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FIRM RESOURCES, COMPETITIVE ACTIONS AND PERFORMANCE: INVESTIGATING A MEDIATED MODEL WITH EVIDENCE FROM THE IN-VITRO DIAGNOSTICS INDUSTRY

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Building on the resource-based view (RBV) and competitive dynamics literatures, this paper proposes that considering resources or actions independently offers an incomplete understanding of the drivers of superior performance. Instead, we hypothesize that resources enable competitive actions and that when these actions leverage the firm's resources, superior performance results. We tested these hypotheses with panelized data on the technological resources and competitive actions of firms in the in-vitro medical diagnostic substance manufacturing industry. The results provide substantial support for our hypotheses, specifically with respect to mediation. Our theory and results underscore how the integration of the competitive dynamics and RBV literatures can significantly improve our understanding of firm performance. Copyright © 2011 John Wiley & Sons, Ltd.

INTRODUCTION

Among theoretical perspectives that focus on understanding drivers of superior performance, the resource-based view (RBV) and competitive dynamics are highly influential. Despite their different emphases, these two perspectives complement each other (Chen, Su, and Tsai, 2007; Grimm and Smith, 1997; Grimm, Lee, and Smith 2006; Sirmon, Gove, and Hitt, 2008). Both address resources and actions as important drivers of competitive advantage and superior performance, but each focuses on one of these factors at the expense of the other.

The RBV primarily addresses resources, or the tangible and intangible factors firms control. Specifically, this research argues that valuable and rare resources provide the basis of competitive advantage and make superior performance more likely (Barney, 1991). However, questions have arisen within this research as to *how* such resources affect performance (Priem and Butler, 2001). Barney and Arikan (2001: 174), for example, lament that the extant literature seems to assume that the actions necessary to leverage resources are self-evident, when in fact they are not.

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On the other hand, competitive dynamics research focuses on actions, or the "specific and detectable competitive move[s]. . .initiated by a firm to defend or improve its relative competitive position" (Smith *et al*., 1991: 61). Although most competitive dynamics scholars acknowledge that resources are necessary to engage actions (e.g., Grimm and Smith, 1997), very little work in this literature stream has addressed how resources, especially those likely to provide the basis of competitive advantage, enable a firm's competitive actions (Smith, Ferrier, and Ndofor, 2001). For instance, competitive dynamics scholars have largely addressed resources by controlling for a firm's liquid financial capacity (Ferrier and Lyon, 2004). Yet liquid financial capital, which is undifferentiated, does not represent the majority of a firm's resources; and it certainly is not the unique and valuable resource that is likely to support competitive advantage or superior performance.

While both the RBV and competitive dynamics perspectives are influential, their overt foci tend to neglect broader linkages between resources and actions. To unlock the potential explanatory power these complementary perspectives offer, scholars suggest the theories should be integrated. For example, the action-based process model of competitive advantage offered by Grimm and Smith (1997) and Grimm *et al*. (2006) propose that actions would likely mediate the relationship between resources and performance. Similarly, Peteraf and Bergen (2003) argue that the value of a resource is derived from its application in product markets through actions that satisfy customer needs. More recently, Sirmon, Hitt, and Ireland's (2007) resource management model further elucidated our conceptual understanding of the linkages between resources, actions, and performance. Indeed, the central though untested thesis of these integrative works is that in general "what a firm *does* with its resources is at least as important as *which* resources it possesses" (Hansen, Perry, and Reese, 2004: 1280, emphasis in original).

Moving beyond this general assessment, we propose and test a theory of how competitive actions mediate the relationship between one specific type of firm resource and performance. Using a sample of in-vitro medical diagnostic substance manufacturers, we examine how the complexity and deviance of a firm's competitive behavior mediate the relationship between the firm's technological resources (captured by its patent portfolio) and performance.

Understanding how complexity and deviance mediate the resource/performance relationship is important not only because prior work has shown these are key elements of a firm's competitive behavior (Ferrier 2001; Ferrier and Lee, 2002; Ferrier, Smith, and Grimm, 1999; Miller and Chen, 1996a, b), but because doing so extends our knowledge of the causal linkages between resources, actions, and performance. Resources alone do not cause performance, but instead offer the potential that competitive actions help realize (Sirmon *et al*., 2007). Thus without greater breadth in the firm's technological resources, firms are prohibited from, or will at least be ineffective in, initiating competitive actions (Lamberg *et al*., 2009). On the other hand, when firms effectively leverage the breadth of their technological resources with complex and deviant actions, they differentiate themselves from rivals providing a basis for superior performance. Thus, instead of arguing that either resources or actions primarily drive performance and merely assuming the other is present, we formulate and test a model that accounts for their causal linkages.

