RADICAL INNOVATION, AGENCY COSTS AND THE SMALL FIRM ADVANTAGE

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ABSTRACT

Despite a number of disadvantages, small firms have been found to be effective developers of product innovations, including at times, radical innovations. This paper proposes an agency theory explanation for this phenomenon, arguing that small firms have lower agency costs in the new product development process when radical innovations are being developed. When a firm develops a radical innovation, the ability to monitor employees during the process may be limited, as will the cost effectiveness of monitoring. Similarly, it is proposed that performance metrics are likely to be imprecise and the firm will be inaccurate in providing rewards to employees. While this is arguably true regardless of firm size, it is also proposed that these monitoring difficulties will be more pronounced in large firms compared to smaller firms.

INTRODUCTION

Researchers have found that smaller firms are quite innovative, successfully developing and commercializing new products and technologies (Acs, & Audretsch, 1988; De Massis et al., 2015; Shah & Tripsas, 2007), with many world-changing radical innovations being developed by small firms (Battelle, 2005; Young & Simon, 2005). Although this pattern has been observed, this may be somewhat counterintuitive, since large firms have several advantages in developing new innovations. Large firms can gain economies of scale (Hambrick et al., 1982) and have the resources to gain a large market share, which has been associated with higher performance (Buzzell & Gale, 1987). Larger firms have the ability to marshal needed resources in a timely manner, since they often have the needed skills and abilities inside the firm or have capital to purchase them from external sources (Chen & Hambrick, 1995). Furthermore, large firms have more products in which findings from research and development can be applied, making research and development output more valuable to large firms (Cohen & Klepper, 1993). However, smaller firms do have several advantages over large firms, including a lack of inertia that can slow down the actions of large firms (Hannan & Freeman, 1984), and the ability to apply effectuation to the new product development process (Berends et al., 2014).

This paper takes an agency theory perspective, and develops a theoretical model proposing that the development of radical innovations is likely to lead to high agency costs within a firm. As the radicalness of an innovation increases, the ability of firms to monitor employees, the cost effectiveness of monitoring, the precision of performance metrics, and the accuracy of rewards are likely to decrease. While this is likely true regardless of firm size, the paper also proposes that the radicalness of the innovation being developed will lead to more monitoring difficulties in large firms compared to smaller ones. The presence of high agency costs may essentially serve as a theory of the firm, answering the question of why many small firms may exist instead of one large one. While high transaction costs have often been viewed as a reason that firms integrate (Williamson, 1975), high agency costs may serve as a theoretical reason for why small firms exist, and can be effective innovators in some contexts. Future

empirical research could test the validity of the proposed theoretical model and offer possible clarifications and extensions.

From a practical standpoint, if lower agency costs are a part of why smaller firms are successful in the development of radical innovations, large firms may need to think about how they can reduce their agency costs to be more comparable to small firms. In fact, some common strategies in developing new innovations, like the use of skunk works projects, may serve to better align the behavior of employees involved in the new product development (NPD) process with that of owners. It is important to note that although the theoretical model developed in this paper provides an explanation to why small firms may face lower agency costs when developing radical innovations, it does not imply that small firms are better overall at developing radical innovations. Much evidence suggest that large firms are quite competent at developing such innovations (Ahuja & Morris Lampert, 2001), and likely have certain advantages over smaller firms (Chen & Hambrick, 1995).

This paper proceeds as follows. First, the research regarding technological development and commercialization in small and large firms is examined. Secondly, the monitoring problem that arises in the NPD process for radical innovations is examined, as well as how this problem leads to difficulty in finding metrics and measuring performance accurately. Also, the role of signaling is discussed, and how high quality employees involved in the NPD process are unlikely to be able to use signals effectively. Propositions are developed for how the development of radical innovations in a firm increases agency costs. Next, it is discussed why the problem of effectively monitoring the NPD process for radical innovations may be less challenging for smaller firms. Finally, the implications are discussed and directions for future research are suggested.

