they have an incentive to behave sub optimally – they work for short-term profits at the expense of the long-term interests of the firm. The observable ramification of this behavior is an underinvestment in long-run projects. [18] Although reconciling these results with our empirical findings requires slightly "shifting" the question from one of an underinvestment in structures, to one of an overinvestment in equipment, the real issue is whether investing in equipment increases earnings more than investing in structures. And, in this regard, it is quite clear that long-term investment projects, such as structures, have distant cash flows. Thus, divisional managers may have an incentive to lobby for short-run investment (in equipment), at the expense of long-run projects with uncertain and distant returns. This argument is not wholly satisfying, however, as it implies that all firm-segments should prefer short-run to long-run investments. How does this imply a systematic flow of resources from efficient to inefficient segments?

[16] Their estimates indicate that, while structures require two to three years from initial planning to final completion, equipment is in place and productive within one year.
[17] See Narayanan (1985), Stein (1989), and Shleifer and Vishny (1990).
[18] In contrast, Bebchuk and Stole (1993) argue that imperfect information and an emphasis on short-term valuation can lead to either an over- or an underinvestment in long-run projects. Underinvestment results when investors cannot observe the level of investment in long-run projects. If investors can observe the level of long-

Financing Many researchers have also focused on the relationship between distortions in investment decisions and the financing of investments. The availability of internal funds, the duration of debt, and project size have all been considered. For instance, conventional wisdom holds that as the availability of internal funds increases, so does overinvestment, as external funds serve as a disciplining device. Similarly, since "major" investment projects, such as structures, are often financed externally, we would expect less distortion regarding these types of decisions. Finally, it may be that long-term projects, financed with long-term debt, are subject to relatively more risk, inducing headquarters to be more careful about their allocation.

While interesting, it is difficult to reconcile any of these arguments with our empirical findings. As we discuss in the introduction, these theories can explain general overinvestment, but they cannot explain why resources in diversified firms flow from segments with good opportunities to segments with poor opportunities. In other words, these arguments are compelling for inefficiencies on the firm-level, but much less so for inefficiencies on the segment-level. Moreover, to apply these theories to segment-level flows, it is necessary to separate firm financing from segment financing. It is not clear what the correct way to go about this would be, or if it is even feasible.

4.2. Capital complementarity

Time-to-build models of the business cycle emphasize the long-run aspect of investment projects, particularly in explaining the propagation of shocks. In an effort to

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run investment, however, but cannot perfectly observe the returns to the project, overinvestment may occur (as a signal to investors that the firm is valuable).

enhance the propagation mechanism in these models, some researchers incorporate heterogeneous capital. The general idea is that structures and equipment are complements, in that completed structures require equipment to be productive. The primary ramification of this link between equipment and structures is the increased persistence of cycles. [19] In our case, however, we are interested in whether the complementary relationship can explain the observed misallocation of equipment in diversified firms.

An implication of capital complementarity is that the flow of spending within a firm should be tied to particular capital projects, and not necessarily segment *q*. For instance, suppose a segment is cleared to begin construction on a factory. For that factory to be productive, further investments in (smaller structures and) equipment must follow. Thus, the allocation of equipment is dependent on the timeframe of the larger project. As the factory nears completion, we would expect the flow of resources to that division to increase as well. Therefore, it is possible that the "correct" decision regarding structures will lead to an "incorrect" decision about equipment. This is because equipment investment is timed to coincide with the completion of that structure.

Testing for this would require detailed information about the flow of resources across firm segments. It should be the case that spending patterns for (some) capital projects are interconnected. Secondly, the results for smaller structures should be similar to those found for equipment. Unfortunately, we do not have the necessary data for such tests.

5. Conclusion

[19] Kydland and Prescott (1982) is, of course, the seminal work on time-to-build models. For further discussion on the business cycle ramifications of capital complementarity see, for example, Christiano and Todd (1995), Montgomery (1995), and Casares (2006).