By integrating the RBV and competitive dynamics literatures, this study offers several contributions. First, we address one of the central criticisms leveled against the RBV (Priem and Butler, 2001) by drawing upon the competitive dynamics and resource management literatures to better understand *how* resources affect performance. Specifically, we argue that competitive action provides a medium through which firms leverage technological resources to gain competitive advantage. Second, by drawing upon resource-based logic, we emphasize a largely overlooked aspect within competitive dynamics research: resources, or in the nomenclature of the competitive dynamics literature, 'capability.'[1] While competitive dynamics research has highlighted the effects of 'awareness' and 'motivation,' it has tended to neglect the resource portion of this theory (Smith *et al*., 2001). Thus, while it is conceptually held that resources matter to competitive dynamics, we actually know

[1] While 'capability' is common in the competitive dynamics literature, in their major review of this literature, Smith *et al*. (2001) replaced 'capability' with 'resource-based factors.' In fact, reading across the RBV and competitive dynamics literatures reveals that the RBV's usage of 'resource' closely relates to competitive dynamic's 'capability.' Therefore, to provide consistency we utilize the term resource throughout this study.

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very little about *how* a firm's 'resources' enable competitive actions. Therefore, we contribute to the competitive dynamics literature by examining and testing the question of *how* resources affect competitive behavior. In total, our theoretical and empirical efforts lead to the development and support of a mediated model where both resources and actions together are necessary for superior performance. Thus, while empirical support for both RBV and competitive dynamics is available, we argue that stronger theory is produced by integrating their causal mechanisms.

In the following section, we discuss the theoretical foundations of the paper: namely RBV and competitive dynamics. Then, we develop our hypotheses that build to support a mediated model depicting how resources and actions work together to affect performance, after which we explicate our methodology and present the results of our research. We conclude with a discussion of the results, focusing on their implications for theory and practice.

THEORETICAL BACKGROUND

Resources and performance

A relatively overlooked assumption in the RBV is that firms know how to leverage their resources to gain competitive advantage, which in turn can lead to superior performance (Barney, 1991). Yet the extant RBV literature does not develop the links between resources and leveraging actions. Moreover, these actions are neither clear nor automatic for the firm (Barney and Arikan, 2001). Thus, controlling superior resources is a necessary but insufficient condition for superior performance. Resources can influence performance only to the extent that a firm can adequately leverage them (Sirmon *et al.*, 2007, 2008; Sirmon and Hitt, 2009). Failure to consider leveraging actions when examining the effects of organizational resources on performance can lead to underspecified models and erroneous conclusions about a resource-performance relationship. Put differently, the results of a resource-based study that fails to include actions may be biased due to the misattribution of effect.

It is therefore not surprising that the three most recent assessments of the empirical evidence of the resources-performance relationship have yielded disparate findings. Barney and Arikan's (2001) review article concluded that empirical investigations into the effect of firm resources on performance have yielded results consistent with the RBV. Newbert (2007), however, argued that Barney and Arikan's conclusion might be premature because the subjective nature of their analysis may have been undermined by nonrepresentative sampling. After conducting another analysis of empirical articles that examined the RBV, he found only modest support for a resource-performance link. Utilizing the more sophisticated analytical tool of meta-analysis, however, Crook *et al.*, (2008) examined 125 studies with data from over 29,000 firms. They concluded that while superior resources are generally related to performance, evidence of underspecification in resource-performance models is present. Specifically, they suggest that the intervening processes between resources and performance require examination.

The suggestion of Crook *et al.* (2008) mirrors critiques by other researchers (e.g., Ketchen, Hult, and Slater, 2007; Sirmon *et al.*, 2007) that the processes through which resources affect performance remain largely unexplained within the RBV. Thus, while empirical research has linked resources to performance, the processes by which resources affect performance remains poorly understood. That is, firm actions have been overlooked. Failure to correctly model these intermediary actions within the resources-performance relationship can cause several problems. For example, performance effects may be misattributed to resources rather than to effective competitive actions. This is one possible explanation for why organizations possessing similar resources and occupying similar environments experience variations in performance. Zott (2003), for example, demonstrates that even when firms have similar resource endowments, performance differentials could still occur due to the timing of leveraging actions. Overlooking the role of competitive actions thus constrains the theoretical development and practical application of resource-based logic.

Competitive dynamics

The competitive dynamics perspective focuses on actions—specifically, on the series of actions (and reactions) firms initiate to enhance their competitive position and improve performance. Thus, the competitive dynamics view posits that a firm's actions and its reactions to rivals' actions determine its performance outcomes (Smith *et al.*, 2001). Moreover, instead of investigating a single action, considering the repertoire of a firm's actions is also a strong point of interest in this research (Ferrier, 2001). The theoretical foundation of the competitive dynamics literature is the 'awareness-motivation-capability model' (where capability refers to firm resources) (Chen, 1996). 'Awareness' refers to the mindfulness of managers about their competitive context, which includes competitors, industry, and the general environment (Smith *et al.*, 2001). Factors that have been shown to influence managers' awareness of their competitive environment include firm size (Chen and Hambrick, 1995), scale of operations (Chen *et al.*, 2007), market diversity (Miller and Chen, 1996b), and top management team characteristics (Hambrick, Cho, and Chen, 1996). 'Motivation' refers the incentive to engage in competitive activity, either proactively or reactively. Prior research has linked past performance, market dependence (Chen, 1996), and competitor activity (Ferrier, 2001) to the motivation to engage in competitive activity.

Firm resources (Grimm and Smith, 1997; Grimm *et al.*, 2006) underscore a firm's ability to implement competitive actions. The nature and subsequent success of a repertoire of actions depend on the firm's relative resource endowments. Without the requisite resources, managers that are aware of the firm's competitive context and highly motivated to engage in competitive activity will nevertheless be unable to formulate and implement competitive actions of value to stakeholders and consumers (Priem, 2007).

