Regulating Organizational Search:
Internal Social Comparisons and Adaptation in Multi-Unit Firms

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Abstract: This paper studies the implications of internal social comparisons – benchmarking business units against each other – for organizational adaptation and performance. While extant research has mainly focused on the effects of internal social comparisons on the *volume* of organizational effort, we build on behavioral theory on organizational adaptation and aspiration-driven search to suggest that such comparisons may also affect the *direction* of effort. Using a computational model, we show how internal social comparisons can effectively regulate organizational search processes through two mechanisms: (1) a classification effect whereby the organization is guaranteed to contain both exploring and exploiting units, and (2) a sampling effect whereby social comparisons protect against premature switching from exploitation to exploration. We explore important boundary conditions on the viability of internal social comparisons, including environmental dynamics, resource munificence, and the comparability of business units. We also demonstrate how the performance of internal social comparisons is boosted in the presence of complementarities between business units. Thus, under appropriate circumstances, internal social comparisons can affect firm performance in beneficial ways, suggesting why many executives actively encourage such comparisons. The study has implications for work on intra-organizational competition, aspirations-driven search, the adaptation of multi-unit firms, and balancing exploration and exploitation.

Keywords: Organizational adaptation, organizational search, multi-unit firm, intra-organizational competition, internal social aspirations, simulation model

1 Introduction

More than 25% of U.S. Fortune 500 firms have been found to use competitive intra-organizational benchmarking to evaluate business units and managers (Stewart, Gruys and Storm, 2010). General Electric (GE) provides a famous, high profile example where Grant (2013: p. 763) notes that "internal competition – between divisions and business units for resources and between individuals for performance bonuses and promotions – was a fundamental feature of [GE's] management systems and organizational culture." Clearly, many organizations believe that having executives and business units set goals relative to one another benefits the organization and have created management control systems that encourage such benchmarking. It is important to note, however, that both micro- and macro-level researchers document detrimental behaviors that result from intra-organizational competition (Nickerson and Zenger, 2008; Charness, Masclet, and Villeval, 2013; Kacperczyk, Beckman, and Moliterno, 2015; Chan, Li, and Pierce, 2014), as these studies suggest potential dysfunctions that emerge from intra-organizational comparisons and the competitive culture they foster. Given the potential downsides, why would managers actively encourage business units to benchmark their performance versus one another?

The literature on intra-organizational competition – which focuses exclusively on downstream, product market competition (Birkinshaw and Lingblad, 2005) – offers some potential insights. Specifically, a portion of this literature suggests that intra-organizational competition will increase unit-level effort (Blanes i Vidal and Nossol, 2011; Stark and Hyll, 2011). This aligns with micro-level research suggesting that effort is higher when individuals feel rivalrous towards similar others (Kilduff, Elfenbein, and Staw, 2010; Kilduff, 2014). To the

extent that it increases effort, this literature suggests that encouraging internal social comparisons should be good for the firm and improve overall performance.

In this study we offer and explore a different potential explanation, one rooted in the literature on organizational adaptation and search. While internal social comparisons may in fact affect the *volume* of effort as noted above, such comparisons may also importantly affect the *direction* of effort within the organization. Viewing intra-organizational benchmarking as creating a specific type of social aspirations (Kacperczyk, Beckman, and Moliterno, 2015) and recognizing how performance versus aspirations affects the direction of organizational search efforts (Greve, 2003), it seems logical that internal social comparisons – the competitive benchmarking of performance between business units of the same company – may have an adaptive effect on multi-unit[1] organizations through the balance between exploratory and exploitative effort (March, 1991; Levinthal and March, 1981). This frames our central question – *how do internal social comparisons affect organizational adaptation through the balance of exploratory and exploitative efforts*?

Given the relatively little available empirical work, the discrepancies between available theoretical perspectives (discussed in detail in Section 2), and the difficulty of obtaining broad enough data on the phenomenon to test a cross-context theory, we use a computational model to investigate the adaptation and performance implications of setting unit-level performance targets via internal social comparisons. The model builds on existing work in the Behavioral Theory of the Firm tradition that links below-aspiration performance and search behavior (Levinthal and March, 1981; Miller and Arikan, 2004; Blettner, He, Hu and Bettis, 2014) to examine how

[1] Note that we use the term "multi-unit" to represent any organization with different, self-contained structural business units. This may include different product divisions of a multi-divisional firm, different regional units of a multinational firm, or different locations for a chain store or restaurant. It would not include firms with different units only for (for example) marketing and finance – each unit would need to have its own processes and profits.

internal social aspirations affect the direction of effort. Aspirational search processes regulate the balance between exploration and exploitation within each individual unit, which in turn affects overall organizational performance. To focus on the effect of internal social comparison on the *direction* of effort as opposed to *volume* of effort, we model units that always exert maximum effort. Thus, our model explores a very different effect from a pure motivational story. We extend prior efforts by representing multiple business units and considering the potential that relevant performance targets (aspirations) may be driven by the performance of other units within the same organization.

The results of our model illustrate two key mechanisms that characterize internal social aspirations:[2] (1) a classification effect whereby internal social aspirations create a separation between winners and losers, and ensure that both are always represented within the organization, affecting the balance between exploration and exploitation; and (2) a sampling effect whereby social comparisons protect against premature switching from exploitation to exploration, thereby creating more organizational stability in a noisy environment. In slowly-changing environments these two mechanisms help balance exploration and exploitation at the organizational level. Internal social aspirations induce the business units to allocate their resources to the type of search that is most beneficial for their current situation – exploitation (refinement) of a given technology for the unit that has the highest potential (and thus is satisfied with its performance), exploratory search for new technologies for the other unit(s), and switching search modes when being outperformed (or outperforming) the competing unit(s). By creating behavioral interdependencies between organizational units, internal social comparisons can lead to higher organizational performance than if unit managers have purely intra-unit (i.e., historical)

[2] In our model we primarily focus on characterizing internal social aspirations by comparing them with historical aspirations (at the unit level), but in Section 5.1 we discuss how internal social comparisons behave similarly and differently from typical external social comparisons (inter-organizational comparisons).

aspirations. Internal social aspirations, however, are a double-edged sword, because the guarantee that one unit is satisfied becomes increasingly detrimental as the environment becomes more dynamic, as that unit may frequently be satisfied with its relative performance advantage even as its absolute performance declines. Similar to environmental dynamism, we outline three other key boundary conditions – the advantage of internal social aspirations is reduced or even reversed when the environment is munificent and resources are abundant, when the firm has a very small number of units, and when the units operate in heterogeneous task environments. These shortcomings stem from the ways in which these conditions weaken the effect of the two core mechanisms outlined above.

Finally, our model also explores the effect of downstream competition or complementarity between business units. We show that, when there are complementarities between units, internal social aspirations serve an important role in helping synchronize search behavior to take advantage of complementarities, greatly improving performance. Given that many either vertically integrated or related diversified firms are likely to have units whose competencies or products complement one another, this presents an important condition whereby internal social aspirations play a significant adaptive role. Meanwhile, when the units are downstream competitors, internal social aspirations suffer. Thus, internal social aspirations can be beneficial and adaptive under some circumstances and detrimental in others, in line with classic research on contingency theory (Lawrence and Lorsch, 1967).

This study links the literature on intra-organizational competition with the literature on organizational adaptation, using behavioral theory about aspirations as the bridge. This allows us to contribute back to each of these the three literatures. First, for the literature on intra-organizational competition, we show that it is not only the volume of effort exerted in response

to incentives (the typical interest for work on intra-organizational competition; e.g., Mezias, Chen and Murphy, 2002), but how that effort is allocated that affects performance. Over time, business units need to dedicate resources to both exploring new opportunities and exploiting existing ones, and getting the direction and timing of that allocation right is more difficult than simply encouraging effort. As our model identifies important boundary conditions, this study extends existing work and identifies research topics for future empirical work, as well as a framework for theoretical research.

Second, from the perspective of the Behavioral Theory of the Firm, our focus on the multi-unit firm further explores an alternative way that aspirations could be constructed – vis-a-vis other units in the firm, expanding work by Kacperczyk, Beckman, and Moliterno (2015). While there are important points of consistency between historical, internal social, and external social aspirations, there are also significant differences that have major implications for firm performance. Depending on the context and other boundary conditions, efforts to direct managerial attention towards different aspiration levels can produce dramatically different results.

Finally, in terms of the literature on the adaptation of multi-unit firms, we fill an important gap in our understanding of how these firms evolve by exploring the role of internal competition between units. Our behavioral viewpoint emphasizes the importance of managerial choice – encouraging one reference point versus another when setting unit-level performance targets has important implications for how the firm adapts. The model shows how the right choice of aspirations can induce a dynamic, decentralized, and effective structure where units appropriately specialize in exploration or exploitation at any given time. Thus, there are circumstances under which managerial efforts such as those at GE to encourage competition may

provide real benefits, but the exact relationship between these aspirations and performance is not obvious.

2 Literature Review

Before explaining the model that we offer in this study, we first identify and explore the three literatures that each are closely connected to our research question – the literatures on intra-organizational competition (Section 2.1), the behavioral theory of the firm's focus on aspirations (Section 2.2), and the adaptation of multi-unit firms (Section 2.3). Each literature has a specific area of interest around the decision to encourage business units within the same firm to benchmark their performance versus one another, and two of the three offer some insights into predictions about the implications of such benchmarking for adaptation and performance. Our goal with this study is to understand whether (and when) these theoretical expectations might be correct, and whether there are important conditions affecting the outcome that prior research has not considered.