The motivations for this paper were twofold: (1) determine the robustness of the established empirical finding that greater firm diversity results in the inefficient internal allocation of capital, and (2) add value to the debate surrounding the efficiency of internal capital markets. Using both COMPUSTAT and the ACES, we confirm that firm diversity is negatively related to the efficiency of investment. This holds for various definitions of efficiency, methods of segmentation, and data sets. Thus, consistent with much of the existing empirical literature, we find that diversification reduces firm value.

The primary contribution of this paper, however, is that we are able to provide a clearer link between diversification and capital allocation. We provide evidence that while firms do inefficiently allocate equipment, they efficiently allocate structures. Implying that diversity is “value destroying” in equipment, but “value creating” in structures. We argue that this is consistent with the framework developed by RSZ (2000). While perhaps our empirical results do not provide definitive answers about the exact source of the inefficiency, they do help in refining our thinking about the issue. Under what circumstances can we expect headquarters to make the “right” decision? When the decision will have long-lasting, non-specific repercussions, headquarters will, more often than not, make the correct choice.

6. Appendix

In this section, we provide more information about our data sources, in section 6.1, and the variables used, in section 6.2.

6.1. Data sources

Our data come from two sources: COMPUSTAT and the Annual Capital Expenditure Survey (ACES). Balance sheet data is drawn from COMPUSTAT, while ACES provides segment-level capital expenditure data. The ACES is maintained by the Census Bureau, and provides detailed information on capital investment by non-farm businesses. Among the data items collected are equipment and structures (new and used), capitalized software, and capital leases. The survey is based on a sample of approximately 46,000 companies with employees and 15,000 companies without employees. For employer firms, the data are collected at the firm level, as well as the industry level. Additionally, beginning in 1998, sampled firms are required to provide disaggregated data on capital expenditures for various types of equipment and structures by industry every five years. The granularity of the data plays a significant role in the national accounting of investment. The Bureau of Economic Analysis uses the annual data as a benchmark for its estimates of nonresidential fixed investment (NRFI). The BEA also uses the quin-quennial asset-type detail as a benchmark for its capital stock tables. For non-employer firms, the data are collected only at the firm level. All data collected represent domestic operations of companies. The micro data are confidential and are protected by Title 13 and 26 of the U.S. Code.

ACES industry categories (ICC) are based on both the Standard Industrial Classification (SIC) system and the North American Industry Classification System (NAICS). Prior to the 1999 survey year, ACES ICCs were constructed from two-digit, and selected three-digit industries from the 1987 SIC system. From 1999-2003, ACES ICCs were constructed from three-digit and selected four-digit industries from the 1997 NAICS. Beginning in 2004, ACES ICCs have been based on the 2002 NAICS. COMPUSTAT, on the other hand, is based solely on the SIC system.

To achieve comparability between the two datasets across the classification systems, we limit our sample to 1998-2004. This helps to ensure that most companies in our sample follow the reporting standards set forth in SFAS 131. In addition, we convert all data to a 1997 NAICS basis when applicable, using the conversions in table A.1. For example, the COMPUSTAT data are first converted into 1987 SIC based ICCs, and then into 1997 NAICS based ICCs. Similarly, the 2004 and pre-1999 ACES data are also converted into 1997 NAICS based ICCs. We then merge the ACES and COMPUSTAT datasets for each year, firm, and ICC.

The possible relationships of the SIC based ICCs (and 2002 NAICS based ICCs) to the 1997 NAICS based ICCs are: 1) one-to-one, 2) one-to-many, 3) many-to-one, and 4) many-to-many.[20] The one-to-one cases were straightforward and were kept them in the dataset. The one-to-many cases (e.g. one SIC to many ICCs) were dealt with by evaluating their contribution to the firms' total capital expenditures. For example, capital expenditures

[20] Conversion tables are available upon request.

reported in 1987 ICC 289 map to 1997 ICCs 3251, 3259, and 3313. If capital expenditures in ICC 289 are not greater than 15% of the firm's capital expenditures, then only this industry is dropped from the dataset (the rest of the industries in the firm are kept). Otherwise, if ICC 289 represents more than 15% of firm capital expenditures, then the whole firm is dropped. If there are multiple ICCs with one-to-many conversions within a given firm, then all of their capital expenditures are summed up and the 15% rule is applied to that sum. Finally, all the many-to-one (SICs to ICC) cases were kept, while all the many-to-many cases were dropped.

