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CORPORATE CAPITAL ALLOCATION: A BEHAVIORAL PERSPECTIVE

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Previous research on capital investment has identified a tendency in multibusiness firms toward cross-subsidization from well-performing to poorly performing divisions, a phenomenon that has previously been attributed to principal-agent conflicts between headquarters and divisions (Stein, 2003). In this paper, we argue that cross-subsidization reflects a more general tendency toward even allocation over all divisions in multibusiness firms that is driven, at least in part, by the cognitive tendency to naïvely diversify when making investment decisions (Benartzi and Thaler, 2001). We observe that this tendency also leads to partition dependence in which capital allocations vary systematically with the divisions and subdivisions into which the firm is organized or over which capital is allocated. Our first study uses archival data to show that firms' internal capital allocations are biased toward equality over the number of business units into which the firm is partitioned. Two further experimental studies of experienced managers examine whether this bias persists when participants are asked to allocate capital to various divisions of a hypothetical firm. This methodology eliminates the possibility of agency conflicts. Nevertheless, allocations varied systematically with the divisional and subdivisional structure of the firm and with a centralized or decentralized capital allocation manner. Copyright © 2011 John Wiley & Sons, Ltd.

INTRODUCTION

Perhaps the most important decisions made by top managers concern how to allocate investment resources among various business opportunities. In companies with multiple divisions, managers have the ability to shift capital between business units in order to fund the best opportunities, thus creating 'internal capital markets' (Stein, Scharfstein, and Gertner, 1994; Lang and Stulz, 1994). In this respect, top managers act as investors evaluating business opportunities within the company. Given the important role capital allocation plays in business strategy (see, e.g., Bower, 1970; Gilbert and Bower, 2005; Peteraf, 1993; Dierickx and Cool, 1989), it is surprising that this topic has received relatively little attention in the empirical strategy literature. A small number of finance papers are concerned with the question of whether internal capital markets allocate money efficiently. Some authors have explored the role of incentives, advancing theoretical agency models (e.g., Harris and Raviv, 1996; Scharfstein and Stein, 2000). Others have investigated the financial criteria, such as net present value and hurdle rates, on which managers reportedly rely when making budget decisions (Graham and Harvey, 2001). The purpose of this article is to offer a

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new, cognitive perspective on capital allocation decisions.

Recent research in corporate finance has documented robust empirical anomalies in capital allocations by firms (for a review, see Stein 2003). In particular, several studies suggest that large multibusiness firms engage in cross-subsidization of weaker divisions by stronger divisions. Berger and Ofek (1995) examined a sample of more than 3,000 diversified firms and documented overinvestment in divisions with limited opportunities and cross-subsidization of poorly performing segments by better performing ones. Likewise, Ozbas and Scharfstein (2010) examined a large sample of multibusiness corporations and found that divisions in high-performing industries tend to receive less investment than their industry stand-alone counterparts, while divisions in poorly performing industries tend to receive more investment than their stand-alone counterparts.

Previous explanations for the subsidization of underperforming divisions rely on the assumption that there are principal-agent conflicts within firms. Managers are depicted as rent-seeking agents who actively lobby the CEO in order to attract more resources, compensation and power (Meyer, Milgrom, and Roberts, 1992). In particular, Rajan, Servaes, and Zingales (2000) propose a model in which the CEO (acting on behalf of shareholders) minimizes incentives for rent seeking by pursuing a policy of spreading capital across all divisions of the firm. Their model assumes that if there is less competition for resources among those divisions, then division managers are more likely to favor investments that enhance the profits of not only their own division but also other divisions (for similar models, see Wulf, 2005; Bernardo, Luo, and Wang, 2006).

Likewise, Scharfstein and Stein (2000) depict division managers as rent-seeking agents, in this case allocating effort between running their divisions, which tends to enhance firm profit, and lobbying the CEO, which tends to attract divisional resources at the expense of firm profit. Meanwhile, the CEO acts herself as a rent-seeking agent who uses capital allocation as a substitute for other forms of compensation (e.g., salary, perks) to division managers. Thus, by diverting capital from well-performing divisions (in which managers receive a better return for their effort managing than lobbying even when they receive less capital) to poorly performing divisions (in which managers would otherwise have a stronger incentive to lobby than manage), the CEO can conserve discretionary funds for more attractive personal uses.

A third class of agency conflict models focuses on informational asymmetries between division managers and headquarters (Harris and Raviv, 1996; Harris and Raviv, 1998; Bernardo, Cai, and Luo, 2004). These models contend that rent-seeking managers have an incentive to exaggerate their divisions' prospects in order to obtain larger allocations than can be legitimately justified, because the true expected value of those prospects will not be clear to the CEO in the short run. The CEO, lacking private information on the expected value of these investments and lacking resources to carefully audit every request for funds, sets a compromise initial common allocation that is 'generous' for less promising projects and 'stingy' for more promising projects. Managers who are underfunded can then request additional capital from the CEO.

In this paper we propose a simpler account of the observation that corporations overinvest in underperforming divisions and underinvest in overperforming divisions. Our account does not require assumptions of principal-agent conflicts or informational asymmetries. Instead, we argue that executives (and teams of executives) who make allocation decisions are susceptible to a commonly observed, not necessarily conscious, cognitive bias toward even allocation. This bias could arise from a variety of mechanisms: (1) a tendency to automatically anchor on even allocations as a natural starting point and then adjust insufficiently in response to differentiating factors; (2) a visceral tendency to 'play it safe' by hedging toward even allocations; and/or (3) overgeneralization of the principle that it is wise to diversify.

Bias toward even allocation has been observed in numerous studies of decision making and judgment. Employees enrolled in defined contribution retirement savings plans tend toward 'naïve diversification' over investment instruments that are offered (Benartzi and Thaler, 2001; see also Samuelson and Zeckhauser, 1988; Langer and Fox, 2011). Organizational actors often rely on an 'equality heuristic,' allocating benefits and burdens relatively evenly among members of a group (e.g., Messick, 1992). Consumers tend to seek variety over all consumption options or categories of consumption options that have been offered (Read and

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Loewenstein, 1995) and tend to allocate financial aid and charity relatively evenly over the groups of individuals or beneficiaries that are identified as possible recipients (Fox, Ratner, and Lieb, 2005). Similarly, experts in decision analysis are biased toward assigning equal probabilities over all identified events that could occur (Fox and Clemen, 2005), and business students applying multiattribute utility analysis tend toward assigning equal weight to all attributes that are identified (Weber, Eisenführ, and von Winterfeldt, 1988). Likewise, equilibrium prices in binary option and experimental asset markets tend toward equal values over all exclusive and exhaustive events that are traded (Sonnemann *et al*., 2011).

Our account of cross-subsidization as a manifestation of a cognitive bias rather than agency conflict yields two unique predictions. First, we expect to see management underweight not only differences in the quality of available investment opportunities among a firm's business units as has been the focus of previous investigations (e.g., Ozbas and Scharfstein, 2010), but also other factors that would generally dictate uneven distributions among a firm's business units, such as differences in past performance or even differences in relative size of divisions. Second, this tendency toward even allocation should persist even when budget decisions are made by individuals with properly aligned incentives and complete information so that the aforementioned agency models no longer apply.

