THE EFFECTS OF RELATIVE SIZE, PROFITABILITY, AND GROWTH ON CORPORATE CAPITAL ALLOCATIONS

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INTRODUCTION

Every year, corporations devote an enourmous amount of time and effort to strategic planning and resource allocation. At almost every organizational level, managers find themselves weighing a number of investment options, whether those options are single projects or entire businesses. Strategic management research has naturally acknowledged the connection between a firm's strategy and its investment decisions, especially at the corporate level. Recent developments in the resource-based view and dynamic capabilities traditions have brought a renewed interest in the impact of allocation processes on the firm's competitive advantage as well as in the potential inefficiencies that might arise in those processes (Teece, 2009; Helfat et al., 2007; Coen & Maritan, 2011; Maritan, 2001; Berry, 2010).

One aspect of those investment processes that has been relatively ignored is the fact that corporate resource allocation, especially in organizations that are large and diversified, is done in relative rather than absolute terms. This means that executives, rather than focusing their attention on one investment proposal at a time and assessing its absolute value according to a number of financial and strategic criteria, are often deciding whether a proposal merits approval over other options or whether a business unit deserves a higher (or lower) allocation than the others (Bower, 1970; Gilbert & Bower, 2005). Such comparisons are facilitated by the way the process is conducted, as companies generally follow standard annual procedures to develop and assess investment projects, procedures that end up with a number of those proposals being jointly analyzed in an allocation or budgeting committee meetings (Gilbert & Bower, 2005).[1] In a large multi-business corporation, that "environment of decision" (Barnard, 1938) can become exceedingly complex to any single decision-maker, thus forcing her attention to focus on a limited set of stimuli while ignoring others (Ocasio, 1997).

Especially at high levels of granularity, executives simply do not have the time and the knowledge to analyze a business in all its dimensions, which leads them to rely on comparisons along a reduced set of variables (e.g., profitability and growth).

Among those variables two particular sets stand out. First, executives tend to be influenced by the relationships among individual businesses within an organization (March & Simon, 1958; Vissa, Greve & Chen, 2010; Baum & Ingram, 2002; Banaszak-Holl et al., 2006). Second, allocators tend to be influenced by a few relative qualities of the investment options such as past performance or future prospects. For instance, several studies (Ozbas & Scharfstein, 2010; Billet & Mauer, 2003; Berger & Ofek, 1995) have uncovered a tendency to subsidize divisions with poor investment prospects by taking away capital from divisions with good investment prospects. More recently, Coen and Maritan (2011) posit that investment in a particular business will be driven not only by its set of future opportunities but also by the asset endowment that the business has accumulated over time and Arrfelt, Wiseman and Hult (2013) find that business units that underperform relative to others tend to receive more managerial attention and investment.

Our study aims at increasing the understanding of how relative comparisons among different segments of the same firm impact resource allocation decisions. In this case, we focus on one characteristic that has often been overlooked as a driver for strategic decisions, namely, the size of a business unit, both in absolute and, especially, in relative terms. Moreover, and since past literature has theorized and empirically explored the effect on investment of various measures of segment "quality" such as Tobin's Q (Stein, 2003; Ozbas & Scharfstein, 2010), profitability (Arrfelt et al., 2013; Bardolet, Lovallo & Rumelt, 2010) and growth (Bardolet et al., 2010), we study the interaction of segment's size and its past growth and profitability.

Size is an interesting and useful metric to study for a number of reasons. First, it is easily measurable, much more so than other characteristics. For example, the use in the cross-subsidization studies of Tobin's Q as a measure of the businesses' quality of prospects has raised some methodological issues (Whited, 2001; Villalonga, 2004), as one could suggest that the median Q in each business' industry constitues a poor approximation to the real value of that business' prospects. Size, on the other hand, can be measured by accurate proxies such as assets or sales. Second, size is also a variable that is easily perceived by the firm's executives. While the quality of a particular business can be subject to endless discussions based on multiple factors and thus be assessed quite differently by managers in the same organization, the size of a business unit is perceived with relatively little noise. Finally, the size of a business unit or a segment is a variable that can be manipulated by the company, there is room for increasing it—for example, by merging divisions or adding assets to any of them—or decreasing it—for example, by spinning off or divesting some parts of a company.

In this study, we first analyze data from a cross-section of multi-business firms to investigate contradicting hypotheses about the effect of segment relative size on allocations. On one hand, Bardolet, Fox and Lovallo (2011) find evidence of naive diversification in corporate allocations, that is, a tendency toward spreading investment equally among the N segments of a firm, suggesting that managers are relatively insensitive to segments' differentiating factors. If that insensitivity extends to segment size, it would drive managers to allocate disproportionately more capital to the smaller units within the firm, after controlling for the other factors. On the other hand, studies of resource allocation have also documented how agency conflicts and political influence can affect segment investment. For instance, studies on the power balances among organizational units (Duchin & Sosyura, 2013; Glaser, Lopez de Silanes & Sautner, 2013; Kim, Hoskisson & Wan, 2004; Hackman, 1985) have shown that powerful units are able to attract more resources relative to the other units. However, those studies tend to define power as corporate governance relations (units with most directors in the keiretsu firm, share ownership, etc.) and only indirectly as correlated with the size of the business (Hackman, 1985). [2] We speculate, as a logical extension of this power hypothesis, that segments with greater relative size, in terms of sales or assets, have more political power and thus are able to attract greater normalized capital investment. This hypothesis directly contradicts the naive diversification account and thus, it becomes important to compare them when investigating their combined role in how segment size affects resource allocation.

We find the combination of the cognitive and the political effects to be quite complex and non-linear. In particular, we find that, holding everything else constant, segment capital expenditures, normalized by sales, increase with the relative size of the segment, which lends support to the power hypothesis. However, the smallest (in relative terms) segments in our sample receive proportionally more capital than other businesses in the multi-business firm. Interestingly, this effect exists after controlling for the absolute size of the units, so it cannot be attributed to a simple consequence of a small denominator when we use capital expenditures over sales as our measure of investment. Previous literature has neither controlled for absolute size nor examined the differential effect of relative size at the opposite extreme ends of the distribution.We obtain quite robust results for this non-linear relationship using both regression analysis and treatment effects from pairwise matching. Therefore, while an initial result of our paper is that we cannot “replicate” Bardolet et al.’s (2011) naive diversification finding with our data, *if we control for absolute size*, our results suggests that concentrating on a general effect of relative size is largely missing the trees for the forest. [3] The bottom 10% of relative size segments drive the previously observed negative correlation between relative size and investment. For the other 90%, relative size is *positively* associated with normalized capital investment.

On the other hand, executives often rely on measures like past growth and profitability to help them make allocation decisions over the company's businesses (Graham & Harvey, 2001). In fact, these measures have traditionally played a large role in assessing the corporate portfolio of businesses. Managers have been taught that growth businesses of any kind, whether profitable or not, tend to be cash-needy (Bardolet, Rumelt & Lovallo, 2010), that is, their investment needs cannot be covered by their self-generated cash and thus should be helped by pruning allocations to low-growth businesses. Therefore, the labels generated by portfolio analysis (e.g., "seed business", "growth business", "cash cow", etc.) introduce an additional behavioral pattern that might interact with any effect of relative size, an interaction that we explore in this study. Our empirical analysis shows evidence that the preference of executives to overinvest in relatively larger units is mostly driven by the low growth-high profitability segments of our sample. In contrast, the tendency to invest in the relatively smallest units is driven by the differential treatment of low-profitability segments.

Resource allocation is still a relatively unexplored area in strategic management, particularly from the empirical side, where there are only a handful of documented empirical regularities. Our empirical observations add to that short list and make a number of contributions. First, this study extends and blends together two different streams on resource allocation and segment size. We are able to investigate how those two theoretical predictions interact with each other, something previously observed in aggregate data. In other words, where the findings in naive diversification and managerial power studies respectively suggest opposing hypotheses regarding investment and relative size, our paper clarifys when one dominates the other, thus helping resolve the confusion between two contradicting results.

Second, this study furthers the understanding of the impact of relative size on allocations by investigating its interaction with segment past growth and profitability. Third, this article also enriches the understanding of the naive diversification phenomenon in resource allocation. Bardolet et al. (2011) proposed a linear relationship that affects all units equally by augmenting allocations in relatively smaller units and decreasing them in relatively larger ones. Our analysis instead shows this effect does not hold on aggregate when one controls for absolute size and that the over investment on small units is concentrated on the far end of the bottom tail. Fourth, this paper also provides evidence that managerial power as defined in the literature (Kim et al., 2004; Hackman, 1985; Pfeffer, 1981) extends to relative segment size. While one could readily assume correlation between the size of a unit and other measures of its influence such as its role in the governance of the firm or even institutional ties, it is not a given that the impact of the fomer automatically follows from that of the latter. Finally, we find a moderating effect of managerial ownership (i.e. the percentage of company shares that the top-5 corporate managers own) on these relative size effects. The fact that the observed preference for the extremes decreases with ownership implies that better-aligned managerial incentives can moderate the size effects. It is also consistent with an explanation that these effects are not optimal and result from agency problems that senior executives face.

In the following sections, we present, in order, the theory leading to two competing hypotheses for the relationship between investment and relative size, as well as two additional hypotheses on the interaction of the previous effect with segment growth and profitability as well as a final hypothesis about corporate ownership by the top executives of the firm. We then present the empirical tests, which include both regression analysis and matching methods to increase the robustness of our findings. We conclude with a discussion of our results and avenues for future research.

THEORY AND HYPOTHESES

Multibusiness corporations must choose how to allocate capital expenditures to their divisions. Research on resource allocation phenomena has taken either a behavioral perspective (Bardolet et al., 2011; Arrfelt et al., 2014; Bower, 1970) or a rational agency-based one (see Stein, 2003, for a summary of that literature). In the rest of this section, we use insights from both traditions to formulate alternative hypotheses regarding the effect of a segment's relative size.

On the behavioral side, naïve diversification—the tendency toward even allocations to all the options in the set (Benartzi & Thaler, 2001)—might be a significant part of the cross-subsidization phenomenon observed in the finance literature. Cross-subsidization occurs when corporations shift resources from better-performing divisions toward worse-performing ones (Stein, 2003). Bardolet et al. (2011) argue that if firms are biased toward investing 1/*n* of capital to each of the *n* segments, then capital allocated to a target segment will decrease as the number of other segments in the firm increases (i.e., as *n* increases), holding other relevant factors constant.