In addition to these conversion issues, mismatches between ACES and COMPUSTAT also arise because of the domestic versus global reporting issue, mentioned in section 2, and because capital expenditures in COMPUSTAT are extracted solely from the cash flows statement (hence, giving only cash transactions). Capital expenditures in ACES can come from cash and non-cash transactions. For example, if a company finances a depreciable asset with debt (whether partially or entirely), the present value of the entire asset is reported to ACES, whereas only the cash portion of the expenditure would be reported in COMPUSTAT.

6.2. Variable definitions

Our variable definitions closely follow RSZ (2000). Below we provide a full listing and description of the variables used.

- Firm size (*SIZE*) = logarithm of sales
- *S* = value of sales
- Book value of assets (*BVA*) = gross property, plant and equipment - accumulated depreciation
- Book value of segment assets (BVA_j) = segment assets - segment depreciation
- Market value of assets (*MVA*) = gross property, plant, and equipment
- Market value of firm (*MVF*) = common stock + preferred stock + long-term debt
- Replacement value (*RVA*)[21] = total assets + net plant at replacement value - net plant at historical value + inventories at replacement value - inventories at historical value
- Tobin's *q* (*Q*) $= \dfrac{MVF}{RVA}$
- Segment-level *q* for multi-segment firms (Q_j) = average *q* in single-segment firms that operate in the same industry as the segment
- Segment book value of assets (BVA_j) = segment assets - segment depreciation
- Segment *j*'s share of total firm assets (w_j) $= \dfrac{\text{segment assets}}{\text{total firm assets}}$
- Capital expenditures of segment *j* (I_j)[22]
- Investment efficiency

[21] Although Lindberg and Ross's (1981) definition of replacement value is theoretically closer to that of Tobin's, companies are no longer required to report replacement cost data. Without this information, we used the depreciated book value of tangible assets (net property, plant, and equipment) as a proxy for replacement cost, as was done in Demsetz and Villalonga (2001).

[22] In regressions involving only data from COMPUSTAT, we use the segment capital expenditures field. In the combined COMPUSTAT and ACES dataset, we use segment-level total, equipment, and structures capital expenditures in separate regressions.

- Relative value added by allocation (*RV*)[23]

$$= \frac{\sum_{j=1}^{n} BVA_j \left(Q_j - \bar{Q}\right)\left(\frac{I_j}{BVA_j} - \frac{I_j^{ss}}{BVA_j^{ss}} - \sum_{j=1}^{n} w_j \left(\frac{I_j}{BVA_j} - \frac{I_j^{ss}}{BVA_j^{ss}}\right)\right)}{BVA}$$

- Absolute value added by allocation (*AV*)

$$= \frac{\sum_{j=1}^{n} BVA_j \left(Q_j - 1\right)\left(\frac{I_j}{BVA_j} - \frac{I_j^{ss}}{BVA_j^{ss}}\right)}{BVA}$$

- Excess value using segment *q*

$$EVQ = \frac{MVA}{RVA} - \sum_{j=1}^{n} Q_j \frac{BVA_j}{BVA}$$

- Excess value using the market-to-sales ratio

$$EVM = \frac{MVA}{S} - \sum_{j=1}^{n} \left(\frac{MVA}{S}\right)_j^{ss} \frac{S_j}{S}$$

We also construct four measures of investment efficiency: measures of the value added by diversification, relative value added by allocation (*RV*) and absolute value added by allocation (*AV*), and measures, based on the excess-value measure of Lang and Stulz (1994), of the relative value added by diversification. One excess value measure is calculated using segment *q* (*EVQ*) and the other is calculated using the market-to-sales ratio (*EVM*).