In this paper, we test the first prediction using archival data. In particular we explore whether there is a general tendency to spread capital over all divisions more evenly than would be dictated by not only the quality of each division's investment prospects, as others have found, but also other relevant variables such as division size, industry, and various business unit characteristics. We test the second prediction using experiments. In particular we examine whether naïve diversification persists when experienced managers make hypothetical capital allocations in an environment stripped of complicating organizational context that could give rise to rent-seeking behavior.

Determining the causes of cross-subsidization is important for a number of reasons. First, it allows us to more accurately predict conditions under which allocations are likely to be biased, in which direction, and to what extent. Second, it can help us develop more effective corrective procedures. For instance, to the extent that we attribute cross-subsidization to internal politics, then firms might develop organizational and/or incentive mechanisms that moderate corporate lobbying or divisional managers' misrepresentations of their business unit's investment opportunities. On the other hand, to the extent that we attribute cross-subsidization to a more general cognitive bias of individual managers, the firm might develop decision analytic tools or organizational routines (Heath, Larrick, and Klayman, 1998) to help them ameliorate this bias.

In order to clearly demonstrate bias toward equal allocation, one must establish that the observed allocation is more equal than some normative standard of an ideal distribution of capital. The field studies reviewed earlier rely on strong methodological assumptions; for example, the notion that divisions embedded within multibusiness corporations are comparable to stand-alone peers. They also rely on strong behavioral assumptions; for example, that managers can be viewed as primarily rent-seeking agents. In our study of archival data we investigate the impact of a variable that should not affect allocations to a target division: the total number of business units into which the firm is divided, while controlling for relevant variables that might reasonably dictate allocation to each business unit (e.g., profitability, growth, size, future investment opportunities). Thus, we invoke the weaker normative assumption that capital allocated to a target division should not be affected by the number of business units into which the firm has been partitioned. In contrast, a cognitive bias toward even allocation predicts that holding relevant characteristics of the firm constant, capital allocated to the target division will decrease with the total number of business units into which the firm is divided. For example, we predict that, *ceteris paribus*, a division in a firm with three business units will receive a lower allocation than that same division would in a firm with two business units.

In our experimental studies, we are able to exert greater control by holding firm characteristics constant and manipulating only the number of divisions over which participants are asked to allocate capital. We perform these experiments by presenting different groups of experienced managers with identical information concerning divisions within a hypothetical firm that is hierarchically organized in different ways for different groups of participants

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(e.g., by geographic region then product division or by product division then geographic region) or by asking them to allocate capital to different levels in the hierarchy (by division or subdivision). We predict that executives' allocations will differ systematically with these partitions of the firm.

To illustrate, consider a simple firm with three business units, one operating in the U.S., one in Europe, and one in Asia. Our cognitive account predicts that if a manager is asked to allocate among three divisions, the final distribution will be biased toward one-third for each business unit. Now suppose, instead, that a manager is asked to allocate first between the domestic division (U.S.) and the international division (Europe and Asia), then later allocate international funds between the European business unit and Asian business unit. Our cognitive account predicts a bias toward one-half of capital allotted to the U.S. business unit (all of the domestic allocation) and one-quarter to each of the European and Asian business units (half to the international business units). We refer to this tendency for allocations to vary systematically with the suggested grouping of different investment projects or business units as 'partition dependence.'

The rest of this paper is organized as follows: the next section presents analysis of archival data to see whether capital allocations to target divisions decrease with the number of business units into which the firm is partitioned. We then present experimental evidence of partition dependence in capital allocation decisions. Experiment 1 explores whether the allocation procedure (centralized versus decentralized) gives rise to partition dependence. Experiment 2 examines whether the organizational structure of the firm (geographic divisions and functional subdivisions versus functional divisions and geographic subdivisions) gives rise to partition dependence. Finally, we close with a general discussion of these results.

FIELD EVIDENCE

As we have mentioned, a small number of corporate finance studies have provided evidence of cross-subsidization by analyzing archival data collected from large samples of firms and business units. In this section, we analyze a similar dataset to see whether there is evidence of a more general pattern of naïve diversification. Our approach is to examine whether the number of business units into which the firm is partitioned has an effect on the investment in the target business when we control for all of the relevant business unit, firm, and industry variables. Thus, we test whether two businesses that have similar size, belong to similarly sized firms, and operate in the same industry will nevertheless receive different allocations depending on the number of units into which the firm has been organized.

To illustrate this prediction, consider two firms depicted in Figure 1a. In both cases, the assets of the target business units (represented by the horizontal dimension) are the same and the aggregate assets of the remaining business units in each firm are also the same. The only difference is the number of business units into which the firms have been partitioned, with Firm A consisting of two business units and Firm B consisting of four business units. Assuming these firms attract approximately the same total amount of investment capital and the target business units are comparable in most relevant respects, the naïve diversification account predicts that the capital allocation to the target division will be biased toward one-half for Firm A and one-quarter for Firm B.

A cognitive bias toward even allocation also makes a secondary prediction. Holding the size of the target division constant, its allocation will increase with the size of the rest of the firm. This is because the total pool of investment resources generated by the firm will generally increase with its size.

To illustrate this point, consider the two firms depicted in Figure 1B. In both cases, the assets of the target business units are the same and both firms have the same number of business units. The only difference is that the aggregate assets of the remaining business units are larger for Firm A than Firm B. Assuming that the target business units are comparable in most other relevant respects, our naïve diversification account predicts that capital allocated to the target division will be biased toward one-half in both cases. Thus, the allocation will be larger to the target business unit in Firm A than Firm B because Firm A will merit more total capital to be allocated.

Note that this relative size analysis also helps us distinguish our new cognitive account of inefficient allocation from the previously articulated agency accounts. The size variable is not included in models that attribute inefficiency to agency

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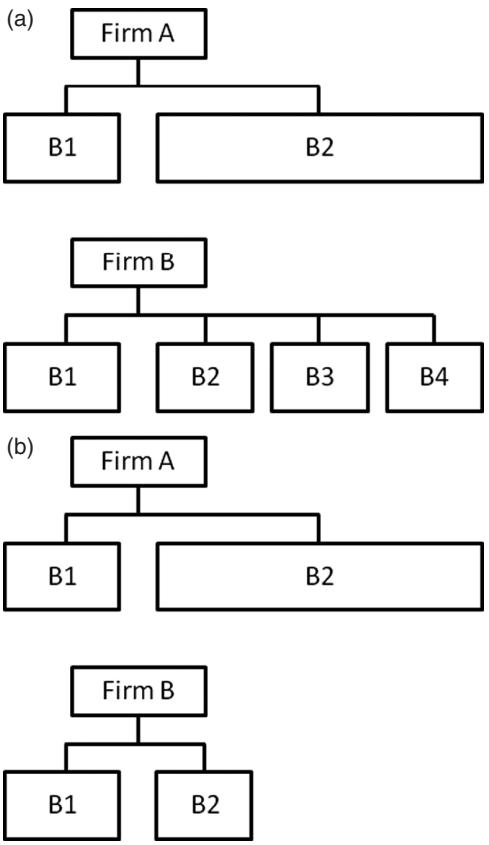

Figure 1. A schematic illustration of tests of naive diversification in capital budgeting.
Figure 1a illustrates the effect of the number of business units (numbered B1, B2, B3 and B4) and Figure 1b illustrates the effect of the relative size of the rest of the firm (represented by the width of business units)

conflicts between headquarters and rent-seeking managers. For example, Scharfstein and Stein's (2000) key point is that managers in *weaker* divisions have a greater incentive to engage in rent-seeking behavior. However, it is not clear that managers of *smaller* divisions would also have a higher incentive to rent seek. Thus, unlike previous accounts, our cognitive account predicts subsidization not only of weaker divisions by stronger divisions, but more generally subsidization of divisions that are less deserving of capital by any measure (including relative size) by more deserving divisions.