2.1 Intra-Organizational Competition

First, the literature on intra-organizational competition focuses on issues of competitive dynamics between different units within the same firm. Most of this research focuses on downstream competition (units that offer similar or competing products) and when this may be beneficial for performance. Most notably, these conditions include the extent of organizational diversification (Hill, Hitt and Hoskisson, 1992), in terms of how likely the units are to have distinct customer groups; the incentive structures within the organization (Marino and Zábojník, 2004), primarily in terms of whether incentives are unit-centered or organizational in nature; and

whether the units' products are substitutes or complements (Bárcena-Ruiz and Paz Espinosa, 1999). Birkinshaw and Lingblad (2005) synthesize this work to develop a typology of intra-organizational competition that stems in part from external environmental conditions that may lead to greater or lesser degrees of competition. Thus, they argue that external environmental factors such as dynamism and munificence may importantly interact with intra-organizational competition. We note these effects to be certain that our model also considers their implications.

To the extent that research on intra-organizational competition offers suggestions about the potential performance implications of internal social comparisons between units, the predominant prediction would be that it would be beneficial to the firm primarily because it would lead to increased effort at the unit level. Stark and Hyll (2011) use a formal mathematical model to suggest that low-performing, low-wage workers will increase their effort in response to realizing their lower level of relative performance. This increased effort provides benefits to the firm with no costs. Similarly, Blanes i Vidal and Nossol (2011) use single-firm data on piece-rate workers to show that revealing relative position to workers creates an increase in productivity for the firm. While both studies (and similar research) provide compelling evidence that workers may increase effort in response to internal competition (at least for the lowest-productivity workers), the research focuses on workers with relatively simple tasks who possess only one real choice – how much effort to exert. For unit managers and others facing more complicated choice sets, the implications of competitive benchmarking are less clear, in that firm-level performance may be dictated not just by the volume of effort but also how that effort is directed. Our model examines the implications of this distinction by standardizing the volume of effort and focusing explicitly on the direction of effort (i.e., whether firms focus effort on exploration or exploitation, and how this affects adaptation and performance). Generally, we seek to expand the

study of intra-organizational competition beyond downstream product market competition by focusing on upstream competition between units – such as the competition for resources, reputation, and career advancement. We show how this type of competition is different from or similar to downstream product market competition, and how the two interact.

2.2 Behavioral Theory of the Firm

Second, the Behavioral Theory of the Firm discusses performance targets in terms of organizational aspirations (Cyert and March, 1963). In empirical and modeling research, aspirations are important because performance below aspirations typically leads to search (e.g., Baum, Rowley, and Shipilov, 2005), risk taking (e.g., Bromiley, 1991), and exploration efforts (e.g., Greve, 2007) to find new solutions that will improve performance, while performance above aspirations continues the status quo and encourages exploitation (March, 1991). Prior research has shown that competitive, inter-organizational comparisons are an important part of aspirations (Greve, 2003), and many researchers have either used a weighted average of competitive and historical aspirations to compute organizational aspirations (e.g., Bromiley, 1991) or focused on the aspiration types separately (e.g., Baum, Rowley, Shipilov, and Chuang, 2005). Most research in this tradition suggests that the outcomes of focusing on competitive versus historical aspirations are relatively similar (Miller and Chen, 2004). As a result, a baseline prediction from behavioral theory would be that internal social aspirations may function much like external social aspirations, which in turn function largely like historical aspirations (for an exception, see Kim, Finkelstein, Haleblian, 2015). So if this study's research question is interpreted as when internal social aspirations are better or worse for effective adaptation and performance than historical aspirations, behavioral theory might suggest that the results should be very similar.

Recent work, however, suggests that internal social aspirations and external social aspirations may function differently. Kacperczyk, Beckman and Moliterno (2015) explore both types of social comparisons for mutual fund managers. They argue that performance below external social aspirations may be viewed as an organizational concerns and lead to changes in behavior, but not necessarily to increased risk. Meanwhile, performance below internal social aspirations is seen as more personally salient, and leads to increased risk taking. This perspective suggests that there may be important differences between internal and external social comparisons processes that may affect behavior and adaptation differently. As a result, we will return to the issue of differences or similiarities between internal and external social comparisons in Section 5.1, after we explore the basic functions of the model.

In addition to the study noted above (Kacperczyk, Beckman, and Moliterno, 2015), one other study in the behavioral tradition has explored the role of internal social comparisons in adaptation processes. Mezias, Chen and Murphy (2002) investigate comparisons between business units using data on 86 retail units of a single financial services organization and find that managers do work to close the performance gap between their unit and relevant others within the organization, thus improving unit-level performance. This seems in line with the economics research discussed earlier highlighting the role of effort in response to intra-organizational competition.

2.3 Multi-Unit Firm Adaptation

The third literature that is central to our study is the literature on the adaptation of multi-unit firms. This literature has also used aspirations as a means of regulating organizational search – poor performance leads to exploration, while strong performance leads to exploitation (Denrell and March, 2001; Greve, 2007; Bendor, Kumar, and Siegel, 2009). Most research on

organizational adaptation, however, has focused on single-business firms or on specific units within broader organizations (Levinthal and March, 1981). Questions of multi-unit structure, and particularly how structure affects adaptation efforts, have been understudied within the existing literature (Gavetti, Levinthal, and Ocasio, 2007).[3] As a result, it is not necessarily clear how this literature would predict an outcome for our research question.

The most relevant study in this tradition to consider related processes to our model is by Gaba and Joseph (2013). The authors argue that the response to being below aspirations will depend on the managerial levers available at different levels in the corporation. For example, for managers that control the direction of R&D allocation, low performance is likely to be met with a shift towards more exploratory efforts in order to improve future prospects. At the corporate level, however, managers mostly control the volume of R&D spending by units and not how it is allocated, so corporate executives are likely to reduce funding to underperforming units as they take low performance as a signal of a weak opportunity space. Thus, this study highlights that the adaptive processes of multi-unit firms are starkly different from those in focused firms. While Gaba and Joseph (2013) focus on the role of vertical hierarchy, this study concentrates on the implications of horizontal comparisons as the complexity of multi-unit firms. This study also emphasizes the importance of considering the effect of headquarters resource allocation policies for exploring the adaptive effects of intra-organizational comparisons, something we explore in more detail in our model.

Overall, this discussion of the important connections between our research question and the existing literatures in three domains suggests that each literature would have a vested interest in exploring the adaptive implications of internal social comparisons between units, but that none

[3] See Rivkin and Siggelkow (2003), Siggelkow and Levinthal (2003), Knudsen and Levinthal (2007), and Csaszar (2013) for important modeling exceptions.

of these literatures has directly investigated this question. The literatures do, however, suggest important contingencies or factors that are especially important for us to consider in our model, namely the role of the environment (dynamism and munificence), the effect of downstream competition (or complementarity) in addition to social comparisons, the structure and size of the organization, the headquarters allocation process, and the potential differences between internal and external social comparisons. Each of these factors plays an important role in the articulation and exploration of our model.

3 Model

3.1 Objective and Intuition

Following from our goal to better understand how internal social comparisons affect adaptation in multi-unit firms, we focus on how they impact the balance of exploratory and exploitative search (March, 1991; Levinthal, 1997, Gupta, Smith, and Shalley, 2006). We build on broad research in the Behavioral Theory of the Firm tradition that documents how organizations classify outcomes into successes and failures. According to this view, unit managers that fail to meet their aspirations are more likely to engage in exploration, whereas units with performance above aspirations are more likely to focus on exploitation (Levinthal and March, 1993; Denrell and March, 2001; Greve, 2007).[4] Hence, our key theoretical objective becomes to understand how internal social comparisons regulate these decisions at the business-unit level, and how these decentralized processes aggregate to affect adaptation and performance

[4] The model thereby incorporates the notion of problemistic search central to the Behavioral Theory of the Firm. Slack and institutional search (Greve, 2003) are beyond the scope of the model.

at the organizational level (Joseph and Ocasio, 2012; Gaba and Joseph, 2013).[5] Understanding choices of adaptive behavior at the unit level, however, requires understanding the structure of the performance feedback that internal social comparisons provide to the units, relative to that provided by other approaches.

To address this issue, we compare internal social aspirations with historical aspirations, which provide for a natural benchmark. Under internal social aspirations, unit managers compare their unit's performance with the performance of other units, whereas historical aspirations are based on comparisons with the focal unit's prior performance. Historical aspirations are one of the two primary aspiration types studied in prior work (e.g., Greve, 2003, Bromiley, 1991), and such year-on-year or quarter-on-quarter comparisons are common in real world organizations.[6]

To explore the adaptive implications of the two aspiration systems, and thus to build new theory, we develop a computational model. This approach allows us to represent and trace the dynamics of an organization's behavior in a richer manner than would be tractable in a mathematical model, but still in way that is systematic and simple enough to produce general insights. Moreover, by formalizing various environmental and organizational contingency factors, computational models allow creating more comprehensive theory (Davis, Eisenhardt, and Bingham, 2007; Harrison et al., 2007). Specifically, our model builds on prior modeling efforts in the Behavioral Theory of the Firm tradition that have studied the links between aspirations, performance, and adaptive search (Levinthal and March, 1981; Denrell and March, 2001; Miller and Arikan, 2004). What crucially distinguishes our model from existing ones is that the latter have represented firms as unitary decision makers, i.e., they have abstracted away

[5] As mentioned in the introduction, in order to focus on the implications of internal social comparisons for the *direction* of adaptive efforts, we are not concerned with its potential effects on the *volume* of effort. Put differently, motivation problems are beyond the scope of our theorizing and modeling efforts.

