Activity Overinvestment: The Case Of R&D

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ABSTRACT

The literature on corporate diversification has often argued for and established the case that companies often overdiversify in a product market sense – i.e. enter into unrelated product markets where they may not fully cover their cost of capital. Yet, even without engaging in unrelated diversification, managers need to make resource allocation decisions to a variety of activities that a company conducts to consummate its business. In this article we focus on Research and Development (R&D) activity and we discuss the effects that the uncertainty, boundary ambiguity, feedback latency, R&D lumpiness and legitimacy that characterize technological contexts can have in making overinvestment in R&D likely. Specifically, in this article we a) draw attention to the construct of activity overinvestment, and specifically R&D overinvestment, b) use the received literature to argue that there exists a prima facie case for examining this construct and its antecedents in order to evaluate the extent and implications of R&D overinvestment, and c) make the more general case that the resource allocation literature needs to study the issue of activity overinvestment systematically.

Keywords: Resource allocation/Management, Patents and R&D Strategies, Technology Strategy

ACTIVITY OVERINVESTMENT: THE CASE OF R&D

INTRODUCTION

The literature on corporate diversification has often argued for and established the case that companies often overdiversify in a product market sense – i.e. enter into unrelated product markets where they may not fully cover their cost of capital. This has resulted in a widespread belief that conglomeration, or product market unrelated diversification, is fundamentally value destroying (Rajan, Servaes & Zingales, 2000; Scharfstein & Stein, 2000). Widespread promulgation and acceptance of this research has led to conglomeration falling out of favor as a corporate strategy.

Yet, managers make resource allocation decisions along many planes of which breadth of corporate scope is but one. In all these domains, investment sub-optimality may be playing a role and lead to the destruction of value. For instance, even without engaging in unrelated diversification managers need to make resource allocation decisions in a variety of activities that a company conducts to consummate its business. Such activities (or functions in common parlance) include research and development (R&D), marketing, manufacturing, etc. It is quite possible that the characteristics of these activities, managerial self-interest and preferences, or decision-making style or circumstances may lead to sub-optimally high or low investments in these different activities. Yet our exploration and understanding of these various activities as loci of resource over- and under-allocation remain very limited.

Although in principle an exploration of the various activities as possible venues of under- and overinvestment is interesting, in this article we focus on R&D activity and on the impact that the uncertainty, boundary ambiguity, feedback latency, R&D lumpiness, and legitimacy that characterize technological contexts can have in making R&D overinvestment likely. We note

that there are many reasons to believe that R&D investment may be significantly subject to sub-optimal investment from the shareholder's perspective. This is not to argue that other activities such as marketing etc. are not subject to over or under investment. Rather, it is to focus attention on one activity to highlight the research potential in the area with the hope that this will spur similar inquiry into the possibilities of sub-optimally high investments in other activities as well.

Specifically, in this article we a) draw attention to the construct of activity overinvestment, and specifically R&D overinvestment, b) use the received literature to argue that there exists a prima facie case for examining this construct and its antecedents in order to evaluate the extent and implications of R&D overinvestment, and c) make the more general case that the resource allocation literature needs to study the issue of activity overinvestment systematically.

Prior research has devoted attention to the problem of R&D investment optimality especially from a policy standpoint, i.e. how much investment in R&D would be socially optimal. Several studies in this area have identified various types of distortion that can lead to underinvesting in R&D. Innovation projects are highly idiosyncratic, have a high probability of failure and involve high levels of information asymmetry, which might induce firms to underinvest (Holstrom, 1989). External pressures from investors and analysts leading firms to meet short-term goals might result in a reduction in investment in long-term innovative projects (e.g. Ahuja & Troyer, 2016; He & Tian, 2013). The fact that innovators are not necessarily able to appropriate the returns from their inventions has also been identified as an important factor reducing the incentives to invest in R&D (e.g. Arrow, 1962). In fact, R&D underinvestment is one of the main rationales behind the design of public policies aimed at supporting R&D such as the patent system.