Data and method

To test our predictions, we obtained a large sample of segment financial data from the COMPUSTAT database. One well-known limitation of COMPUSTAT segment data is the different criteria used by firms in deciding what constitutes a business unit. Moreover, the same firm might assign business units to segments differently over time. We decided to use a unifying criterion to avoid this problem. We used Standard Industry Classification (SIC) codes to aggregate reported segments at the three-digit SIC code industry level. Thus, in our sample a firm has as many business units as industries at the three-digit level. We note that consolidating segments using SIC codes is common in other segment-based studies of capital investment (e.g., Lamont, 1997; Ozbas and Scharfstein 2010). We confined our analysis to a 19-year period (1979 to 1997), which spans the beginning of the COMPUSTAT segment database until the industry code designations were changed in 1998. We also limited our sample to nonfinancial business units.[1] This left us with 7,432 business unit-years from 638 multibusiness firms (average number of business units = 2.82, range = 2 to 10). Table 1 shows basic sample statistics.

Our dependent variable was capital expenditures by each business unit i belonging to corporate parent j for each year t, normalized by business unit lagged assets ($\text{Capx}_{ijt}/\text{Asset}_{ijt-1}$). Our independent variables included the proportion of sales that the focal business unit represents within the firm (SALESHARE), the total number of business units in the target firm (N_{jt}), and a vector of dummy variables corresponding to year fixed effects. Moreover, we included several variables that control for the perceived 'attractiveness' of a particular business unit. Specifically, we control for the growth rate of each business as the slope coefficient of a five-year moving window exponential function of business unit sales.[2] We control for differences in profitability by using an estimate of the business unit's rate of return, measured as the operating profit minus the cost of

[1] Including financial firms in the sample does not significantly alter our main results, though we think the relationship between investment and assets in those firms is fundamentally different than the one in the rest of the economy. Similar treatment of financial industries can be found in the related literature (e.g., Ozbas and Scharfstein, 2010).

[2] For each business unit-year, we fitted an exponential curve using the sales figures of the five years previous to the current year and used a simple linear regression to obtain the slope coefficient of that curve. This procedure reduces the noise contained in the yearly business unit sales figures reported by COMPUSTAT.

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Table 1. Summary statistics

Variables	Mean	Median	St. dev.	Min	Max
Investment (dep. var.)	0.106	0.060	0.132	0	4.99
Tobin's Q	1.110	1.018	0.381	0.50	5.88
BU growth	0.071	0.052	0.243	−1.77	4.95
Industry investment	0.064	0.054	0.053	0	1.47
BU profitability	−0.025	0.016	0.365	−4.72	14.30
Saleshare	0.423	0.354	0.310	0.01	1.00
N	2.848	3.000	1.125	2	10.00
Diversification	0.695	0.698	0.188	0	1
Firm cash flow	3.720	3.801	1.671	−4.97	4.99

Correlation matrix

	1	2	3	4	5	6	7
Tobin's Q	1						
BU growth	0.039	1					
Industry investment	−0.230	0.037	1				
BU profitability	0.004	0.089	−0.017	1			
Saleshare	−0.009	0.085	0.054	0.016	1		
N	−0.057	−0.029	0.018	0.007	−0.366	1	
Diversification	0.021	−0.002	0.041	−0.017	0.417	−0.463	1
Firm cash flow	0.006	0.079	0.016	−0.011	−0.125	0.311	−0.089

assets, all normalized by sales. We also included a control for the typical level of investment that businesses receive in the target industry. We measure this as the (lagged one period) median of our dependent variable (capital spending over assets) for all businesses in the target industry defined at the three-digit SIC code level. As an additional control for the quality of the investment opportunities available to each business unit in the sample, we include an estimate of Tobin's Q in the regression. Tobin's Q is a standard proxy for the quality of a firm's investment prospects, generally calculated as the ratio of the market value of a firm to the book value of its assets.[3] Because it is not possible to obtain Tobin's Q for each segment directly, we computed the median Q for all the stand-alone firms in each industry (at the three-digit SIC code level) and assigned them to each business unit in a multibusiness firm as proxy values of Q. Finally, we used firm cash flow (normalized by firm sales) as a control for systematic differences in the amount of capital available across firms.

Results

Table 2 (Models 1, 2, and 3) presents results of the aforementioned regression for our sample. First, as expected, investment increases significantly with business unit growth, as well as industry median investment. Second, there is a positive effect of Tobin's Q on business unit investment, a result that is consistent with previous studies that explore this relationship (e.g., Ozbas and Scharfstein, 2010). Third, and most central to the present analysis, we observe that investment in the target business unit decreases as the number of business units in the firm increases. This result reflects 'partition dependence' in capital allocation and was predicted by our cognitive account in which managers tend toward naïve diversification of capital expenditures over business units. Finally, also as predicted by our cognitive account, investment increases with the size of the rest of the firm relative to the target business unit. This result reflects the fact that as the rest of the firm grows, so does the available pool of investment resources

[3] In our study, we follow Kaplan and Zingales (1997) by calculating stand-alone firm's Q as MarketValue/(0.9 × BookValue + 0.1 × MarketValue), where the book value of assets equals COMPUSTAT item 6 and the market value of assets equals the book value of assets plus the market value of common equity less the book value of common equity (item 60) and balance sheet deferred taxes (item 74). This simple market to book ratio differs from the standard definition of Q in that it does not estimate the replacement value of assets nor does it adjust for taxes. Previous studies have shown that these adjustments are not essential (Perfect and Wiles, 1994).

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Table 2. Estimating the effect of N on investment
The dependent variable is yearly business unit capital expenditures over lagged business unit assets. Tobin's Q in the regression is the median Q for all the stand-alone firms in each business unit's industry (at the three-digit SIC code level). BU growth rate of each business is measured as the slope coefficient of a five-year moving window exponential function of business unit sales. Industry investment is measured as the (lagged one period) median of our dependent variable (capital spending over assets) for each industry defined at the three-digit SIC code level. BU Profitability is measured as the operating profit of a business unit minus the cost of its assets, all normalized by business unit sales. Firm Cash flow is the logarithm of total firm cash flow. Saleshare is the proportion of sales that each business unit represents within its firm. N is the total number of business units in each focal business unit's firm. Diversification is the 'specialization ratio' proposed by Rumelt (1974), measured as the proportion of sales that the largest business in the focal business unit's firm represents. Coefficients for the time dummies are not reported. All regressions include controls for error clustering within firms

	(1)	(2)	(3)
Tobin's Q	0.027	0.008	0.006
	(5.65)**	(1.43)	(0.87)
Saleshare	−0.025	−0.019	−0.026
	(6.06)**	(3.60)**	(3.31)**
N	−0.006	−0.004	−0.004
	(6.83)**	(3.39)**	(2.42)**
Firm cash flow	0.071	0.091	0.089
	(4.58)**	(4.92)**	(4.25)**
Industry investment		0.876	0.867
		(9.95)**	(8.38)**
BU growth		0.042	0.084
		(3.84)**	(3.18)**
BU profitability		0.023	0.015
		(1.72)	(0.75)
Diversification			0.015
			(1.10)
Constant	0.167	0.027	−0.017
	(8.35)**	(1.93)*	(0.85)
Fixed effects	Year, Industry	Year, Industry	Year, Industry
Observations	15,933	15,933	15,933
Adj. R-squared	0.101	0.142	0.145

Robust t-statistics in parentheses.
* significant at 5% level; ** significant at 1% level.

that are spread over the same number of business units.