Despite acknowledging that firms need resources in order to act, scholars of competitive dynamics have conducted very limited research that directly examines the effect of a firm's resources on its competitive actions. In fact, the most direct examination to date is that of Chen *et al.* (2007: 112) who found that in their sample of 13 major airlines, the salience of a firm's 'capability to contest,' operationalized with the similarity of rivals' aircraft fleets, positively influenced its perceived competitive tension with rivals and subsequently increased competitive attack volume. Additionally, some competitive dynamics research has examined such antecedents as top management team heterogeneity (Ferrier, 2001; Hambrick *et al.*, 1996) and firm size (Chen and Hambrick, 1995). Other research (e.g., Ferrier and Lyon, 2004) has controlled for the effects of resources on competitive actions by including liquid financial resources in their models. As noted above, such antecedents represent neither the most unique nor the most valuable of a firm's resources. Thus, the competitive dynamics literature, while conceptually acknowledging the role of resources, has largely failed to adequately test their effects or, more importantly, theoretically address *how* they affect competitive actions.

Individually, then, the RBV and the competitive dynamics prospective provide an incomplete picture of performance drivers. Both theories refer to resources and actions, yet each tends to focus on one of these drivers at the expense of the other. To better understand the nature of superior performance, a more complete model that combines both resources and actions needs to be examined. Specifically, we draw upon resource management logic to combine both literatures and develop a mediated model.

Resource management

The growing theoretical and empirical literature related to resource management incorporates both resources and actions (Sirmon *et al.*, 2011). Resource management focuses on the actions firms use to structure their resource portfolios, bundle resources into capabilities, and leverage those capabilities to create value (Sirmon *et al.*, 2007). In fact, research by Sirmon *et al.* (2008) demonstrates that the managers' resource bundling and deployment efforts affect performance and become more important as rivals' resource portfolios approach parity. Additionally, research shows that the fit between separate actions matters. For example, Kor and Leblebici (2005) found that bundling senior partners with less experienced associates in law firms positively affects performance, but that service and geographic diversification influences this relationship. Additionally, the fit between resource investments and leveraging actions are also critical to performance (Sirmon and Hitt, 2009).

Despite these new insights, the basic logic of resource management is based on an untested proposition: the link between resources and actions, not just the fit between actions, affects performance. The developing resource management literature directly assumes that Grimm and Smith's

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(1997) action-based process model of competitive advantage, in which actions mediate the relationship between resources and performance, is supported. However, this model has not been tested. Therefore, to address the efficacy of the RBV, competitive dynamics, and the nascent resource management research stream, this mediation logic requires investigation.

HYPOTHESES

A firm is often conceptualized as a set of resources (Penrose, 1959). Thus, instead of focusing on an isolated resource, as most RBV-related studies do, a more complete understanding of the performance effects of resources can be gained by considering the portfolio of firm resources (Sirmon *et al.*, 2010). For any high technology firm, including this study's sample of in-vitro medical diagnostic substance manufacturers, technological resources are critical not only to the firm's performance but also to its long-term viability. 'Technological resources' refers to the firm's repository of technological knowledge and technological competencies, which include the ability to design and develop new products and processes (Miller, 2004; Patel and Pavitt, 1997).

According to RBV logic, the unique characteristics of technological resources give them the potential to positively affect firm performance. A factor market for such resources is incomplete; instead, firms must develop such resources internally. The resulting technological resources are not only valuable, but often difficult to replicate because of the causal ambiguity inherent in their creation (Dierickx and Cool, 1989). Although technological resources are not rare *per se*, each firm's technological resources with their unique attributes are likely to be rare because of path-dependencies in their development. Prior research strongly suggests that these idiosyncratic, research-focused resources are strategically important in technology-driven industries (Dierickx and Cool, 1989; Henderson and Cockburn, 1994).

In this paper, we focus specifically on firms' breadth of technological resources, defined as the scope of the firm's knowledge related to technological advancement (Miller, 2004; Nesta and Saviotti, 2005). Prior research has shown that such breadth is an antecedent to rent generation (Sampson, 2007), research outputs (Durand, Bruyaka, and Mangematin, 2008), breakthrough innovations (Phene, Fladmoe-Lindquist, and Marsh, 2006), and the scope of the firm (Argyres, 1996; Silverman, 1999). Clearly, a firm's breadth of technological resources is influential on many important firm-level outcomes.

As for firm performance, we expect the breadth of a firm's technological resources to have a positive influence for at least two reasons. First, the rarity of the firm's whole portfolio of technological resources will be greater than the rarity of any individual aspect of the portfolio. This increases the idiosyncratic nature of the firm's resource base and, concomitantly, its ability to generate rents. Second, greater breadth of technological resources provides for valuable complementarities between the various aspects of the firms' knowledge (Argyres, 1996). Firms with greater breadth of technological resources have developed correspondingly broader absorptive capacities and are therefore more likely to assimilate knowledge spillovers (Rosenkopf and Nerkar, 2001). Thus, we propose that increased breadth of technological resources will positively affect performance. Formally:

Hypothesis 1: The breadth of a firm's technological resources will positively affect its performance.