Other studies have instead identified antecedents for overinvestment, especially in the context of competitive dynamics among rivals. For example, the "business stealing effect", related to the fact that entry by the latest innovator destroys or appropriates previous incumbents' rents, can result in overinvestment (e.g. see Denicolo' & Zanchettin, 2014). A second class of reasons that could lead to R&D overinvestment is the monopoly distortion effect, related to the fact that monopoly leads wage rates to be lower than the true social cost of labor hence the monopolist faces an excessive incentive to invest in R&D (Denicolo' & Zanchettin, 2014). In addition, R&D overinvestment can occur due to "congestion" or "winner takes all" effects. These effects, for example, are modeled in auction models, where invention is seen as a deterministic outcome and firms that commit the greatest expenditure today will obtain the invention before others (e.g. Dasgupta & Stiglitz, 1980; Reinganum,1989). Similarly, R&D overinvestment can occur in the context of patent races, where all firms compete in the discovery but only the firm that gets to it first gets the "lion's share" (Cockburn & Henderson, 1994; Jones & Williams, 2000). However, this literature has focused on competitive dynamics in explaining overinvestment. In our article we emphasize the potential for future research to focus more closely on behavioral motivations and biases of managers as the cause of systematic overinvestment in an activity (in our case, R&D).

We suggest that while prior literature has largely emphasized the risks associated with R&D underinvestment, looking at R&D overinvestment is a very relevant problem as well. Increasingly, the business world is characterized as being in the throes of a technological revolution. Larger and larger amounts of money are being invested in technological efforts and technology-based companies are commanding valuations in the billions, indeed obtaining their own nomenclatural category, i.e. "unicorns". Even in the domain of publicly held companies, the

technology-stock-heavy-NASDAQ index is increasingly very highly valued, suggesting optimism in the prospects of technology companies. Yet, the availability of plentiful resources is often associated with a lack of discipline in their usage (e.g. Jensen & Meckling, 1976). Thus, the time might be opportune to develop a better understanding of the efficacy of investments in R&D. Understanding the conditions under which we overinvest in R&D is also meaningful for theoretical reasons as we shall see below.

We hope that this article induces broader exploration of overinvestment in R&D and eventually also induces research into other activities - such as marketing, operations, etc. - to identify the incidence and antecedents of overinvestment in those activities as well. While we recognize that overinvestments can be systematically related to characteristics of firms, their management teams and their business environments, in this paper we focus on the specific characteristics of R&D investments to draw attention to the possibilities of overinvestment in the R&D activity.

Defining And Identifying R&D Overinvestment

Activity overinvestment occurs when the returns from an investment in a particular activity (e.g. R&D, marketing, operations) fail to generate returns that cover the investing firm's cost of capital, i.e. the NPV of such investments is negative. Correspondingly, we define R&D overinvestment as investments in research and development efforts that are characterized by a negative net present value. Hence, such projects are likely to never bring returns that cover their cost of capital.

In principle, in a value-maximizing entity, overinvestment should not occur. To the extent that managers are motivated to create value they should limit investment in a specific activity to levels that generate a positive return net of all costs. Nevertheless, anecdotal evidence

suggests that activity overinvestments can and do occur. For instance, Ghemawat (1999) notes that between 1980 and 1997 GM invested 167 billion dollars in technology and capital equipment (332 billion in net present value if compounded at 1997). Yet, GM's market value was at $ 13 billion in 1980 and increased to $ 42 billion by the end of 1997. In other words, even assuming that R&D investments have a short life, it is very likely that many of these investments were value destroying. Similarly, Google and Apple in the current era and Kodak, IBM and other companies in the past have all been accused of unproductive R&D investments.

Overinvestment can often only be recognized ex-post. On some of these occasions overinvestment might occur because, at the time at which the investment occurred, the decision maker genuinely believed ex-ante that the investment would lead to returns that will cover the costs of capital involved; on other occasions, instead, the decision maker might be ex-ante aware that the returns on the investment are likely to be lower than the cost of capital or might even not be interested in understanding ex-ante whether the returns of the investment will cover the cost of capital, for instance due to agency reasons. The basic thesis of this article is that specific characteristics of R&D investments (such as uncertainty, boundary ambiguity, feedback latency, R&D lumpiness and legitimacy) make overinvestment likely to occur: on the one hand, these characteristics likely make the ex-ante identification of overinvestment difficult for decision makers genuinely interested in avoiding it; on the other hand, they give decision makers operating under personal agency the opportunity to "cover" overinvestment more easily and bypass the safeguards in place that would prevent managers from investing poorly.