The naïve diversification hypothesis has wider implications for corporate resource allocation than. While Bardolet et al.'s analysis mostly focuses on the 1/n bias leading corporate managers to underweight differences in quality among different business units (and thus provides a cognitive root for the previously observed cross-subsidization from good to bad business units), it is easy to see how a tendency toward even allocations could make managers underweight any differentiating attribute among business units. In those circumstances, units that are at a disadvantage in terms of past performance or future prospects would receive a disproportionate amount of funds. More interestingly for this study, naive diversification would also make managers underweight differences of size among business segments. As a result, smaller segments would get relatively more funds than larger segments, after controlling for the other relevant factors (growth, profitability, future prospects, etc.) This would mean in turn that segments from different companies that are similar in all the control attributes and differ only in their size relative to other businesses in the firm would get different allocations.

One difference between our interpretation of this explanation and Bardolet et al. (2011) is that we control for the absolute size of a segment. There are several neo-classical reasons why investment might differ by *absolute* size. Smaller businesses (in absolute size) might require relatively more resources due to potential growth opportunities (Sengul & Gimeno, 2013) or greater efficiency (Maksimovic & Phillips, 2002). For these reasons, it is unclear whether we would expect to find their 1/n prediction in our data. That being said, our stated hypothesis is very similar to theirs.

Hypothesis 1A. Relative size is negatively correlated with capital investment. That is, segments that are smaller relative to the other segments within their company will receive more capital investment than similar segments that are larger relative to the other segments within their company, holding all else equal (i.e., absolute size, profitability, sales growth, age, industry).

On the other hand, allocation inefficiency in internal capital markets has generally been attributed to agency conflicts between divisional managers and corporate headquarters. Several authors (Rajan, Servaes & Zingales, 2000; Scharsftein & Stein, 2000; Wulf, 2009) portray divisional managers as rent-seeking agents who spend time and effort trying to lobby headquarters for more money and the corporate managers as principals that use the capital allocation process as an incentive scheme to control those managers. This agency-based account contains some strong assumptions. For instance, one needs to assume that managers of underperforming divisions are powerful enough to merit the principal's worry about their shirking and, thus, the increased allocations. Moreover, one needs to assume that managers of underperforming divisions are more powerful than managers of well-performing ones in order to generate cross-subsidization. In fact, more than thirty-five CFOs of large multi-business companies with whom one of the authors has held private interviews on resource allocation did not think that this was plausible enough to justify consideration.

Even if that particular aspect of the agency account is difficult to connect to managerial practice, the basic insight that allocation decisions are influenced by managerial opportunism and political factors is well established. Bower's (1970) single-firm field study led to a framework - known as the Resource Allocation Process (RAP) model - that describes allocation processes as a competition among business units for the limited pool of resources available from the corporation (Burgelman, 1991). Successive extensions of Bower's model to several strategic processes (Noda & Bower, 1996; Bower & Christensen, 1996; Burgelman, 1983), all point at the relationship between corporate and divisional managers as a key source of allocation inefficiency.

On the other hand, looking at differences in relative size within the firm instead of differences in relative performance might make the agency account more plausible. In this case, there would still be an inbalance of lobbying power between two types of managers/segments but it would be in favor of larger segments over smaller ones rather than in favor of poorly-performing segments over better-performing ones. Power and influence are an inherent factor in strategic decisions (Pffefer, 1981), especially decisions concerning the distribution of scarce resources (Salancik & Pfeffer, 1974). In resource allocation processes, the relative power of each division has been found to affect the amount received. For instance, an early study by Hackman (1985) found that university departments with higher levels of institutional power (e.g., with longer history and visibility inside and outside the organization and with higher numbers of employees and customers) received more money in the budgeting process. More recently, Kim, Hoskisson and Wan (2004) found that powerful keiretsu members are given resources to grow while less powerful ones have a difficult time obtaining those resources, instead being “milked” for profits. Other studies of the influence of power on resource allocation reach similar conclusions (Glaser, Lopez de Silanes & Sautner, 2013; Duchin & Sosyura, 2013). Although the relative size of a business unit measured by percentage of total assets or sales has not yet been proposed as a direct source of power, Hackman (1985)’s correlation between a university department number of employees and its institutional power suggests that size might indeed lead to increased influence within a corporation. Moreover, the amount of institutional power has been linked with the length of the unit’s history in the company and its visibility (Hackman, 1985), its ability to provide resources for the organization (Pfeffer & Moore, 1980) and its previous power position (Lachman, 1989), all of them factors that one could easily associate with the unit’s relative size. Thus, we hypothesize that relatively larger business units wield higher amounts of power when fighting for resources with the other units and successfully attract a larger share of those resources.

Hypothesis 1B. Relative size will be positively correlated with capital investment. That is, segments that are larger relative to the other segments within their company will receive more capital investment than similar segments that are smaller relative to the other segments *within their company, holding all else equal (i.e., absolute size, profitability, sales growth, age, industry)..*

Generally, managers claim that their capital allocation decisions are driven by the segment's future opportunities or, at the very least, by the segment's recent performance (Graham & Harvey, 2001). The previous hypotheses addressed the possibility that relative size affects allocations after controlling for future opportunities (Tobin's Q) and past performance (profitability and sales growth). However, this does not mean that the effects must be independent along those variables. For instance, very often segments with high profitability but low growth—are "self-sufficient" in terms of capital (Bardolet, Lovallo & Rumelt, 2010) since their return on assets generally exceeds their growth rate, making them net generators of cash flow within the firm. Classic portfolio analysis frameworks advise executives to use the excess cash from those businesses to fund other segments within the firm that are "cash-needy", that is, they do not generate enough cash flow on their own to sustain their required investments. Those cash-needy businesses are in turn segments with high growth prospects (hence the need for investment) but low profitability (often but of course not always a direct consequence of their being at their initial stages of development in the market). Given these heuristics, one could wonder how the preference for segments of certain relative size within the company would change for different types of segments. In our case, such hypothesizing implies the possibility that the size effects proposed by Hypotheses 1A and 1B might vary by segments that fall into different growth-profitability types. Therefore, in the following paragraphs, we discuss the potential interaction effect between the business unit relative size and its growth-profitability type.

First, the basis for Hypothesis 1A—the 1/n heuristic—is a cognitive bias. Its prediction is based precisely on the inability of individuals –or even groups (Larrick, 2004)- to take into account the relative differences among choices (Benartzi & Thaler, 2001). If managers are mostly anchored on the 1/n allocation, then the difference in capital investment between two businesses of different companies that only differ in relative size (i.e., identical sales, growth, and profitability measures) cannot be altered by changes in their growth-profitability type, which leads us to the following hypothesis.

Hypothesis 2A: Hypothesis 1A—the increased capital invesment for businesses of small relative size all else being equal—will hold ***within*** *all growth/profitability types.*

It is important to stress that this hypothesis is testing an interaction effect. That is, while we find natural to expect differences in the relative amount of capital that each growth-profitability type gets -after all, portfolio matrix heuristic rules advise managers to redirect cash flows generated by the “cash cows” towards high-growth low-profitability businesses-, hypothesis 2A looks past such effect. Specifically, we are interested in testing whether the preference for relatively very small business units holds independently in each of the growth-profitability types.

On the other hand, hypothesis 1B is an agency-based prediction. It assumes corporate managers are well-aware of the profitability and growth of subsidiary business segments but might be susceptible to lobbying from them (Scharfstein & Stein, 2001) or might have strategic reasons to favor certain segment types over others (Sengul & Gimeno, 2013). On their part, segment managers often emphasize the growth and profitability of their businesses to corporate managers as a justification to receive more capital investment (Arrfelt et al, 2013). This would be akin to employing an "eat what you kill" rule, in which the unit gets to keep their earnings for future investment. In terms of underlying causes, such rules would reflect procedural justice concerns rather than simple power-based lobbying and it could partially explain why corporate managers might be more generous toward relatively large low-growht high-profitability segment. On the other hand, this tendency will be more influencial the greater the political power segment managers have. For instance, Hoskisson et al. (2004) found that keiretsu members with stronger ties to the corporate center are more likely to be allowed to invest in diversifying their business while less powerful members are more likely to be "milked" for profits. Thus, while portfolio prescriptions prod managers to pull investment from low growth businesses, their actual behavior might be significantly influenced by the segment managers' ability to leverage their needs (i.e. "we need to increase our growth") and their past performance (i.e. "we are generating enough cash flow to cover those needs as long as you let us"). For example, some anecdotal evidence (Brass, 2011) suggests that this occurred at Microsoft, where resources that could be devoted to developing opportunities such as tablets or phones were instead absorbed by the mature software business by virtue of its high profitability. [4] For these reasons, we propose the following hypothesis.

Hypothesis 2B: Hypothesis 1B—the increased capital investment for businesses of large relative size all else being equal—will be most apparent in the low growth, high profitability quadrant in the growth/profitability matrix.

Figure 1 illustrates Hypotheses 2A and 2B by providing a representation of all four growth/profitability quadrants.

Insert Figure 1 about here

Finally, a central feature of the agency account is the possibility to moderate its effect through mechanisms that align the managers' interests to those of the company. One of the mechanisms is the degree of ownership in the company that corporate managers' hold. A higher stake in the firm should make corporate executives more sensitive to efficient allocations and drive them away from self-serving decisions. In fact, Ozbas & Scharfstein (2010) find that "corporate socialism,"–that is, the tendency to spread capital over segments of different value beyond what is efficient-, is less pronounced in firms where managers have a larger stake in the firm's ownership. Hoskisson et al. (1994) find similar dynamics but at the board level, where smaller ownership leads to less divestment across the firm, presumably because in that case board members have weaker incentives to confront rent-seeking managers. Regarding the relative size effect, a natural prediction that complements the agency account is that when corporate managers possess larger stakes in the firm they will be less inclined to give in to the lobbying and power of managers of large segments and as a consequence, will make more efficient allocations. Similarly, those corporate managers might also be less prone to fall into a naive diversification bias over the firm's differently-sized segments (Larrick, 2004). Therefore, we would predict corporate management ownership to moderate both size effects, which is expressed in the following hypothesis.

Hypothesis 3: The effects predicted by Hypotheses 1A and 1B will be mitigated by increased ownership by the top five managers in the company.

In summary, whereas a cognitive account predicts relatively larger allocations for smaller segments, the power/agency account predicts relatively larger allocations for larger segments. We examine these two seeemingly contradictory predictons in the next section.