[6] As mentioned earlier, we will discuss how internal social comparisons contrast with the other primary aspiration measure – external or competitive social comparisons – in Section 5.1.

from the fact that firms often consist of multiple business units that each engage in exploratory and exploitative efforts at the same time. Single-agent models by definition do not allow studying internal social comparisons; by explicitly representing firms as multi-agent systems, in contrast, our model addresses these shortcomings.

< Insert Figure 1 about here >

Our core modeling idea is to represent the typical division of labor in multi-unit firms that consist of corporate headquarters and a number of business units, as represented in Figure 1. In each period of the simulation, headquarters allocate resources to the business units, which then decide independently for which type of search to use them – exploration or exploitation. Because resources used for one type of search are not available for the other, and vice versa, each unit faces an exploration-exploitation challenge – whether to search for refinements to its current technology (exploitation) or for a new technology that can replace the existing one (exploration).[7] The importance of search, and of switching between exploitation and exploration, is driven by environmental dynamics that (slowly or quickly) decay the value of existing technologies. In deciding about how to search, unit managers compare their unit's performance with their aspirations, which are formed either through historical or internal social comparisons. Finally, after the units have engaged in search, their performance is realized in their respective task environments, corporate headquarters provide feedback, and the units update their aspirations, thus setting the stage for adaptive search in the subsequent time step. Below, we describe in detail how we implemented the different parts of the model.

[7] With the term "technology," we broadly relate to all performance-relevant aspects of the business unit such as a policy configuration (Gavetti and Levinthal, 2000), a set of organizational routines (Nelson and Winter, 1982), or a business model (Chesbrough and Rosenbloom, 2002).

3.2 Implementation

3.2.1 Corporate resource allocation

The multi-unit firm in our model consists of corporate headquarters and N units U_1, U_2, …, U_N. In each period t, headquarters distribute a fixed amount of search resources R across the units.[8] We adopt a simple behavioral allocation rule and assume that headquarters distribute resources evenly, i.e., each unit i receives $R_{i,t} = R/N$ resources. While this rule may seem myopic, a more competitive resource allocation where success is rewarded by larger amounts of resources (and failure is punished) is much more representative of markets than of organizations (Williamson, 1985). Moreover, recent behavioral work on corporate capital allocation has documented a cognitive bias for even distributions (Bardolet, Fox, and Lovallo, 2011) which can, for example, result from lobbying processes within organizations (Scharfstein and Stein, 2000). Finally, an even resource allocation rule also incorporates elements of forward-looking behavior, since current performance might not be indicative of future performance in dynamic environments. (In a variant of our model reported below, we allow headquarters to allocate resource based on unit-level performance, thus rewarding higher-performing units and punishing lower-performing ones.)

3.2.2 Exploration and exploitation

Each unit i holds one technology T_i and in each period t uses the $R_{i,t}$ resources it receives to engage in $R_{i,t}$ attempts of exploitative or exploratory search to further exploit the current value of its technology or to explore a potential substitute technology. If any of the $R_{i,t}$ search attempts

[8] In a different model variant, we make the number of resources R a function of organizational performance, thus incorporating a notion of firm growth (or contraction). Qualitative results are similar to the ones reported in the results section. Because our focus is on the effects of intra-organizational competition, we opted for keeping R fixed, which allows us to better disentangle the effects of different aspiration systems from those of the available resources. We do, however, report the effects that different levels of R have.

yield a technological option (either a new technology or a refined version of the existing technology) that has higher value than the unit's current technology, the unit adopts the best of these options; otherwise, it retains its existing technology. We model search as a stochastic sampling process, i.e., its outcomes are uncertain, and agents do not know the probability distributions that they are sampling from (March and Levinthal, 1981; Levinthal, 1997, Denrell and March, 2001). To capture the notion that the returns to exploration are "systematically less certain, more remote in time, and organizationally more distant" (March, 1991: 73) than those of exploitation, we make different assumptions about the underlying probability distributions.[9]

In modeling exploitation, our goal is to capture two key aspects. First, exploitation reflects an attempt to improve the mean of a given technology. We thus let the unit draw $R_{i,t}$ refinement values from a normal distribution with mean $\mu = T_{i,t}$ (the current value of the unit's technology). Hence, exploitation produces potential technological options that are "in the neighborhood" of the unit's existing technology. Second, the expected gains from refining a given technology decline over time, as a technology's refinement potential becomes exhausted gradually (Fleming, 2001). To capture this aspect, we set the standard deviation of the refinement distribution to $\sigma = \sigma_{exploit} \cdot RC^{r_i}$. Here, RC (with $0 < RC < 1$) is the "refinement carryover" that specifies how the standard deviation of exploitation attempts for a given technology changes from one exploitation period to the next, while r_i represents the number of times a technology has been successfully refined after its inception. Hence, the more often a technology has already been refined, the smaller the standard deviation of the refinement distribution will be.[10]

[9] The model structure is thus also consistent with notions of distant search (exploration) and local search (exploitation) that are prevalent in much of the recent literature on organizational search and adaptation (Stuart and Podolny, 1996; Levinthal, 1997).

[10] Throughout all experiments, we set $\sigma_{exploit} = 0.2$ and $RC = 0.99$. Changes in these values produce qualitatively similar results.

Our approach to modeling exploration likewise builds on stylized facts about innovation. Specifically, we assume that the bulk of innovation efforts fail. Among those that are successful at producing a potentially usable technology, many are of similar (average) quality, whereas tapping into the long tail of high-quality innovations is both rare and difficult. To do so, we let the units draw $R_{i,t}$ samples from a fixed lognormal distribution, with mean $\mu_{explore} = 0$ and standard deviation $\sigma_{explore} = 0.8$. To capture that most innovative efforts fail, we also assume that discovery search turns up innovations that have a negative value (and therefore are never adopted) with probability 0.5 (qualitative results are robust for higher failure rates).

3.2.3 Aspiration formation and adaptive behavior

In each period *t*, the adaptive behavior of the manager of each unit *i* is driven by how her unit performed relative to her aspirations in the prior period *t*-1. If her unit's performance $\pi_{i,t-1}$ has met or exceeded the aspiration level $A_{i,t-1}$ that she had set for the prior period, the manager in the current period allocates all her resources $R_{i,t}$ to exploitation; if the aspiration level has not been met, she shifts all available resources to exploration.[11]

Conversely, after performance has been realized in the focal period (see 3.2.4 below), the manager updates her aspiration level, which in turn affects aspirations for the subsequent period.[12] To model internal social aspirations, we follow prior work that models external social comparisons (e.g., Greve, 2003, Joseph and Gaba, 2014) and use the mean performance of all units within the organization as the reference point, i.e., unit *i's* aspiration level in period *t+1* is given by $A_{i,t+1} = \pi_{i,t} - \frac{\Pi_t}{N}$. Historical aspirations, on the other hand, are based on absolute unit-

[11] Rather than allocating all resources to one type of search, units could also allocate resources more gradually, based on how much their performance is below (or above) their targets. Because prior versions of the model included such considerations but resulted in qualitatively similar results, we opted for the simpler approach.
[12] The aspiration level for the first period of the simulation is set exogenously. The specific value of this initial level, however, has no qualitative effect on the behavior and outcome of the model.

level goals and previous performance. Here, the manager of unit *i* uses absolute unit performance $\pi_{i,t}$ when updating the historical benchmark. Following extant theoretical and empirical work (March, 1988; Greve, 2003), we construct historical aspirations as an exponentially weighted average of current and past performance, i.e., $A_{i,t+1} = \alpha A_{i,t} + (1-\alpha)\pi_{i,t}$, with $1 \leq \alpha \leq 0$.[13]

3.2.4 Task environments and performance realization

Finally, each unit *i* applies its technology in its task environment, which results in a unit performance of $\pi_{i,t}$ and an overall firm performance of $\Pi_t = \sum_{i=1}^{N} \pi_{i,t}$. To keep the model parsimonious, we abstract from modeling costs and assume that $\pi_i = \tau T_i$. In doing so, however, we do capture the impact of a unit's external and internal task environments by letting them affect the value potential of the unit's technology. Specifically, to represent the external task environment, we assume that in each period, the value of a unit's technology decays with a rate of τ ($0 < \tau < 1$). In relatively stable environments (e.g., $\tau = 0.01$), technologies decay slowly, for example because of lower levels of technological competition or stable customer preferences. For high values of τ (e.g., $\tau = 0.5$), in contrast, technologies decay more rapidly, thus characterizing a context of intense technological competition or high market volatility. Hence, in the former environments, a technology's value can be sustained over a longer period of time, thus favoring growth through the expansion of current technologies (exploitation), whereas the latter environments might mandate faster adaptation through the exploration of new technologies (Bendor, Kumar, and Siegel, 2009).

A unit's internal task environment refers to task interdependencies between units, which can have positive or negative effects for unit-level performance. Knowledge spillovers or

[13] In the main analysis, we focus on $\alpha = 0.5$, where aspirations are the average of last period's incoming aspirations and last period's performance. This is in line with prior empirical research trying to uncover real world values of α (e.g., Moliterno, Beck, Beckman, and Meyer, 2014; Joseph and Gaba, 2014). We discuss other values for α in Section 4.5.

product complementarities (Hill, Hill, and Hoskisson, 1992) entail positive effects, such as when successful exploration in one business unit (e.g., the development of a new gaming platform) raises the potential of the technologies held by other units (e.g., existing content and distribution channels). Negative effects can arise when successful exploration in one unit (e.g., a mobile-based business model in the financial industry) reduces the potential of other units' technologies (e.g., traditional financial business models) due to product market cannibalization and charter overlaps.