Note that this issue of overinvestment as estimated through the NPV of investments is an issue that transcends investments in activities, and indeed attends almost all managerial resource allocation – as almost by definition investments are made on the basis of expected cash flows.

The point we make is that noting that some characteristics of R&D investments might bias or affect the R&D investment decisions toward overinvestment is important – irrespective of the extent to which managers are willing or able to know with precision ex-ante whether an investment is optimal. Understanding the construct and antecedents of R&D overinvestment could in fact lead companies towards the employment of more deliberative attitudes in anticipation of these possible effects. Further, by identifying the characteristics most commonly associated with overinvestment, it might allow firms to develop organizational arrangements that address or limit such possibilities. This highlights the need for building a theory of resource misallocation in the context of R&D investment.

While this article focuses on the case of R&D investment as a specific case of "activity overinvestment", it may be worth emphasizing the possibility of building a similar case for resource misallocation in other activities as well as recognizing the distinctive attributes of activities in those areas that might be more likely to lead to overinvestment; that task is however beyond the scope of this article and we leave it for future research in this domain.

We suggest that R&D overinvestment may result from a variety of antecedents. In this article we focus on identifying some of the key features of R&D investments and elaborate on how these features appear to make a case for the occurrence of R&D overinvestment. Specifically, we identify five inherent characteristics of technological domains that make R&D overinvestment likely to occur: uncertainty, boundary ambiguity, feedback latency, R&D lumpiness and R&D legitimacy. We recognize that this list is illustrative rather than exhaustive. In the sections that follow we elaborate on how each of these characteristics could potentially make R&D overinvestment more likely and call for research on this topic to validate or invalidate these various plausible effects. We make a distinction between horizontal R&D

overinvestment, wherein excess investment is funneled into research that ends up being applicable in business areas beyond the core business of the company and vertical R&D overinvestment wherein the excess R&D investment occurs in an existing business area of the company. Some antecedents of R&D overinvestment are likely to influence both vertical and horizontal overinvestment while others will influence only one of these types of overinvestment.

Uncertainty And R&D Overinvestment

Investments in R&D face uncertainty of several different kinds, each of which raises the possibility of R&D overinvestment. First, R&D investments are often conducted in an environment of significant environmental uncertainty (i.e. exogenous or external uncertainty) wherein the competitive landscape is being redrawn (Folta, 1998; Lee & Paruchuri, 2008; Mitchell, 1988). Second, R&D investments are in themselves often uncertain in terms of their success or failure due to the fact that the firm is actually trying to do something that has not been attempted before; hence it is difficult to foresee what outcomes this may lead to. This type of uncertainty has often been referred to as endogenous or technical uncertainty in prior research (e.g. Folta, 1998; Maritan, 2001). For instance, which investment will lead to products as well as the time and effort that will be required to complete a project is often only known via investment and direct learning (Folta, 1998; Rosenberg, 1998). Third, in the context of R&D investment it is more difficult to predict when in time the returns from the investment will manifest themselves, a characteristic we label temporal uncertainty (McGrath, 1997; Scherer & Harhoff, 2000). Jointly these suggest that investments in R&D can commonly be considered as occurring under high uncertainty.

Uncertainty is likely to increase the difficulty of evaluating R&D investment projects closely. For instance, the application of tools of financial analysis, such as the method of

discounted cash flows to calculate net present value, are more problematic in context of high uncertainty (Christensen, Kaufman & Shih, 2008). In these contexts, not only is the estimation of the cash flows and terminal values highly uncertain, but also it is unclear how to calculate the counterfactual value to which such NPV should be compared (i.e. the NPV that the firm would have obtained if the investment was not made, as suggested by Christensen et al., 2008). Although prior research (Christensen et al., 2008) indicates that these complexities could lead to underinvestment, we note below how the same issues could lead to overinvestment. With high uncertainty in estimating cash flows it is quite easy for managers to overestimate the expected returns from a new technology. Indeed, research suggests that entrepreneurs systematically overestimate the commercial potential of a technology (Cassar, 2010). This overestimation is based upon both an optimism bias that is often intrinsic to entrepreneurs in valuing their prospects, but may also be strategically driven to provide a more positive picture to potential investors.