DATA AND ESTIMATION

SEC regulations require all publicly listed companies to report sales, operating profit, depreciation, capital expenditures and total assets at the business segment level. These business segment data are included in the Standard & Poor's COMPUSTAT database. In order to identify the main activity of each segment, COMPUSTAT assigns a primary and secondary four-digit Standard Industrial Classification (SIC) code to each of a company's segments, as well as a "segment name" as reported by the company. One well-known limitation of COMPUSTAT segment data is that different companies use different criteria in deciding what constitutes a business segment. Moreover, some companies report business segments differently at different points in time. We decided to use a unifying criterion to minimize this problem and used SIC codes to aggregate reported segments at the three-digit industry level. Thus, in our sample, a firm has as many businesses as industries at the three-digit level. This method has the advantage of reducing noise inherent in the definition of segments in the COMPUSTAT files. [5] Having said this, consolidating segments using SIC codes is common in other segment-based studies of capital investment (e.g. Lamont, 1997; Ozbas & Scharfstein, 2010). In order to avoid observations with unreasonably high investment to assets ratios, we require the remaining firms to have total consolidated sales and assets of at least $20 million.

The raw COMPUSTAT database from 1991 to 2004 contained 152,287 segment-year observations. After consolidating at the three-digit SIC code level and eliminating the segments with incomplete data, 13,639 segment-year observations remained.

Absolute vs. relative size and dummy regressions

Unlike previous studies on resource allocation, our paper examines the effects of both a segment's absolute size (i.e. its total amount of sales) and relative size (i.e. the percentage of sales out of the firm's total sales) in capital investment. Making this distinction is quite important because. as the two values are correlated, one might conflate the effect of one variable with the other. It is conventional wisdom that small businesses in absolute size receive a disproportionate share of investment for standard neo-classical reasons. One possible reason is these smaller businesses have greater growth opportunities because they are at an initial stage of development. If this absolute size effect is correct, and one does not account for absolute size, one could spuriously conclude that relative size is inversely proportional to capital investment.

To control for this, we divide our sample into ten deciles for both absolute size (total segment sales) and relative size (total segment sales/total parent firm sales) and create dummy variables for each decile. That means a segment will have two indicator variables, one for absolute size decile and one for relative size decile. Looking at the correlation between relative and absolute size deciles (0.282) it seems clear that a nth-decile-relative-size-segment need not correspond to an nth-decile absolute size segment. Moreover, a look at the breakdown of the joint distribution of the two types of deciles (see Appendix Table 1) reveals that at most only 28% of one type of decile is contained in another decile, which confirms the distinction between being a small (large) segment in absolute terms (or, more precisely, relative to all the other segments in the sample) and being a smaller (large) segment in relation to the other segments within one's own firm.

Having split our data into deciles, we start investigating the relationship between the decile-based size indicators and the segment's normalized investment, which we define as segment capital expenditures divided by segment sales as reported in COMPUSTAT segment files. We first perform a descriptive statistical analysis, looking for stylized facts that we can build on later.

Insert Table 1 about here

Table 1 provides summary statistics for our main variables over the two main sample subsets used in the paper. The variables sales, assets, capital expenditures, cash flow, and age are taken directly from the COMPUSTAT segment files. Capital expenditures divided by sales will be our main dependent variable. Cross-industry studies of internal capital markets use either assets or sales (they are highly correlated) as valid scaling variables of the unit's investment (Ozbas & Scharfstein, 2010; Lamont, 1997). Relative size of the segment is the ratio between the segment's sales and the firm's total sales (defined as the sum of all its segments' sales). Segment profitability is defined as segment cash flow divided by sales. Sales growth is defined as is the difference between current and previous year's sales divided by previous year's sales. Industry Q in a given year is the median bounded Q of stand-alone firms in the industry.

In the top panel we compare the bottom decile of relative size to the other deciles. In the bottom panel we exclude that bottom decile and divide the observations equally between above and below median relative size. Looking over this raw data, we observe that sales-normalized capital expenditures are significantly higher in both smaller relative size groups. However, profitability is also significantly higher for those smaller segments, so it is unclear at this point whether to attribute the extra investment to a size effect or to a simple response to segment performance. Furthermore, we have yet to control for industry and segment fixed effects to make a more clear comparison of capital investment by relative size in the regressions.

Finally since this study includes both absolute and relative size, a natural place to begin is to examine whether previous effects would hold if we account for both. Table 2 provides the regressions of Bardolet et al. (2011), specified as

$$Investment_{ijt} = \alpha + \delta\, relative\ size_{ijt} + \beta X_{ijt} + \gamma_t + \varepsilon_{ijt}$$

where δ is the coefficient on relative size X_{jt} is a vector of control variables with absolute size deciles dummy variables (included in the regressions in columns 3 and 4) and Z_{it} is a vector with relative size deciles dummy variables and γ represents the fixed effects in the model. The first two columns show the regression model without accounting for absolute size. Under specifications for both industry and segment fixed effects, we find a significantly negative relationship between relative size and relative capital investment. However, once we control for absolute size—in the form of absolute decile dummy variables—we find no significant relationship between relative size and capital investment (columns 3 and 4).

Insert Table 2 about here

Thus, once we control for absolute size of a segment, we are unable to confirm the result of Bardolet et. al (2011) regarding relative size. We see no aggregate relationship between relative size and normalized capital investment. To better understand the relationships that might be occuring in the data, we continue by performing regression analysis with dummy variables representing the relative and absolute size decile. In this case, the regression is as follows:

$$Investment_{ijt} = \alpha + \beta_1 Y_{jt} + \delta Z_{it} + \gamma_t + \varepsilon_{ijt}$$

where Y_{jt} is a vector with absolute size deciles dummy variables and Z_{it} is a vector with relative size deciles dummy variables. Figures 2a and 2b graph the decile dummy variable regression coefficients for absolute and relative size, respectively. Since the bottom decile (in both absolute and relative size) dummy variable is omitted in the regressions (because we include a constant term), each dummy variable indicates the estimated difference between a given decile and the bottom one.

Insert Figures 2a and 2b about here

Regarding the relationship between absolute size and investment, we first notice that segments outside the absolute size bottom decile receive less investment than the bottom decile. Second, we also observe a downward trend in absolute size. As a segment's decile increases, a segment receives less normalized investment relative to the bottom decile. The trend is more pronounced when we use segment fixed effects rather than industry fixed effects. The relationship between investment and relative size is more complicated. The bottom decile in relative size receives the greatest amount of normalized capital investment. However, after accounting for this bottom decile effect, there appears to be an upward trend as higher deciles seem to receive more capital investment than lower deciles. These first approximations suggest at least two interesting patterns. First, as shown in Figure 2a, small segments in absolute terms receive relatively more investment than large ones. Thus, it will be important that in further analysis we control for the absolute size of the segment to ascertain any relative size effect. Second, Figure 2b suggests that the effect is reversed when looking at relative size. In this case, investment in a segment gets proportionally larger as the relative size of that segment increases. On the whole, controlling for absolute size, we find that for 90% of segments the relationship is opposite to what Bardolet et al. (2011) conclude; for most segments greater relative size actually increases capital investment; the aggregate effect hides the two underlying mechanisms.

The two-sided relative size effect

Our preliminary analysis suggest that Hypothesis 1A and 1B may both hold, albeit in different places in the spectrum of relative size. We investigate these relationships further in our main regressions, using a version of the typical investment equation proposed in previous studies on capital allocations in multi-business firms (Ozbas & Scharfstein, 2010; Rauh, 2006).

$$Investment_{ijt} = \alpha + \beta_1 RelativeSize_{jt} + \beta_2 Bottom\ Decile_{jt} + \delta X_{it} + \lambda_t + \gamma_j + \varepsilon_{ijt}$$

The dependent variable in this regression is capital expenditures in the focal business segment normalized by that segment's sales. Given that the preliminary analysis of the deciles revealed a specific potential phenomenon in the lowest decile (i.e., larger investment in those units) and a different more continuous one in the others (i.e., larger investment as relative size increases), we include a separate indicator variable for the bottom decile of relative size (Bottom Decile in the equation below) to separate the two effects. Control variables – the X_{it} vector in the above equation – include the business unit's Tobin's Q, [6] which provides an estimate of the quality the segment's set of investment opportunities, the business unit's cash flow to sales ratio, which provides an estimate of the segment's past profitability, and past year's sales growth which provides an estimate of the segment's growth potential. The equation also includes industry and segment firm effects, depending on the specification, as well as year dummy variables for year to control for time-related effects. The regression results are presented in Table 2.

Insert Table 2 about here

First, we find a bottom decile effect. Segments in the bottom decile of relative size receive 0.020-0.029 additional capital investment/sales. Considering the average segment in the dataset receives 0.155 capital investment relative to sales, this equates to a 13%-19% increase in total investment for the average segment. For the average bottom decile business, which has $135 million in capital investment per year, this is roughly $17-27 million in additional capital investment per year. This result would seem to offer partial support for Hypothesis 1, that is, that relatively smaller segments receive proportionally higher allocations, although this only holds for the bottom decile. Second, we also find a relative size effect. The coefficient on relative size is 0.011-0.013. To put this value in perspective, excluding the bottom decile, the average relative size of a below-median segment is 0.238, the average relative size of an above median segment is

0.641 (see Table 1, bottom panel, for both measures). Moving from the average below median to the average above median segment in relative size is predicted to increase normalized capital investment by 0.004-0.005. This equates to a 5-7% increase on the average normalized capital investment of a segment. This result offers support for Hypothesis 2, that is, larger segments receive proportionally higher allocations.[7]

The other terms in the regression are quite telling. Lagged industry Q and profitability both have positive and significant relationships with normalized capital investment. Sales growth and age have little explanatory power. The coefficients are generally the same whether industry or segment fixed effects are used, though the relative size term is not significant when segment fixed effects are used. The loss of significance is not because of a change in the estimated coefficient but because of an increase in the standard error.

Matching analysis

To check the robustness of these two main two effects, namely, additional investment for the relatively smallest segments and larger ones, matching techniques are used. Matching is a statistical method that allows for the estimation of the hypothesized effect by comparing a “treated” group (for example, business units with relative size above the sample median) and a “non-treated” group (in that example, business units with relative size below the sample median) in a quasi-experiment (Abadies & Imbens, 2011). The goal of the matching procedure is to find, for every unit in the “treated” group, one (or more) non-treated unit(s) with similar if not identical observable characteristics. In our case, by matching treated segments with similar non-treated ones, we establish a comparison of outcomes (i.e. normalized capital expenditures) that tests the regression analysis findings and, moreover, provides an estimate of the effect size. Among other things, we can match on absolute size. This means we can compare two segments of nearly identical absolute size with different relative size to see how this difference affects investment.