To capture the performance effects of downstream, product-market complementarities or competition between units, we manipulate the value potential of the units' technologies using parameter τ. To do so, we extend our baseline model by allowing the level of decay τ_i that unit i faces to be endogenously determined. Specifically, we express the level of task interdependence by a factor c, and assume that each time a unit j adopts a new technology, the current level of decay τ_i in each other unit i ($i \neq j$) is changed to $(1\text{-}c)\ \tau_i + c\ \tau_{base}$. That is, successful exploration in one unit "moves" the other units' decay level τ_i by c percent toward a baseline level τ_{base}.

The underlying logic is that, depending on whether units have a complementary or competitive relationship, significant and breakthrough innovations by one unit are likely to significantly raise or lower the appeal and viability of competing offerings from other units. To the extent that the decay of a unit's technology can represent both efforts to exploit synergies across units or competitive efforts to weaken the unit's advantage, our modeling approach recognizes that this effect will accelerate with significant improvements by other units. Accordingly, in the case of complementarities, τ_{base} is smaller than the initial level, reducing the other units' τ and thus raising the performance potential of their technologies; in the case of competition, on the other hand, τ_{base} is larger than the initial level, increasing the other units' τ

and thus reducing the potential of their technologies. (The τ of any successfully innovating unit is set back to the initial level.)

4 Results

We first report the core result from analyzing a baseline version of our model (section 4.1) and explain the underlying mechanisms (section 4.2). In section 4.3, we systematically explore the boundaries of the core result by examining how the underlying mechanisms are affected by each of the key variables of the model. Section 4.4 analyzes the model extension in which business units exhibit task interdependences (as described in Section 3.2.5) and affect each other in positive or negative ways, thus representing complementarities and (downstream) competition, respectively. Section 4.5 reports further robustness checks.

< Insert Table 1 about here >

In the baseline condition, we assume that firms consist of $N = 10$ business units, each of which receives $R = 5$ resources that it can allocate to exploration or exploitation in each period. Moreover, all units face relatively stable task environments ($\tau = 0.01$). These settings form a useful baseline, because they allow us to demonstrate our core findings in the simplest way possible, and because they are characteristic for a broad range of parameter values. All parameter settings of this baseline model, including minor parameters, are shown in Table 1.

All results are based on running our model for 1,000 time steps (by which time the system has reached a steady-state) and 10,000 replications (to average across individual stochastic outcomes and focus on the underlying model behavior). Because we are interested in how unit-level

aspirations affect multi-unit organizations as a whole, we report primarily overall organizational performance, i.e., the aggregate performance of all business units.

4.1 The Benefits of Internal Social Aspirations

Figure 2 reports how cumulative organizational performance evolves over time, when the business units are following (internal) social and historical aspirations, respectively. As Figure 2 shows, social aspirations lead to higher performance across the entire time span. To understand why these performance differences arise, it is important to recall that the firms in our baseline model are structurally identical and are facing the same task environment. Thus, performance differences must result from the search and resource allocation patterns that the aspiration systems induce at the business-unit level. We explore these patterns in Table 2, which reports a number of performance and adaptation metrics (measured in period 1,000).[14]

< Insert Figure 2 and Table 2 about here >

In line with Figure 2, the first row of Table 2 indicates that firms using social aspirations perform better than those using historical aspirations. At the same time, however, they also entail sharper performance differences between a firm's units: while the best units achieve higher performance (Row 2), the worst units have lower performance than under historical aspirations (Row 3). Most notably, the technologies held by the units under social aspirations are refined to a much higher degree than those under historical benchmarks (Row 4), whereas historical aspirations push units to allocate substantially more resources to exploration than to exploitation (Rows 5, 6). Nonetheless, the likelihood that a unit discards its current technology and adopts a

[14] To check robustness, we confirmed that the differences in average performance are not driven by outliers, but are true shifts in the outcome distribution between competitive and historical benchmarks.

novel technology is somewhat larger in firms that apply social comparison than in those under historical aspirations (Row 7; more on this below).

4.2 Regulating Mechanisms

The performance benefits of internal social aspirations stem from how they regulate a firm's collective exploration and exploitation activities. Ideally, each unit should switch from exploration to exploitation once search uncovers an attractive technology, and revert back to exploration when a technology has exhausted its refinement potential, i.e., when the remaining refinement potential is lower than the decay rate – a task that would be easy to accomplish, if decision makers were to know the precise decay rate and the probability distribution of their search activities. In reality, however, decision makers must make inferences from the performance feedback they receive. This creates the problem of making the wrong inferences and the dual risks of under-exploration (i.e., holding on to an unattractive technology for too long) and of over-exploration (i.e., abandoning an attractive technology too soon) (Levinthal and March, 1993). We identify two systematic effects that help explain why the performance feedback provided by social aspirations results in a more effective balance between exploration and exploitation: (1) a classification effect that ensures a baseline level of exploitation, independent of specific performance levels; and (2) a sampling effect – the fact that unit-level decisions are based on a larger amount of information. Taken together, the two mechanisms help explain why social aspirations offer organizations adaptive benefits in stable environments: they result in a higher baseline rate of exploitation (due to the classification effect), and they are less prone to over-reacting to misleading feedback and give up exploitation prematurely (due to the sampling effect).

4.2.1 Classification effect

The classification effect relates to the fact that social aspirations, unlike historical aspirations, classify business units into "winners" and "losers," which shapes the units' search behavior. Winners – the units that are performing better than the average of their peers – engage in exploitation, whereas losers explore. Because social comparison always creates winners, it ensures a lower boundary for exploitation activities (and, consequently, an upper bound for exploration efforts). To illustrate this effect, consider a firm with $N = 2$ units. Because one unit will always perform above the social reference point, 50% of all organizational resources will be allocated to exploitation, irrespective of any specific conditions of the units' task environments at any point of time. That is, one unit would exploit and one would explore, yet the identity of who is the winner and who is the loser at any point in time is adaptive. Returning to our baseline setting, the classification effect explains the almost 50-50 split in exploration and exploitation activities shown in Table 2.[15] The sharper performance differences between stronger and weaker units are also a testimony to the classification effect that enforces more exploration by the losers (with some then falling behind relatively more due to the higher risks of exploration).

Historical aspirations, in contrast, do not possess this feature; instead, success and failure are evaluated based on individual performance feedback. This makes historical aspirations more adaptive in principle, allowing an organization to draw from the entire set of resource allocation patterns that range from exploitation-only (all units could improve their performance over their historical targets) to exploration-only (all units failed to reach their historical targets) without systematic constraints. In the baseline case reported in Table 2, the majority of business units

[15] Because average unit performance and median unit performance can be different, the classification effect does not always result in a 50-50 split between exploration and exploitation as in the case of $N = 2$ units.

(70.5%) explores in an average time step – a much higher exploration intensity than under social aspirations.

4.2.2 Sampling effect

The sampling effect relates to the fact that social aspirations condition a unit's switching between exploitation and exploration on feedback about the performance of others, rather than on the unit's own experience alone. Put differently, a decline (or rise) of unit performance is neither necessary nor sufficient for changing search behavior, because this decision also depends on the feedback received from peers. That is, a business unit only switches to exploration (exploitation) when its own performance suffers (improves) more than the average performance of its peers. Because social aspirations thus incorporate a higher number of samples (from the unknown probability distributions that generate feedback) in the decision-making process, they stabilize the units' responses and lower the risk of wrong inferences from feedback. This interpretation is consistent with the results reported in Table 2, where social aspirations are much more persistent and successful in exploitation than internal aspirations, leading to an average of 62.63 successful refinements for each technology.

Historical aspirations, on the other hand, work differently. Even if a technology's refinement potential is still quite substantial (and well above the decay rate), a unit may be unlucky in its refinement draws and receive negative performance feedback, because external events (as captured by the decay rate) lower performance below current aspirations. For historical aspirations, this is sufficient to re-ignite exploration, even though a technology still has ample refinement potential. In consequence, historical aspirations can suffer from a risk of over-exploration by abandoning an attractive technology too soon. As illustrated by the results reported in Table 2, firms that follow a regime of historical aspirations on average spend

considerably fewer resources on exploitation (29.5%) in a semi-stable environment and tend to refine technologies considerably less (20.87).

Given the mechanics of the sampling effect, one might thus expect a higher rate of switching technologies for historical aspirations. This is not the case, though, given that social aspirations exhibit a significantly higher switching rate (0.19 vs. 0.12) despite having lower exploration intensity (51.1 vs. 70.5). However, recall that social aspirations also create sharper performance differences across units than historical aspirations. That means that some of the underperforming units operate far below the average performance of their peers. These units are locked in to sustained exploration and thus tend to change their technology quite often. With historical aspirations, all business units continuously move through cycles of exploration and exploitation (but break off exploitation too soon in favor of exploration). On average, for instance, only 2.56 (out of 10) units under social aspirations start exploring in every single period, as compared to 3.55 units for historical aspirations.