In order to control for the possibility that the effect of the number of business units is driven by firms that are diversifying their activities (and, thus, reallocate large amounts of capital from large profitable divisions to small new ones), we included a measure of specialization (Rumelt, 1974) consisting of the percentage of sales of the overall firm that the largest business represents.[4] Specifically, we were interested in seeing whether the coefficient for *N* remained unchanged in the presence of this control variable. Model 3 in Table 2 shows that this is the case, lending additional credence to our claim that the number of business units *N* affects capital allocations in a way that is not justifiable on economically rational grounds.[5]

As an additional check against the possibility that our main result is merely an artifact of the data, we established a comparison between the multibusiness firms in our sample and their stand-alone peers, using two samples. The first sample,

[4] We use this measure because most other standard diversification measures (e.g., Palepu, 1985) include the number of businesses in the firm and, thus, would correlate with our independent variable of interest (*N*).

[5] We also note that our consolidation of segments by three-digit SIC codes should moderate concern that cross-subsidization could be interpreted as a rational attempt to achieve potential synergies between segments. Defining business units at the three-digit SIC code level focuses our analysis on businesses that are more 'unrelated' to each other than if we had defined them as COMPUSTAT segments, which makes potential synergies less plausible.

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which we call 'real,' is made up of multibusiness firms in the COMPUSTAT files in the years mentioned. The second sample, which we call 'virtual,' was obtained by randomly selecting, for each of the business units in the real sample, a COMPUSTAT single-segment firm of similar size in the same industry.[6] Thus, the virtual sample matched the major characteristics of the real sample except that it lacked a layer of corporate management allocating capital over multiple business units. By construction, one would expect the number of segments *N* (and, likewise, the aggregate assets of businesses in the rest of the firm) to have no effect for the firms in the virtual sample. Using standalone firms as a benchmark for multibusiness firms is a common device in the capital budgeting literature (e.g., Berger and Ofek, 1995; Ozbas and Scharfstein, 2010). Table 3 shows the regression coefficient estimates for each sample. As expected, we observe that *N* has no effect on investment in the virtual sample, which is consistent with the notion that diversification bias requires the hand of management.

In sum, the results of our regression analysis support the present interpretation of cross-subsidization in terms of naïve diversification over business units into which a firm is organized. They extend previous observations of cross-subsidization based on divisional performance to cross-subsidization based on size and number of units. Naturally, units with better business opportunities (as reflected by higher growth and profitability rates) and larger business units (as measured by sales) tend to attract greater investment in both real and virtual firms. However, when we hold these factors constant, there is a tendency for the focal business units to attract greater investment when they share corporate membership with larger business units (so that there is more capital to spread around) and when they share corporate membership with fewer business units (so that there are fewer units with whom to share capital).

We note that the significance level of the *N* coefficient is not as striking as that of the size coefficient. We suggest that this is largely due to methodological constraints: size has a valid objective measure in terms of total assets, whereas the number of business units had to be inferred from the three-digit SIC codes (which provide an imperfect measure of the actual divisional structure that corporate managers observe when making allocations). Although the 1/*n* and relative size variables do not explain an enormous proportion of the variance in capital allocation, the proportion of variance explained is comparable to other studies of capital allocation that rely on the COMPUSTAT database (e.g, Ozbas and Scharfstein, 2010). Moreover, we expect that the magnitude of the bias toward 1/*n* will be lower in real companies than in other contexts, such as personal investment

Table 3. Real firms versus virtual firms

The dependent variable is yearly business unit capital expenditures over lagged business unit assets. Tobin's Q in the regression is the median Q for all the stand-alone firms in each business unit's industry (at the three-digit SIC code level). BU growth rate of each business is measured as the slope coefficient of a five-year moving window exponential function of business unit sales. Industry investment is measured as the (lagged one period) median of our dependent variable (capital spending over assets) for each industry defined at the three-digit SIC code level. BU profitability is measured as the operating profit of a business unit minus the cost of its assets, all normalized by business unit sales. Firm cash flow is the logarithm of total firm cash flow. Saleshare is the proportion of sales that each business unit represents within its firm. N is the total number of business units in each focal business unit's firm. Coefficients for the time dummies are not reported. All regressions include controls for error clustering within firms

	Virtual firms	Real firms
Tobin's Q	0.001	0.031
	(0.06)	(3.24)**
Saleshare	0.003	−0.039
	(1.01)	(4.27)**
N	−0.001	−0.004
	(1.61)	(2.42)**
Firm cash flow	0.002	0.065
	(3.52)**	(4.13)**
Industry investment	1.033	1.015
	(19.86)**	(10.87)**
BU growth	0.054	0.068
	(5.24)**	(3.02)**
BU profitability	0.015	0.016
	(2.05)	(1.54)
Constant	0.007	−0.019
	(1.31)	(1.12)
Observations	7,227	7,227
Adj. R-squared	0.19	0.14

Robust t-statistics in parentheses.
* significant at 5% level; ** significant at 1% level.

[6] We matched industries using three-digit SIC codes. We matched size by pairing businesses that were within 30 percent of the target business unit assets. Subject to these constraints we selected matching stand-alone business units at random.

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studied by Benartzi and Thaler (2001), for a number of reasons: (1) not all capital allocations are made simultaneously by a single individual; (2) CFOs are likely to be more sophisticated than the average 401(k) investor in Benartzi and Thaler's study; and (3) changes in divisional structure over the sample period might dilute the effect.[7]

Although the present results were predicted by our cognitive account and generalize previous findings of cross-subsidization, it may be possible to accommodate them by modifying previous accounts based on principal-agent conflicts and information asymmetries. For instance, in response to our results, one might argue that every business unit manager lobbies relatively equally regardless of unit performance or that corporate management defers relatively equally to the superior information available to managers of all business units. In order to further investigate whether cross-subsidization persists when we remove the possibility of agency conflicts, we next turn to an experimental investigation of naïve diversification and partition dependence. Experiments allow us to independently manipulate the number of business units and hierarchical structure into which the firm is partitioned, isolate managers from social/political factors, and eliminate information asymmetries.

EXPERIMENTAL EVIDENCE

In this section, we present two experimental studies that test the naïve diversification account of internal capital allocation by examining whether finance-trained executive MBA students making hypothetical budgeting decisions are susceptible to partition dependence. Studying how individuals allocate capital in a simplified environment accomplishes two goals. First, it allows us to exert greater control by holding firm characteristics constant and manipulating only the number of divisions over which participants are asked to allocate capital. Thus, these experiments test the robustness of the results described in the previous section. Second, because the experimental capital budgeting task is stripped of any social or political context, a finding of partition dependence would suggest that agency conflicts are not necessary to produce the cross-subsidization pattern. In each of our experiments, we randomly assigned executives to one of two groups and asked them to allocate capital among the business units of a hypothetical firm. Each group faced a different partition of the business units within that firm. Thus, any differences in allocation between experimental conditions would provide evidence of a bias toward even allocation without relying on any assumptions concerning normatively appropriate criteria for allocation.