Competitive dynamics research has established a link between competitive actions and performance. A firm's competitive repertoire represents the entire set of actions it carries out to attract customers and defend its market position (Miller and Chen, 1994). This repertoire is reflected by two characteristics that are particularly salient for our study: competitive complexity and competitive deviance.

Competitive complexity is the inverse of competitive simplicity. Miller (1993 : 117) defines simplicity as 'an overwhelming preoccupation with a single goal, strategic activity, department, or world view—one that increasingly precludes consideration of any others.' A firm whose strategic activities are characterized by competitive simplicity focuses exclusively on a very limited set of actions relative to its competitors (Miller and Chen, 1996b). For firms facing competitive and turbulent markets, a narrow range of actions may limit their ability to pursue new opportunities or react to sudden change (Stacey, 1992). These firms

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fail to satisfy the 'law of requisite variety,' which means that their range of competitive behavior is neither adequate to meet the needs of their customers nor sufficient to match the attacks by competitors (Miller and Chen, 1996a). In contrast, a firm whose strategic activities are characterized by competitive complexity has a more varied repertoire of actions than most rivals, where no single action dominates in frequency of engagement (Ferrier, 2001). Firms with more complex competitive repertoires will be more aggressive (Ferrier, 2001) and perceived as more capable (D'Aveni, 1994) than competitors. Both competitive dynamics literature (Ferrier *et al*, 1999; Ferrier, 2001) and Austrian economics (Kirzner, 1973) argue that a wider range in competitive activity enables firms not only to attain but also to sustain performance gains in turbulent environments more readily than more competitively limited rivals. These arguments are especially valid for firms competing in technology-based industries like those in our sample, where dynamic environments are expected. Formally, we then argue that:

Hypothesis 2a: The complexity of a firm's competitive behavior will positively affect its performance.

Competitive deviance is a 'nonconformist' action repertoire. It reflects the degree to which a firm's actions differ markedly from industry norms. These differences may arise from emphasizing a novel mix or sequence of actions seldom used by competitors (Miller and Chen, 1996a). It is analogous to action repertoire dissimilarity (Ferrier *et al*., 1999) or attack heterogeneity (Ferrier and Lee, 2002). Deviant competitive behavior provides firms with performance advantages because it enables firms to develop distinctive competitive advantages (Prahalad and Hamel, 1990) that surprise competitors (Chen and MacMillan, 1992) and are difficult for competitors to anticipate and imitate or retaliate against (Chen and Miller, 1994). Caves and Ghemawat (1992), for example, found that top firms enjoyed market share gains when their actions deviated from those of competitors. When a firm implements a mix or sequence of actions that deviates from industry norms, it seeks to disrupt competition and change the rules of competition in its favor (D'Aveni, 1994), thus improving its performance.

Hypothesis 2b: The deviance of a firm's competitive behavior will positively affect its performance.

Moving beyond the direct performance effects of resources and actions, we now discuss how the breadth of technological resources affects the firm's competitive behaviors (i.e., complexity and competitive deviance).

As the competitive dynamics perspective suggests, a firm's resources affect the actions it can take, proactively or reactively, with respect to competitors. The innovation literature has shown that technological resources (e.g., knowledge and research capacity) that span technological boundaries are essential for innovation (Phene *et al*., 2006). Greater technological resource breadth allows firms to examine and find more useful combinations of resources to support a greater variety of actions. This ability to explore different resource combinations increases the firm's ability to create radical innovations or enhance production efficiencies for existing products. Of course, the opposite is true as well: increasingly limited breadth of resources constrains the firm's range of competitive actions and may require competitive simplicity where one or very few actions dominate. While competitive actions can be conducted with few resources, greater breadth of resources, especially technological resource for technological-based firms, enables greater variety in the firm's *repertoire* of competitive actions. Therefore, we argue that a wider breadth of technological resources allows a firm to formulate and implement a wider variety of actions, thus producing greater complexity in its competitive repertoire than competitors. Formally:

Hypothesis 3a: The breadth of a firm's technological resources will positively affect the complexity of its competitive behavior.

The breadth of technological resources is also expected to affect the firm's level of competitive deviance. First, a broader array of technologies, including the knowledge of recently hired employees, exposes a firm to different assumptions, environments, and/or markets. This exposure promotes learning new ways to compete (Miller, 1993; Miller and Chen, 1996a). For example, Kim and Mauborgne (2004) argue that drawing assumptions, insights, and knowledge from outside the

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firm's focal industry is critical to making unorthodox strategic moves.

Second, when competitors within an industry share factor markets, they tend to exhibit similar strategic behavior (Fiegenbaum and Thomas, 1995). Not only does a shared factor market provide firms with similar resources, it also homogenizes the ensuing strategic behaviors they exhibit (Peteraf, 1993). Increased breadth of technological resources however, allows a firm to have potentially rare resource combinations. This provides the firm with more degrees of freedom to produce resource combinations that support the formulation and implementation of actions not common within its competitive arena—actions that may be inconceivable to its rivals. When a firm's resource combinations are dissimilar from those of its competitors, it is more likely to engage in deviant behavior (Peteraf, 1993).