To test for the potential overinvestment in relative size bottom-decile segments, segments in the sample are classified within each year as being either in the bottom relative size decile or outside of it (i.e., in any other decile). Bottom decile segments are then matched with non-bottom decile segments, exactly by year and industry and continuously (i.e., closest available match) by size, age, profitability and sales growth. The average difference in outcome between the matches is then estimated. Table 3a provides results. Segments in the bottom decile, controlling for absolute size, age, profitability and sales growth within each year and industry get 0.15-0.2 of additional normalized investment, an increase of 18-25% of capital investment compared to the average segment. The coefficient is not much different than the 0.2-0.29 value calculated for the initial regressions in Table 2.

Insert Tables 3a and 3b about here

In order to test for the potential overinvestment in relative size larger segments, we follow a similar procedure. Excluding the bottom decile of relative size segments from our analysis (determined the same way as in Table 3a), [8] we divide our remaining sample by above or below median relative size for each year. Above and below median relative size segments are then matched, exactly by year and industry and continuously by size, age, profitability and sales growth. The difference between the matches is then estimated. Table 3b provides results. Segments with above median relative size, controlling for absolute size, age, profitability and sales growth within each year and industry, receive 0.0035-0.0045 additional normalized capital investment. This equates to a roughly 5% increase in investment per year for the average segment. Thus the two main effects we observe in our regressions—a bottom decile and relative size effect—are robust to matching analysis with only minor deviations in the estimated coefficient. In the next section we examine the interactions of these results by interacting them with business unit profitability and growth.

The size effects and segment past performance

Previous literature as well as managerial practice recognize that capital allocation decisions are driven by the segment's future opportunities (Ozbas & Scharfstein, 2010; Billet & Mauer, 2003) or, at the very least, by the segment's recent performance (Graham & Harvey, 2001; Arrfelt et al., 2013). In the previous sections we have uncovered evidence that relative size impacts those allocations after controlling for past performance (profitability and sales growth). However, this does not mean that the effects must be constant along those variables. To investigate potential interactions we study how the relative size effects vary across groups of segments with different combinations of past profitability and growth. In this way, we mimic the categories at the core of the portfolio matrices that managers have been using for decades in their internal investment processes (Bardolet, Lovallo & Rumelt, 2010). Thus, we ask questions like, is the relative size effect stronger or weaker when the larger segments are low growth-high profitability? Or is the bottom decile effect consistent across all quadrants of the growth-profitability matrix?

To that purpose, we calculate sales growth (change in sales from last year to this year/sales last year) and profitability (cash flow/sales) and then classify each segment in our sample as below- or above-median for each of the two variables. We rerun the matching analysis of previous sections for each one of the four cells generated by combining high-low growth and high-low profitability. Table 4a provides the matching analysis for the difference between bottom decile relative size segments and others. Table 4b provides the matching analysis for below median vs. above median relative size. In this case, matching is continuous with respect to sales, age, profitability and sales growth and exact to industry and year.

Contrary to Hypothesis 2A, which predicts equal effects across all four quadrants, the overall bottom decile effect observed in the data seems to be driven by low profitability segments, regardless of growth. For high profitability, the effect seems to be reversed, especially for high profitability-low growth segments, with the the bottom decile actually receiving *less* normalized investment than other deciles. The result is only suggestive, because of high standard error, it is only significant at the 10% level. Taken together, the results in Table 4a suggest that firms have a special inclination to invest in their smallest segments when these show below-average profitability and slightly underinvest in them when they show above-average profitability. Perhaps corporate managers are willing to tolerate lower profitability out of these relatively smaller segments because they have less effect on the firm's bottom line. Along the same lines, the low profitibility of a relatively small business will have less of an effect on a firm's balance sheet than a relatively large business, and may be more likely to be excused.

Insert Tables 4a and 4b about here

There are also great differences in the magnitude and sign of the relative size effect when isolated to specific growth and profitability types. Consistent with hypothesis 2B, the increase in investment overall for segments of larger relative size appears to be driven entierly by low growth–high profitability segments. The increase in investment for this type of segment is 0.021, about 5.5 times the coefficient for the overall effect. This translates into a 25% increase in investment for the average segment. Conversely, for low growth-low profitability and high growth-high profitability segment types the difference within the quadrant is negative. In these cases, relatively smaller segments would receive additional investment relative to their larger counterparts. When only examining low profitability, high growth types there is little difference in investment between large and small relative size segments.

It is interesting to note that this type of segment (low growth – high profitability) is the only type not to show a bottom decile effect and is the type that drives the relative size effect. However, because all these comparisions are done within quadrant, our data analysis to this point hast not indicated whether these large relative size low-growth, high-profitability segments are favored by management over any other type of segment out of quadrant. To provide some suggestive answers to this question, Figure 3 displays normalized net cash outflows by quadrant for each type of segment (the bottom decile is included). Management generally takes cash out of both high profitability quadrants and generally is more likely to take from large relative size segments.[9] However, the low growth – high profitability quadrant is the only one where there is a distinct advantage for being relatively large. This finding is consistent with Hypothesis 2B and our preceding analyis.

Insert Figure 3 about here

Managerial ownership

Hypothesis 3 made a prediction about the moderating effect of top five managers having a larger stake in the company. Perhaps when managers have greater ownership in the multi-segment firm, they are less susceptible to size-related biases. Our results in Table 5a and 5b suggest this may be the case. For each year we identify the median management ownership of the firm's top-5 managers—as reported in ExecuComp COMPUSTAT database—and rerun the matching specifications found in Table 3a for segments that belong to firms with below-median ownership and for segments that belong to firms with above-median ownership. Table 5a shows the results of this analysis for the bottom decile effect. Though the differences are not significant, segments in firms with low management ownership exhibit a more pronounced bottom-decile effect than segments with high management ownership. This is potentially an interesting finding that suggests that managers with larger stakes in the company are less prone to naively diversify their allocations and thus favor the bottom decile, but, of course, we must caution the reader that our measure of managerial ownership is crude and there could be better measures. [10]

Insert Tables 5a and 5b about here

Table 5b presents a similar analysis for the relative size effect. For below-median ownership firms the coefficients of the effect are generally positive, indicating a greater investment in large relative size segments. However, for above-median ownership firms, the effect is reversed, indicating an overinvestment in smaller relative size segments. This would offer support for Hypothesis 3, as top managers with high ownership would be less willing to engage in political games and, more importantly, let their allocation decisions not be influenced by power. On the other hand, only one of the specifications in Table 5b shows significant coefficients and differences, so this evidence is only suggestive.

Finally, one robustness check on our data analysis so far would be examining if these preceeding results still hold on different types of spending (e.g., marketing and research and developement). These types of spending are conceivably different than pure capital investment and businesses of different relative sizes might have different needs.

Unfortunately, our dataset is limited in the number of observations: a little less than 1% and 10% of the businesses in our sample have marketing and research expenditures data, respectively. We also do not know the reasons behind data availability, so the usual caveats about selection apply. That being said, we find a bottom decile effect for both measures that is equal or greater to what we observe for capital. Interestingly, we do not seem to find a positive size effect. There appears to be a negative correlation between normalized research and marketing expenditures in the other deciles.[11] One conjecture is that political power is more influenced by relative size which fluctuates much less year on year than marketing or research and development expenditures. Furthermore, the latter influence the current year's profitability whereas capital expenditures are depreciated over numerous years and impact the current year's earnings much less. Given the issues mentioned above, we cannot say definitively if this relationship is meaningful. We do think it would be an interesting topic for future research if the full data were available. We refer our reader to Appendix tables 2 and 3 for the full analysis.

DISCUSSION

This study partially contests a previous finding on relative size and the use of the 1/n heuristic in corporate capital allocations. This study locates that effect only in the bottom decile of relative size segments in a corporation. There is no evidence for the effect in other deciles. If it exists, it is swamped by a contradictory effect, the positive correlation of relative size and normalized capital investment. That latter effect is consistent with the idea that executives in large segments have greater ability to influence their allocations. Our results point at an interesting combination of phenomena affecting allocations across businesses of different relative sizes. On one hand, the political power hypothesis laid out above is supported, since capital allocations increase with the relative size of the segment. On the other hand, this does not happen to the smallest of segments within corporations, where the 1/n heuristic seems to dominate. Taken together these opposite pieces of evidence point to a combination of cognitive and political factors that lead to the favouring of the extreme relative size types within corporations.

Furthermore, our analysis of the moderating effect of growth and profitability indicates that larger allocations for larger units is an phenomenon that is mostly driven by the low growth-high profitability segments in our sample. Moreover, the relative size effect decreases in companies where top management possess a higher percentage of shares. This result is consistent with Ozbas and Scharfstein's (2010) finding that corporate socialism is more common when management has a small equity stake, as both results suggest that weak monitoring and misaligned incentives contribute to poor investment choices.

On a different note, our results might find a complementary explanation in Maritan's (2001) finding that investments in existing capabilities tend to follow standard bottom-up resource allocation processes while investments in new capabilities do not. In the latter case, it is top managers who take a more direct role in the allocation decisions. If one assumes that relatively larger units contain most of the firm's existing capabilities and that relatively smaller units contain most of the developing ones, then our results and Maritan's mirror each other. However, our data are only suggestive; the data is not fine-grained enough to draw a conclusion. Moreover, Coen and Maritan (2011) develop the idea of resource allocation being influenced by the asset stock or capability existing endowment of the business unit. Again, if one considers size is positively correlated with that asset stock, our results are consistent with Coen and Maritan's findings that relatively larger units are favored by the firm's traditional resource processes.

There are a number of promising directions for future research that are suggested by our results. First, although we document an empirical regularity in corporate resource allocation that is consistent with a bias toward even allocation, it would be useful to more directly investigate cognitive and social factors that cause the relatively larger investment in the smallest units in the firm. Second, the COMPUSTAT segment data on which we relied has a number of well-known limitations, such as the sometimes inconsistent reporting of segment information by the firms in the sample. Although we took steps to minimize distortions, there remains some inherent measurement error. Alternative databases that provide more accurate measurements of organizational structure would help test our findings.