Experiment 1: centralized versus decentralized allocation

In the first experimental study, we test for partition dependence using a stylized capital allocation task that mimics an important feature of real organizational budgeting: its level of centralization. Some firms are characterized by a centralized capital investment process in which headquarters determines the budgets for all investment projects throughout the firm, whereas other firms are characterized by a decentralized process in which headquarters allocates only among top-level divisions and allows divisional managers to subdivide investment resources (Bower, 1970). The present account suggests that the hierarchical level to which a manager's attention is drawn (major divisions versus business units) will influence the allocation of capital when there are a different number of business units under the major divisions. To illustrate, consider a firm in which one division is composed of three business units, one is composed of two business units, and one has a single business unit (i.e., six total business units). In this case, a bias toward even allocation in *decentralized* budgeting implies a bias toward one-third allocation to each of the three major divisions, whereas *centralized* budgeting implies a bias toward one-half allocation to the first division (i.e., one-sixth to each of the three business units that comprise it), one-third allocation to the second division (one-sixth to each of its two business units), and one-sixth allocation to the final division. We refer to the equal proportions to which allocations may be biased as 'ignorance prior' allocations because prior to learning distinguishing information about each division or business unit, even allocations might seem like a

[7] This said, it is worth noting that we found that a statistically significant bias toward $1/n$ persists even when we restrict our analysis to the quartile of firms that reported the greatest change in divisional structure, as measured by variance in the N variable.

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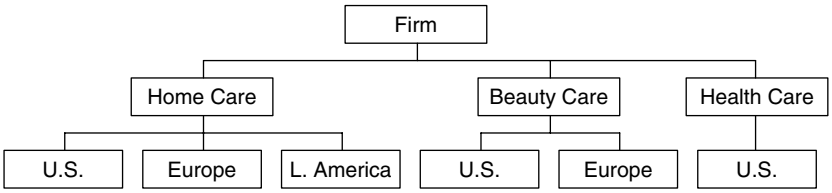

Figure 2. A schematic representation of experimental manipulations of firm partitioning in Experiment 1. Figure 2 displays the organization of the firm used in Experiment 1 in which one group of participants made a 'centralized' allocation among the six business units (Home Care-U.S., Home Care-Europe, etc.) and the other group made a 'decentralized' allocation among the three major divisions (Home Care, Beauty Care, Health Care)

natural starting point. Of course, such even allocations cannot be defended readily on normative grounds.

Method

We recruited 64 participants from the Executive MBA program at the Australian Graduate School of Management to complete a 15-minute in-class survey. As compensation, two participants were selected at random from the group to receive expensive ($100) bottles of wine. We presented participants with a four-page anonymous survey that included general instructions, information concerning the divisions of the firm, a request for a budget allocation, and a request to explain one's answers. We asked participants to complete the survey one page at a time and in the order that was given. Instructions and information concerning the company are reproduced in Appendix I.

We asked each participant to take the role of the top manager in charge of capital allocation in a hypothetical international consumer product company (see Figure 2) with three main product divisions (Home Care, Beauty Care, and Health Care). Each division was composed of a different number of geographical business units (Home Care was in the U.S., Europe, and Latin America; Beauty Care was in the U.S. and Europe; and Health Care was in only the U.S.). Respondents in the *centralized allocation* condition ($n = 32$) were asked to allocate funds directly among all six business units. Respondents in the *decentralized allocation* condition ($n = 32$), were asked to allocate capital only among the three main divisions (Home Care, Beauty Care, and Health Care).

Participants in both conditions were provided with the same two-sided information sheet that contained a brief description of each line of business and each geographical region, as well as tables with financial figures. On one side of the information sheet, data were arranged by line of business first and by geographical region second (in a hierarchical manner). On the other side of the information sheet, the order was reversed (first by region and then by line of business). The side that was facing up was randomized for each participant. We presented all participants with identical financial information arranged in both ways so as to rule out the possibility that the way in which information was presented would affect allocation decisions. In those tables, we provided respondents with the most basic financial figures regarding past performance (revenues, costs, profit margin, and assets in the previous year) and a measure of expected future performance (internal rate of return) that has been identified by managers as particularly relevant when making capital investment decisions (Graham and Harvey, 2001). A sample of the information provided to participants is shown in Appendix 1.

Results

The present account predicts that respondents will exhibit partition dependence in their allocations of capital across divisions. In particular, allocation to the Health Care division should be higher in the decentralized condition (in which the ignorance prior allocation is one-third) than in the centralized condition (in which the ignorance prior allocation is one-sixth), the allocation to Home Care should be lower in the decentralized condition (in which the ignorance prior allocation is one-third) than in the centralized condition (in which the ignorance prior is one-half), and the allocation should be roughly equal across conditions for the Beauty Care division (in which the ignorance prior is one-third for both conditions). All three of these predictions were borne out in the data

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Table 4a. Mean responses for Experiment 1 (centralized versus decentralized allocations)

	Decentralized partition		Centralized partition		
	Ignorance prior	Mean	Ignorance prior	Mean	t-statistic for the difference between means
Home U.S.			16.7%	16.3%	
Home Europe			16.7%	12.8%	
Home Latin America			16.7%	25.4%	
Total Home	**33%**	**38.5%**	**50%**	**54.5%**	**−4.07**
Beauty U.S.			16.7%	14.6%	
Beauty Europe			16.7%	12.8%	
Total Beauty	**33%**	**27.6%**	**33%**	**27.4%**	**0.08**
Health U.S.			16.7%	18.1%	
Total Health	**33%**	**33.9%**	**16.7%**	**18.1%**	**5.71**

Table 4b. Percentages of participants claiming use of each allocating criterion

IRR	Revenue	Perceived potential for growth	Perceived capability for innovation	Geographical presence	1/n rule	Other criteria	No response
44.6%	15.4%	50.8%	27.7%	20%	3.1%	41.5%	6.2%

NOTE: Participants were allowed to select multiple criteria in their responses.

(see Table 4a). The t-statistics for the difference between allocations in the decentralized versus centralized conditions were $t(45) = 5.71$, $t(53) = -4.07$, and $t(62) = 0.08$, for Health Care, Home Care, and Beauty Care divisions, respectively.

A casual inspection of Table 4a suggests that participants did not adhere strictly to the ignorance prior distribution on average. For instance, they allocated significantly less than one-sixth of the funds to the Home Care-Europe business unit ($t(31) = -4.22$) and significantly more than one-sixth to the Home Care-Latin America business unit ($t(31) = 5.26$). Furthermore, it is clear participants in *both* elicitation conditions allocated more money than the corresponding ignorance prior to the Home Care division (the division with the highest average IRR) and less than the corresponding ignorance prior to the Beauty Care division (the division with the lowest average IRR), suggesting a tendency to rely on both the ignorance prior and a consideration of how the divisions differ. To examine this effect more systematically, we regressed mean allocations for each division on the corresponding ignorance prior and (mean divisional) IRR, obtaining $F(2,63) = 7.72$, $p < 0.001$, $R^2 = 0.38$, with significant weights on both the ignorance prior ($t(63) = 23.6$, $p < 0.001$) and IRR ($t(63) = 2.88$, $p = 0.005$).