4.3 Boundaries of the Core Result

The mechanisms identified above also help us understand how key organizational contingencies such as environmental dynamism, the availability of corporate resources, the heterogeneity of the units' task environments, and the number of business units establish boundaries to the performance benefits of internal social aspirations in multi-unit organizations (Figure 3). Clockwise, the figure shows that social aspirations generally become less beneficial the higher the rate of environmental change (panel A), the larger the organizational resource endowment (panel B), and the more diverse the task environments of units (panel C). Conversely, a higher number of business units improve the relative performance of social aspirations (panel D). We discuss these results below.

< Insert Figure 3 about here >

Fast-changing environments (a higher decay rate τ) require more intense exploration, because existing technologies become obsolete more rapidly and need to be replaced by new technologies at a higher rate. The constraints on exploration imposed by the classification effect now hurt the relative performance advantage of social aspirations (Figure 3, panel A). For example, in the extremely turbulent case of $\tau = 0.5$, firms under social aspirations allocate an average of 62% of all resources to exploration, while historical aspirations lead to an exploration rate of 67%. Historical aspirations, on the other hand, perform relatively better in dynamic environments, since the negative consequences of breaking off exploitation early are much less detrimental. Indeed, historical aspirations are faster and more effective at replacing old technologies than social aspirations in dynamic environments, as their disadvantages with regard to the sampling effect become much less of a liability.

Likewise, a higher search intensity resulting from a better endowment with corporate resources mitigates the shortcomings of historical aspirations and thus reduces the performance advantage of social aspirations (Figure 3, panel B). The primary reason is that more resources allow for a more intensive search process and thereby improve the reliability of feedback from search activities. Technically speaking, more resources increase the number of samples and reduce the likelihood of a unit experiencing an outlier "bad" period and thus switching to exploration without need. The performance properties of historical and social aspirations therefore converge.

Social aspirations also become much less beneficial the more diverse the task environments of the business units are, because the sampling mechanism becomes less informative and even misleading. The reason is that heterogeneous task environments (Figure 3,

panel C) provide an additional source for making wrong inferences, which only matters for social aspirations. For example, when a unit in a semi-stable environment compares itself with a unit that operates in a dynamic environment, the consistently higher performance (relative to the mean) that the former can achieve will lead that unit to under-explore and the unit in the dynamic environment to over-explore. Historical aspirations, in contrast, are unaffected by the environments of other units, as they tune their aspirations and their rate of exploration to their respective task environment.

Finally, higher numbers of business units increase the performance of social aspirations (Figure 3, panel D). Because more units correspond to more samples in the search process, the efficacy of the sampling effect for social aspirations is strengthened. The performance of historical aspirations, on the other hand, is unaffected, because every business unit receives performance feedback and updates aspirations in isolation. As panel D likewise illustrates, this also means that the performance of social aspirations suffers quite markedly, if too few units are available to establish the social reference point. However, past a point where aspirations stabilize, increases in the number of units produce minimal benefits for the firm.[16]

4.4 Implications of Task Interdependencies

4.4.1 Complementarities across business units

The above analyses assumed that business units were independent in the sense that their performance was unaffected by the performance of other units (only aspirations were affected and only in the case of social aspirations). Relaxing this assumption, Figure 4 reports the effects of positive task interdependencies, where successful exploration in one business unit has a

[16] Though the mechanism is quite different, this is similar to work showing that increases in competition past a certain point produce diminishing, or even negative, returns (Garcia and Tor, 2009; Boudreau, Lacetera, and Lakhani, 2011). Other work focuses on how such competition affects the volume of effort, while our model shows this result through reduced gains from the sampling effect.

complementary relationship with the value of technologies in other business units. As panel A demonstrates, and in line with expectations, complementarities increase the absolute performance of both social and historical aspirations. By slowing down technological decay, positive interdependencies increase the value of current technologies, which explains the modest increase in the absolute performance of historical aspirations. More noteworthy, however, is how positive interdependencies magnify the absolute and relative performance advantages of social aspirations (panels A and B).

< Insert Figure 4 about here >

The reason for this substantial advantage of social aspirations is that, in the presence of positive task interdependencies, the classification mechanism serves to establish a more pronounced division of labor between business units, consisting of three segments of units that differ in their search patterns. A first segment of units operates persistently below the social reference point, engaging in exploration with frequent changes in technologies and only a very low probability of performing above the social reference point and switching to exploitation. By frequently innovating new technologies, however, these exploratory units have important beneficial effects on other business units in the organization. The second segment consists of exploiting business units with very high performance. These units spend a long time on refining technologies, while frequently benefitting from the successful exploration by other business units. The third segment, finally, consists of units near the social reference point that regularly switch to exploitation (and back again). In addition, because the top-performers in the second segment create a larger discrepancy between the mean and median performance, the sampling effect implies that a majority of all business units operates below social aspirations, thus ensuring a sufficient level of (beneficial) exploration.

High levels of complementarities, on the other hand, affect the performance of social aspirations negatively, because they render the two effects less effective. Under strong complementarities, the specific behavior of individual units become less important for unit performance (relative to the positive spillovers induced by other units), which decreases the variance of unit-level performance in the organization and makes the units more similar. As the discrepancy between mean and median performance becomes smaller, however, the fraction of business units that engage in exploration also becomes smaller, because fewer units now perform below the social reference point, which results in an under-exploration on the organizational level.

4.4.2 Downstream competition between business units

Figure 5 reports the performance implications of negative interdependencies (downstream competition) between units. As expected, competition has an overall negative effect on the absolute performance of both social and historical aspirations (panel A). Comparing relative performance levels (panel B) reveals that historical aspirations perform better than social comparison for low levels of internal competition between business units, but this difference gets smaller for higher levels of competition, as the absolute performance of historical aspirations suffers relatively more (cf. Panel A).

< Insert Figure 5 about here >

In general, the negative spillovers induced by downstream competition raise the average level of τ faced by the units, and the overall effect is thus very similar to that of higher environmental dynamism, which we discussed previously (cf. Figure 3, panel A). What's different in the case of negative interdependencies, however, is that social comparison holds up

relatively better than historical aspiration for higher level of competition. The reason is that, for high levels of competition, historical aspirations underinvest slightly into exploration, as business units learn individually to become satisfied with lower performance. For social comparison, on the other hand, the classification and sampling effects stabilize behavior by allowing for sufficient exploration to mitigate the rapid obsolescence of technologies. For example, for $c = 0.7$, only 56% of all units with historical aspiration explore, in contrast to 60% of all units under social aspirations. Note, however, that the overall effect of competition shown in panel B of Figure 5 is far smaller than the effect of complementarities shown in panel B in Figure 4 – competition generally affects social and historical aspirations similarly, whereas complementarities create real differences.

4.5 Robustness

In addition to the analyses reported above, we conducted a broad set of further experiments to probe the robustness of our model. While we do not include the results in the paper for the sake of brevity, we discuss them below and note that all conform to expectations. First, we modeled hybrid benchmarks that are formed by a linear combination of social and historical aspirations, much the way prior empirical research has combined historical and social benchmarks (e.g., Greve, 2003). As one might expect, the hybrid benchmarks entail a behavior between that of "pure" social and historical aspirations. In terms of performance, they perform as well as social aspirations in the baseline case and nearly as well as historical aspirations in very dynamic task environments, suggesting that hybrid benchmarks may be a robust option when the firm finds it hard to assess the environment it is operating in. Second, we assumed a moderate level of updating historical aspirations to the previous period's performance ($\alpha = 0.5$). For higher levels of α, historical aspirations become more stable and their performance increases, owing to

the fact that the detrimental effects of the sampling effect are mitigated. In fact, for $\alpha = 0.9$, historical aspirations perform as well as social aspirations in the baseline case. For lower levels of α, on the other hand, the detrimental implications of the sampling effect become more important, thus increasing the performance benefit of social aspirations over historical aspirations. Third, we also changed the way we model internal social aspirations, representing them as each unit's contribution (share) to overall organizational performance. While most results are identical to the ones we obtained with our main model, we find the alternative measure to be more effective when the number of business units is small, but less advisable in large firms. Fourth, we varied the resource allocation rule of the corporate headquarter, testing a competitive allocation policy that distributes resources according to the relative performance of each unit. When resources are allocated competitively, social aspirations suffer a stronger performance penalty than historical aspirations (in the baseline case, for instance, performance drops by 7% for social aspirations, but only by 1% for historical aspirations). This is to be expected, since a competitive allocation policy distributes fewer resources to underperforming business units, which in turn reduces exploration. This situation, however, is particularly harmful for social aspirations, because it hampers the endogenous specialization process between units that we highlighted in the results section. Fifth, we also checked whether the initial conditions of the model (e.g., the aspiration levels or technologies at the start of the simulation) matter, but found no changes, even when (historical) aspirations were updated more slowly.

5 Discussion and Conclusion

Our study is motivated by the question of how internal social comparisons between units affect the adaptive performance of organizations. Prior work established the empirical prevalence

of intra-organizational benchmarking systems in multi-unit firms (Nickerson and Zenger, 2008; Stewart, Gruys and Storm, 2010) and showed how they affect managerial behavior (Mezias, Chen and Murphy, 2002; Tsai, 2002). Yet, we still lack a good understanding of the performance implications of such internal social comparisons. To address this gap, we developed a behavioral model to examine the performance consequences of internal social comparisons. Following prior modeling efforts and drawing on stylized facts about search behavior and innovation outcomes, the model focuses on how internal social comparisons impacts search behavior and the balance between exploration and exploitation at the unit level, and in turn how this behavior affects organizational performance.