We also specify several control variables. Following Lang and Stulz (1994), and Berger and Ofek (1995) we construct two measures of corporate focus. The first is simply the number of segments (*SEGMENTS*), while the second measures focus by the Herfindahl index (*HERFINDAHL*) of segment asset size. Debt ratio (*DEBT*) is the (book) value of long-term debt divided by total assets, investment size (*INVSIZE*) is measured by the amount of the investment divided by total assets, and firm size (*SIZE*) is simply defined as the logarithm of firm sales. Finally, following Lang, et al (1991) we define free cash flow as operating income before depreciation minus interest expense, taxes, preferred dividends, and common dividends divided by total assets.

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[23] Where *j* indicates a particular segment, *n* is the total number of segments, and superscript *ss* indicates single segment firms.

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Table 1: Summary Statistics

Variable	Single Segment Mean	Single Segment Median	Single Segment Std	Multiple Segment Mean	Multiple Segment Median	Multiple Segment Std	N
Tobin's *q*	7.181	4.00	8.146	4.945	2.497	5.803	953
Market-to-sales ratio	1.559	0.98	1.802	1.466	1.002	1.454	957
Average of segment *q*'s	9.857	4.51	18.869	6.028	2.601	10.263	961
Average of segment market-to-sales	1.937	1.08	3.851	1.579	1.101	2.027	965
Excess value (using *q*)	1.814	1.71	0.899	1.854	1.75	0.604	950
Excess value (using market-to-sales	0.075	0.00	0.520	0.251	0.077	0.75	950
Adjusted investment in segments (*q* > average *q*)	0.075	0.00	0.52	-0.218	-0.131	1.036	364
Adjusted investment in segments (*q* < average *q*)	0.075	0.00	0.520	-0.096	-0.076	0.159	388
Relative value (added by allocation)	0.00	0.00	0.00	-0.048	-0.004	0.659	931
Absolute value (added by allocation)	0.829	0.29	4.576	0.591	0.175	1.319	931
Std. deviation of segment *q*'s	6.188	1.45	24.284	2.856	0.668	10.39	961
Inverse of average *q*	0.380	0.25	0.405	0.445	0.401	0.304	953
Diverstiy	0.380	0.25	0.405	0.303	0.206	0.284	823
Number of segments	1.00	1.00	0.00	2.364	2	0.609	965
Herfindahl index of segment's size	0.998	1.00	0.030	0.664	0.648	0.174	931
Firm size	6.517	6.37	1.437	7.358	7.221	1.726	965
Coefficient of variation of segment *q*'s	0.385	0.32	0.263	0.278	0.212	0.232	961
Coefficient of variation of segment size	0.069	0.05	0.100	0.044	0.034	0.036	965

Notes:

Table 2: Allocation of Funds in a Diversified Firm

Measure of transfers	$q > \overline{q}$	$q < \overline{q}$	Difference
Investment ratio	-0.013	0.054	-0.066
Industry adjusted investment ratio	-0.216	-0.096	-0.120
Firm and industry adjusted investment ratio	-0.085	-0.075	-0.009
Number of Segments	366	489	

Note: Segments are defined to be low (high) *q* if the industry *q* for that segment is below (above) the asset-weighted *q* for the firm.

Table 3: Segment Investment and Diversity in Investment Opportunities (Total Investment)