INNOVATION AND NEW PRODUCT DEVELOPMENT

Firms of all sizes have been successful at developing and commercializing innovations; however, the ability of small firms to engage in this task has been most surprising. Many exemplars of small firms can be seen that were particularly successful in commercializing innovations of a radical nature. For example, Google was originally started in 1996 by Larry Page and Sergey Brin while they were doctoral students at Stanford, making use of the school's computer system to run their software. Over two decades later, Google not only dominates with its search engine technology, but has expanded into related domains such as self-driving cars (Birdsall, 2014). Likewise, Apple was founded in a garage by Steve Jobs and Steve Wozniak in 1976, and is known for its successful commercialization of the personal computer (Young & Simon, 2005). While many large firms failed to be successful in this market, Apple was able to become a commanding player despite its humble beginnings. Although both Google and Apple ultimately became very large, this growth was a function of their success, and they both started out as very small operations. Furthermore, more rigorous research has supported the anecdotal evidence that small firms are effective at developing and commercializing technological innovations (Audretsch, 2002; Brouwer & Kleinknecht, 1995; Link & Bozeman, 1991).

Some research has even suggested that small firms are more innovative than their larger counterparts. Wagner and Hansen (2005) looked at the wood products industry in the United States, and found that although large firms tended to outperform smaller firms when it came to process innovations, smaller firms tended to be more innovative when it came to product and business innovations. Likewise, Audretsch (2002) found that smaller firms were more innovative

and had a faster growth rate, when measured by new employees, than large firms. Furthermore, large firms have often been noted for their difficulty in developing innovations, and therefore often obtain technology from other channels (Brockhoff, 1998). The ability of small, often new firms to commercialize technology successfully is the cause of what Schumpeter (1942) terms creative destruction. As small, new firms introduce revolutionary technology to the marketplace, they drastically change the shape of the industry that they enter, displacing large incumbent firms and making themselves dominant players in the industry. Anecdotally firms such as Amazon, Apple, Google, and Netflix are firms that seem to have been effective at creative destruction, starting when they were quite small firms. Some empirical research has supported the idea of creative destruction, demonstrated by the fact that there is a substantial change in the firms making up the Fortune 500 over time (Kirchhoff, 1989; Perry, 2015).

Nevertheless, some of the research concerning the innovativeness of large and small firms has been more nuanced. Large firms have been found to be more innovative in capital-intensive industries that are highly unionized, while small firms have been found to be more innovative in industries that are very innovative and that use a significant amount of highly skilled labor (Acs & Audretsch, 1987). Findings that show large firms more innovative when large amounts of capital are required makes sense, because they are likely to be able to obtain needed resources more quickly, and are sometimes able to share needed assets among many different product lines, generating economies of scope (Panzar & Willig, 1981; Teece, 1997) that are not available to smaller, single-product firms. Even Schumpeter (1942) who popularized the phrase "creative destruction" argued that large firms would eventually come to dominate the new product development and commercialization processes. As this occurred, there would simply be no room left for the small new firm as an effective introducer of new technologies to the marketplace. However, Schumpeter's prediction has yet to come to pass.

AGENCY PROBLEMS IN NEW PRODUCT DEVELOPMENT

Agency Theory

The distinction between ownership and control has long been recognized and examined by researchers (Berle & Means, 1932; Classens, Djankov, & Lang, 2000; Fama & Jensen, 1983; Jensen & Meckling, 1976; Krause & Bruton, 2014). Just because an individual or group of individuals own the assets used in a process, this does not mean that the owner(s) will have unilateral control over the use of the resource. Individuals who are hired to use the resource may use it in a way that is different from how the owner wants it to be used. For example, managers of a firm may use funds to buy a corporate jet or company cars that are not necessary for the operation of the firm, but benefit the individual managers greatly. This problem is known as the principle-agent problem (Jensen & Meckling, 1976). One of the reasons that agents are able to pursue their own self-interest instead of those of the principal is the presence of informational asymmetries (Eisenhardt, 1989). Agency relationships become more uncertain when the principle cannot clearly see the relationship between effort and outcome on the part of the agent, and when there is no agreement on the effort and outcome between the principle and the agent. However, by spending money to monitor the agent, the principal can have a better understanding of what the agent is doing, which will likely lead to the agent acting in a way that is more consistent with the interests of the principal (Jensen & Meckling, 1976).

The principle-agent problem has been examined in a number of contexts, including the venture capitalist-entrepreneur relationship as well as the CEO-shareholder relationship (Gompers, 1995; Kaplan & Stromberg, 2003; Zona, 2016). Researchers have also argued that high agency costs may be a relevant barrier that can limit a firm's ability to innovate and can influence what types of innovations a firm develops (Francis & Smith, 1995; Holmstrom, 1989; Yin, 2009).