Our primary result indicates that internal social comparisons can offer adaptive benefits to organizations, working through two specific mechanisms. First, the classification effect suggests that some business units within the firm will always be satisfied with their performance under internal social comparisons, which leads to a baseline level of investment in exploitation that can be beneficial for the firm. Second, the fact that the business unit compares itself with multiple other units as opposed to only its own past performance leads to greater stability in investment, which prevents the unit from changing technology needlessly. We label this the sampling effect. These two underlying mechanisms, however, have important boundary conditions that can lead internal social aspirations to create dysfunctional behavior within the firm. Specifically, when the environment is very dynamic or when resources are highly abundant, the benefits of exploitation decrease and the classification effect becomes less valuable. Similarly, when the firm is very small or when the business units are highly dissimilar, the comparison benefits of the sampling effect disappear and internal social comparisons perform relatively poorly. We also explored the implications of downstream competition or complementarity between the business units for the

performance of internal social aspirations. Interestingly, the results showed a small disadvantage for internal social aspirations when the units are in competition, but a significant advantage when the units are complementary.

In the sections below, we outline how our study extends and complements existing work on aspirations (Section 5.1), ambidexterity and aspiration systems (5.2), intra-organizational competition (5.3), and the adaptation of multi-unit firms (5.4), before discussing limitations and conclusions (5.5).

5.1 Internal versus External Social Aspirations

While comparatively little existing research has considered the idea of internal social aspirations, the recent work by Kacperczyk, Beckman, and Moliterno (2015) does focus on this idea. As mentioned earlier, that work distinguishes between internal social (comparisons between managers within the same firm) and external social (comparisons across firm boundaries). Their central point is that internal social comparisons are seen as more salient and threatening, leading to expectations of increased risk seeking when managers fall short of those aspirations. By contrast, external social comparisons are a problem for the organization, and lead to changes in behavior without necessarily increasing risk taking. In the current study, we focus on comparing internal social aspirations with historical comparisons, not with external social comparisons. While this decision is primarily made to simplify the modeling approach, we believe that our model does allow us to explore aspects of how internal and external social comparisons may differ and extend the contribution of Kacperczyk, Beckman, and Moliterno (2015). We note four likely differences that our model informs: number of comparisons, similarity of comparisons, correlation in performance, and resource allocation processes.

The first two points are straightforward. In most cases, external comparisons allow firms to average across a relatively large number of firms. Such aspirations would be less impacted by outliers and breakthroughs by specific alter firms. In internal comparisons, managers are benchmarking against relatively few other units, meaning that changes by one other unit may have significant implications for behavior. Our model shows that, if there are too few comparisons (below about eight units), then internal social comparisons perform poorly. The second point involves the comparability of comparisons. Given that managers tend to identify firms as relevant competitors to the extent that they occupy the same industry, are of similar size, and offer similar products (Porac and Thomas, 1990), external social comparisons are likely to be made between highly comparable firms. By contrast, internal social comparisons may emerge between units that operate in very different environments, diminishing the viability of the comparison. Our model shows that comparisons between dissimilar units can lead to significant dysfunctional behavior. These two points suggest that, in many firms, internal and external social comparisons may behave similarly.

The third point is about the correlation in performance between compared units. In external social comparisons, logic suggests a negative correlation – these firms are in competition, and the success of one is likely to lead to the failure of others. In our model, we see that when there is competition between units in terms of downstream performance (mimicking external social comparisons), the social comparisons perform relatively poorly – about as well as historical aspirations. This is in line with existing research suggesting that (external) social aspirations and historical aspirations produce relatively similar organizational outcomes (Miller and Chen, 2004). By contrast, most firms that may encourage internal social comparisons are likely to have business units whose performance is either uncorrelated or where units are complementary. As

shown earlier, such complementarities have a dramatically enhancing effect on the performance of social comparisons. Thus, we suggest that external social comparisons are likely to be quite similar to historical comparisons because of the competitive effect between units, while internal social comparisons are (in the real world) likely to be quite different.

Finally, external social comparisons are likely to feature resource distributions aligned with performance – the highest performing firms accumulate the most resources, which they can then use to facilitate future search. As noted in our robustness checks, our model shows that shifting away from equal resource allocation towards performance-based resource allocation diminishes the performance of social comparisons. With moderate favoritism towards high performing units, this tends to produce social and historical comparisons that perform relatively similarly, again reinforcing the idea that external social and historical aspirations are frequently similar. Our base model, by contrast, features equal distribution of resources in any given period, which is only really likely to happen within a firm, making it more likely a feature of internal social comparisons.

In sum we feel that in addition to the differences noted by prior work about change versus risk taking (Kacperczyk, Beckman, and Moliterno, 2015), our model allows us to highlight four other likely differences between internal and external social comparisons – the number of comparisons, the similarity of comparisons, the downstream competition between compared units, and the resource allocation process. Our results suggest that, when social aspirations are applied in settings more akin to external social comparisons, the performance differences between social and external comparisons may be relatively small. When social aspirations more closely align with internal social comparisons, we find that social comparisons perform much better than historical comparisons (as long as there are enough units and the comparisons are

relatively good). We believe that these insights further elaborate on our understanding of how different aspiration levels affect organizational outcomes.

5.2 Adaptation and Aspiration Systems

We also contribute to the literature on balancing exploration and exploitation in organizational learning and adaptation. Prior work has considered primarily how learning speed (March, 1991, Denrell and March, 2001; Greve, 2002; Miller, Zhao, and Calantone, 2006), communication structures (Lazer and Friedman, 2007; Fang, Lee, and Schilling, 2010; Schilling and Fang, 2014, Knudsen and Srikanth, 2014), and organizational designs (Siggelkow and Levinthal, 2003, Siggelkow and Rivkin, 2009) help organizations to maintain an effective balance between exploration and exploitation. Only few studies have examined how (historical) aspirations regulate exploratory search and organizational learning (Denrell and March, 2001; Greve, 2002; Greve, 2007; Bendor, Kumar, and Siegel, 2009), and these studies focus on how the speed of updating aspirations based on performance feedback impacts the efficacy of organizational adaptation. Faster updating magnifies the exploitation bias of organizations, especially in stable environments. We add to this literature by showing that social and historical aspirations differ systematically in how they regulate organizational search processes and achieve a balance between exploration and exploitation. The classification effect creates upper bounds on the organizational exploration rate, while the sampling effect shapes the switching point between exploration and exploitation, and back.

Our findings also call into question the implicit assumption in much of the behavioral literature that social and historical aspirations have a close correspondence in terms of how they affect organizational search and learning. Kim, Finkelstein and Haleblian (2015) showed that external social and historical aspirations differ in their effect on acquisition behavior. According

to their study, social aspirations denote a more ambiguous performance benchmark, because heterogeneity in the reference group is often unobserved or inaccurately assessed; accordingly, the higher ambiguity in external social benchmark makes managers more (less) cautious below (above) aspirations. While their arguments largely highlight the problem of making inferences from ambiguous feedback, our model emphasizes how structural differences between internal social and historical reference points play out in adaptive processes. The problem of ambiguous performance benchmark should also be less pronounced within companies, because the organizational context strengthens observability, salience, and assessment of social reference points.

5.3 Intra-Organizational Competition

In terms of the research on intra-organizational competition, our research highlights a very different but analogous process from most existing research. To date, most research on intra-organizational competition has focused on downstream competition (Birkinshaw and Lingblad, 2005), where firms offer similar products to similar or overlapping customer groups. Our study builds from the idea that managers may also compete upstream within the firm – benchmarking versus each other for resources, status, promotions, and other executive attention (Nickerson and Zenger, 2008). Not only does this competition have implications for the manager in question, it also affects firm-level outcomes by affecting how managers allocate the resources they control. Our study suggests that such internal, upstream competition may actually help organizations under the right set of circumstances, primarily by helping the units synchronize their search efforts to optimally allocate them within the organization. But when such comparisons are implemented under inappropriate circumstances, the negative performance effects can be significant. Most importantly, when internal social comparisons are layered over an organization

where the units already compete in the same downstream markets, the benefits of internal social comparisons disappear. This suggests that the two forms of competition (upstream for resources and downstream for customers) may be important substitutes for one another. This may mean that firms cannot effectively reap both coordination benefits (documented in our study) and motivation benefits (the typical view on internal competition), but further research is necessary to understand these boundary conditions. We suggest that upstream competition for resources within the firm is a fertile area for more research, including how this does or doesn't interact with more traditional downstream competition.

5.4 The Adaptation of Multi-Unit Firms

In terms of the adaptation of multi-unit firms, our model extends existing work on organizational adaptation (Levinthal and March, 1981) by integrating the realities of complex multi-unit organizations. Despite the overall and longstanding interest in organizational structure and multi-unit firms, especially within the tradition of the Behavioral Theory of the Firm (Simon, 1947; March and Simon, 1958), questions of structure and particularly how structure affects adaptation efforts have been understudied within the existing literature. Consistent with recent literature (Gaba and Joseph, 2013), adaptation behavior in multi-unit firms is noticeably different from adaptation in single-business firms. Our model specifically suggests that encouraging managers to benchmark performance versus other intra-organizational units may actually facilitate adaptation efforts within the firm, especially to the extent that units are producing complementary products or services. The underlying process, as discussed in detail above, involves providing more reliable signals on when units should switch from exploitation to exploration in order to improve organizational outcomes. This idea that governance and organizational structures may not just enable decentralized decision making but also coordinates

decisions across the firm is especially provocative. Our study thereby contributes to recent work on organizational ambidexterity that has studied how organizations can simultaneously engage in exploratory and exploitative activities (Tushman and O'Reilly, 1996; Raisch, Birkinshaw, Probst and Tushman, 2009). Relating to this body of work, our insights into the effects of internal social comparisons suggest a novel mechanism through which horizontal (and vertical) interactions in multi-unit firms may endogenously provide for an effective organizational balance between exploration and exploitation. In many organizational contexts, social benchmarking may be an effective managerial tool to delegate and to decentralize decision-making about whether and when to explore. We hope that future research will explore these possibilities both empirically and through modeling efforts.