	Adjusted Investment in Segments with							
	$q > \overline{q}$ $\lambda q > \lambda \overline{q}$		$q > \overline{q}$ $\lambda q < \lambda \overline{q}$		$q < \overline{q}$ $\lambda q > \lambda \overline{q}$		$q < \overline{q}$ $\lambda q < \lambda \overline{q}$	
	COMPUSTAT	ACES	COMPUSTAT	ACES	COMPUSTAT	ACES	COMPUSTAT	ACES
Panel A: Basic Specification								
Intercept	-0.08936***	0.00693	-0.03006	-0.55335	-0.10845***	-0.07533***	-0.03286	-0.04823
	(0.03374)	(0.048997)	(0.08998)	(0.52365)	(0.03098)	(0.02762)	(0.03654)	(0.03318)
Inverse Q	-0.02834	-0.01567	0.09026	0.84773	0.07986**	0.04886***	0.02925	0.02203
	(0.03123)	(0.036337)	(0.08869)	(0.76521)	(0.03072)	(0.01683)	(0.01985)	(0.02000)
Diversity	0.12612***	0.07273***	-0.11364*	-0.01233	0.09753**	0.04856*	0.08074***	0.06558***
	(0.01970)	(0.024057)	(0.06434)	(0.27454)	(0.03624)	(0.02789)	(0.01711)	(0.01768)
Firm size	-0.00186	-0.01002*	-0.01100	-0.00510	0.00811**	0.00629**	-0.00314	0.00100
	(0.00381)	(0.00586)	(0.00893)	(0.03007)	(0.00331)	(0.00301)	(0.00456)	(0.00396)
N	231	231	88	88	87	87	386	386
Log Likelihood	-411.373	-250.031	6.308	369.699	-195.300	-261.595	-400.631	-421.776
R^2								
Panel B: The Effect of Focus								
Intercept	0.00895	0.09567	0.14462	0.82830	-0.06165	-0.02950	-0.05089	-0.07479**
	(0.04530)	(0.06266)	(0.14132)	(1.08948)	(0.03984)	(0.03359)	(0.03664)	(0.03216)
Inverse Q	-0.00491	0.00547	0.08732	0.82447	0.08147**	0.05044***	0.02378	0.01397
	(0.02685)	(0.03189)	(0.08714)	(0.73685)	(0.02998)	(0.01597)	(0.02478)	(0.02452)
Diversity	0.14656***	0.09119***	-0.03893	0.57857	0.12718***	0.07761**	0.07657***	0.05945***
	(0.02116)	(0.02612)	(0.10771)	(0.82773)	(0.03571)	(0.02771)	(0.01541)	(0.01509)
Herfindahl index	-0.00002***	-0.00002***	-0.00003	-0.00021	-0.00001*	-0.00001**	0.00000	0.00001
	(0.00001)	(0.00001)	(0.00002)	(0.00022)	(0.00000)	(0.00000)	(0.00001)	(0.00001)
Firm size	-0.00107	-0.00931*	-0.01021	0.00116	0.00729**	0.00549*	-0.00331	0.00074
	(0.00344)	(0.00561)	(0.01083)	(0.04927)	(0.00329)	(0.00293)	(0.00459)	(0.00402)
N	231	231	88	88	87	87	386	386
Log Likelihood	-410.651	-236.373	23.772	383.327	-174.492	-242.161	-378.480	-400.579
R^2								

Panel C: The Effect of the Coefficient of Variation of Segment *q*								
Intercept	-0.08756**	-0.01214	-0.01697	-0.31618	-0.12550***	-0.08524***	-0.01630	-0.04025
	(0.03943)	(0.04899)	(0.07073)	(0.35807)	(0.03372)	(0.03006)	(0.04299)	(0.03563)
Inverse Q	-0.02939	-0.00453	0.08575	0.76602	0.08508**	0.05190***	0.02012	0.01763
	(0.03147)	(0.03713)	(0.08223)	(0.68011)	(0.03064)	(0.01744)	(0.02123)	(0.02093)
Diversity	0.12599***	0.07408***	-0.10913	0.06937	0.10345**	0.05201*	0.07965***	0.06506***
	(0.01958)	(0.02345)	(0.06991)	(0.33976)	(0.03721)	(0.02879)	(0.01702)	(0.01776)
Coeff. of	-0.00399	0.04211	-0.02145	-0.38856	0.03089	0.01795	-0.03585	-0.01728
variation (*q*)	(0.04990)	(0.05281)	(0.06341)	(0.48487)	(0.02133)	(0.01946)	(0.04179)	(0.03452)
Firm size	-0.00188	-0.00975*	-0.01178	-0.01918	0.00870**	0.00663**	-0.00346	0.00084
	(0.00387)	(0.00574)	(0.00847)	(0.03919)	(0.00322)	(0.00295)	(0.00469)	(0.00396)
N	231	231	88	88	87	87	386	386
Log Likelihood	-406.263	-246.537	8.918	367.847	-191.186	-256.450	-396.827	-417.005
R^2								

