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From big to small: the relative size effect on corporate capital allocation

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Abstract

Building on previous studies of corporate capital allocations, we investigate the effect of the relative size of a business unit with respect to the size of the rest of the corporation on internal investment behavior. Using field data from a large set of firms we find that business unit capital expenditures normalized by assets are higher when a business unit is smaller relative to the rest of its firm, holding other relevant variables (growth, profitability, etc.) constant. We find further support for this relative size effect in a simple allocation experiment. Our analysis extends findings of inefficiencies in capital allocation decisions in a novel direction by suggesting that corporate cross-subsidization is 1) mostly centered around reallocation of capital from large to small business units rather than from high to low performing business units as predicted by the agency-based accounts and 2) due to a simple heuristics that leads managers to naively diversify

their allocations in favor of small units. Furthermore, we find no moderating effect of the performance of those small units on the observed cross-subsidization from bigger to smaller units. Managers favor relatively smaller units over larger ones regardless of how those smaller units are performing. Existing agency-based explanations of cross-subsidization in the finance literature cannot readily explain this relative size effect.

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FROM BIG TO SMALL:

THE RELATIVE SIZE EFFECT ON CORPORATE CAPITAL ALLOCATION

Abstract

Building on previous studies of corporate capital allocations, we investigate the effect of the relative size of a business unit with respect to the size of the rest of the corporation on internal investment behavior. Using field data from a large set of firms we find that business unit capital expenditures normalized by assets are higher when a business unit is smaller relative to the rest of its firm, holding other relevant variables (growth, profitability, etc.) constant. We find further support for this relative size effect in a simple allocation experiment. Our analysis extends findings of inefficiencies in capital allocation decisions in a novel direction by suggesting that corporate cross-subsidization is 1) mostly centered around reallocation of capital from large to small business units rather than from high to low performing business units as predicted by the agency-based accounts and 2) due to a simple heuristics that leads managers to naively diversify their allocations in favor of small units. Furthermore, we find no moderating effect of the performance of those small units on the observed cross-subsidization from bigger to smaller units. Managers favor relatively smaller units over larger ones regardless of how those smaller units are performing. Existing agency-based explanations of cross-subsidization in the finance literature cannot readily explain this relative size effect.

I. Introduction

In recent years, there has been an ever-increasing interest in the micro-foundations of strategy. Many scholars have set to incorporating the insights of cognitive and social psychology into the study of individual and collective managerial decision-making. Particularly, there has been a call for a better understanding of the weight and the scope of heuristics in strategic decisions (Powell, Lovallo & Fox, 2011). Although research on heuristics has been mostly devoted to uncovering their pernicious effects (i.e. how they lead individuals and groups to systematic biases) there has always been an assumption that they quite often constitute a source of fast and efficient decisions, by providing satisfactory outcomes while greatly reducing the amount of analysis that "rational" models would require.

This paper contributes to research on strategy and heuristics by connecting capital allocation in multi-business companies, a phenomenon long present in the strategy and the corporate finance literatures (Bower, 1970; Stein, 2003), with the heuristics and biases view. In particular, we investigate cross-subsidization across business units and we propose a new account for its existence, namely, the tendency by managers to reallocate capital from large business units to small ones. Moreover, such tendency can be explained by naïve diversification (Benartzi & Thaler, 2001), a cognitive heuristic that biases allocations toward an even split among business units. The phenomenon documented in this article possesses a "double-edged sword" that is typical of most heuristics. On one hand, using cash generated in a large business unit to fund smaller cash-needy units is certainly defensible on rational grounds (after all, managers have been taught that that is precisely why one should have "cash cow" and growth businesses within one firm). On the other hand, however, managers who use this heuristic too generously risk biasing their allocations too heavily in favor of undeserving small units. In this

paper, we provide evidence that multi-business firms do indeed bias their allocations towards smaller units and that such bias increases as the relative size of the target unit decreases. This constitutes a novel implication of the naïve diversification account as well as a dimension of the cross-subsidization phenomenon that was previously ignored in the corporate allocation literature.

Previous research on capital allocation has uncovered a pattern of cross-subsidization in multi-business companies, by which corporations have a tendency to overinvest in poorly performing business units (compared to what similar stand-alone firms receive) using cash-flows generated in better-performing units (Ozbas & Scharsftein, 2010). Thus, this corporate socialism is predicated upon the inability of corporate managers to distinguish between "good" and "bad" business units. The studies on this "dark side" of capital budgeting, however, face two main challenges. On the empirical side, the claim of inefficient cross-subsidization is usually based on a comparison between multi- and single-business firms. However, one could say that multi-business firms have better (and empirically unobservable) information about the businesses in their portfolios than the one provided by the external financial market, as well as other reasons (e.g. synergies) to have them within. On the other hand, single-business firms are assessed exclusively by the external market. Therefore, the "quality" of a division in a multi-business firm might be something very different than the "quality" of a similar stand-alone business, rendering any comparison between the two fundamentally flawed. On the theoretical side, cross-subsidization has mainly been attributed to agency conflicts between divisional managers and corporate headquarters (Stein, 2003). While the agency account is largely plausible the models that have been proposed to date contain very strong assumptions about the opportunistic behavior of managers involved in capital budgeting. More importantly, these models predict

over-investment in under-performing business units regardless of size and thus are not well suited to explain cross-subsidization from large to small business units.