An internal analysis of responses provides further evidence that the results were not driven merely by a tendency of some participants to uncritically allocate precisely the ignorance prior distribution: no participant did so in the centralized condition and only two out of 32 participants did so in the decentralized condition. Omitting these responses does not qualitatively change any of the results we've reported. Moreover, we calculated the absolute difference between allocations and ignorance priors for each observation and examined the average for each respondent. The median of those averages was 5.83 percent, further supporting the notion that participants did not merely revert to *1/n* allocations due to ignorance about the task or lack of motivation.

Finally, as noted earlier, we asked participants to provide brief explanations of their decisions. We first read all responses to determine a manageable number of categories into which we could categorize the large majority of responses. Next, two hypothesis-blind and decision-blind judges coded each participant's explanation according to the categories into which it fell; each explanation could

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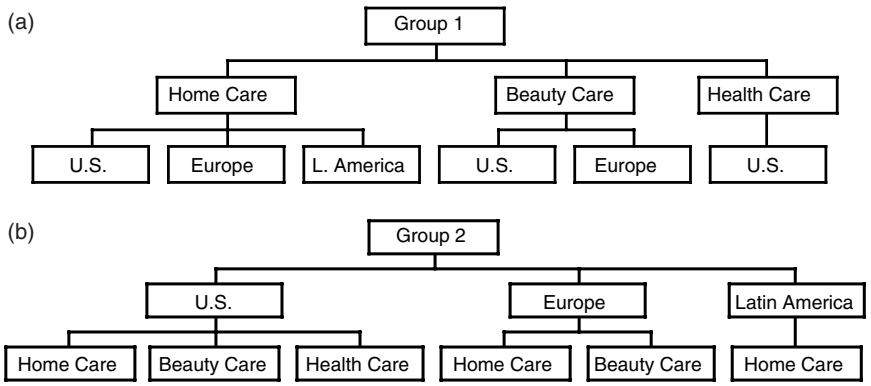

Figure 3. Schematic representation of experimental manipulations of firm partitioning in Experiment 2 Figures 3a and 3b display the organizational charts implied by the instructions of Experiment 2. One group made allocations to product divisions then geographic business units (as represented in Figure 3a), whereas the other group made allocations to geographic divisions then product business units (as represented in Figure 3b)

be characterized by more than one category. We recorded categories on which the judges agreed (they agreed on coding an average of 86% in each category and we resolved the disagreements by randomly choosing one of the judge's categories). The results of this analysis are presented in Table 4b. It is worth noting that although nearly every participant (60 of 64) described at least one criterion in their explanation, only two out of 64 respondents (3.1% of the total) explicitly mentioned using a diversification rule. Still, close to half the participants cited IRR as the main criterion for their allocations and more than half cited 'potential for growth.' Thus, it appears that while participants were aware of several criteria that they were using to vary allocation among divisions, they were not aware of their bias toward even allocation.

Finally, we note that Experiment 1 should allay concern that managers interpret the number of business units in any firm as endogenously determined by capital needs (for example a firm is organized into three units because each target business deserves one-third of the capital). Note that participants in both conditions of this experiment evaluated the same number of business units even though they were asked to allocate capital at different levels of the firm (division versus subdivision). Thus, it would be difficult to argue that, for example, Health Care-U.S. deserves one-third of the allocation at the division level and one-sixth of the allocation at the subdivision level because Health Care-U.S. is one of six units in both conditions.

Experiment 2: product versus geographic hierarchies

The previous study provides evidence of partition dependence among experienced managers in hypothetical capital allocation decisions. In particular, we found that allocations vary systematically with the budgeting procedure (centralized versus decentralized). We next turn to a replication of this result in a situation where all allocations are centralized and all firm information is held constant, but the administrative organization of the firm varies. Also, we wished to invoke a wider range of ignorance priors. Specifically, we used the same hypothetical firm as in Experiment 1, but this time we varied whether the firm was organized by product division then geographic business unit (see Figure 3a) or by geographic division then product business unit (see Figure 3b). This implies a range of ignorance prior allocations that vary from one-ninth to one-third.

Method

We recruited a new sample of 40 Executive MBA students at the Australian Graduate School of Management in Sydney to complete a 15-minute survey in exchange for a chance to win a bottle of expensive ($100) wine. We discarded three of the surveys because of incomplete responses. The procedure was identical to that of Experiment 1 with one important difference. Participants in the *geographic partition* condition ($n = 18$) were asked to indicate first the percentage of available capital they would allocate to each geographic division

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Table 5. Mean responses for Experiment 2 (product versus geographical hierarchies)

	Product partition		Geographical partition				
	Ignorance prior	Mean	Ignorance prior	Mean	Difference between ig. priors	Difference between means	t-statistic for the difference between means
Home U.S.	11.1%	12.2%	11.1%	9.2%	0%	3%	1.77
Home Europe	11.1%	9.5%	16.7%	14.1%	−5.5%	−4.6%	−2.53
Home Latin America	11.1%	16.7%	33.3%	39.6%	−22.2%	−23%	−4.65
Beauty U.S.	16.7%	15.4%	11.1%	9.4%	5.5%	6%	5.66
Beauty Europe	16.7%	14.1%	16.7%	16.5%	0%	−2.4%	−0.91
Health U.S.	33.3%	32.2%	11.1%	11.2%	22.2%	21%	7.85

(U.S., Europe, Latin America) and then (on the following page) the percentage they would allocate to each product business unit (except for the case in which there was a single product business unit). Participants in the *product partition* condition ($n = 19$) were asked to indicate first the percentage of available capital they would allocate to each product division (Home Care, Beauty Care, Health Care) and then (on the following page) the percentage they would allocate to each geographic business unit (except for the case in which there was a single geographic business unit). The present account predicts that allocations to each business unit should be biased toward one-third times the reciprocal of the number of business units comprising the relevant parent division. Thus, for example, Health Care-U.S. should receive a larger allocation in the product partition condition (Figure 3a, ignorance prior $= 1/3 \times 1 = 1/3$) than in the geographic partition condition (Figure 3b, ignorance prior $= 1/3 \times 1/3 = 1/9$).

Results

Results of Experiment 2 are displayed in Table 5 and accord closely with our predictions. In particular, it is evident that mean allocations closely track predicted ignorance prior distributions. First, as expected, allocations differ dramatically and significantly when ignorance priors differ most between conditions (ignorance priors of one-third versus one-ninth for Health Care-U.S. and Home Care-Latin America, $t(16) = 7.85$ and $t(16) = -4.65$, respectively). Second, as expected, allocations differed by an intermediate amount, but significantly, where ignorance priors differed less dramatically (ignorance priors of one-sixth and one-ninth for Beauty Care-U.S. and Home Care-Europe, $t(16) = 5.66$ and $t(16) = -2.53$, respectively). Finally, as expected, we observed no significant difference when ignorance priors were identical between conditions (Beauty Care-Europe and Home Care-U.S., $t(16) = -0.91$ and $t(16) = 1.77$, respectively). Plotting the difference in mean allocations (across experimental conditions) against the difference between ignorance priors reveals a close correspondence (see Figure 4), with a Pearson correlation of 0.994.

As with Experiment 1, we regressed allocations on ignorance prior and IRR, obtaining a significant fit of the model, $F(2, 36) = 25.23$, $R^2 = 0.33$, with a highly significant coefficient for the ignorance prior ($t(36) = 7.07$, $p < 0.001$) and a significant coefficient for IRR ($t(36) = 2.02$, $p = 0.05$).