Further, moving beyond entrepreneurial organizations, one could imagine that such overinvestment could also occur in large multidivisional corporations. Faced with complex decisions under high uncertainty, managers are more likely to use heuristics to identify "good" decisions rather than attempting global optimization (Rivkin, 2000). However, heuristics can interact with the structural attributes of the modern corporation and create overinvestment. For instance, Bardolet, Fox & Lovallo (2011) show that firms' internal capital allocations are biased toward equality over the number of business units into which the firm is partitioned, reporting systematical variation with the divisional and sub-divisional structure of the firm. In the context of R&D investment, this would correspond to suggest that faced with five potential R&D investment projects, in the face of uncertainty regarding how much is the right level of support to

provide for a given business, a manager might be inclined to allocate resources evenly across the five projects. Such an allocation process may also be politically attractive in the context of a large corporation with many divisions. The fact that different options are allocated resources on an "even" basis and not on the basis of the actual value that each option might yield could lead to inappropriate diversification and overinvestment in some areas – an illustration of vertical R&D overinvestment in those domains. Support for the occurrence of this kind of behavior is provided by research on decision-making heuristics which suggests that - in allocating resources across options- decision makers often resort to the "1/n heuristic" (Benartzi & Thaler, 2001), i.e. the tendency to allocate capital evenly across the options presented, irrespective of the actual value of each option. For example, Benartzi & Thaler (2001) show that, in the choice of contribution saving plans, some investors divide their contributions evenly across the funds offered in the plan. In the context of multidivisional corporations too, evidence of some forms of corporate socialism have been observed (Rajan et al. 2000). Documenting and identifying the extent to which different forms of uncertainty do or do not lead to R&D overinvestment may be a useful exercise from the perspective of improving resource allocation into the future by providing managers with guidelines on when such errors are more likely to occur.

Boundary Ambiguity And R&D Overinvestment

The second characteristic that makes R&D investments potentially vulnerable to the risk of overinvestment is the fundamental boundary ambiguity that characterizes them. The boundary ambiguity associated with R&D investment could potentially lead to a specific type of R&D overinvestment that we label horizontal R&D overinvestment as it may result in firms overinvesting in R&D in areas beyond the focal product domain of the firm. Boundary ambiguity in technological investment arises for a variety of reasons. First, for a firm operating in any

individual industry, the boundaries for R&D investments are difficult to draw due to the fact that firms need to know more than they make because having absorptive capacity for related fields is important to product development (Brusoni, Prencipe & Pavitt, 2001; Gambardella & Torrisi, 1998). However, while the broad recognition that firms need to know more than they make supports enhancing the R&D scope of the corporation, it does not provide guidance on when to stop. Further, in recent years, the technological environment has become increasingly populated by systems of complementary products, the boundaries of which are quite vague and could be biased by misperception (Siggelkow, 2002). Both the above characteristics of R&D investment make investments in R&D beyond the focal product more likely. However, with no clear guidance on what is the appropriate breadth of R&D within the firm one could imagine entrepreneurs and CEO's overreaching in terms of their technology investments in building up extremely broad research programs as they pursue "ecosystem dominance". In this pursuit they can often invest in technologies that are successively more distant from their focal business. For instance, a firm engaged in focal product A may invest in technology for a product B that is complementary to product A and then invest in a technology for product C that is complementary to product B. Such long-linked chains of R&D investment may lead firms to increasingly broader portfolios of technology, which may themselves create an impetus for further R&D investment. Note that companies like Google have diversified into technology relevant for a very broad range of purposes including cars. An attempt by Google to directly diversify into the car business may have been met with opposition and skepticism. Yet, a technology-routed investment into that business has likely not been as closely evaluated or identified as inconsistent. Identifying how R&D overinvestment can originate as a result of the

ambiguity in R&D boundaries would help furthering the understanding of R&D investment sub-optimality.