Given these concerns, we incorporate business unit relative size as a factor in the study of inefficiency in corporate capital allocations. We posit that large multi-business companies smooth out allocations not (or at least not only) over units of different "quality" as proposed in the past literature but over units of different size. Thus, it is smaller (larger) business units that receive more (less) capital than they deserve. Our approach avoids the above-mentioned two problems inherent to cross-subsidization studies to date. On the empirical side, relative size is an easily observable variable, subject to small measurement errors for scholars and little to none informational asymmetries for managers. On the theoretical side, studying the effect of relative size on capital allocations allows us to propose a cognitive account that makes very little assumptions on the behavior of managers. In our account, rooted in the heuristics and biases view, managers are simply influenced by a tendency to naively diversify capital allocations, thus ignoring (or more accurately, underweighting) differences in the relative size of the firm's business units. Moreover, the fact that cross-subsidization between large and small units is deeply embedded in managerial thinking and might sometimes be a rational and efficient way to make capital allocations might lead managers to use it in a way that reinforces the bias. The proposed cognitive account follows from Bardolet, Fox and Lovallo (2011), which find evidence that the number of business units in a firm is negatively correlated with investment in the target unit. Their field data analysis and, more especially, their experimental tests show that naïve diversification leads corporate managers toward an even distribution of capital among all units in the firm. Our paper extends that account and applies it to a situation in which managers make allocations among business units of different size. The results of our analysis not only lend

additional support to the existence of a naïve diversification heuristic in corporate allocations but also provide a new direction in the studies of capital budgeting in multi-business firms by highlighting relative size instead of quality as a main driver of cross-subsidization.

The rest of the paper is organized as follows. Section II provides an overview of capital allocation inefficiency and its main causes. Section III briefly describes the data set used in our analysis. Section IV describes the estimation procedure and its results as well as some robustness checks. Section V discusses the potential cognitive basis of the observed phenomenon and presents an experimental study that provides further evidence of our cognitive account. Section VI presents a final discussion and possible directions for future research.

II. Inefficiencies in capital allocation

The corporate finance literature provides a number of studies that assess, both theoretically and empirically, the phenomenon of cross-subsidization in multi-business firms capital allocations (see Stein 2003 for a review). For example, Ozbas and Scharfstein (2010) show that multi-business firms allocate more (less) capital to divisions with worse (better) investment opportunities (as measured by Tobin's Q) compared to similar stand-alone firms. Similarly, Rajan, Servaes and Singales (2000) find that industry-adjusted investment in low-Q divisions within corporations is higher than the industry-adjusted investment in high-Q divisions[1]. Other

[1] Some methodological issues have been raised regarding these "corporate socialism" results (Villalonga, 2004). The concerns have to do with the possibility that corporate divisions are systematically different from their stand-alone counter parts in the same industry. For instance, Whited (2001) and Chevalier (2004) claim that standard measures of industry q's may be better suited to represent the investment opportunities of stand-alone firms than those of corporate divisions. Chevalier (2004) investigates the relative weight of these methodological issues by looking at the investment behavior of divisions in the years before they joined their corporation. In this pre-merger phase – when the divisions were still stand-alone firms and by definition there could have been no reallocation – she finds some of the same patterns as Rajan, Servaes and Zingales (2000) and Ozbas and Scharfstein (2010), albeit in a weaker form. This suggests that correcting for various econometric biases weakens, though does not necessarily

studies offer additional evidence on the cross-subsidization phenomenon (Berger & Ofek, 1995; Billet & Mauer, 2003). On the other hand, Maksimovic and Phillips (2002) find little evidence of cross-subsidization in their analysis of plant productivity across single- and multi-segment firms.

This evidence of corporate "socialism" in capital allocation has generally been attributed to agency conflicts between divisional managers and corporate headquarters. Several authors (Rajan, Servaes & Zingales, 2000; Scharfstein & Stein, 2000; Wulf, 2009) portray divisional managers as rent-seeking agents that spend time and effort trying to get the CEO to give them more money, in the form of either higher compensation or higher capital allocations for their divisions. In particular, Scharfstein and Stein (2000) propose a model in which the CEO is also a rent-seeking agent who willingly uses capital instead of cash to compensate managers because while using cash might ensure the efficiency of the capital allocation process it might also be more costly to the CEO (since he could otherwise use the cash for more personally attractive purposes). In a slightly different vein, Rajan, Servaes and Zingales (2000) and Bernardo, Luo and Wang (2006) propose models in which the CEO is a principal who uses the capital allocation process as an incentive scheme to control rent-seeking behavior by managerial agents.[2]

The agency-based account of cross-subsidization finds some echo in the strategy literature. As Gilbert and Bower (2005) note, Bower's (1970) RAP model comes close to the agency-based explanations of the corporate finance literature that we described above. In essence, both perspectives present the resource allocation process as a competition among business units for the limited pool of resources available to the corporation (Burgelman, 1991).