As in Experiment 1, we asked participants to provide reasons for their answers, and we coded these responses using the same method (the agreement rate between the two coders was 89%). Again, we found that very few participants (less than 8%) cited a desire to spread out their allocations evenly among the criteria they mentioned. Moreover, partition dependence does not appear to have been driven by a subset of participants who allocated budgets precisely evenly: only two out of 37 participants reported an exact $1/n$ split in their allocations. Moreover, there was high variance in these allocations; for instance, when allocating among the three main geographic regions participants' responses ranged from 10 to 70 percent of the total budget (ignorance prior = one-third). Finally, as in Experiment 1, we calculated the absolute difference between allocations and ignorance priors for each observation and examined the average for each respondent. The median of those averages was 5.93 percent, again supporting the notion that participants did not merely revert to $1/n$ allocations.

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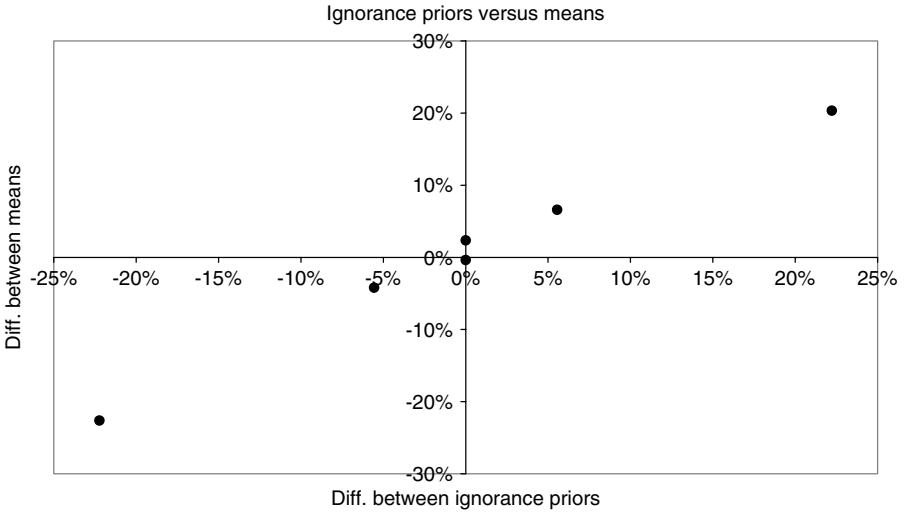

Figure 4. Correlation between differences in ignorance priors and differences in mean responses across the two conditions

GENERAL DISCUSSION

In this paper, we have provided evidence that the previously identified pattern of cross-subsidization of underperforming business units by better performing business units is more general than has been previously supposed. The analysis of archival data presented earlier suggests that, controlling for relevant business unit and firm factors (e.g., assets of the target and remaining business units, Tobin's Q of the target industry), capital allocation to the target business decreases with the number of business units into which the firm is partitioned. Moreover, controlling for the number of business units, we observed that the capital allocation to the target business unit increases with the aggregate assets of the rest of the firm. Both of these patterns are consistent with a tendency of multibusiness firms to naively diversify their assets over all business units (i.e., a bias to allocate $1/n$ of the capital to each of n units). We attribute this pattern to a more general cognitive tendency to spread out allocations over all identified options, which has been observed in numerous studies of judgment and choice in the behavioral decision-making literature.

Later we turned to a pair of experimental studies in which finance-trained executive MBA students performed capital allocations over alternative partitions of the same firm. Experiment 1 demonstrates that the bias toward equal allocation can give rise to investment in major divisions that varies dramatically depending on whether that investment is done on the level of major divisions (i.e., decisions are decentralized) or on the level of business units (i.e., decisions are centralized). Experiment 2 extends the observation of partition dependence to normatively irrelevant variations of the organizational chart that prompt alternative partitions of the firm. In particular, allocations varied dramatically depending on whether participants allocated to product divisions then geographic business units or geographic divisions then product business units. Moreover, Experiment 2 shows that differences in the amount invested in business units closely track differences predicted by multistage naïve diversification.

Although one can legitimately argue that the survey-based experimental approach is a simplification of real-world capital allocation, this methodology provides several advantages that complement the analysis of archival data. First, by examining simplified decisions by individual managers, we are able to eliminate the possibility of agency conflicts between divisional management and headquarters. Second, by using alternative partitions of the same firm, we are able to clearly observe systematic bias while remaining agnostic concerning what constitutes a rational allocation. Third, by simplifying the information load on participants and offering summary measures such as IRR, we are able to demonstrate that naïve diversification in capital allocation extends to situations where information is clear and precise.

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Fourth, we note that unlike previous demonstrations of naïve diversification that rely on data from unsophisticated investors making personal investment decisions (Benartzi and Thaler, 2001; Langer and Fox, 2011), our experiments show that naïve diversification extends to financially sophisticated executives making simplified capital investment decisions.

One might wonder the extent to which partition dependence would be observed if participants were more accountable for their decisions, as they are in real-world contexts. Several previous studies have found that manipulations of accountability moderate a number of judgment and decision-making biases (see, e.g., Lerner and Tetlock, 1999; Brown, 1999). Individuals who are made to feel more accountable by being asked to justify their decisions in front of an audience often behave differently than those whose responses are kept confidential. To investigate whether we might observe such a pattern, we replicated Experiment 1 using a total of 144 students from an Executive MBA course. Participants in the 'low-accountability' condition were told 'your responses will remain confidential' whereas participants in the 'high-accountability' condition were told 'you might be selected to explain and justify your choices in front of the class' (this manipulation was modeled after Tetlock, Skitka and Boettger, 1989). If executives rely more heavily on socially accepted criteria for distinguishing among divisions (e.g., IRR) when they think they might have to justify their decisions publicly, then we would expect to observe less reliance on the ignorance prior distribution and less partition dependence in the 'high accountability' condition. However, contrary to this prediction, we found that participants in the 'high accountability' condition made allocations that were statistically indistinguishable from participants in the 'low accountability' condition (in all cases $p > 0.05$).

One might also wonder whether the results of our experimental studies would persist had we provided participants a financial incentive to maximize firm performance. It is possible that some participants considered the hypothetical fairness of allocations, implicitly invoking an 'equality heuristic' (Messick, 1992). For instance, prior work has shown that a desire to maintain harmony of intergroup relationships and improve morale may drive people toward equal social allocations (Stake, 1985; Leung and Park, 1986). We note that none of the written protocols in Experiments 1 and 2 appeared to cite such an explanation. Additionally, we note that fairness norms applied in a consistent manner should lead to a bias of $1/n$ to each business unit that is not affected by our partition manipulations. However, we can substantially eliminate such concerns if we find that partition dependence persists when we offer participants incentives that are tied to overall firm performance.