Panel D: The Effect of Variation of Segment Size								
Intercept	-0.08062**	0.00443	-0.05125	-0.87103	-0.13054***	-0.09326***	-0.03137	-0.04117
	(0.03220)	(0.05093)	(0.11308)	(0.84736)	(0.03637)	(0.03220)	(0.03718)	(0.02942)
Inverse Q	-0.03035	-0.01509	0.09275	0.88493	0.08489**	0.05295***	0.03175*	0.02406
	(0.03076)	(0.03517)	(0.09143)	(0.80376)	(0.03186)	(0.01795)	(0.01797)	(0.01755)
Diversity	0.12581***	0.07282***	-0.11356*	-0.01111	0.10364***	0.05353*	0.07285***	0.05859***
	(0.01953)	(0.02410)	(0.06564)	(0.28060)	(0.03697)	(0.02826)	(0.01575)	(0.01639)
Coeff. of	-0.13385	0.03836	0.22283	3.34030	0.21678	0.17594	0.02953	-0.00515
variation (size)	(0.18284)	(0.18214)	(0.47243)	(3.67286)	(0.20883)	(0.12719)	(0.18525)	(0.16155)
Firm size	-0.00212	-0.00995*	-0.00956	0.01645	0.00947***	0.00740**	-0.00300	0.00043
	(0.00370)	(0.00594)	(0.00922)	(0.03388)	(0.00336)	(0.00311)	(0.00404)	(0.00337)
N	231	231	88	88	87	87	386	386
Log Likelihood	-410.306	-249.116	5.049	363.922	-195.083	-261.014	-500.228	-525.559
R^2								

Table 4: Relative Value as a Function of Diversity and Size

	COMPUSTAT	ACES	ACES (Equipment)	ACES (Structures)
Intercept	0.00408	0.00481	0.00430	0.00051
	(0.00353)	(0.00349)	(0.00262)	(0.00145)
Inverse Q	-0.00091	-0.00031	0.00254	-0.00285
	(0.00153)	(0.00145)	(0.00243)	(0.00231)
Diversity	-0.00469***	-0.00451***	-0.00811**	0.00360
	(0.00138)	(0.00136)	(0.00385)	(0.00393)
Size	-0.00038	-0.00053	-0.00057*	0.00004
	(0.00037)	(0.00037)	(0.00031)	(0.00018)
Firm Dummies	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Log Likelihood	-5391	-5434	-4638	-4698
N	939	939	939	939

Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% (one-sided) level, respectively. Standard errors in brackets (robust standard errors).

Table 5: Added Value as a Function of Diversity and Size

	COMPUSTAT	ACES	ACES (Equipment)	ACES (Structures)
Intercept	-0.02272	-0.01055	-0.03951*	-0.00529
	(0.02006)	(0.01490)	(0.01382)	(0.00982)
Inverse Q	-0.01940*	-0.00482	0.02606***	-0.00836
	(0.01153)	(0.00792)	(0.00756)	(0.00586)
Diversity	-0.02299**	-0.01534**	-0.01404*	0.00887*
	(0.00961)	(0.00762)	(0.00750)	(0.00485)
Size	-0.00057	-0.00483**	-0.00193	-0.00166
	(0.00280)	(0.00157)	(0.00163)	(0.00128)
Firm Dummies	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Log Likelihood	-1126	-1183	-1777	-3074
N	939	939	939	939

Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% (one-sided) level, respectively. Standard errors in brackets (robust standard errors).

Table 6: Excess Value as a Function of Diversity and Size

	Using *q*	Using market-to-sales
	2.58949***	-0.31690**
Intercept	(0.23096)	(0.12185)
	-0.33354*	0.51429***
Inverse Q	(0.12820)	(0.09306)
	-0.21916*	-0.08375
Diversity	(0.11773)	(0.07546)
	-0.06721**	0.02612
Size	(0.02642)	(0.01837)
Firm Dummies	Yes	Yes
Year Dummies	Yes	Yes
Log Likelihood	1359	589
N	939	939

Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% (one-sided) level, respectively. Standard errors in brackets (robust standard errors).

Figure 1: Investment as a Percentage of Diversity