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overturn, the evidence of on-average socialism in these papers.

[2] Note that the influence cost model (Rajan et al, 2000) is predicated at the project level but tested empirically at the business unit level, thus failing to measure the effect of multiple projects within a single-segment firm. In contrast, the cognitive account proposed in this paper is both predicated and tested at the business unit level, thus allowing for a better comparison between multi- and single-segment firms.

Bower's field study revealed a corporation with ample strategic advantages in markets and technology but also with performance that was merely average due to misaligned incentives of divisional managers in the resource allocation process (RAP). The model proposed by Bower involves multiple organizational levels, as operational managers within the divisions provide to their divisional managers the *definition* of the several investments available to the company, who in turn provide in budget meetings with corporate headquarters the *impetus* to sponsor some of those investments. Finally, corporate headquarters decides on the final allocations while also being in charge of providing the *structural context* (organizational design, incentives, etc) in which this process takes place. This model has been used to study diverse strategic processes, including business development (Noda & Bower, 1996), response to disruptive technology (Bower & Christensen, 1996) and internal corporate venturing (Burgelman, 1983), among others. Hoskisson at al. (1991) hypothesize that divisional managers are increasingly risk-averse as their firm becomes more diversified, due to the difficulty of headquarters to monitor effectively the proposal and execution of ambitious goals for each division as well as the divisional managers' low incentive to pursue them. Moreover, Hoskisson at al. (1994) find that higher equity stakes among board members makes firms more effective in divestment situations. Sull (2005) notes that the role of headquarters is especially important in promoting divestment, because divisional managers often perceive such divestment as jeopardizing their job and compensation and, hence, refuse to support it.

One major goal of this paper is to describe a novel form of systematic inefficiency in capital allocation that follows from a simple heuristic. In particular, we hypothesize that businesses that are smaller relative to their corporate peers will receive more capital than businesses that are larger relative to their peers, after controlling for the other relevant factors.

We assert that using the size of a business unit as the basic point of reference with which to differentiate investment options presents several advantages to both managers and scholars. Unlike Tobin's Q, relative size is not affected by potentially "hidden" information because the size of a business is common knowledge to all the managers in the firm (both at the corporate and at the divisional level) and it is easily measurable (by looking at total assets, total sales or any other equivalent measure). In the next two sections we investigate how the relative size of the corporation's business units affects the capital allocations they receive.

III.Data

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 firms use different criteria in deciding what constitutes a business segment. Moreover, some firms report business segments differently at different points in time. We decided to use a unifying criterion to avoid 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. 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 but 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. 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.

After 1998, a transition toward a new industry identification system began. Thus, COMPUSTAT stopped assigning SIC codes for many of the segments in its files and began assigning NAICS codes. We identified equivalent industries in both systems and translated NAICS codes to SIC codes. Thus, we were able to include a large number of observations that did not have SIC codes in the raw COMPUSTAT file. The raw COMPUSTAT database from 1989 to 2004 contained 152,287 segment-year observations. After consolidating at the three-digit SIC code level and eliminating the segments with incomplete data, 57,853 segment-year observations remained. Table 1 contains descriptive statistics and correlations.

Insert Table 1 here

IV. Estimation and control variables

Previous studies on cross-subsidization (e.g. Ozbas & Scharfstein, 2010; Rauh, 2006) have compared the investment behavior of multi- and single-business firms. We first estimate a typical equation proposed in those studies:

$$INVESTMENT_{ijt} = \alpha + \beta_1 Q_{jt-1} + \beta_2 (Q_{jt-1} * Div)_{ijt-1} + \beta_3 CashflowToSales_{ijt-1} + \beta_4 (CashflowToSales_{ijt-1} * Div) + \gamma_i + \varepsilon_{ijt}$$

The dependent variable in this regression is capital expenditures in the target business unit normalized by that business unit's lagged assets. Cross-industry studies of internal capital markets use assets or sales as valid scaling variables of the unit's investment. Moreover, by normalizing capital spending with assets we are controlling for the business unit's size. Q is the business unit's lagged Tobin's Q, which provides an estimate of the quality the business unit's set of investment opportunities. Because it is not possible to calculate Tobin's Q for business units in multi-business firms, we follow one of the standard practices in the literature and estimate those units' Q by calculating the beginning-of-year median Q for all the stand-alone firms in that business unit's industry. DIV is a dummy that labels whether the business unit belongs to a multi-business firm (value 1) or constitutes a stand-alone company (value 0). CashflowToSales is a control variable that measures the ratio of business unit's cash-flow (operating profit plus depreciation) to business unit's sales. Year and business unit fixed effects are included as well.

Model 1 in Table 2 replicates Ozbas and Scharfstein's basic finding. The relevant coefficient is the interaction between business unit's Tobin's Q and DIV. The significant negative coefficient of Q*DIV indicates that units with higher (lower) Q receive less (more) capital in multi-business firms than in single-business ones.