Finally, such breadth minimizes the firm's need to conform to isomorphic pressures of external stakeholders (DiMaggio and Powell, 1983). A firm with a broader range of technological resources can engage a wider variety of partners and thus reduce the firm's reliance on any single partner. Reducing its dependency on specific partners dampens the salience of many competitive norms (Miller and Chen, 1996a). Thus, the breadth of technological resources insulates the firm from isomorphic pressures (Mezias, 1990), allowing the firm to more freely contemplate and engage in novel actions. Therefore we propose the following hypothesis:

Hypothesis 3b: The breadth of a firm's technological resources will positively affect the deviance of its competitive behavior.

Next, in building theoretical support for a mediated model we turn our attention toward mediation itself. Namely, we extend previous work that suggests general linkages among resources, actions, and performance (e.g., Grimm and Smith, 1997) by providing a more nuanced understanding of mediation. That is, how action mediates the relationship between resources and performance. Following Penrose (1959: 22) who asserted it is not resources themselves that are important, 'but only the services that the resources can render,' we argue that competitive complexity and competitive deviance are important factors in determining the realized effects of the firm's technological resources.

Firms gain competitive advantage from their technological resources by accumulating knowledge, actualizing that knowledge into competencies, and deploying those competencies through competitive strategies (DeCarolis, 2003; Sirmon *et al*., 2011). This three-part process highlights the role of competitive action in realizing the potential of such resources. Although the resources themselves offer potential advantages, a firm's ability to realize these advantages depends on the actions it employs. For example, a biotechnology firm might accumulate broad technological resources in the form of patents, but without actions such as developing new products, forming needed partnerships, seeking supportive legal protection, and so on, those technological resources will not yield any advantage or meaningful performance outcomes. Thus, competitive actions mediate the relationship between the breadth of technological resources and performance by actualizing the value embedded in them.

Although the rationale for *why* competitive activity mediates the resource-performance relationship applies to both competitive complexity and competitive deviance, *how* they mediate this relationship differs. Increased complexity in a firm's competitive repertoire not only leverages the firm's technological resources more fully; it also increases the firm's opportunities to learn. As a firm conducts more and different actions to leverage its technological resources, it learns which actions are most effective or which modifications are needed to increase their effectiveness. This learning effect is not limited to internal factors. Instead the firm is able to compare the results of numerous actions in different external (i.e., environmental) contexts, which also facilitates learning. Importantly, this iterative comparison of numerous and different actions in varied contexts increases the firm's ability to respond to dynamic and turbulent environments.

In comparison, while firms choosing to leverage their technological resources with a simple repertoire of actions may increase their efficiency, they forgo the learning opportunities available from reviewing the results of numerous and varied actions. Efficiency is desirable, but when competitive pressure and turbulence increase, these missed learning opportunities will undermine the firm's ability to respond. For example, because a simple repertoire provides few learning opportunities and offers limited flexibility, the firm may be forced to take actions in which it is ill-prepared to engage. That is, desperation may lead to inappropriate actions; actions that do not leverage the firm's technological resources effectively. This is especially valid for technology-driven firms where competitive pressures and turbulent environments can quickly alter the firm's competitive context. Therefore, the complexity of competitive actions is expected to enhance firm performance because the underlying actions more fully utilize the potential of the firm's technological resources (that is, it increases the flexibility the firm has to act with) as well as offer new opportunities to learn, which enhances the effectiveness of future actions. Formally:

Hypothesis 4: The complexity of a firm's competitive behavior will mediate the relationship between its technological resources and its performance.

Next, deviance in a firm's competitive behavior is also expected to mediate the relationship between breadth of technological resources and performance. Austrian economists argue that deviant actions, be they radical and disruptive actions that create disequilibrium (Schumpeter, 1950) or incremental and innovative actions (Kirzner, 1973), are important to gain competitive advantage. Firms that initiate deviant actions to utilize their rare resource combinations may create Schumpeterian 'gales of creative destruction' through which the advantage of rivals diminish and their own advantage increase. Indeed greater breadth of technological resources allows the firm to pioneer new resource combinations that can support disruptive competitive actions (Galunic and Rodan, 1998) that lead to gains in market share (Caves and Ghemawat, 1992; D'Aveni, 1994) as well as gains in consumers' perceived value (and thus increases in their willingness to pay) (Priem, 2007).

Moreover, a deviant repertoire of actions enables the firm to not only realize the potential value of its technological resources but also to thwart rivals attempts at imitation. In order to imitate, the rival must go beyond matching the firm's technological resources, but it also must execute the deviant actions as well. In addition, as a byproduct of broadening their technological resources, firms develop and patent potential substitutes for their core technologies. This gives them the ability to lock out competitors from 'engineering around' their technologies to develop substitute products (Ceccagnoli, 2009). Thus, instead of merely running down the price curve to increase market share, firms that formulate and implement deviant actions to leverage their breadth of technological resources are able to simultaneously increase demand (by creating new consumer value) while enhancing their competitive position (by limiting rivals' ability to imitate or offer substitutes). For example, Ford's Model T was the result of several deviant actions (adopting the assembly line, radical pricing, simple design, etc.) that led simultaneously to decreased costs to the firm, increased demand of its product, and increased profits (Kim and Mauborgne, 2004).