New Product Development for Radical Innovations

The new product development (NPD) process has been described in detail in past research (Cooper, 2016; Griffin, 1997; Page, 1993; Veryzer, 1998). When a firm attempts to develop a new innovative product, there is substantial uncertainty about what the final product will look like (Griffin & Page, 1996). Even when specifications are explicitly stated a priori, the firm knows that there is a substantial possibility that technological barriers may prevent them from accomplishing their goal. Furthermore, it is not known exactly how to get to the specified product. Although the firm may have a development process, such a process likely has much room for individual discretion. The NPD process also raises the problem of joint production. When a principle assigns a single agent to a task, it is much easier to evaluate the individual's performance than to judge the performance of individual team members that have been assigned to complete a task (Alchian & Demsetz, 1972). Therefore, monitoring the NPD process and those individuals participating in it can be very difficult, and can only be monitored imperfectly (Fuente & Marin, 1996).

The monitoring problem seems to be particularly problematic when a firm is developing a radical innovation. A *radical innovation* is an "innovation that contains a high degree of new knowledge" (Dewar & Dutton, 1986, p. 1442). More specifically, Leifer et al. (2000, p. 5) stated that radical innovation "concerns the development of new businesses or product lines-- based upon new ideas, technologies or substantial cost reductions that transform the economics of a business." In a case study of the development of discontinuous/radical innovations, Veryzer (1998) classifies the NPD process as an eight-step process, summarized in Table 1.

While uncertainty can be seen throughout the NPD process for radical innovations, several of the phases in particular may contain high levels of uncertainty. The dynamic drift stage consists of exploration and "playing in the lab," and therefore the outcome of this process is particularly uncertain (Veryzer, 1998). It cannot be predicted with accuracy what the outcome of this phase will be, and it would be difficult to monitor employees taking part in the process. An employee who is supposed to be working hard at exploring possible new technologies that might eventually be useful to the firm, might simply be tinkering around with a contraption that is of personal interest. Likewise, the convergence phase is uncertain in the sense that it requires people involved in the process stepping forward and putting the pieces together in order to find an applied use for a technology. Due to the uncertainty and nature of the process, even if the managers of the firm were to watch every action taken by the individuals working on the NPD project, they would have a difficult time distinguishing between those who are productive and those who are not. Therefore, the possibility of moral hazard is likely to be high in these situations.

Table 1 RADICAL INNOVATIONS AND THE NEW PRODUCT DEVELOPMENT PROCESS	
PHASE	**DESCRIPTION**
Dynamic Drift	Various technologies are considered and explored. Effort is not guided by an existing problem.
Convergence Phase	Technology converges toward an applied use. Individual(s) find how technologies can fit together and be valued by the market.
Formulation Phase	It is decided how to use the technology in an actual product design.
Preliminary Design Phase	A preliminary design for the product is developed. Information is collected from customers concerning user requirements.
Evaluation Preparation Phase	Product is refined in preparation for formal review. A business case is made for commercialization.
Formative Prototype Phase	Prototype is developed. This prototype is not necessarily identical to what will be produced; often available parts will simply be used.
Testing and Modification Phases	Prototype is tested, evaluated, and modified.
Prototype and Commercialization Phases	Previous prototype is refined, and production aspects are considered. Customer trials are used and marketing plans are developed.
Summarized from Veryzer (1998)	

Conversely, the development of incremental innovations is likely to be much different. There will be less uncertainty associated with outcomes, because managers have a better idea of what the outcome will be (Dewar & Dutton, 1986). Furthermore, the process associated with incremental innovation may be more truncated than the radical innovation development process. For example, Veryzer (1998) describes the dynamic drift phase, as the first phase of the NPD process for radical innovation. This phase involves the consideration and exploration of various technologies, and contains a high level of uncertainty. However, this phase may be truncated, or even non-existent when incremental innovations are developed. Due to less uncertainty, development of incremental innovations should be easier to monitor than processes that are developing radical innovations.

Proposition 1: The more radical the innovation being developed by a firm, the more difficult it will be to monitor the NPD process.