As mentioned before, we believe the relative size of the business unit with respect to the rest of the firm does play a role in capital allocation. To investigate the possible effect of relative size, we add the variable RESTREL to the previous estimation. RESTREL is defined as:

$$RESTREL = 1 - \frac{BUAssets}{FirmAssets}$$

We use the converse of the unit's share of assets within the firm because this way RESTREL values conveniently range from zero (when the firm is single-business) and close to one (when the target business unit is very small relative to the rest of the firm). This facilitates the interpretation of the RESTREL coefficients in the estimations. Model 2 in Table 2 presents the Ozbas-Scharfstein estimation with the variable RESTREL included. The significantly positive coefficient of RESTREL indicates that the smaller the target business unit is with respect to the rest of the firm (higher RESTREL), the more capital it receives, other things being equal. Conversely, the bigger the target business unit is with respect to the rest of the firm (lower RESTREL) the less capital it receives. This allows us to postulate a previously undocumented relative size effect on top of the cross-subsidization from "good" to "bad" that was found in past studies of corporate allocations.

On the other hand, whenever we have asked managers with direct responsibility in capital budgeting what criteria guide their decisions, they overwhelmingly mentioned two of them as the basic criteria for their decisions: business unit growth rate and business unit profitability[3]. Thus, even though there are many other factors that might influence their allocations, it seems that any study of such decisions should include growth and profitability as controls. To that purpose, we modified the estimation equation above by including controls for the target business unit's growth rate and profitability, as well as for the unit's industry's level of investment We estimate the target business unit's growth rate in a given year by computing the yearly sales growth in percentage and adjusting an exponential function on the three-year period preceding the

[3] One of the authors interviewed more than 20 CFOs of large diversified companies.

observation year in order to smooth out the changes in sales. We measure the target business unit's profitability as the three-year average operating profit over sales. Finally, we also include a variable to control for the different levels of investment across industries by computing the median of the dependent variable (capital spending over assets) lagged one period for each industry defined at the 3-digit SIC code level. We also include business unit fixed effects, which should absorb all time-invariant, business-specific features, such as the time and place of market entry, the characteristics' of the unit's particular technology, as well as managerial skill that varies minimally over time. Finally, we include a dummy variable for every year in the panel sample to account for sizable shocks in the economy that could have affected capital investment. All models are robust to heteroskedasticity and errors are clustered by firm to avoid within-firm serial correlation.

Insert Table 3 here

Models 1 and 2 in Table 3 show the estimation results. As Model 1 shows, the target business unit's growth, profitability and industry's level of investment do have a strong effect on allocation decisions. Moreover, all three coefficients are positive, indicating that, in general, managers tend to reward better-performing businesses. However, we already saw in the previous estimation that multi-business firms do not reward those better-performing businesses as much as single-business firms. Here, we observe that cross-subsidization seems more centered around the difference between larger and smaller units rather than the difference between higher and lower quality units, as the coefficients for Tobin's Q become non-significant once we introduce the new controls.

Model 2 in Table 3 adds the RESTREL variable to the previous estimation and finds that RESTREL has a significant positive effect on investment. Thus, our new specification shows that a business unit that is relatively smaller within its firm receives more investment than a similar business unit that is relatively larger within its firm.

A relevant question related to these results concerns the distinction between smaller high performing units and smaller low performing ones. Does the relative size effect impact these two groups differently? One could say that a situation where smaller high performing divisions receive proportionally more money is more justified than one in which it is the low performing smaller units receiving the extra money. To investigate this issue, we included the interaction terms between RESTREL and business unit's growth, profitability and Tobin's Q. Models 3, 4 and 5 in Table 3 show the coefficients for those terms. First, we notice that the interaction term between RESTREL and the target business unit's growth rate is significantly negative. We interpret this as evidence that the relative size effect increases as the growth rate of the smaller unit decreases. Similarly, the interaction term between RESTREL and the target business unit's profitability is significantly negative. Again, we interpret this as evidence that the relative size effect increases as the profitability of the smaller unit decreases. Finally, we observe no significant effect between RESTREL and the target business unit's Tobin's Q. Taken together, these results show that the relative size effect observed in our sample is not driven solely by a rational transfer of capital from larger to smaller business units. In fact, firms seem to pour some additional capital into low performing smaller units rather than into high performing ones. This might be due to a number of reasons: more lobbying from divisional managers of poorly performing divisions (Scharsftein & Stein, 2000), escalation of commitment to bad investments

(Ross & Staw, 1993) or a fundamental difficulty for managers in assessing the "quality" of a business unit.