Third, it would be interesting to investigate the dynamic aspect of these size effects. A preliminary examination of our sample reveals extremely high serial year-to-year correlations in business units' shares of a company's total capital allocations, which suggests that corporations are very slow in changing the allocation balance among their business units. This organizational inertia can impair a firm's ability to redistribute appropriately in response to strategic challenges and ultimately hinder performance. One possible cause of such inertia could be related to the size effects described here, as larger businesses would use their influence to maintain their allocation advantages over time. The case of Microsoft, a company where one dominant business unit often absorbed the resources that smaller new ventures needed (Brass, 2010), anecdotally illustrates this behavior. The fact that we find this larger-relative size effect mostly concentrated among high profitability-low growth businesses is suggestive that, over long periods of time, these businesses might be starving smaller higher-growth units of resources. Further research on this issue could help identify the distributions of relative size among businesses that better foster firm growth in the long run.

Finally, it would be interesting to investigate in future research other competitive and organizational factors that moderate the magnitude of the relative size effects that we documented in this paper. For instance, in Rajan et al. (2000), inefficient capital transfers increase when segments are more diverse in their total investment opportunities. The socialism-as-optimal-mechanism model of Bernardo et al. (2006) encompasses the above predictions and further suggests that socialism increases with firm maturity and the degree to which the division manager's job requires firm-specific human capital. Furthermore, Lamont (1997) showed that firms might also be socialistic when times are tough, cutting investment across the board, even in the business units for which the set of investment opportunities remains unchanged. Although the evidence presented in this paper shows that the relative size effects are robust across different cross-sections of our sample, it would be interesting to identify factors that tend to moderate (or exacerbate) those effects.

One potential implication of the findings of this study for executives is that *if* the finding on segments holds for the business units – i.e, the largest and smallest are favoured in corporate allocations- a company generally seeking allocation efficiency should stay away from having very large or very small segments, especially if those do not contain the best investment prospects.

Further studies of resource allocation are needed as resource allocation is one of the most understudied areas in the economy. One estimate of the amount capital allocated by internal capital markets ($640 billion a year) is larger than the amount allocated by capital markets in the U.S. verses ($621 billion a year) (Guedj, Huang & Sulaeman, 2009). However, far less academic literature has addressed the issue of these internal capital markets. Thus, the relative attention on corporate allocators is small relative to their impact on the economy. Part of the reason for this is certainly data availability. Thus it is important that academics take the time to cultivate new and more fine-grained data on resource allocation.

REFERENCES

Abadies, A., & Imbens, G. 2011. Bias-corrected matching estimators for average treatment effects. *Journal of Business & Economic Statistics*, 29, 1-11.

Arrfelt, M., Wiseman, R., Hult, G. 2013. Looking backward instead of forward: Aspiration-driven influences on the efficiency of the capital allocation process. *Academy of Management Journal*, 56, 1081-1103.

Banaszak-Holl, J., Mitchell, W., Baum J. A. C., & Berta W. B. 2006. Transfer learning in ongoing and newly acquired components of multiunit chains: U.S. nursing homes, 1991–1997. *Industrial and Corporate Change,* 15, 41–75.

Bardolet, D., Fox, C.R. & Lovallo, D. 2011. Corporate capital allocation: A behavioral perspective. *Strategic Management Journal*, 32, 1465-1483.

Bardolet, D., Lovallo, D., & Rumelt R. 2010. "The hand of management: Differences in capital investment behavior between multi-business and single-business firms". *Industrial and Corporate Change*, 19(2), 591-612.

Barnard, C. 1938. The functions of the executive. Cambridge, Massachussets: Harvard University Press.

Baum, J. A. C., & Ingram, P. 2002. *The Economics of Choice, Change, and Organization. Essays in the Memory of Richard M. Cyert*, Interorganizational learning and network organizations: Toward a behavioral theory of the "interfirm", eds Augier M., March J. G. Edward Elgar, Cheltenham, UK, pp 191–208.

Benartzi, R. & Thaler, R. 2001. Naïve diversification strategies in retirement saving plans. *American Economic Review, 91,* 475-482.

Berger, P., & Ofek, E. 1995. Diversification's effect on firm value. *Journal of Financial Economics*, 37, 39-65.

Bernardo, A., Luo, J. & Wang, J. 2006. A Theory of Socialistic Internal Capital Markets. *Journal of Financial Economics,* 80, 485-509.

Berry, H. 2010. Why do firms divest? *Organization Science*, 21, 380-396.

Billett, M., & Mauer, D. 2003. Cross-subsidies, external financing constraints, and the contribution of the internal capital market to firm value. *Review of Financial Studies,*16,1167–1201.

Bower, J.L. 1970. *Managing the Resource Allocation Process*. Boston, Mass.: Harvard Business School Press.

Bower, J.L., & Christensen, C.M. 1996. Customer power, strategic investment and the failure of leading firms. *Strategic Management Journal*, 17 (3), 197-218.

Brass, D. 2010. Microsoft's creative destruction. New York Times, February 4.

Burgelman, R. 1983. A model of the interaction of strategic behavior, corporate context and the concept of strategy. *Academy of Management Review*, 81(1), 61-71.

Burgelman, R. 1991. Intraorganizational ecology of strategy making and organizational adaptation: Theory and field research. *Organizational Science*, 2, 239-262.

Coen, C., & Maritan, C. 2011. Investing in capabilities: The dynamics of resource allocation. *Organization Science*, 22, 99-117.

Duchin, R., and D. Sosyura. 2013. Divisional Managers and Internal Capital Markets. Journal of Finance, 68, 387-429.

Gilbert, C.G. & Bower, J.L. 2005. *From Resource Allocation to Strategy*. Oxford University Press.

Glaser, M., F. Lopez-de-Silanes, and Z. Sautner. 2013. Opening the Black Box: Internal Capital Markets and Managerial Power. Journal of Finance, 68, 1577-1631.

Graham, J.R., & Harvey, C. 2001. The theory and practice of corporate finance: Evidence from the field. *Journal of Financial Economics*, 60, 187-243.

Guedj, I., Huang, J.C. & Sulaeman, J. 2009. Internal Capital Allocation and Firm Performance, working paper.

Hackman, J.D. 1985. Power and centrality in the allocation of resources in colleges and universities. *Administrative Science Quarterly*, 30, 61-77.

Helfat, C.E., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D., & Winter, SG. 2007. Dynamic capabilities: Understanding strategic change in organizations. Malden, MA: Blackwell.

Hoskisson, R.E., Hitt, M.A., & Hill, C.W.L. 1991. Managerial Risk Taking in Diversified Firms: An Evolutionary Perspective. *Organization Science*, 2, 296-314.

Hoskisson, R.E., Johnson, R., & Moeser, D.D. 1994. Corporate Divestiture Intensity in Restructuring Firms: Effects of Governance, Strategy and Performance. *Academy of Management Journal*, 37, 1207-1251.

Kim, H., Hoskisson, R.E., & Wan, W.P. 2004. Power dependence, diversification strategy and performance in keiretsu member firms. *Strategic Management Journal*, 25(7), 613-636.

Lachman, R. 1989. Power from what? A reexamination of its relationships with structural conditions. *Administrative Science Quarterly*, 34(2), 231-251.

Lamont, O. 1997. Cash flow and investment: evidence from internal capital markets. *Journal of Finance*, 52, 83-109.

Larrick, R. P. 2004. *Debiasing*. In D. J. Koehler & N. Harvey (Eds.), *Blackwell Handbook of*

Judgment and Decision Making, (pp. 316–337). Blackwell Publishing Ltd.

Maksimovic, V. & Phillips, G. 2007. Conglomerate firms and internal capital markets. In E. Eckbo (ed.), Handbook of Corporate Finance, 1: 423–479. New York: Elsevier.

March J.G., & Simon H.A. 1958. *Organizations*. Wiley, New York.

Maritan, C.A. 2001. Capital investment as investing in organizational capabilities: An empirically grounded process model. *Academy of Management Journal*, 44(3) 513–531.

Noda, T., & Bower, J.L. 1996. Strategy Making as Iterated Processes of Resource Allocation". *Strategic Management Journal*, 17, 169-192.

Ocasio, W. 1997. Towards an attention-based view of the firm. *Strategic Management Journal*, 18, 187–206.

Ozbas, O. & Scharfstein, D. 2010. Evidence on the dark side of internal capital markets. *Review of Financial Studies*, 23(2), 581-599.

Pfeffer, J. 1981. *Power in organizations*, Pitman Pub.

Pfeffer, J, & Moore W.M. 1980. Power in university budgeting: A replication and extension. *Administrative Science Quarterly*, 25(4), 637-653.

Rajan, R., Servaes, H. & Zingales, L. 2000. The cost of diversity: the diversification discount and inefficient investment. *Journal of Finance*, 55, 35-80.

Rauh, J. 2006. Investment and financing constraints: Evidence from the funding of corporate pension plans. *Journal of Finance*, 61, 33–71.

Salancik, G.R., & Pfeffer, J. 1974. The bases and use of power in organizational decision-making: The case of a university. *Administrative Science Quarterly*, 19(4), 453-473.

Scharfstein, D.S., & Stein, J.C. 2000. The dark side of internal capital markets: divisional rent-seeking and inefficient investment. *Journal of Finance*, 55, 2537-2564.

Sengul, M. & Gimeno, J. 2013. Constrained delegation: Limiting subsidiaries's decision rights and resources in firms that compete across multiple industries. *Administrative Science Quarterly*, 58(3), 420-471.

Stein, J. 2003. Agency, Information and Corporate Investment, in *Handbook of the Economic of Finance*, edited by Constantinides, G.M., Harris, M. and Stulz, R. Elsevier Science.

Teece, D.J. 2009. Dynamic capabilities and strategic management. Oxford: Oxford University Press.

Villalonga, B. 2004. Diversification discount of premium? New evidence from the business information tracking series. *Journal of Finance*, 59, 475–502.

Vissa, B., Greve, H., & Chen, W. 2010. Business group affiliation and firm search behavior in India: Responsiveness and focus of attention. *Organization Science*, 29, 696-712.

Whited, T. 2001. Is it inefficient investment that causes the diversification discount? *Journal of Finance*, 56, 1667–1691.

Wulf, J. 2009. Influence and inefficiency in the internal capital market. *Journal of Economic Behavior and Organization*, 72, 305-321.

FOOTNOTES

[1] Even in companies where proposals can be submitted at any time during the year, managers know it is relatively easier to obtain capital in the earlier months, when non-committed funds are still abundant, and concentrate their proposals in a certain period of the year, thus fostering comparisons amongst them.

[2] In contrast, Sengul and Gimeno (2013) use our exact measure of relative size as a control variable for strategic importance but find it negatively correlated with capital investment. They speculate the relation is due to a correlation with age, a variable we control for in our analysis.