Thus, while competitive complexity offers the firm greater flexibility to fully leverage its breadth of technological resources and learn from these actions to improve future actions, competitive deviance allows the firm to leverage the firm's breadth of technological resources by increasing the novelty of its offerings, while decreasing rivals' ability to imitate or offer substitutes for them. Thus, we propose:

Hypothesis 5: The deviance of a firm's competitive behavior will mediate the relationship between its technological resources and its performance.

METHODS

Sample

Our sample consists of the population of publicly traded firms in the in-vitro diagnostic substance manufacturing industry (North American Industry Classification System code: 325 413; Standard Industrial Classification code: 2835). These are technology-intensive firms that fall under the hierarchy of the pharmaceutical and medicine manufacturing industry (32 541) in the chemical manufacturing subsector (325). While often considered an extension of the pharmaceutical industry, the in-vitro diagnostics industry is closely intertwined with cutting edge developments in the diagnosis of human and animal disorders, and involves extensive genetic research that produces significant technology- and knowledge-intensive resources for the participants. More specifically,

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firms in this industry create chemical, biological, or even radioactive materials used to diagnose or monitor body fluids or tissues for several different maladies. For example, Alliance Pharmaceuticals, a leader in this industry, developed and manufactured 'Imagent,' an injectable ultrasound contrast agent for use with echocardiography in the diagnosis of heart conditions. Technological resources are therefore central to competing in this industry.

We created a longitudinal dataset by drawing our sample from this industry over the years 1995 through 1999. This original sampling provided 78 publicly traded firms. However, because we are interested in firms' technological resources, we retained only those firms with patents (which form the basis of our resource measures discussed below). This led to a final sample of 69 firms. For several reasons (e.g., mergers and/or new entrants), our panel is unbalanced and provided 239 firm-year observations. Importantly, our sample selection provides several additional attributes of value. First, confounding industry effects are not present because the sample includes data on a single industry. Second, the vast majority of these firms are undiversified, thus ensuring that their resources and competitive activity share a common competitive arena. Finally, because mediation hypotheses entail causation, it is necessary for the independent variables to be measured temporally antecedent to any dependent variable(s). As such resource breadth was measured prior to competitive activity in time, which in turn was measured prior to performance. Put differently, the sample is lagged such that causality is appropriately addressed to support the testing of a mediated model.

As in most sampling procedures, a key concern is the potential for selection bias. We investigated this concern and based on three separate approaches concluded that selection bias is not present in this sample. First, we empirically tested for selection bias using Wooldridge's (2002) modified Heckman test (i.e., two-stage approach) for panel datasets. The nonsignificant inverse Mills ratio (Lambda) coefficient (0.56; $p < 0.44$) indicates that selection bias due to endogeneity of patenting behavior is not a concern for our sample. Second, because patenting is an intensive process, firms are unable to 'turn it off and on' easily; thus, the choice is time invariant (i.e., constant over time) over the short and midterms. Because our sampling frame addresses five years of activity, this choice is for all intents and purposes time invariant; therefore, any selection bias is empirically addressed or controlled for by analyses' treatment of firm effects (Wooldridge, 2002). Finally, to ensure the robustness of our results, we also ran our analyses using a sample that included the non-patenting firms. These results offered no substantive differences from those presented herein.

MEASURES

Dependent variables

Performance

We measured performance as a firm's rate of return on assets (ROA). A firm's technological resources and competitive actions, however, may not immediately affect its performance. We therefore measured performance across three separate periods. First, the most immediate performance effect was measured using the subsequent year's performance, labeled (ROA1). Second, the intermediate performance effect was measured using the sum of ROA one to three years out (ROA3). Finally, the longer-term performance effect was captured using the sum of ROA one to five years out (ROA5). Performance data were collected from Compustat from 1996 to 2004. Importantly, 21 firms ceased to exist as independent companies during the time we drew the observations (performance data) (1996–2004). This reduced the number of observations in models that included performance measures and created a concern about the potential for attrition bias. The results of Nijman and Verbeek's (1992) test for biases due to attrition, however, indicate that attrition bias is not present in this sample. The attrition indicator was not significant (-0.306, $p = 0.264$)

Technological resource breadth

Competition and success within the in-vitro diagnostic substance and equipment manufacturing industry is based primarily on innovative new products that are effective in diagnosing specific ailments. Research, especially in genetics, is crucial in the development of such products. A firm's patent portfolio results from its inventiveness and level of invention, and thus represents its level of technological knowledge (Hall, Jaffe, and Trajtenberg, 2001). Therefore, the breadth of a firm's patent portfolio is utilized as the indicator of the

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firm's breadth of technological resources (Miller, 2004). And as Miller noted, we acknowledge that patents do not "reveal all valuable knowledge of the firm, but that the breadth of knowledge represented by patents is an accurate indicator of the breadth of the firm's technological resources" (2004: 1118).