Virtual Sample Analysis

The effect of relative size observed so far in our analysis is a direct consequence of the existence of a diversified corporation. Another way to test the notion that the relative size effect can be attributed to the actions of a centralized corporate decision maker (or team of decision makers) and to show that our results are not an artifact of the data is to compare our multi-business firms with a "virtual" group of artificial multi-business firms, constructed by matching every unit in a multi-business firm with a similar stand-alone. Thus, we created two subsamples from our main sample. The first subsample was obtained by retaining all the multi-business firms from the original sample. The second subsample was obtained by randomly matching each business unit from the multi-business sample with a single-business firm of similar size and within the same industry[4]. Thus, this second subsample contains a collection of "virtual" firms that are akin to the multi-business firms in "real" subsample. Therefore, the only major difference between the two subsamples is that the allocation decisions in the "real" sample are made by corporate (multi-divisional) management, whereas the allocation decisions in the "virtual" sample are made by single-business management.

We ran our basic regression separately on both subsamples. If the relative size effect were driven by a cognitive bias toward even allocation then it should only exist in multi-business firms. Thus, we predict that only the "real" sample will exhibit a positive coefficient for relative size. Table 4 shows the results for both regressions and accords with this prediction: relative size

[4] We did the size matching by ensuring that every business unit in a virtual firm was within 30% in terms of assets of the corresponding business unit in the real firm.

is positively and significantly correlated with investment in the real sample but shows no significant correlation in the virtual sample. We interpret these results as further evidence that the relative size effect is robust in multi-business firms and not an artifact of the data or the regression specification. Furthermore, our results are consistent with the notion that the relative size effect is driven by a decision bias at the corporate level of firms.

Insert Table 4 here

V. The cognitive account

Studying the impact of the relative size of business units allows us to distinguish traditional agency accounts of inefficient capital allocation from our proposed cognitive account. Note that business unit size is not included in any models that attribute inefficiency to agency conflicts between headquarters and rent-seeking managers. For example, Scharfstein and Stein's (2000) key point is that managers of *weaker performing* divisions have a higher incentive to engage in rent-seeking behavior. However, such models cannot explain why managers of *relatively smaller* divisions would have a higher incentive to rent-seek. In fact, relatively smaller divisions often have an excellent set of investment opportunities that would make their managers much less inclined to lobbying. Moreover, one could argue that relatively larger divisions should, on average, get a larger share capital investment because their managers would naturally have more clout within the corporation. Thus, whereas the agency account would predict no effect of relative size in capital allocations (or, if anything, an advantage for relatively larger divisions), the cognitive account predicts an advantage for relatively smaller divisions. Furthermore, none of the managers we spoke with granted the core of the agency-based corporate socialism hypothesis

–that under-performing business unit's leaders may shirk if not provided with additional funds- any merit.

To date, very little research has attributed inefficient allocation of capital to biases in managerial cognition. In one of those few efforts, Ross and Staw (1993) and Heath (1995) discuss escalation of commitment, the bias to continue investing in projects beyond the point at which expected benefits exceed expected costs, in essence throwing "good money after bad". Such behavior is attributed in part to a tendency to inappropriately incorporate sunk costs into decisions about the future (Arkes & Blumer, 1985). Another isolated study of managerial biases affecting investment decisions is Camerer and Lovallo (1999) showing in a number of experiments that individuals suffer from "competition neglect", a form of overconfidence that leads them to overestimate their chances of successfully entering a new market. This phenomenon may underlie the observation of excessive entry in certain industries (Dunne et al, 1988).

We propose that the relative size effect documented in the previous sections is caused by a bias of financial decision makers to naïvely diversify capital allocations among all businesses in the firm, just as employees have been found to exhibit a bias toward even allocation over investments offered in 401(k) plans (Benartzi & Thaler, 2001). This tendency to allocate money evenly over investment options appears to be a manifestation of a more general cognitive tendency to allocate money, choices from a menu, and beliefs evenly among the options, attributes, and possible events that have been identified (for a review see Fox, Bardolet & Lieb, 2005).

The notion that capital allocation in multi-business firms might be perturbed by naïve diversification was first proposed by Bardolet, Fox and Lovallo (2011). In that paper the authors

explore the notion that if firms are biased toward investing $1/n$ of capital to each of the n businesses, then capital allocated to a target business will decrease as the number of other businesses in the firm increases (i.e., as n increases), holding other relevant factors constant. For instance, in one study, participants in an Executive MBA program were asked to allocate investment capital to businesses of firm with three product divisions (Home, Beauty, and Health products). The Home division had three geographical subdivisions (U.S., Europe and Latin America), the Beauty division had two (U.S. and Europe) and the Health division had only one (U.S.). Half of the participants were asked to make the allocation at the divisional level (three product divisions) and half were asked to make it at the subdivision level (a total of six subdivisions). Mean allocations accorded quite closely with the naïve diversification prediction (a bias toward 1/3 for allocation to the three product divisions and 1/6 for allocation to the six business units). For example, this led participants to allocate much less money to the same business (Health – U.S.) when allocating to six business units than when allocating to three divisions (recall that an allocation to the Health product division is tantamount to an allocation to the Health – U.S. business unit). Taken together, their results establish the possibility of corporate managers naively diversifying their allocations over all businesses in the firm.