5.5 Limitations and Conclusions

Like all studies, this one has important limitations to consider as well. Most importantly, our model abstracts away from typical issues considered in prior research on intra-organizational social comparisons – namely the distinction between risk taking and behavioral change (Kacperczyk, Beckman, and Moliterno, 2015), sabotage (Milgrom and Roberts, 1988; Charness, Masclet, and Villeval, 2013), the undermining of cooperative behavior across units (Tsai, 2002) or individuals (Chan, Li, and Pierce, 2014), and envy (Nickerson and Zenger, 2008). One strength of our model is that it allows us to explore the performance and behavioral implications of internal social comparisons even once those effects are removed, but we recognize that the real world implications of social comparisons will have to take these other factors into account. In addition, we recognize that our modeling approach does not allow us to calibrate our model to real world data. This is because our approach builds from existing behavioral research to make behaviorally-plausible assumptions that produce interesting insights, as opposed to calibrating to

observed real world data and offering a potential mechanism to explain the data. Each modeling approach has its strengths and weaknesses, and we feel that the core research question explored here matches the modeling approach that we have chosen, but other modeling approaches to this question may produce different insights.

We began this study with the observation that many firms encourage some sort of internal social comparison processes for managers. Clearly, these executives believe that such comparisons provide an advantage for their organization, but existing theory doesn't necessarily provide clear insight into why beyond the assumption that such rivalry would increase managerial effort. The model introduced in this study offers a range of additional insights about internal social comparison processes and implications. Using two underlying mechanisms that we label the classification effect and the sampling effect, we explore the conditions under which internal social comparisons may actually increase the adaptability and responsiveness of the organization by affecting the direction of organizational search efforts. Our results indicate that firms such as GE may be right to encourage social comparisons, especially to the extent that these firms have many managers or units to compare, the comparisons are relatively similar in terms of environmental dynamics, and to the extent that there are strong complementarities between units – for example vertically integrated firms or firms leveraging shared resources to offer closely related products. Given that these conditions are likely to exist in many organizations, though certainly not all even among the Fortune 500, we suggest that our model provides important insights into why social comparisons can actually help firms adapt and succeed.

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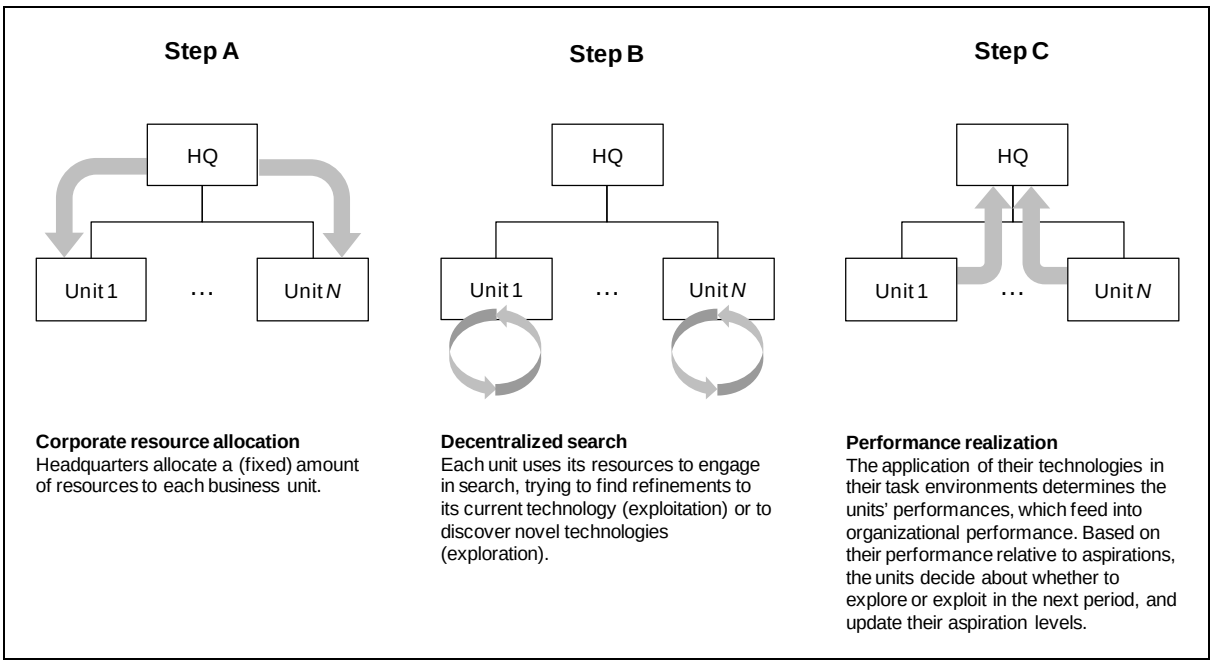
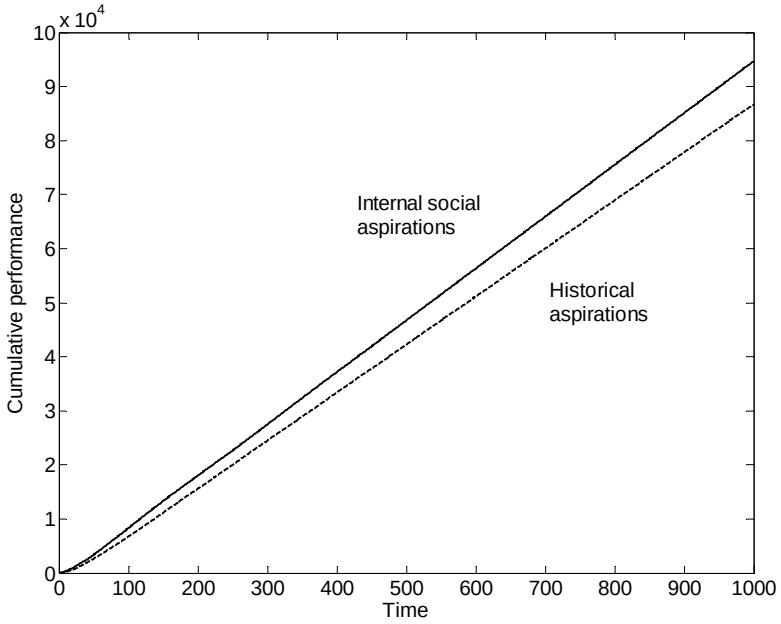
Figure 1: Resource allocation and search in multi-unit firms



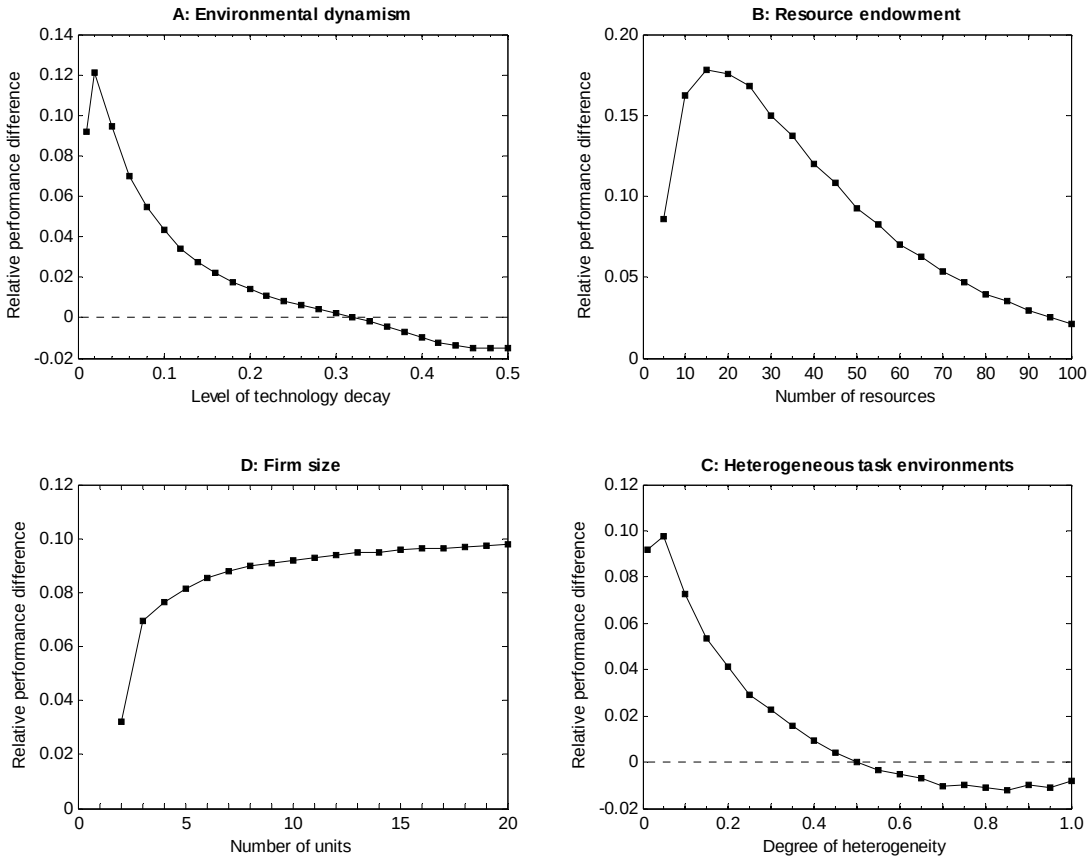
This figure illustrates the adaptive processes in multi-unit firms that are captured by our model. In each period of the simulation, the model iterates through steps A to C.