According to agency theory, agency costs are a summation of (1) monitoring expenses by the principle, (2) bonding expenditures by the agent, and (3) the residual loss (Jensen & Meckling, 1976). Monitoring expenses include expenditures related to "watching, compensating, and evaluating the agent's behavior" (Panda & Leepsa, 2017; p. 84). Bonding expenditures are restrictions bore by agents that limit their activity, such as a non-compete clause in an employment contract. Residual losses refer to inefficiencies that result from the divergent goals of the principle and the agent that is not eliminated through monitoring and bonding (Jensen & Meckling, 1976). Agency theory generally assumes that additional information concerning the behavior of the agent can be purchased by the principle for a price. (Eisenhardt, 1989; Nilakant & Rao, 1994). Therefore, by spending additional money on monitoring, the principal can decrease the potential residual loss. Increased monitoring is only undertaken if it leads to an even greater reduction in the residual loss, therefore minimizing total agency costs. The value that a firm obtains by increasing expenditures on monitoring, or the amount of the residual loss

reduction associated with purchasing one unit of monitoring, will vary based upon the activity being monitored. Some activities can be monitored more cheaply than others, and the principal might obtain a better value for every dollar spent on monitoring. In the NPD development process, spending a given amount on monitoring should be more effective when the NPD process is developing an incremental innovation than when a radical innovation is being developed. This will be largely due to the same reason it is difficult to monitor the NPD process for radical innovations in the first place, that is, the inherent uncertainty surrounding the process (Veryzer, 1998).

Proposition 2: The more radical the innovation being developed by a firm, the more costly it will be to monitor the NPD process effectively.

In addition to monitoring work effort and individual employee performance, it can be difficult to evaluate the eventual outcome of the NPD process. Project success can be determined on several dimensions, including: whether the product was popular with customers, the amount of internal learning and capabilities improvement that resulted from the project, whether it met the proper technical specifications, and whether it was a financial success for the organization (Awwad & Akroush, 2016; Griffin & Page, 1996). While a new product might be a technical success, it might fail to find a significant customer base and make a significant return for the firm. Measuring financial success itself might be difficult as the allocation of costs may be complicated if the firm has engaged in multiple NPD processes that make use of shared resources, such as the technical expertise of the engineering staff.

Measuring success may be even more problematic in the case of the development of a radical innovation. Since radical product innovations consist of a new product line (Leifer, 2000), the firm will not have a good historical benchmark on how to judge whether the product meets its standard for a success. This may be particularly true when looking at dimensions of success such as meeting technical specifications and obtaining a sufficient number of customers. The technical specifications may be somewhat fluid, particularly at the early stages of the NPD process (Veryzer, 1998). It may be difficult to hold people involved in the NPD process accountable for not meeting technical specifications, if such specifications are imprecise and evolve over time. Likewise, it may be difficult for firms to measure success by the number of customers who purchase the product, as there may not be a clear benchmark that the firm can use as a baseline. This is different from incremental innovations, where sales of previous iterations of the same product or similar products may serve as guidance for what level of sales constitutes a success or failure.

Proposition 3: The more radical the innovation being developed by a firm, the more difficult it will be to judge the success of the NPD process.

Despite the fact that monitoring the NPD process, especially when it involves the development of a radically new product, can be difficult, it is important for firms to do so. Collectively U.S. firms spent approximately $375 billion on R&D in 2016 (National Science Foundation, 2018). Although some of this research is likely basic in nature and not tied directly to the development of new products, private firms typically have a propensity to spend much of their R&D resources on developing new products that can be commercialized. The future success of organizations is often highly linked to the successful development of new products (Artz et

al., 2010; Calantone et al., 1995; Chaney et al., 1991). Thus, firms are likely to monitor these projects as much as possible. Therefore, some monitoring will likely exist, even if it is not especially effective or all that cost efficient.[1] Furthermore, the monitoring process is likely to obtain noisy results. Even if monitoring leads to information concerning, for example, potential employee shirking, it is likely to be incomplete and inaccurate as well. Furthermore, the monitoring of employees involved in the NPD process will be a source of information for allocating rewards and punishments among employees. However, any incentive system used will be far from perfect, doling out rewards and punishments with a low degree of accuracy. Although short-term monitoring is likely to solve this problem, using it to measure the success of a NPD process for a radical innovation will have several problems. Measuring the success of the project on a short-term basis is likely to be even more difficult than doing so on a long-term basis, since certain milestones will not have had a chance to be met yet (Veryzer, 1980). Success will likely be equated with easy-to-obtain input measures, such as hours worked, how much of the project is completed, and the amount of money that has been spent. However, these types of measures are problematic. Measuring how successful a project is being managed before the process is completed is likely to be inaccurate and possibly even lead to unproductive behavior, such as spending on window dressing. Agency theorists often prescribe the use of outcome-based contracts in domains in which agency problems are significant (Eisenhardt, 1989; Jensen & Meckling, 1976; Jones & Butler, 1992). However as mentioned, the NPD process for radical innovations is uncertain with regards to outcomes, and measuring outcomes of the process is difficult (Griffin & Page, 1996). Most metrics used to gauge performance and hand out rewards and punishments are likely to be unreliable.