The relative size effect documented in this paper expands on the potential consequences of naïve diversification in capital allocation. That is, in a firm with business units of different size, managers will have a tendency to smooth out those differences when making the allocations. This will result in an additional advantage by smaller units that is not justified on rational grounds. Moreover, such tendency to treat small and big units more equally might be reinforced by the common idea that larger units are often cash cows, destined to support the smaller units that are growing within the firm. Just like Bardolet, Fox and Lovallo (2011)

presented experimental evidence on how the number of business units in a corporation influences the final allocations, here we present a simple experiment that shows how naïve diversification applied to business units of different size affects final allocations. We asked business students to perform an allocation task on a hypothetical firm with two divisions. As shown in Figure 1, participants in the two conditions of the experiment were provided with exactly the same information about the two divisions, which was such as to strongly suggest a "seed business"/"cash cow" situation. Moreover, participants in both conditions were asked to allocate the same amount of capital, namely $100 million. The only variable we manipulated from one condition to the other was the relative size of the target division, which was 40% of the total firm in Condition 1 and 20% in Condition 2. The results in Table 5 replicate the relative size effect observed in the field data. When the relative size of the target business unit is smaller (Condition 2), people invest proportionally more capital (as shown by the difference between participants' mean allocation and the small unit's relative size, which is significantly larger at the 1% level in Condition 2). It is also worth noting that the overwhelming majority of participants in the survey explained their decision in terms of taking money from a "cash cow" and giving it to a fast-growing "seed" business, a rationale that is perfectly defensible on rational grounds in this situation. However, this "rational" heuristic does not justify the different allocation between the two conditions. These results support our claim that naïve diversification in firms with business units of significantly different size makes a rationally sound heuristic become biased.

Insert Table 5 here

VI. Discussion

When making capital allocation decisions, managers seek guiding measures that allow them to distinguish among the available options. Standard investment theory teaches managers to use financial tools (e.g., net present value, internal rate of return, payback period, real option valuation, etc.) as those guiding measures. In fact, surveys of managers have shown that they believe that they use such measures to guide their decisions. Graham and Harvey (2001) report that around 75% of the surveyed managers claim to be using NPV and IRR methods in their assessments. Moreover, in private interviews with managers in charge of allocation decisions we have observed that many of them claim to mainly use the business unit past growth and profitability as criteria for basing future allocations. The results in this paper provide a more refined view of these claims. On one hand, we can say that managers do take business unit's growth, profitability and Tobin's Q into account when making allocations (as shown by the positive effects our control variables). However, managers in multi-business firms are forced to perform comparisons among the units over which to allocate. Such comparisons are difficult to make due to a number of cognitive and social factors (informational asymmetries between headquarters and units, reputational issues, unrelatedness among the business units, etc). Therefore, corporate managers must often rely on heuristics other than growth and profitability to make capital allocations. Some of these heuristics might be conscious and grounded in traditional managerial wisdom (e.g, "milk the cash cow in order to fund the future star businesses") and some others might just operate at a more unconscious and automatic level.

In this paper we provide additional support to Bardolet, Fox and Lovallo's (2011) hypothesis that naïve diversification plays a significant role in determining how much capital each business unit receives. In particular, we find that a heuristic of reallocating capital from larger to smaller

units is useful in explaining the relative size effect that we observe in multi-business firms. We find that managers in multi-business firms increasingly bias their allocations in favor of smaller business units as the difference in size between those units and the rest of the firm increases. Moreover, this effect is not moderated (in fact, it is accelerated) by the smaller business unit's growth rate, profitability rate or Tobin's Q. This effect is also independent of the absolute size of the target business unit and cannot be completely attributed to young and small businesses that are being "groomed" by the corporation. This constitutes a novel instance of the heuristics-based account of inefficiencies in corporate allocations, as well as a test of the robustness of Bardolet, Fox and Lovallo's (2011) findings. One could argue that naively diversifying over business units of diverse quality is just a consequence of the manager's inability to accurately assess that quality. On the other hand, naively diversifying over units of different size is much harder to justify in cognitive terms given how easy it is to allocate proportionally.

On the theoretical side, the notion that corporate financial managers are biased toward even allocation of capital across all business units is a simpler account for previous results on cross-subsidization proposed in the corporate finance literature, as it covers a wider range of allocation inefficiencies than those that can be readily explained by agency models. For example, some agency-based models (Scharfstein & Stein, 2000) posit that the CEO is biased toward giving allocating more capital to the poorly performing business unit because of its higher lobbying potential. However, this accounts makes no prediction about whether having a larger size relative to the rest of the firm influences the final allocation, an empirical regularity documented in this paper. If anything, a straightforward agency-based account would suggest that managers of larger divisions within a firm should have more political clout in the budgeting process and thus should command larger marginal allocations than the smaller divisions, which

is the opposite to what we find in our data. Similarly, the influence cost model proposed by Rajan et al. (2000) makes no prediction about the effect of relative size on capital allocations. In that model, incentives are set in order to reach some kind of "collaborative" investment decision on the part of business unit managers and, as a consequence, final allocations are more "socialized" than the optimal first-best solution. However, it is important to note that our results do not rule out the possibility that political and social factors contribute to the "smoothing out" of capital allocations. For instance, a "fairness"-based account, where the CEO is compelled to allocate an equal "minimum" amount to each one of the business units simply because they are part of the firm, might also contribute to the phenomenon observed in our study.