[3] It is akin to describing the general correlation of life-expectancy on height/weight, without accounting for the data at the extremes, which drive a large part of the variation in the data.

[4] Moreover, as Sengul and Gimeno (2013) propose, certain competitive conditions such as large multi-market contact among competitors might lead corporate managers to withhold investment from high growth segments for fear of triggering a competitor's response in their more profitable low growth markets. The natural consequence of this is that investment remains more concentrated in low growth businesses.

[5] However, three-digit SIC allows us only to examine diversified firms and may obscure distinctions between business units within an industry. For example, if a COMPUSTAT firm reported three segments all within the same three-digit code, it would be misleading to say that such company is diversified, given that all those segments operate in essentially the same business.

[6] Because it is not possible to directly calculate Tobin's Q for segments in multi-business firms, we follow one of the standard practices in the literature and estimate it by calculating the beginning-of-year median Q for all the stand-alone firms in that business unit's industry.

[7] The results do not appreciably change when current year's profitability and sales growth are replaced by next year's. So it is unlikely these results are due to current year's profitability and sales growth being imperfect proxies for future (rational) expectations of business profitability and growth.

[8] We exclude the bottom decile of relative size segments to not have the aforementioned bottom decile effect confound our relative size effect. This is similar in spirit to using a dummy variable for bottom decile in our initial regressions.

[9] For more detail on this issue, we refer the interested reader to Bardolet et al. (2010) who examine this relationship as the central thesis of their paper.

[10] For one thing, we have only looked at the effect of ownership on corporate managers and not divisional ones. Future research may explore this topic.

[11] We thank an anonymous reviewer for suggesting this analysis.

Table 1

Descriptive statistics by group

Observations are by segment and year (Compustat segment files, 1989-2004). Segment cash flow is defined as segment operating profits plus segment depreciation. Segment sales, assets, capital expenditure, and cash flow are in millions of dollars. Sales growth is the difference in this yearly change in sales over last year's sales. Profitability is measured as cash flow over sales. Sales growth is the difference between current and previous year's sales divided by previous year's sales. Industry Q in a given year is the median bounded Q of stand-alone firms in the industry. Mean comparison tests between groups are performed without the assumption of equal variance. Asterisks indicate statistical difference at the 10% (*), 5%(**), and 1%(***) levels using a two-tailed test.

Sample: All multi-segment firms	Bottom decile in relative size (in sales)		Other deciles	
Segment level	Mean	SD	Mean	SD
Segment sales	707	1,681	2,663***	8,709
Segment assets	1,450	5,749	2,218***	6,157
Segment relative size (in sales)	0.06	0.03	0.45***	0.24
Segment relative size (in assets)	0.11	0.12	0.44***	0.25
Segment capital expenditures	135	807	161*	568
Segment cash flow	233	1,368	345***	1,021
Segment captial expenditures/sales	0.16	0.32	0.08***	0.14
Segment profitability	0.22	0.37	0.15***	0.15
Segment sales growth	0.04	0.41	0.10***	0.46
Segment age	8.47	7.033	11.14***	7.25
Lagged industry Q	1.38	0.38	1.42**	0.44
Obs	1,681		15,205	
Sample: Excluding bottom decile	Below median relative size (in sales)		Above median relative size (in sales)	
Segment level	Mean	SD	Mean	SD
Segment sales	1,482	2,664	3,833***	11,906
Segment assets	1,583	3,668	2,839***	7,803
Segment relative size (in sales)	0.24	0.09	0.65***	0.16
Segment relative size (in assets)	0.26	0.14	0.62***	0.20
Segment capital expenditures	120	382	202***	696
Segment cash flow	268	829	415***	1123
Segment captial expenditures/sales	0.08	0.17	0.07***	0.12
Segment profitability	0.16	0.18	0.14***	0.13
Segment sales growth	0.08	0.41	0.12***	0.50
Segment age	10.4	7.28	11.84***	7.13
Lagged industry Q	1.42	0.45	1.41	0.42
Obs	7,600		7,600	

Observations are by segment and year (Compustat segment files, 1989-2004). Segment cash flow is defined as segment operating profits plus segment depreciation. Segment sales, assets, capital expenditure, and cash flow are in millions of dollars. Sales growth is the difference in this yearly change in sales over last year's sales. Profitability is measured as cash flow over sales. Sales growth is the difference between current and previous year's sales divided by previous year's sales. Industry Q in a given year is the median bounded Q of stand-alone firms in the industry. Mean comparison tests between groups are performed without the assumption of equal variance. Asterisks indicate statistical difference at the 10% (*), 5%(**), and 1%(***) levels using a two-tailed test.

Table 2

Previous evidence for the 1/N effect (Bardolet et al. 2011)

Regressions of the effect of relative size (in sales) on capital spending over sales for segments in multi-segment firms (Compustat segment files 1990-2004). Industry definitions follow the Input-Output Benchmark Surveys of the Bureau of Economic Analysis. Industry Q in a given year is median bounded Q of stand-alone firms in the industry. Heteroskedasticity-robust standard errors are in parentheses. Standard errors are corrected for clustering at the industry-year level. Asterisks indicate significance at the 10%(*), 5%(**), and 1%(***) levels (two-tailed).

dependent variable:	capital spending/sales	capital spending/sales	capital spending/sales	capital spending/sales
relative size	-0.02***	-0.04***	-4.27E-03	-1.99E-03
	(4.74E-03)	(0.01)	(5.12E-03)	(0.01)
lagged industry Q	9.04E-03***	9.84E-03***	9.44E-03***	11.54E-03***
	(3.07E-03)	(2.99E-03)	(3.07E-03)	(3.03E-03)
profitability	0.26***	0.22***	0.27***	0.22***
	(0.03)	(0.04)	(0.03)	(0.03)
number of businesses in firm	-4.41E-03***	-6.40E-03**	-7.91E-04	-3.97E-03**
	(1.13E-03)	(2.04E-03)	(1.15E-03)	(1.99E-03)
industry F.E.	yes	no	yes	yes
segment F.E.	no	yes	no	yes
absolute size decile F.E.	no	no	yes	yes
year F.E.	no	no	no	no
observations	13,639	13,639	13,639	13,639
R^2	0.49	0.75	0.49	0.75

Table 3

Investment and relative size

Regressions of the effect of relative size (in sales) on capital spending over sales for segments in multi-segment firms (Compustat segment files 1990-2004). Industry definitions follow the Input-Output Benchmark Surveys of the Bureau of Economic Analysis. Industry Q in a given year is median bounded Q of stand-alone firms in the industry. Heteroskedasticity-robust standard errors are in parentheses. Standard errors are corrected for clustering at the industry-year level. Asterisks indicate significance at the 10%(*), 5%(**), and 1%(***) levels (two-tailed).

dependent variable:	capital spending/sales	capital spending/sales
bottom decile of relative size	0.03***	0.02**
	(7.19E-03)	(0.01)
relative size	0.01**	0.01
	(5.21E-03)	(0.01)
lagged industry Q	8.90E-03***	0.01***
	(2.68E-03)	(2.74E-03)
profitability	0.26***	0.22***
	(0.03)	(0.04)
age	-2.49E-04*	-6.02E-04
	(0.14E-03)	(5.68E-04)
sales growth	-2.62E-03	-3.02E-03
	(3.01E-03)	(3.06E-03)
industry F.E.	yes	no
segment F.E.	no	yes
absolute size decile F.E.	yes	yes
year F.E.	yes	yes
observations	13,639	13,639
R^2	0.50	0.75

Table 3a

Matching analysis: Lowest decile vs other segments

Abadie and Imbens (2011) bias-corrected estimates for average treatment effect for treated segments with relative size (in sales) in lowest decile relative to segments outside of lowest decile (Compustat segment files (1989-2004). Treatment outcome is capital spending over sales ratio. Matching is continuous with respect to sales, age, profitability (cash flow over sales ratio), and sales growth (yearly change in sales over last year's sales) and exact with respect to industry and year. Number of matches is four. Standard errors are in parentheses. Asterisks indicate significance at the 10%(*), 5%(**), and 1%(***) levels (two-tailed).

match variables:	Lowest decile of relative size
Sales, profitability	0.02** (0.02E-03)
Sales, profitability, age	0.02** (6.42E-03)
Sales, profitability, age, sales growth	0.02*** (6.88E-03)

Table 3b

Matching analysis: Above-median vs below-median segments

Abadie and Imbens (2011) bias-corrected estimates for average treatment effect for treated above-median-relative-size (in sales) segments to control below-median-relative-size segments (Compustat segment files, 1989-2004). Segments in the lowest decile of relative size were excluded from analysis. Treatment outcome is capital spending over sales ratio. Matching is continuous with respect to sales, age, profitability (cash flow over sales ratio), and sales growth (yearly change in sales over last year's sales) and exact with respect to industry and year. Number of matches is four. Standard errors are in parentheses. Asterisks indicate significance at the 10%(*), 5%(**), and 1%(***) levels (two-tailed).

match variables:	Above median relative size (excluding lowest decile)
Sales, profitability	4.42E-03** (1.79E-03)
Sales, profitability, age	4.40E-03** (1.87E-03)
Sales, profitability, age, sales growth	3.83E-03* (2.04E-05)

Table 4a

Matching analysis: Profitability and growth for the bottom decile effect

Abadie and Imbens (2011) bias-corrected estimates for average treatment effect for treated segments with relative size (in sales) in lowest decile relative to segments outside of lowest decile (Compustat segment files (1990-2004). Treatment outcome is capital spending over sales ratio. Matching is continuous with respect to sales, age, profitability (cash flow over sales ratio), and sales growth (yearly change in sales over last year's sales) and exact with respect to industry and year. Number of matches is four. Low- and high-profitability bins are based on the annual sample median of profitability. Low- and high-sales growth bins are based on the annual sample median of sales growth. Standard errors are in parentheses. Asterisks indicate significance at the 10%(*), 5%(**), and 1%(***) levels (two-tailed).

	Profitability		
Sales growth	All	Low	High
All	0.02***	0.02***	-0.01
	(6.88E-03)	(4.25E-03)	(0.01)
Low	0.01	0.03***	-0.03*
	(9.70E-03)	(6.55E-3)	(0.02)
High	0.01	0.02***	-0.01
	(0.01)	(4.12E-03)	(0.02)

Table 4b

Matching analysis: Profitability and growth for the relative size effect

Abadie and Imbens (2011) bias-corrected estimates for average treatment effect for treated above-median-relative-size (in sales) segments to control below-median-relative-size segments (Compustat segment files, 1992-2004). Segments in the lowest decile of relative size were excluded from analysis. Treatment outcome is capital spending over sales ratio. Matching is continuous with respect to sales, age, profitability (cash flow over sales ratio), and sales growth (yearly change in sales over last year's sales) and exact with respect to industry and year. Number of matches is four. Low- and high-profitability bins are based on the annual sample median of profitability. Low- and high-sales growth bins are based on the annual sample median of sales growth. Standard errors are in parentheses. Asterisks indicate significance at the 10%(*), 5%(**), and 1%(***) levels (two-tailed).