Feedback Latency, R&D Lumpiness And R&D Overinvestment

The third feature of R&D investment that is relevant in this context is the scarcity and latency of feedback on the results of the investment. Marketing and supply chain investments are often scalable so that immediate feedback can be obtained and potential overinvestments corrected during a project itself. For example, marketing investments are often run in pilot locations in order to learn from the immediate feedback. Moreover, these investments tend to target the current customers of the firm, about whom firms tend to have knowledge. Conversely, R&D investments are often non scalable and they are targeted to produce outcomes that will be valuable to customers in the future. Technologies, indeed, often have long and uncertain development times and feedback on the investment is limited and sparse during the development process. Most radical new technologies, such as the laser or the radio, typically emerged in a very primitive condition and went through very extensive development processes that led to a long exploration of their repertoire of technical applications until the most successful ones were eventually discovered (Rosenberg, 1998). Further, very often technology development is "lumpy". While other types of investments could be localized to a given geography or medium and hence reduce the fixed cost required to run a pilot, such an option may not be available for R&D investments, which often need a lump sum of investments to create a proof of concept, technology or product before any feedback can be obtained. As a result, while how much should a firm invest in a given research project is often difficult to estimate ex-ante, this problem is compounded by the difficulty in obtaining timely feedback on the actual performance of a new technology.

Another factor driving vertical overinvestment in R&D may emerge from behavioral tendencies such as "belief perseverance" (Lord, Ross & Lepper, 1979) and escalation of commitment (Arkes & Blumer, 1985; Staw, 1976) - i.e. ignoring negative feedback and continuing investing once an investment has been initiated- especially in the presence of sizeable sunk costs (O'Brien & Folta, 2009). The scarcity and uncertainty of feedback that characterize technological investments is likely to worsen this natural tendency (Maritan, 2001; O'Brien & Folta, 2009), creating a special hazard from the perspective of R&D overinvestment. In addition to the lack of internal feedback, external feedback is also likely to be confusing in the case of technological investment. External parties may legitimately not be aware of how successful a given technology development enterprise is for a long period, until its results are finally revealed. Investing firms are likely to face divergent pressures, with technological pressures, on the one hand, calling for increasing investment in new technologies and institutional pressures, on the other hand, arising from analysts' reactions to these investments (Benner & Ranganathan, 2012; Lee and Paruchuri, 2008). With feedback clarity and timeliness managers might themselves conclude that the efforts are misplaced and may de-escalate investments. Alternately, unambiguous and timely feedback might impose other external restrictions on managers' behavior (Heath, 1995; Northcraft & Neale, 1986; Northcraft & Wolf, 1984) such as analysts and investors protests that may cause managers to curtail R&D investments. However, absence of feedback for an extended period may lead to managers increasing their commitment in such technological investments beyond the optimal level and continuing to invest when the right call would be to limit further investment. However, whether lack of timely feedback does or does not lead to R&D overinvestment can be conjectured as above, current research doesn't really provide us with evidence one way or the other.

R&D Legitimacy And R&D Overinvestment

Another characteristic of R&D investment that makes it susceptible to the risk of overinvestment is the high level of legitimacy that is commonly associated with R&D investments. R&D legitimacy can in fact be useful for managers who wish to disguise overinvestment that occurs in the context of an agency relationship, as a result of information asymmetry and incentive misalignment between managers and owners (e.g. Bebchuk & Stole, 1993; Harris & Raviv, 1996). The possibility of managerial malfeasance generally fosters a heightened level of scrutiny from owners (e.g. Dey, 2008; Harris & Raviv, 1996). However, in this article we draw attention to the possibility that the legitimacy that characterizes R&D investments might reduce the level of scrutiny that is applied to control investments in the R&D area.

Our logic stems from a recognition that investment in R&D is usually considered socially legitimate and can serve as signal of good management; indeed, not investing in R&D is often perceived as a prima facie metric of agency behavior by managers (Stein, 1988; 1989). In addition, R&D is recognized as an appropriate response locus for many environmental threats, further cementing its legitimacy. This is so for several reasons. First, it is well known that R&D is key to long-term productivity increases for firms and societies (Schumpeter, 1942; Solow, 1957). Second, R&D has been the source of some of the most visible wealth creation in recent times at both individual and corporate levels. Bill Gates, Steve Jobs, Mark Zuckerberg and similar other entrepreneurs and their companies are all established examples of extreme success associated with technological investment. Third, R&D is inherently regarded as “cool” and the possibility of being associated with something that could become “completely revolutionary” rather than just “moving the needle a bit” acquires salience relative to being able to estimate the