There are a number of directions one can take to further the research question of the paper. First, although our results document a systematic inefficiency in corporate resource allocation that is consistent with a bias toward even allocation, it does not provide a full account of this bias. For one thing, like other studies of naïve diversification, we do not provide an explanation of the specific cognitive factors that mediate this bias. For another, there may be additional cognitive and social factors that affect lower levels of organizations that contribute to the observed bias in firms' investment behavior. Second, the COMPUSTAT segment data on which we relied has a number of well-known limitations, one being the sometimes inconsistent reporting of segment information by the firms in the sample. Although we took steps to minimize some of those reporting issues, there is remains a certain amount of inherent measurement error. The use of alternative databases that can provide more accurate measurements of organizational structure would help strengthen our findings. Recent papers by Guedj and Scharfstein (2005), Khanna and Tice (2001) show the benefits of analyzing industry-specific data sets and of having a specific industry context in which to interpret the results.

Third, and more interesting, we believe there could be additional cognitive biases in capital allocation worth investigating in further studies. For example, the total amount of capital that a business unit has received in the past may influence current allocations in a way that goes well beyond normal simple correlation. Organizational inertia can reduce a firm's ability to expeditiously and appropriately redistribute in response to strategic challenges that a firm faces. A brief examination of our sample reveals extremely high serial correlations between in business units' shares of a company's total capital allocations. For example, the correlation between the allocation shares of 1993 and 1994 is 0.86. More interestingly, the correlation between allocation shares of 1993 and 1997 is 0.75 and between the shares of 1993 and 2001 is 0.66. These numbers suggest that corporations are very slow in changing the allocation balance among their business units. Such inertia regarding the budgeting process could in fact be connected to a cognitive bias known as "anchoring" in which the past allocations serve as a starting point for the allocation process and, due to insufficient adjustment, end up accounting for most of the current ones (e.g., Tversky & Kahneman, 1974; Chapman & Johnson, 2000).

Finally, we remain open to the possibility that additional competitive and organizational factors induce different allocation behaviors on by managers. For instance, in Rajan et al. (2000), inefficient capital transfers increase when segments are more diverse in their total investment opportunities. Ozbas and Scharfstein (2010) find that socialism is more common when management has a small equity stake, suggesting that weak monitoring contributes to poor investment choices. 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 a remarkable robustness of the relative size effect across different cross-sections of our sample, it would be interesting to identify factors that tend to moderate (or exacerbate) the effect.

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Table 1

Descriptive Statistics and correlations

	Mean	St. dev.	Min	Max
Tobin's Q	1,4841	0,4917	0,4994	8,9621
BU Cashflow to sales	0,1401	0,1953	-2,7019	11,8310
BU Growth	-0,0106	0,1485	-0,9992	0,9841
BU Return rate	0,0868	0,1229	-1,1389	1,8943
Industry Investment	0,0061	0,0261	-0,4866	0,5931
Restrel	0,1883	0,3125	0,0000	0,9966

Correlation Matrix

	Tobin's Q	BU Cashflow to sales	BU Growth	BU Return rate	Industry Investment	Restrel
Tobin's Q	1					
BU Cashflow to sales	0,0659	1				
BU Growth	0,0563	0,3896	1			
BU Return rate	0,0596	0,5932	0,7352	1		
Industry Investment	-0,0281	0,2697	-0,0114	0,1231	1	
Restrel	-0,0543	0,0359	0,1049	0,0771	-0,0311	1

Table 2

Relative Size and Investment

Observations are by segment and year (Compustat segment fields, 1989-2004). Dependent variable is capital spending over lagged segment assets. Industry is defined at the level of 3-digit SIC code. Tobin's Q in a given year is the median bounded Q of stand-alone firms in that business unit's industry. DIV is a dummy that takes value 1 if the target business unit belongs to a multi-business firm. Relative Size is one minus the percentage of unit assets over firm assets. BU Cashflow to sales is the ratio of business unit's cashflow (operating profit plus depreciation) over sales. Both models below include business unit and year dummies (coefficients not reported). t-statistics are shown below each coefficient and are corrected for clustering at the firm level.

	Model 1	*Model 2*
Tobin's Q	0,0126	0,0126
	9,44	9,45
Tobin's Q x DIV	-0,0029	-0,0031
	-2,19	-2,21
DIV	0,0078	0,0064
	3,59	2,28
Restrel		0,0035
		2,29
BU Cashflow to sales	0,0383	0,0382
	8,57	8,54
BU Cashflow to sales x Div	-0,0361	-0,0359
	-5,58	-5,57
Intercept	0,0792	0,0781
	3,21	3,29
Business Unit F.E.	Yes	Yes
Year F.E.	Yes	Yes
Adj. R-squared	0,11	0,12
# observations	57853	57853

Table 3

Relative Size and Investment

Observations are by segment and year (Compustat segment fields, 1989-2004). Dependent variable is capital spending over lagged segment assets. Industry is defined at the level of 3-digit SIC code. Tobin's Q in a given year is the median bounded Q of stand-alone firms in that business unit's industry. DIV is a dummy that takes value 1 if the target business unit belongs to a multi-business firm. Relative Size is one minus the percentage of unit assets over firm assets. BU Growth is the exponentially-adjusted sales growth rate for the previous 3-year window. BU Return rate is the 3-year average ratio of business unit's operating profit over sales. Industry Investment is the median of the dependent variable for the target business unit's industry. All models below include business unit and year dummies (coefficients not reported). t-statistics are shown below each coefficient and are corrected for clustering at the firm level.