We obtained patent data from several sources. First, data from the United States Patent and Trademark Office (USPTO) was acquired through Delphion's searchable database. Searching for patents through Delphion is advantageous because corporate trees (prior acquisitions and subsidiaries) have already been mapped onto the parent firm. Each firm was searched individually, with particular attention to variations in firm name. This search yielded 1420 patents. Next, we matched the patent numbers from Delphion to the National Bureau of Economic Research (NBER) patent data (Hall *et al.*, 2001). We then searched for additional patents using organization numbers assigned to these patents in NBER's database. This step was essential because the Delphion database did not cover patents granted prior to 1990 (used in the control variable discussed below). We obtained 802 additional patents. Next, for firms that had no patents, we searched the USPTO database directly. In total, of our original sample, nine firms held no patent information prior to 2000. In addition, we deleted patents granted prior to 1975 (only seven patents) to keep our patents within their useful economic life (20 years to 1995).

Technological resource breadth was calculated using a Herfindahl-type index analogous to Hall *et al.*'s (2001) approach:

$$Technological\ resource\ breadth = 1 - \sum_{i}^{n} S_i^2$$

where S_i is the proportion of n patents in USPTO class i.

Competitive repertoire complexity

In order to measure firms' competitive activity, we utilized structured content analyses of firm actions based on reports from newspaper and trade publications identified in Lexis-Nexus. We used NVivo structured content analysis software to categorize each news article into one of several preestablished competitive actions. Two coders first independently read through each article and, using the NVivo software, classified it into preestablished action categories such as new product introductions, licensing, legal actions, and others. Their intercoder reliability was 0.74. A third coder classified actions on which the two coders did not agree and worked toward agreement. We then used this data to calculate our measures of competitive activity. This methodology is established in the competitive dynamics literature to measure the competitive actions of firms (Ferrier, 2001; Ferrier and Lyon, 2004; Ferrier *et al.*, 1999).

Competitive repertoire complexity measures the extent to which a firm's action portfolio for a given year consists of a broad variety of actions. It captures the within-firm diversity of actions (Ferrier *et al.*, 1999). Following Ferrier (2001) and Ferrier *et al.* (1999), we used a Herfindahl-type index represented below:

$$repertoire\ complexity = 1 - \sum_{i} P_i^2$$

where P_i is the proportion of i^{th}-category of competitive actions. Higher values represent firms that utilize a broader range of actions and thus a more complex competitive repertoire; lower values represent firms with a narrower range of actions and thus a simpler competitive repertoire.

Competitive repertoire deviance

Competitive repertoire deviance captures the extent to which a firm's portfolio of actions for a given year differed from those of its competitors. Similar to Ferrier *et al.*'s (1999) calculation of leader-challenger action dissimilarity, deviance is calculated as the sum of squared difference in proportions of categories of competitive action between the focal firm and the industry mean:

$$repertoire\ deviance = \sum_{i} (P_i - \overline{P}_\iota)^2$$

where P_i is the proportion of i^{th}-category of competitive action for the focal firm, and $\overline{P}_\iota$ is the industry mean proportion (excluding focal firm) of i^{th} category of competitive action.

Control variables

Next, we measured and included in our analyses five control variables. First, we controlled for firm

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size because larger firms may have larger resource portfolios to conduct competitive actions. Firm size was measured as the natural log of number of employees. Second, we controlled for organizational slack because of its influence on the potential for competitive actions (Ferrier, 2001). We focused on a firm's unabsorbed slack, using the firm's current ratio as its proxy (Chen *et al.*, 2007). Information for these two control variables was collected from Compustat. Third, we controlled for firm age. Age was measured as the number of years since the year of a firm's founding. Because technological resources are path dependent, a firm's longevity will in part determine its opportunity to develop patents. Founding date was collected from Compustat and Mergent Online. Fourth, we controlled for the average age of the firm's patent portfolio. Lastly, we controlled for prior performance as it often influences competitive activity and future performance. Prior performance is calculated as the net income of the prior year.

Analyses

Our final dataset consists of panel data of 239 firm-year observations. Although we account for changes in a firm's technological resources and competitive actions across years, it is quite possible that some firm-specific factors (such as management) remained constant across the years. This implies firm observations might be correlated across years, thus violating the assumption of independence across observations necessary for ordinary least squares regressions. We therefore used the maximum likelihood estimation of generalized estimating equations (GEE) to estimate the parameters for all our analyses.

GEE is a form of generalized linear models that allows for the modeling of correlated observations within subjects in longitudinal studies (Hardin and Hilbe, 2003). Compared to fixed or random models, GEE estimates more consistent and robust parameters when autocorrelation due to nonindependence is present (Liang and Zeger, 1986). GEE does this by estimating parameters and standard errors based on an estimation correlation derived from within-cluster residuals. As such, GEE offers two clear advantages over fixed- or random-effect models for this study. First, GEE does not assume the dependent variable is normally distributed. This is particularly relevant when our hypotheses specify competitive action measures as the dependent variable because they are derived from count data and therefore yield a 'limited range dependent variable' (Harrison, 2002). Second, GEE is more robust than other panel data methodologies because it offers multiple correlation matrix structures to best match the data (Liang and Zeger, 1986). Prior research has shown that the 'unstructured' matrix option that we employ, which allows for 'all possible correlations between within-subject responses and includes them in the estimation of the variances' (Ballinger, 2004: 133) is more appropriate (and efficient) than fixed or random effects models. This is because "it is the least restrictive in terms of modeling the true correlation structure within subject" and is especially appropriate when "there is no reason to expect that the correlation of the responses between trials would decrease over time" (Ballinger, 2004: 142) as is the case for our empirical context. GEE therefore produces more efficient parameter estimators, and, more accurate standard errors than fixed- and random-effects models (Burton, Gurin, and Sly, 1998).