> *Proposition 4: The more radical the innovation being developed by a firm, the less accuracy there will be in handing out rewards and punishments during the NPD process.*

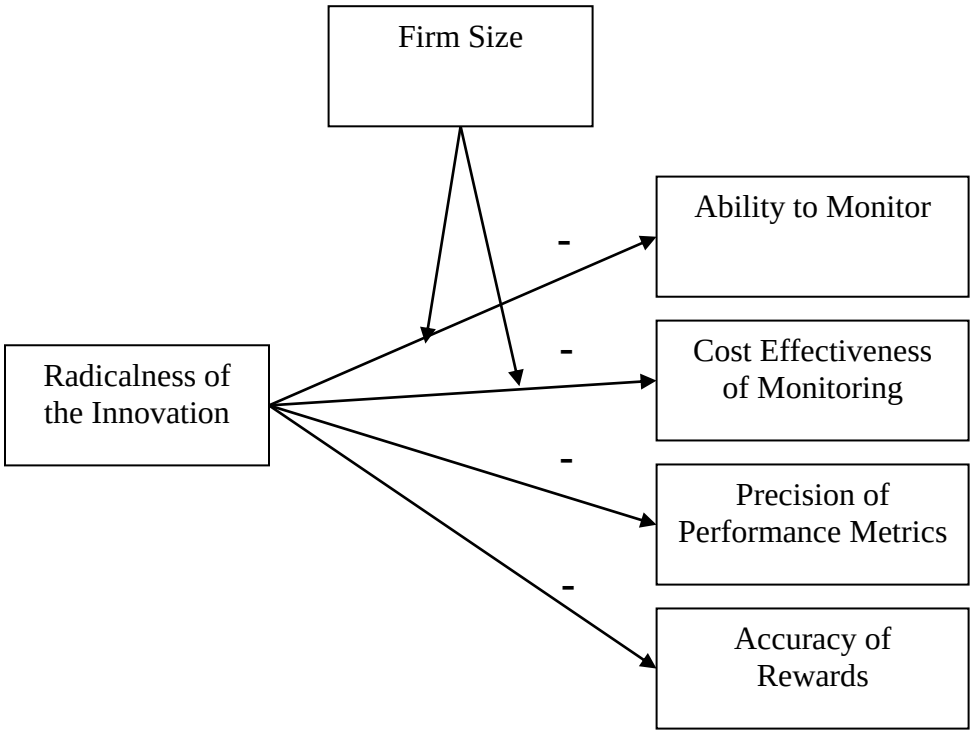
Signaling and False Signals

This paper has proposed that employees involved in a NPD process developing a radical innovation are likely to have their success measured by less precise and less accurate measures. Therefore, this creates quite a problem for firms attempting to monitor the NPD process. However, it may be that signaling provides a means in which agency costs can be minimized, even when a firm is engaging in radical innovation. According to signaling theory, those in a market selling a high quality product who wish to inform buyers of their quality may do so by investing resources in a signal (Spence, 1973). In such a case, the seller would be the signaler who sends a signal to the buyer (receiver) about the quality of the product. A signal refers to the "information cues sent out by one party to another in order to influence desired outcomes" (Taj, 2016; p. 2). Since signals can be used to differentiate high-quality products or individuals from low-quality products or individuals, those that can effectively signal their high quality can earn a premium over those in the market who do not signal. Signaling theory has been applied to how managers inform stock market investors of their quality, and such events such as stock splits and stock buybacks are often viewed as signals that managers believe that the firm is in a position to be very successful in the future (Ikenberry et al., 1996; Fama et al., 1969). Likewise, product warranties have also been viewed as a way for a producer to signal their quality to the consumer

[1] Unless monitoring costs are so high that they exceed the cost of the residual loss, in which the firm will not pay for additional monitoring and will simply accept the residual loss.