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*
Tobin's Q	0,0039	0,0039	0,0036	0,0037	0,0039
	2,34	2,34	2,21	2,21	2,39
Tobin's Q x DIV	-0,0011	-0,0012	-0,0008	-0,0009	0,0004
	-0,72	-0,76	-0,53	-0,58	0,22
DIV	-0,0002	-0,0002	-0,0009	-0,0003	-0,0025
	-0,1	-0,11	-0,34	-0,14	-0,82
Restrel		0,0052	0,106	0,0064	0,0116
		2,87	4,66	3,68	2,25
BU Growth	0,0672	0,0668	0,0622	0,0733	0,0671
	18,36	18,28	18,11	16,74	18,36
BU Return rate	0,0536	0,0539	0,0623	0,0529	0,0537
	10,53	10,59	11,45	10,32	10,53
Industry Investment	0,8033	0,8039	0,8027	0,8037	0,8033
	16,56	16,56	16,57	16,58	16,57
Restrel x BU Growth			-0,0339		
			-2,97		
Restrel x BU Return rate				-0,0563	
				-3,21	
Restrel x Tobin's Q					-0,0044
					-1,36
Intercept	-0,0082	-0,0082	-0,0085	-0,0083	-0,0084
	-2,63	-2,63	-2,71	-2,65	-2,67
Business Unit F.E.	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0,186	0,187	0,187	0,187	0,187
# observations	33659	33659	33659	33659	33659

Table 4

Real firms vs. Virtual firms

Observations are by segment and year (Compustat segment fields, 1989-2004). Dependent variable is capital spending over lagged segment assets. Industry is defined at the level of 3-digit SIC code. Tobin's Q in a given year is the median bounded Q of stand-alone firms in that business unit's industry. Relative Size is one minus the percentage of unit assets over firm assets. BU Growth is the exponentially-adjusted sales growth rate for the previous 3-year window. BU Return rate is the 3-year average ratio of business unit's operating profit over sales. Industry Investment is the median of the dependent variable for the target business unit's industry. All models below include business unit and year dummies (coefficients not reported). t-statistics are shown below each coefficient and are corrected for clustering at the firm level.

	real firms	*virtual firms*
Tobin's Q	0,0013	0,0008
	0,73	0,43
Restrel	0,0046	0,0029
	2,45	1,61
BU Growth	0,0426	0,0409
	8,37	7,8
BU Return rate	0,0349	0,0311
	3,81	3,37
Industry Investment	0,7613	0,7585
	9,39	9,22
Intercept	-0,0061	-0,0038
	-1,57	-1,01
Business Unit F.E.	Yes	Yes
Year F.E.	Yes	Yes
Adj. R-squared	0,162	0,171
# observations	15319	15319

Table 5

Capital allocation task (low vs high relative size)

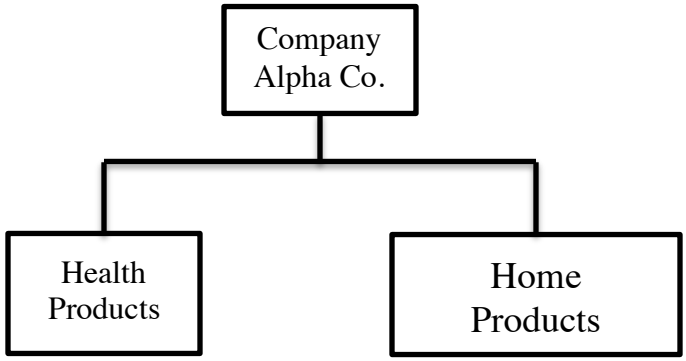
The first two rows indicate the information given to participants regarding the two business units' growth and profitability rates. Relative size of each unit is given in the third row whereas participants' means allocations in each condition are shown in the fourth row. The last row indicates the difference between mean allocations and relative size.

	Condition 1		**Condition 2**	
	Lower Restrel		Higher Restrel	
	Small Unit	**Big Unit**	**Small Unit**	**Big Unit**
Growth Rate	21.6%	1.4%	21.6%	1.4%
Return Rate	3.1%	11.7%	3.1%	11.7%
Relative size	0,400	0,600	0,2	0,8
Mean allocations	0,612	0,388	0,534	0,466
Difference	0,212		0,334	

Figure 1

Capital allocation task (low vs high relative size)

Condition 1: Lower relative size



Condition 2: Higher relative size