	Profitability		
Sales growth	All	Low	High
All	3.83E-03*	-5.04*E-03**	3.65E-04
	(0.00642)	(0.00136)	(0.00400)
Low	4.29E-03*	-9.35E-03***	0.02***
	(2.58E-03)	(1.99E-03)	(5.27E-03)
High	-1.74E-03	-2.18E-03	-0.01**
	(3.24E-03)	(1.88E-03)	(5.99E-03)

Table 5a

Matching analysis: Managerial ownership effect on the lowest decile

Abadie and Imbens (2011) bias-corrected estimates for average treatment effect for treated bottom decile relative size (in sales) segments to control other segments (Compustat segment files, 1992-2004). Treatment outcome is capital spending over sales ratio. Matching is continuous with respect to sales, age, profitability (cash flow over sales ratio), and sales growth (yearly change in sales over last year's sales) and exact with respect to industry and year. Number of matches is four. Low- and high-management bins are based on the annual sample median of management ownership. Standard errors are in brackets. Comparisons between low- and high-management bins assume independence of estimated average treatment effects. Asterisks indicate significance at the 10%(*), 5%(**), and 1%(***) levels (two-tailed).

Match variables	Management ownership Low	High	Difference H-L
Sales, profitability	0.03*	0.02**	-0.01
	(0.01)	(8.86E-03)	(0.02)
Sales, profitability, age	0.03**	0.02**	-0.01
	(0.01)	(8.94E-03)	(0.02)
Sales, profitability, age, sales growth	0.04**	0.02***	-0.02
	(0.02)	(0.01)	(0.02)

Table 5b

Matching analysis: Managerial ownership effect on relative size

Abadie and Imbens (2011) bias-corrected estimates for average treatment effect for treated above-median-relative-size (in sales) segments to control below-median-relative-size segments (Compustat segment files, 1992-2004). Segments in the lowest decile of relative size were excluded from analysis. Treatment outcome is capital spending over sales ratio. Matching is continuous with respect to sales, age, profitability (cash flow over sales ratio), and sales growth (yearly change in sales over last year's sales) and exact with respect to industry and year. Number of matches is four. Low- and high-management bins are based on the annual sample median of management ownership. Standard errors are in parentheses. Comparisons between low- and high-management bins assume independence of estimated average treatment effects. Asterisks indicate significance at the 10%(*), 5%(**), and 1%(***) levels (two-tailed).

Match variables	Management ownership Low	High	Difference H-L
Sales, profitability	6.52E-03	-3.96E-03	-0.01
	(5.35E-03)	(3.90E-03)	(6.60E-03)
Sales, profitability, age	7.67E-03	-8.32E-04	-8.50E-03
	(5.41E-03)	(3.87E-03)	(6.64E-03)
Sales, profitability, age, sales growth	5.01E-03	-7.38E-03*	-0.01*
	(5.96E-03)	(3.90E-03)	(7.12E-03)

Figure 1

Hypotheses by growth/profitability quadrants.

Predictions of Hypotheses 1A and 1B by growth/profitability quadrants. Hypothesis 1A predicts that relative size will be negatively correlated with normalized capital investment. Hypothesis 1B predicts that relative size will be positively correlated with normalized capital investment. Hypotheses 2A and 2B further elaborate 1A and 1B to hold in specific quadrants of growth and profitability. These predictions are illustrated in Figure 1.