potential returns on investment from it (Petkova, Wadhwa, Yao & Jain, 2014). Fourth, the general view of R&D as the source of creative destruction legitimizes investments in it, from both the perspective of the incumbent in a given arena (to protect their advantage) and the entrant (to create upheaval). Indeed technological developments raise the specter of Schumpeterian upheaval and so trigger the need from the company standpoint to generate a response (Lavie, 2006). Hence, from a corporate perspective, technological investments are associated with outcomes that are considered "good" - such as productivity, wealth creation and quantum increases in performance. This legitimacy of R&D as a repository of good investments is further enhanced by availability heuristics. Although it is likely that a systematic and unbiased analysis might find that average returns to technological investment are much lower, decision-makers may remember much more saliently the extreme outliers (e.g. "Bill Gates became the richest man in the world through developing technology") and may thus be conditioned to invest highly in it.

In addition, investments in R&D can lead to signals that are "hard" or measurable (Bebchuk and Stole, 1993) in the sense that R&D investments are also often associated with intermediate, quantifiable markers of performance such as patents that serve as indicators of progress and convey a sense of value creation (Hsu & Ziedonis, 2013). For example, investment in R&D and preannouncement of new products (i.e. products being developed but not marketed yet) by a firm are used by investors as positive signals of the future value of the firm (Tinn, 2010). For instance, Microsoft saw a 25% gain in the stock price in the six months before launching the Microsoft Vista operating system, a gain that disappeared once the operating system was effectively launched on the market. This phenomenon is referred to as "adoption to signal" (Tinn, 2010). In contrast, investment in other activities may be less measurable (e.g.

marketing or general management skill development), or provide fewer "early" signals of output (Doyle, 2000; Rust, Ambler, Carpenter, Kumar & Srivastava, 2004) or generally be less widely regarded as legitimate, relative to R&D. For instance, while pharmaceutical companies' investments in R&D are lauded, their investments in marketing are sometimes criticized.

This legitimacy of R&D when combined with its signaling benefits may be very useful to managers who seek to signal their "long-termism" (and hence non-agency behavior) to owners and markets. Technological investments can serve as visible indicators of "long term orientation" of the company and hence of managers' "behaving appropriately", i.e. investing in long-term interests of the company (Bebchuk & Stole, 1993; Tinn, 2010). In line with this, several studies have shown that investment in R&D is associated with stock overpricing (Perez, 2003; Polk & Sapienza, 2009). As a result, R&D investments are likely to be promoted and may eventually lead to R&D overinvestment.

In fact, the above tendency to overinvest in R&D appears to be even more likely for companies operating in R&D intensive environments due to the fact that, in the case of these firms, investment in R&D is even more legitimized. Research on organizational identity and its impact on firms' action notes how some firms are likely to focus on certain parts of the environment more than other parts (Livengood & Reger, 2010; Ravasi & Schultz, 2006). Some competitive areas have a higher psychological value for firms' managers and are perceived as more "central, distinctive and enduring" arenas where actions carry greater consequences. These environments constitute the "identity domain" of the firm (Livengood & Reger, 2010).

In R&D intensive environments technology is a salient feature, dimension of activity and perceived source of competitive advantage. Accordingly, technology will receive a disproportionate amount of managerial attention and investment (Ocasio, 1997). Managers are

likely to feel more aware, more motivated and more capable of investment in the domain and are more likely to invest in it irrespective of performance implications (Livengood & Reger, 2010). For example, Intel developed a strong identity as "the memory company" as it almost invented the DRAM business. In 1985, the top management decided to invest approximately one-third of the entire R&D budget of $195 million in the DRAM business despite the fact that Intel's market share in DRAM was only 3.4 percent (Burgelman, 1991; Livengood & Reger, 2010).

In addition, in R&D intensive sectors, it is not just managers whose attention is focused on R&D. Technology trends and events dominate the informational landscape. Investment bankers, press, consultants, lay public, shareholders, all increase (rather than dampen) the visibility of any technological shock and hence its salience, expected magnitude and influence. This panoply of considerations creates an environment where hyperactivity in the technology arena will be regarded as beneficial and legitimate. A firm that is seen as a "technology" company and identified as such will legitimately be expected to invest in R&D to preserve and develop its technology advantage (Meyer & Rowan, 1977). Hence, the level of scrutiny applied to technological investment by owners in the context of technology companies is likely to be lower than that applied to non-technology companies.