(Boulding & Kirmani, 1993). Job applicants can indicate their quality by both indices, which are observable and unalterable attributes such as age, and signals, which consist of observable attributes that the applicant can manipulate (Spence, 1973). Although an individual seeking a job would like to signal to potential employers that they are high-quality employees, they must often engage in costly activities such as obtaining a high level of education in order to do so. The costs associated with these activities are known as signaling costs (Autor, 2001; Spence, 1976). If a signal is known by the receiver to be costly for the signaler to obtain, than the signal is likely to be viewed as more reliable (McAndrew, 2018).

Figure 1



Since monitoring the NPD process for developing radical innovations is so difficult, signals are a possible way that individuals working on an NPD project can make the quality of their work known. Individuals taking part in the NPD process can signal their quality in various ways. Obviously, they can signal their overall quality through their educational obtainment and work experiences (Hussey, 2012; Ko and McKelvie, 2018; Spence, 1973). However, they can also signal the effort that they contribute to the NPD process. This can be done by performing well on visible performance metrics, as well as being helpful to managers and working many hours. Therefore, if such signaling is effective, a manager might have a way to judge the efforts and performance of employees. However, this assumes that workers who are performing poorly or putting in little effort are unable to use signals to their advantage because doing so is much more costly for them (Spence, 1973). However, some signals that may be relevant in the NPD process may not require a substantial investment, even from lower-quality workers. For example,

employees can make sure that they are seen looking busy by managers, which can be done at low cost to the employees. In some cases, employees may be able to manipulate performance numbers, especially subjective ones inherent to the process, in order to signal (falsely) their performance.

These false signals, may not only be low cost to obtain, but might also allow employees to reap significant rewards. However, using false signals can be costly to the party using them in the sense that (1) they may fail to work or (2) managers discover the false signal and subsequently punish the offender for engaging in these behaviors. Therefore, although using false signals may not be cost free, the risk of getting caught will be lower when the employee is engaging in an uncertain task. The use of false signals is likely to be very pronounced in the NPD process for radical innovations if managers rely on signals as a gauge of worker effort or quality. As with active monitoring, this is likely to be an inaccurate metric, meaning that managers will not be able to rely on signals to substitute for the inaccuracy associated with active monitoring. This creates a problem for firms attempting to develop radical innovations. Monitoring the NPD process for the development of radical innovations is likely to be difficult, costly, and inaccurate. However, they will likely be unable to take advantage of signaling by high-quality (high performing) employees due to the inaccuracy of any perceived signal.

Role of Firm Size

Despite the high agency costs that are likely to arise when a firm is developing a radical innovation, the severity of these agency problems may vary depending on firm characteristics. The agency problems mentioned may help explain one of the reasons that small firms have often successfully developed and commercialized radically innovative products. Despite the fact that smaller firms often lack resources, they have been successful at this process (Audretsch, 2002; Brouwer & Kleinknecht, 1995; Link & Bozeman, 1991). Although agency costs are likely to be high if a firm engages in radical innovation, this relationship may be weaker for smaller firms than larger firms.

Consider a venture consisting of only the owner as an employee. Such a firm has no agency problems, since the owner retains all profits that the business earns (Jones & Butler, 1992). In such a firm, the manager is the owner, and there should be no misalignment in goals between the manager and the owner since they are the same person. As a firm grows and there becomes multiple owners, and there becomes some separation of ownership and control, agency problems may arise. However if an innovative firm is relatively small, the firm will likely have owners who will be involved directly in the NPD process. Such owners/managers will receive a direct benefit for seeing that the development of the new product is ultimately successful. Since these principles actually receive the residual income from the business, they have more incentive to monitor carefully. At the same time, the simplicity of the organization structure may make it easier to monitor the NPD process as well.

Although owners of a large corporation, who are true principles, have a similar incentive to monitor, the dilution of ownership among many shareholders also dilutes any incentive to monitor (Berle & Means, 1932). Even more importantly, it is simply not feasible for the shareholders of a large corporation to monitor every employee involved in the NPD process effectively. They may focus on monitoring the top managers, which serve as their agents, and making sure that they have sufficient incentives to in turn monitor those below them in the

organization. While all firms may have a difficult time monitoring the NPD process when radical innovations are being developed, smaller firms will likely be more effective at it than large firms.