To explore whether partition dependence is robust to incentives, we asked 63 Chilean executives enrolled in an Executive MBA program at UCLA to take the role of top management at a large firm that operates four business units in four geographical regions (Chile, U.S., Europe, and Japan); we dropped three participants due to incomplete or incoherent responses. Participants allocated \$20 million of investment capital among these four divisions, assuming that returns on the portfolio of projects in each division precisely track the performance of a corresponding regional stock index (the Chilean IPSA index, the U.S. Dow-Jones Industrial Average, the European DAX index, and the Japanese Nikkei index, respectively) the day following administration of the survey. In particular, participants were told that the capital allocated to a division would yield a 20 percent return if the corresponding stock index went up in the following day and 0 percent if that index went down. Participants randomly assigned to the *nonhierarchical* partition condition allocated percentages of the \$20 million among the four divisions in a single step; participants randomly assigned to the *hierarchical* partition condition were asked to first allocate to a domestic (Chilean) unit and foreign unit, then subdivide the amount allocated to the foreign unit among the three divisions (U.S., Europe, and Japan). To introduce an incentive to maximize firm profits, we told participants we would select two people at random and pay them the actual return of their total investment divided by 100,000. Thus, participants had an opportunity to earn as much as \$40 (or as little as nothing) for completing this 15-minute task.

Responses again reveal strong evidence of partition dependence. The mean investment to Chile in the hierarchical condition was 43 percent (close to the ignorance prior of one-half) whereas the mean investment in Chile in the nonhierarchical condition was only 26 percent (close to the ignorance prior of one-fourth), a statistically significant difference ($t(51) = 3.83$, $p < 0.01$). Thus, we

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find that partition dependence in allocation decisions extends to a highly simplified situation with incentive-compatible payoffs, thereby casting further doubt that partition dependence is driven by considerations of fairness or information derived from the choice of firm structure.

Although our primary goal in this article has been to document pervasiveness of naïve diversification and partition dependence in capital budgeting, a question arises: what are the psychological mechanisms underlying the bias toward even allocation in this context? By stripping away social and political context in our laboratory studies and by replicating partition dependence in the aforementioned study involving incentives for maximizing aggregate payoffs, we are able to rule out the necessity of social and political factors postulated in prior work. The rationale provided by participants in written protocols (Experiments 1 and 2) might provide a unique clue to participants' conscious motives for tending toward $1/n$, yet our informal analysis of these protocols suggests that the large majority of participants were not aware of a bias or motive toward even allocation. We surmise, therefore, that the tendency toward $1/n$ is an associative ('system 1') phenomenon (Kahneman, 2003), perhaps driven by enhanced accessibility in memory of divisions that are explicitly identified (cf. Strack and Mussweiler, 1997). Further work is needed to verify this interpretation and test its boundaries.

Despite the complementary strengths of the present field- and experiment-based methodologies, we acknowledge several limitations in interpreting the present results. First, our experimental studies model the capital allocation process using a number of simplifying assumptions: namely that such decisions are made anew in a periodic and structured fashion by individual managers. Naturally, real-world capital allocations usually take into account past allocations, can be made in a continuous iterative fashion, and involve deliberation of multiple managers. It would be instructive to follow up the present results with experimental investigations of the role of past allocations on managers' decisions, the effects of making adjustments on tentative allocations, and the impact of making allocation decisions in groups. Clearly, any of these modifications could potentially exacerbate or mitigate naïve diversification and partition dependence.

Second, our experiments assume that managers allocate to all the divisions simultaneously. Of course, it is also possible that some of the allocations might be made in a sequential fashion, thus attenuating the $1/n$ bias. For example, some evidence (Garbuio, Lovallo, and Viguerie, 2009) based on managers' surveys suggests that at the very least, 30 to 40 percent of allocation decisions are made within a structured simultaneous budgeting process. The remaining decisions might be made as opportunities arise or at the discretion of corporate and divisional managers. We believe that even in cases where allocations are sequential, managers are likely to keep track of those allocations against the total budget and, therefore, might still be biased toward an even distribution.

Third, there is an inherent limitation in the precision of our measure of the number of divisions in our field data analysis. Using SIC codes at the three-digit level as a proxy for what constitutes a business unit is admittedly an imperfect measure of N. On the other hand, we do not see how the error in this measure would correlate with our results in any meaningful way. Furthermore, the results of our comparison between the virtual and the real samples substantially rules out SIC code noise as the explanation of our findings.

Despite these limitations we are struck by the robustness of partition dependence when using our simplified experimental paradigm. We are also struck by the fact that we were able to find evidence of this phenomenon in archival data of real-world decisions that encompass all of these factors and require us to make an educated guess concerning how managers frame the partition of their firms (by three-digit SIC codes). In sum, whether one looks at capital allocations to a cross-section of real firms in a complex natural environment or to hypothetical firms in a controlled experimental environment, the results are the same: allocations are biased toward equality over the business units into which the firm happens to be partitioned.

The present results suggest a few prescriptive recommendations. First, top managers in charge of capital allocation might consider using more than one partition of the firm in their decision-making process. This can help them discover any discrepancies in the amounts allocated to the same division, like the ones we observe in our experiments. Second, firms could focus the allocation process on sets of projects rather than business

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units. This would reduce the dependence on any specific partition of the firm. Third, firms can more critically examine allocations in conditions where they are expected to be more biased. In particular, the present account suggests that smaller and worse-performing business units will tend to receive more funds than they deserve, especially in firms with fewer divisions. Tests of these recommendations await further study.

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APPENDIX 1. INSTRUCTIONS TO PARTICIPANTS IN EXPERIMENTS 1 AND 2

On a separate page, you will find information about an international consumer products firm, including descriptions of lines of business and geographical regions where it operates. Last year's financial figures for each line of business and region are also provided.

In addition to those numbers, you will find each division's internal rate of return (IRR), which is the company's estimation of the future returns of the projects available in each line of business or region. The higher the IRR, the better the expectations for each division.

We would like you to take the role of the manager in charge of capital allocation for the entire firm. In the following pages of this survey, you must decide *how to allocate the capital available for investment* this year among the different divisions. Note that this is not the operational budget (advertising, etc.), but rather the funds to be used for investment in developing new products, plant expansions, production technology improvements, etc.

	Health Care		***Beauty Care***			***Home Care***			
	Total	*U.S.*	***Total***	*Europe*	*U.S.*	***Total***	*Latin America*	*Europe*	*U.S.*
Total revenues	**8,370**	8,370	**10,420**	5,920	4,500	**12,130**	5,100	4,700	2,330
SG&A	**1,504**	1,504	**2,035**	1,035	1,000	**1,360**	410	450	500
Net income	**1,640**	1,640	**2,020**	975	1,045	**2,310**	1,110	650	550
Total assets	**3,245**	3,245	**4,750**	2,000	2,750	**5,105**	1,005	2,100	2,000
Net income margin	**20%**	20%	**19%**	16%	23%	**19%**	22%	14%	24%
IRR	**16%**	16%	**14%**	13%	15%	**15%**	17%	15%	13%

	Latin America		***Europe***			***United States***			
	Total	*Home Care*	***Total***	*Beauty Care*	*Home Care*	***Total***	*Health Care*	*Beauty Care*	*Home Care*
Total revenues	**5,100**	5,100	**10,620**	5,920	4,700	**15,200**	8,370	4,500	2,330
SG&A	**1,504**	1,504	**1,485**	1,035	450	**3,004**	1,504	1,000	500
Net income	**1,110**	1,110	**1,625**	975	650	**3,235**	1,640	1,045	550
Total assets	**1,005**	1,005	**4,100**	2,000	2,100	**7,995**	3,245	2,750	2,000
Net income margin	**22%**	22%	**15%**	16%	14%	**21%**	20%	23%	24%

(Two additional pages of text describing conditions and forecasts concerning the product and geographic divisions are omitted here for brevity and can be obtained from the authors.)

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