Figure 2: Performance advantage of internal social aspirations



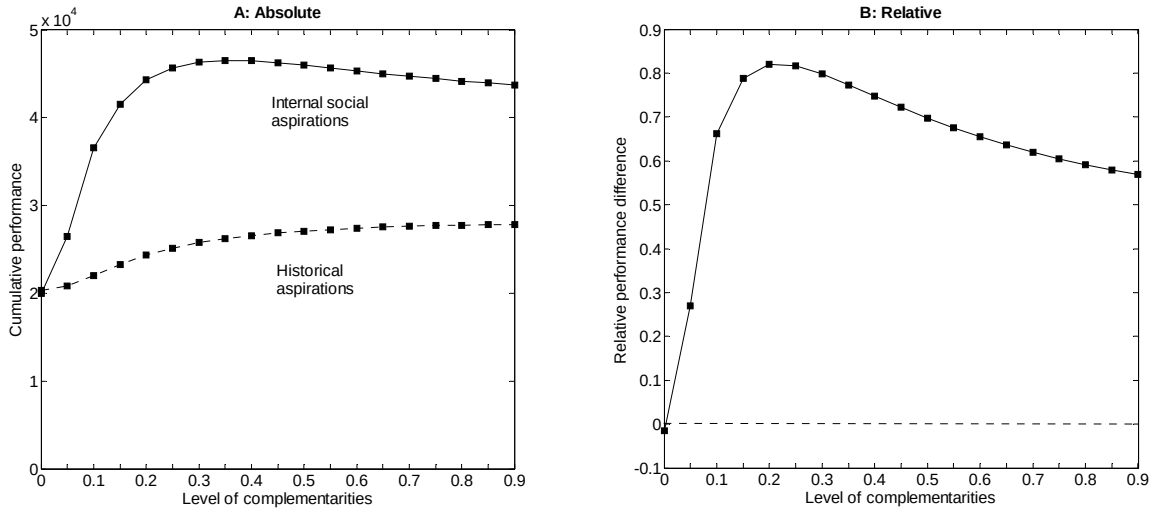
This figure reports cumulative firm-level performance over time, subject to different aspiration systems. The results are based on a setup with $N = 10$ business units, $R = 50$ resource units per period, and a slowly-changing task environment ($\tau = 0.01$). Each unit decides independently whether to explore or exploit, as regulated by its performance relative to aspirations. The results are averaged over 10,000 replications.

Figure 3: Determinants of the performance advantage



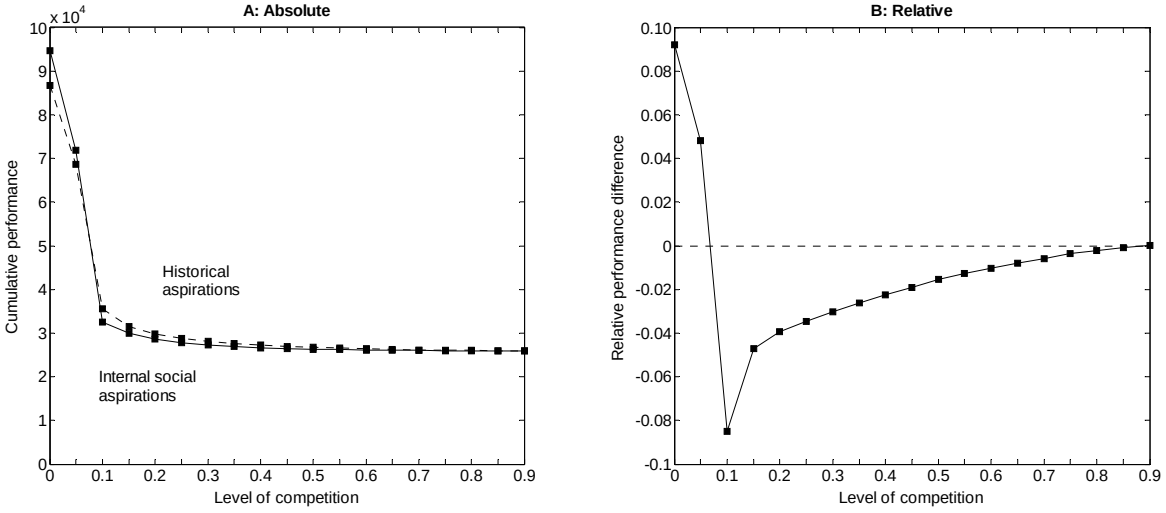
The panels of this figure report the relative performance difference (in %) between firms that follow internal social aspirations and firms that follow historical aspirations, subject to variations in key organizational factors. (Positive values thus indicate that internal social aspirations outperform historical aspirations; negative values indicate that historical aspirations are preferable.) Panel A is based on a setup with $N = 10$ business units and $R = 50$ resource units per period, while the level of technology decay (τ) is varied. In panel B, the number of resources (R) is varied, while the number of units is kept constant at $N = 10$, and all of them operate in a slowly-changing task environment ($\tau = 0.01$). Panel C is based on a setup with $N = 10$ business units, $R = 50$ resource units per period, while the individual units face a different level of technology decay (τ). Specifically, for a "degree of heterogeneity" of x, each unit's technology decay is drawn stochastically from a uniform distribution with U[0;x]. In panel D, the number of business units (N) is varied. In doing so, the number of resources per period (R) is adjusted proportionally, ranging from $R = 10$ when $N = 2$, to $R = 100$ when $N = 20$. The units operate in slowly-changing task environments ($\tau = 0.01$). In all panels, the results are averaged over 10,000 replications.

Figure 4: Performance implications of complementarities across units



The panels of this figure report the implications of positive interdependencies (complementarities) between the business units' tasks environments. Panel A shows absolute firm performance, subject to different aspiration systems; panel B reports the relative performance difference (in %) between firms that follow internal social aspirations and firms that follow historical aspirations. Each business units' task environment is characterized by an initial level of dynamism, $\tau_{initial} = 0.5$. Successful exploration of a new technology in any unit decreases all other units' level of dynamism by c ("level of complementarities") percent toward a baseline level $\tau_{base} = 0.01$. The innovating unit's level of dynamism is set back to $\tau_{initial} = 0.5$. The results are based on a setup with $N = 10$ business units and $R = 50$ resource units per period, and are averaged over 10,000 replications.

Figure 5: Performance implications of downstream competition between units



The panels of this figure report the implications of negative interdependencies (downstream competition) between the business units' tasks environments. Panel A shows absolute firm performance, subject to different aspiration systems; panel B reports the relative performance difference (in %) between firms that follow internal social aspirations and firms that follow historical aspirations. Each business units' task environment is characterized by an initial level of dynamism, $\tau_{initial} = 0.01$. Successful exploration of a new technology in any unit increases all other units' level of dynamism by c ("level of competition") percent toward a baseline level $\tau_{base} = 0.5$. The innovating unit's level of dynamism is set back to $\tau_{initial} = 0.01$. The results are based on a setup with $N = 10$ business units and $R = 50$ resource units per period, and are averaged over 10,000 replications.

Table 1: Parameter values for the baseline model

	Parameter	Variable	Value
MAJOR	Number of business units	N	10
	Total number of search resources units to be distributed in each period	R	50
	Task environment ("technology decay")	τ	0.01
MINOR	Weight on prior aspirations when updating historical aspirations	α	0.5
	Exploitation distribution: initial standard deviation	$\sigma_{exploit}$	0.2
	Exploitation distribution: reduction factor ("carryover")	RC	0.99
	Exploration distribution: mean	$\mu_{explore}$	0
	Exploration distribution: standard deviation	$\sigma_{explore}$	0.8

This table lists all model parameters as well as their values in the baseline set-up. All "major" parameters affect the outcomes of the model in significant ways, in the sense that they change the effects of the key mechanism we demonstrate. We analyze their individual role in detail. All "minor" parameters, while being relevant to the model, do not affect the model outcomes in qualitatively significant ways, instead reducing, for instance, the size of an effect. We report the effects of varying these parameters in the robustness section.

Table 2: Performance and adaptation metrics for the baseline model

	Internal social aspirations	Historical aspirations
Firm performance	95.73	88.76
Performance of strongest unit	15.83	13.62
Performance of weakest unit	4.67	5.48
Number of refinements of each technology	62.63	20.87
Share of exploration among total search efforts	51.1%	70.5%
Share of exploitation among total search efforts	48.9%	29.5%
Likelihood of switching a technology	0.19	0.12

This table reports performance and adaptation metrics for the benchmarks reported in Figures 1. All metrics are measured in period 1,000 and are averaged over 10,000 replications. They are based on a setup with $N = 10$ business units, $R = 50$ resource units per period, and a slowly-changing task environment ($\tau = 0.01$).