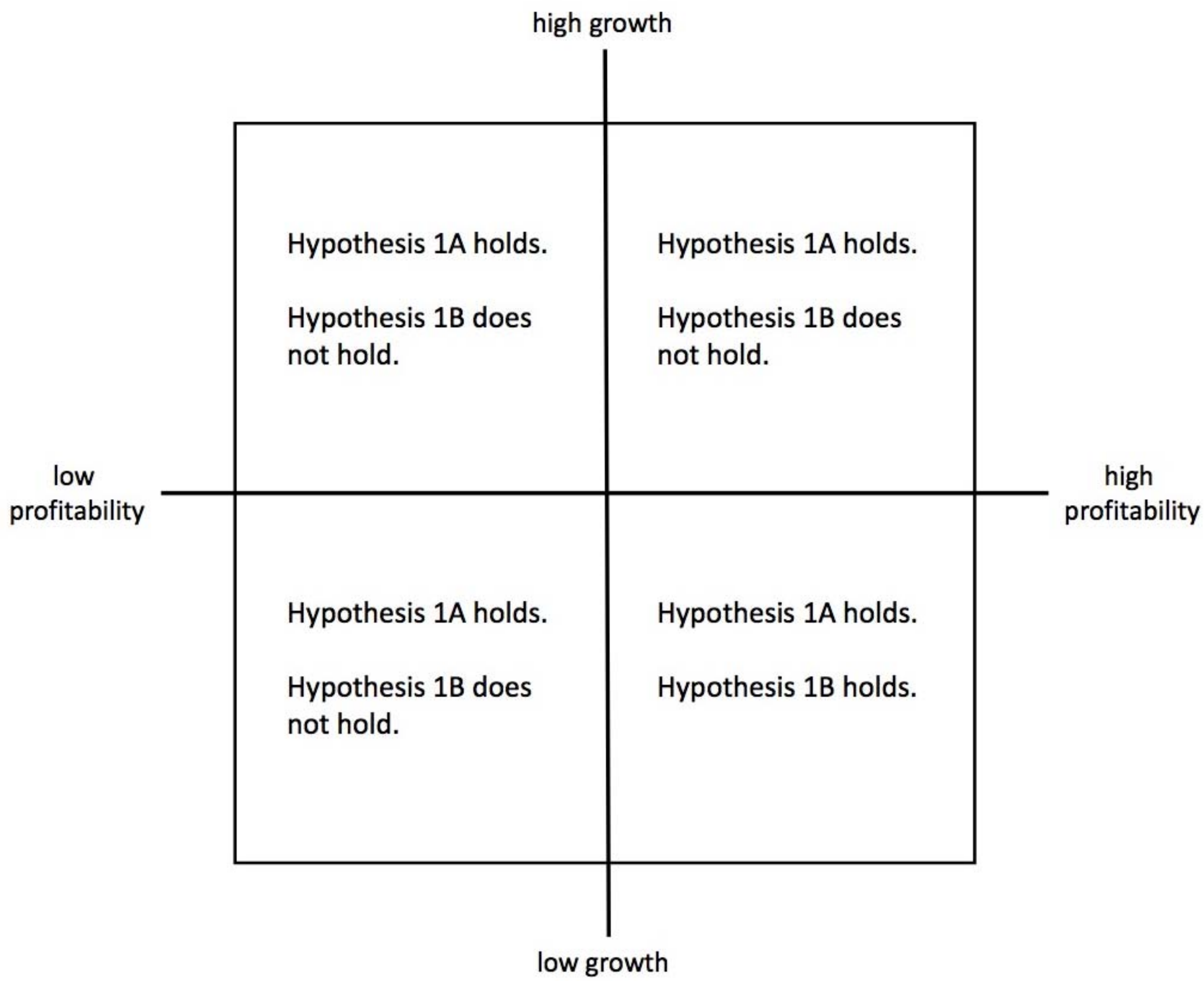


Figure 2a

Absolute size decile averages

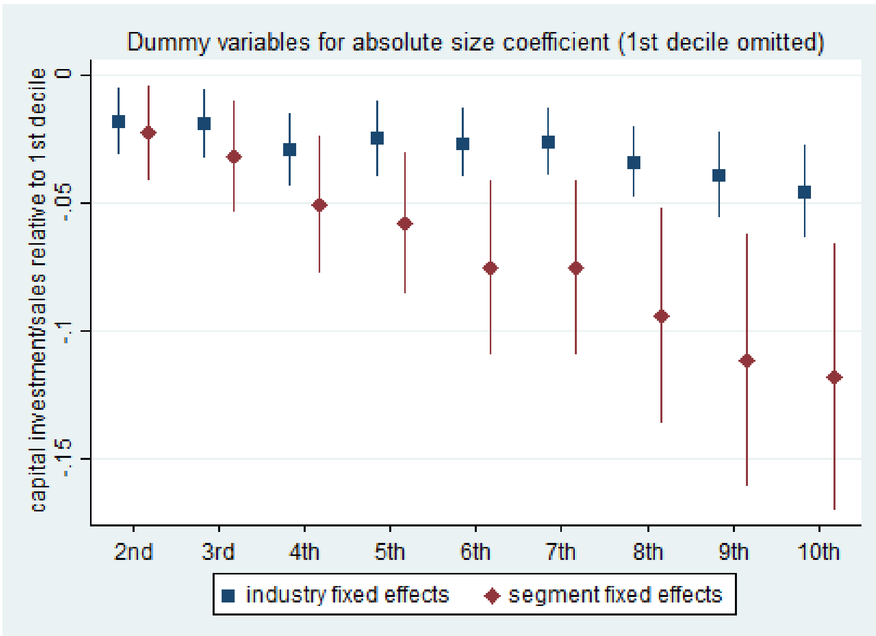


Figure 2b

Relative size decile averages

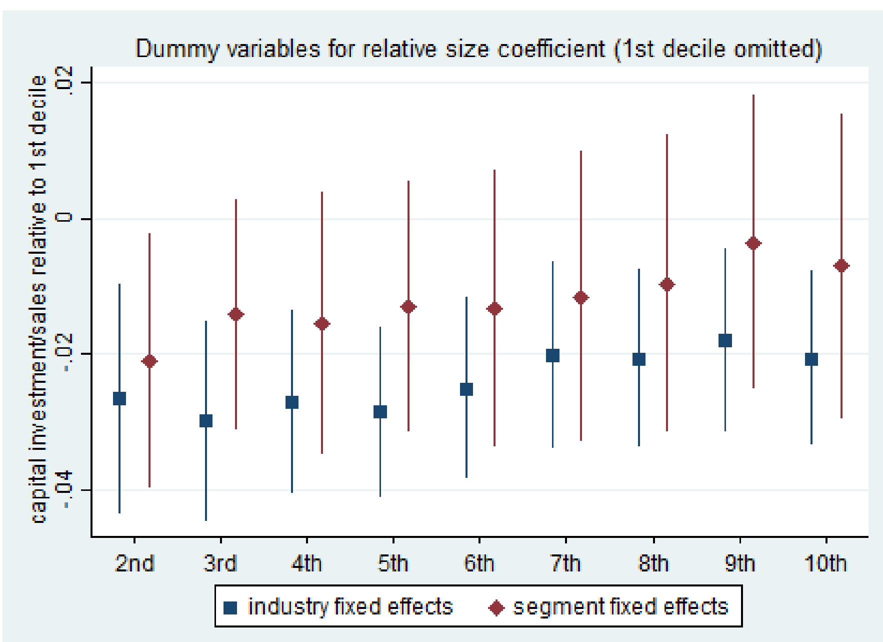
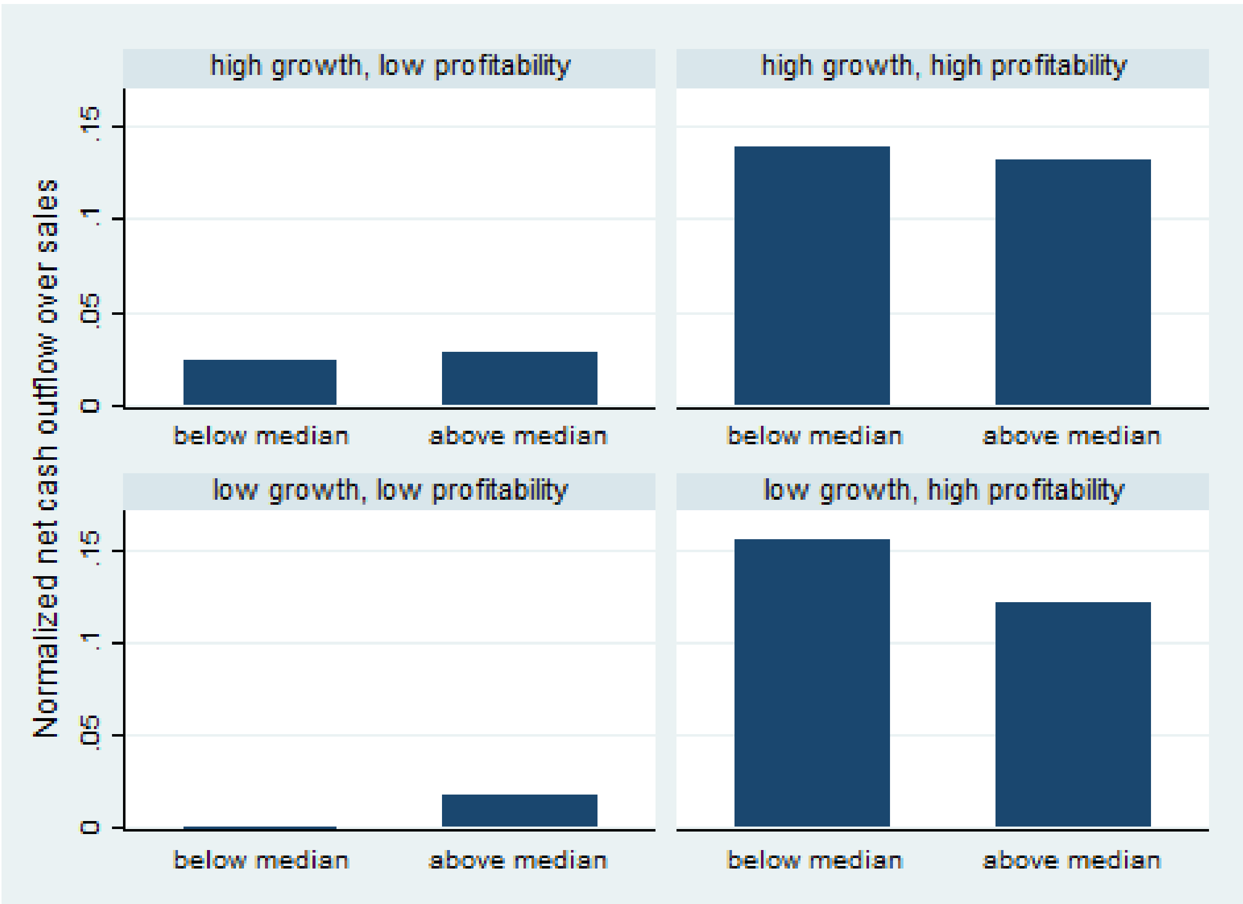


Figure 3

Normalized net cash outflow within corporate segments by growth/profitability quadrant.

Normalized net cash outflow (capital expenditures minus cashflow divided by sales) by below and above median relative size for each of the four growth/profitability quadrants. Bars indicate one standard deviation. These values do not include retained earnings or dividends.



Appendix Table 1

Absolute vs relative size deciles correlations

	Absolute size quantile									
Relative size quantile	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
1st	473	250	185	159	179	143	99	79	80	43
	2.80	1.48	1.09	0.94	1.06	0.85	0.59	0.47	0.47	0.25
2nd	207	188	216	178	181	155	164	118	157	125
	1.23	1.11	1.28	1.05	1.07	0.92	0.97	0.70	0.93	0.74
3rd	169	233	198	191	169	158	163	176	127	106
	1.00	1.38	1.17	1.13	1.00	0.93	0.96	1.04	0.75	0.63
4th	174	215	166	170	173	184	147	200	163	97
	1.03	1.27	0.98	1.01	1.02	1.09	0.87	1.18	0.97	0.57
5th	175	189	220	148	154	141	198	155	162	148
	1.04	1.12	1.30	0.88	0.91	0.83	1.17	0.92	0.96	0.88
6th	166	158	190	195	166	184	166	122	185	157
	0.98	0.94	1.12	1.15	0.98	1.09	0.98	0.72	1.10	0.93
7th	132	166	178	167	163	208	158	179	195	144
	0.78	0.98	1.05	0.99	0.96	1.23	0.93	1.06	1.15	0.85
8th	123	151	142	184	186	171	207	230	158	137
	0.73	0.89	0.84	1.09	1.10	1.01	1.23	1.36	0.94	0.81
9th	55	106	129	176	161	167	187	229	223	257
	0.33	0.63	0.76	1.04	0.95	0.99	1.11	1.36	1.32	1.52
10th	16	33	66	121	158	178	201	201	240	475
	0.09	0.20	0.39	0.72	0.94	1.05	1.19	1.19	1.42	2.81

Appendix Table 2

Correlations between independent variables

independent variable	relative size	profitability	sales growth	lagged industry Q
relative size	-	-0.11	0.08	4.40E-03
profitability	-0.11	-	0.02	0.06
sales growth	0.08	0.02	-	0.03
lagged industry Q	4.40E-03	0.06	0.03	-

Appendix Table 3

Summary statistics of research and marketing spending

Observations are by segment and year (Compustat segment files, 1989-2004). Segment sales, capital expenditure, marketing expediture and research expenditure are in millions of dollars. Mean comparison tests between groups are performed without the assumption of equal variance. Asterisks indicate statistical difference at the 10% (*), 5%(**), and 1%(***) levels using a two-tailed test.

Sample: All multi-segment firms	Bottom decile in relative size (in sales)		Other deciles	
Segment level	Mean	SD	Mean	SD
Segment research expenditures	68.3	292	84.9	236
Segment research expenditures/sales	0.04	0.07	0.03***	0.04
Segment research-to-capital expenditures	0.82	1.43	0.68	1.14
Obs	84		1,117	
Segment marketing expenditures	278	509	137	245
Segment marketing expenditures/sales	0.27	0.08	0.15***	0.12
Segment marketing-to-capital expenditures	12.9	27.3	6.72	12.5
Obs	12		107	
Sample: Excluding bottom decile	Below median relative size (in sales)		Above median relative size (in sales)	
Segment level	Mean	SD	Mean	SD
Segment research expenditures	68.9	165	100***	288
Segment research expenditures/sales	0.03	0.04	0.02**	0.04
Segment research-to-capital expenditures	0.72	1.01	0.63	1.22
Obs	544		571	
Segment marketing expenditures	74	127	179*	291
Segment marketing expenditures/sales	0.18	0.14	0.13**	0.10
Segment marketing-to-capital expenditures	6.66	10.9	6.71	13.5
Obs	42		65	

Appendix Table 3

Main regressions using research and marketing spending as dependent variables

Segments in the bottom decile of relative size (in sales) are compared to other segments in multi-segment firms (Compustat segment files 1990-2004). The effect of relative size in general is also measured. Dependent variable is capital spending over sales. Industry definitions follow the Input-Output Benchmark Surveys of the Bureau of Economic Analysis. Profitability is measured as cash flow over sales. Industry Q in a given year is median bounded Q of stand-alone firms in the industry. Sales growth is the difference between current and previous year's sales divided by previous year's sales. Industry Q in a given year is median bounded Q of stand-alone firms in the industry. Heteroskedasticity-robust standard errors are in parentheses. Standard errors are corrected for clustering at the industry-year level. Asterisks indicate significance at the 10%(*), 5%(**), and 1%(***) levels (two-tailed).

dependent variable:	research spending/sales	reseach spending/sales	marketing spending/sales	marketing spending/sales
bottom decile of relative size	0.02*	0.02*	-0.02	0.13***
	(0.01)	(0.01)	(0.09)	(0.04)
relative size	-0.02***	-4.15E-03	-0.62***	-0.03
	(0.01)	(0.01)	(0.24)	(0.16)
lagged industry Q	3.41E-03	1.79E-03	0.03	-0.50E-04
	(3.17E-03)	(2.27E-03)	(0.02)	(9.51E-03)
profitability	0.04**	0.03	0.19	-0.17
	(0.02)	(0.03)	(0.22)	(0.22)
age	-2.34E-05	-7.77E-04***	-0.01	3.18E-03
	(2.12E-04)	(2.75E-04)	(7.09E-03)	(3.71E-03)
sales growth	-1.42E-03	7.95E-03**	-0.09	-5.61E-03
	(1.71E-03)	(3.93E-03)	(0.05)	(0.01)
industry F.E.	yes	no	yes	no
segment F.E.	no	yes	no	yes
absolute size decile F.E.	yes	yes	yes	yes
year F.E.	yes	yes	yes	yes
observations	987	987	108	108
R^2	0.68	0.94	0.86	0.98