Proposition 5: The difficulty in monitoring the NPD process when radical innovations are being developed will be moderated by firm size. Smaller firms will be able to monitor the NPD process for radical innovations with less difficulty than large firms.

This proposed moderation effect can be seen in Figure 1. The separation of ownership and control in large firms (Berle & Means, 1932) not only gives owners less incentive to monitor, but ultimately makes such monitoring more difficult. The monitoring process does not have to pass through layer after layer of agents in smaller firms, which will likely make additional spending on monitoring more effective in smaller firms than large firms.

Proposition 6: The cost effectiveness in which the NPD process can be monitored when radical innovations are being developed will be moderated by firm size. Smaller firms will be able to monitor the NPD process for radical innovations in a more cost effective manner than large firms.

DISCUSSION AND DIRECTIONS FOR FUTURE RESEARCH

The primary theoretical contribution of this paper is that agency theory, like transaction cost economics, can be used as a theory of the firm. High agency costs provide a reason why the NPD process for radical innovations could possibly be more effectively completed by a number of small firms than by a single entity. This is because with small firms, fewer agents exists and thus fewer agency problems are likely to arise. The owners for the firm (principals) are more likely to be involved in the operations of the business, including the research and development function. With regards to firms that develop radically innovative products, agency theory can be used to explain why many firms exist instead of just a few. This also sheds light on an advantage that smaller firms are likely to have compared to large firms in developing radical innovations. While this paper specifically discusses the NPD process of a radical product innovation, it is likely that agency costs play a role in determining the optimal firm size in other situations as well, in which uncertainty is high and monitoring is difficult. Despite the argument presented here, many others can be made for why small firms are successful at developing new products, and why so many innovative products are developed by small firms. One alternative explanation for this comes from the embeddedness literature (Granovetter, 1985). It might be that relationships between owners and employees that can take the place of monitoring are more likely to develop in small firms. Therefore, employees might be motivated to perform well and to refrain from shirking as a function of their relationship with the owner, rather than for their own economic reasons. While they are unlikely to have any direct ties with the principals of a large firm, it is much more likely that employees will develop strong ties with the owner(s) of a smaller firm. Explanations of less inertia (Hannan & Freeman, 1984), and more flexibility (Berends et al., 2014) are likely advantages small firms have as well when developing radical innovations.

One of the major limitations of this paper is that the conceptual model developed is not empirically tested. Empirical testing of the model will require measuring some difficult to measure constructs, such as the radicalness of innovations, the cost effectiveness of monitoring

the NPD process, and the accuracy of rewards. In addition to developing such measures and testing the proposed model, there are several issues that can be addressed by future research. One issue is how the agency costs (due to monitoring difficulties) of the NPD process vary with firm size. While this paper argues that smaller firms will have lower agency cost, how much lower it will be is not addressed, due to the fact that this is essentially an empirical question. Another issue is what contextual factors are likely to affect the difficulty of monitoring (and therefore increase the agency costs) during the NPD process. Certain industries are likely able to monitor more effectively, and this will likely be demonstrated by the presence of large firms and their ability to generate radical innovations effectively. The idea that small firms may have an advantage in the NPD process when developing radical innovations may also apply to other types of firms. For example, family firms, at least in some cases, may have lower agency costs than non-family firms (Chrisman et al., 2004). However, others argue that family firms may just experience different types of agency costs (Songini & Gnan, 2015). The impact this has on their ability to develop radical innovations may be a fruitful area for future research.

CONCLUSION

Firms of all sizes develop radical innovations. Large firms have certain advantages in this area, such as access to resources (Buzzell & Gale, 1987; Chen & Hambrick, 1995) and the ability to take advantage of economies of scale (Hambrick et al., 1982). Smaller firms may have advantages such as a lack of inertia and more flexibility in their strategies (Berends et al., 2014; Hannan & Freeman, 1984). This paper proposes another reason why smaller firms may have an advantage in developing radical innovations: lower agency costs. The NPD process is full of uncertainty, which makes monitoring of employees difficult and costly. However, smaller firms have a distinct advantage over larger firms, in that the principals (owners) are closer to the NPD process, likely making monitoring more effective, and having more incentive to monitor the process as well. Therefore, smaller firms may incur lower agency costs when developing radical innovations, and this may provide an explanation for why smaller firms can be quite innovative (Battelle, 2005; De Massis et al., 2015).

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