We note that the exploitation of R&D legitimacy for disguising sub-optimal investments in the context of misaligned incentives might be a course of action not unique to managers. One can conceive of contexts in which there might be an incentive misalignment problem in the ranks of the owners themselves. For instance, owners with a concentrated stake in a publicly held company may have interests at odds with the other shareholders of the company. If such individuals are also the managers in such a company (as is often the case for companies when a

founder retains management control) this misalignment can lead to resource allocation consequences.

Unlike non-concentrated owners, concentrated owners often have a large proportion of their personal wealth locked up in the enterprise and this may affect their appetite for risk-taking (Wright, Ferris, Sarin & Awasthi, 1996). Diversifying directly into different lines of business may be one way to reduce their risk exposure; however, this may require significant amounts of capital and may raise questions about the firm's focus, depressing its external market valuation (e.g. Amihud & Lev, 1981). In other words, the agency assumption that owners are risk neutral because they can diversify their positions with investment outside the firm is weakened in the context of concentrated ownership. R&D investments may present an opportunity to address the problem of diversifying the block-holder's exposure while not appearing to be taking actions inconsistent with the broader shareholder interest. Investing in R&D may present less of an appearance of conflict of interest as investing in new technologies may be viewed as a way of preserving the firm's competitive advantage. Since the results of R&D investments are often applicable in areas beyond the original business (Nelson, 1959), investing in R&D may thus provide an "option" to eventually diversify. Thus, for a variety of reasons, the legitimacy accorded to R&D investments may in fact foster R&D overinvestment.

DISCUSSION AND CONCLUSIONS

In this paper we introduced the notion of R&D overinvestment and argued that this issue has perhaps been understudied in the literature. Yet, decisions on how much to invest in a given activity are as central for a firm as decisions to invest in a given line of business. Although overinvestment in given lines of business (e.g. overinvestment in "legacy" businesses) and across lines of business (e.g. overdiversification or unrelated diversification) have been extensively

studied, far more limited work has looked at why overinvestment occurs in the context of individual activities. Raveendran, Puranam and Warglien (2016) have argued and demonstrated that "products" or "objects" are more likely to be attended to than "activities". This conclusion, in line with other related research (Gentner, 1982; Raveendran et al. 2016; Rosch, Mervis, Gray, Johnson & Boyes-Braem, 2004), seems to suggest that researcher's relative emphasis on overinvestment in product scope - but not on overinvestment in activities- reflects an imbalance of attention consistent with such a bias. We noted that there were many possible and plausible mechanisms that could lead to R&D overinvestment. Yet, in spite of the plausibility of the above arguments and the logics derived from them, there is very limited - if any - research evaluating these possibilities. The current article's goal is to increase the research effort dedicated to this topic and put the topic more squarely on the agenda of resource allocation scholars. Indeed, while we focused our attention on the specific features of R&D to identify possible arguments for overinvestment, one could imagine a focus on the particular attributes of marketing or some other activity, generating a similar set of plausible arguments that could be analytically and empirically evaluated. Being able to understand the antecedents and implications of activity overinvestment would be helpful to improving resource allocation practices in addition to being informative about behavioral influences on managerial decision-making.

Moving the needle towards correcting this bias and considering more closely the trade-offs implied in resource allocation decisions across multiple projects within the same activity as opposed to resource allocation decisions across different lines of business is important. Overinvestment is by definition, value destructive. The literature has largely focused on investments made in excessive product diversification; yet, this article highlights that overinvestment (and hence value destruction) may emerge across multiple projects of a given

activity as plausibly. By exploring the specific case of R&D investment, this paper suggests that such activity overinvestment can be identified through its antecedents – which in this case emerge from close consideration of the specific features of R&D. More broadly, a similar approach could be taken to identify the possibilities of overinvestment in other activities based on their specific characteristics. Understanding more about these possibilities of overinvestment in activities could lead companies to design more effective and efficient "activity-specific" safeguard mechanisms to address these antecedents and improve resource allocation. Going forward, we hope that the preceding arguments and other conjectures will hopefully be put to test as the literature on resource allocation moves towards deeper investigation of R&D overinvestment- in particular- and activity overinvestment -more broadly.

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