RESULTS

Table 1 lists descriptive statistics and intercorrelations for the variables. The results of our hypotheses based on GEE analyses are presented in Table 2. Multicolinearity does not present any problems to our analyses as the variance inflation factor scores are below 2.18.

Hypothesis 1 predicted that the breadth of a firm's technological resources will positively affect performance. Models 4, 5, and 6 in Table 2 show the effect of technological resource breadth on immediate (ROA1), intermediate (ROA3), and long-run (ROA5) performance, respectively. In all three models, technological resource breadth is positive and significant. Hypothesis 1 is strongly supported.

Hypotheses 2a and 2b predicted the direct effects of actions on performance. Models 1, 2, and 3 in Table 2 show positive and statistically significant coefficients for both types of actions across all three time frames (with action deviance in Model 5 only having marginal statistical significance). In total, these results offer support for Hypotheses 2a and 2b.

Hypothesis 3a predicted that the breadth of a firm's technological resources will positively affect

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Table 1. Sample statistics and correlations

	N	Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1. Firm age	239	12.5	7.61										
2. Slack	239	4.26	5.80	0.01									
3. Firm size	239	8.11	5.29	0.10	0.34								
4. Average patent age	239	3.28	3.19	0.37	−0.05	0.02							
5. Prior performance	239	−3.32	18.19	0.08	−0.08	0.05	0.09						
6. Breadth of resources	239	0.42	0.30	0.03	0.06	0.05	0.21	0.03					
7. Action deviance	239	0.34	0.37	0.02	0.17	0.27	0.07	0.02	0.16				
8. Action complexity	239	0.18	0.28	−0.16	0.09	0.19	−0.05	0.01	0.09	−0.12			
9. ROA1	205	−0.54	1.25	0.11	0.15	0.06	0.05	0.13	0.12	0.07	0.09		
10. ROA3	171	−1.46	2.53	0.08	0.14	0.13	0.08	0.16	0.17	0.15	0.16	0.73	
11. ROA5	147	−2.06	3.37	0.07	0.11	0.08	0.10	0.21	0.10	0.18	0.14	0.62	0.91

Correlations are significant at $p < 0.05$ when coefficients are |0.13| where N = 239; |0.14| where N = 205; |0.15| where N = 171; |0.16| when N = 147.

the complexity of its competitive behavior. Model 7 in Table 2 provides the results of this test. The coefficient of technological resource breadth is both positive and significant. This provides support for Hypothesis 3a.

Hypothesis 3b predicted that the breadth of a firm's technological resources will positively affect the deviance of its competitive behavior. Model 8 in Table 2 provides the results of this test. The coefficient of technological resource breadth is both positive and significant, thus providing support for Hypothesis 3b.

Hypotheses 4 and 5 predict that the complexity and deviance of a firm's competitive activity will mediate the relationship between its technological resources and its performance. We adopt Baron and Kenny's (1986) widely used methodology to examine the mediation effects. We supplement this analysis with Sobel's (1982) test to determine the type and significance of the mediation effect (MacKinnon *et al*., 2002).

Three conditions are necessary for the presence of a mediation effect (Baron and Kenny, 1986). First, the independent variable must significantly influence the dependent variable(s). Second, the independent variable must significantly influence the mediator(s). Third, the mediator(s) must significantly affect the dependent variable(s) after the influence of the independent variable is controlled. When these relationships are present, a mediation effect is present.

Models 1–8 provide support for the first two conditions necessary for mediation. The third condition necessary for mediation is presented in Models 9, 10, and 11. These models show the effects of technological resource breadth, action complexity, and action deviance on the performance measure across the three different periods. As seen in these models, with technological resource breadth controlled, action complexity and action deviance maintain a positive and significant effect on all three performance measures, thus confirming the third step. The confirmation of all three conditions therefore supports the presence of a mediation effect (Baron and Kenny, 1986).

To further probe the nature of this mediation, we utilized the Sobel (1982) test to investigate the type of mediation (i.e., partial or full; Jose, 2008). There is no significant indirect effect if the Sobel test z-value is not significant (<1.96); the mediation relationship is partial if the Sobel test z-value is significant (>1.96) and the effect ratio is lower than 0.8; and the mediation relationship is full if the Sobel test z-value is significant (>1.96) and the effect ratio is over 0.8 (Jose, 2008). Table 3 provides the results of the Sobel test.

As shown in Table 3, for the mediator *action deviance*, the z score for ROA1 is 1.60 ($p > 0.05$), providing no support for an indirect effect; the z score for ROA3 is 1.96 ($p < 0.05$) and for ROA5 is 1.99 ($p < 0.05$), providing support for the presence of an indirect effect. In terms of magnitude, effect ratios of 0.12 and 0.25 for ROA3 and ROA5, respectively, indicate a partially mediated relationship. As for the mediator *action complexity*, the z score for ROA1 is 1.76 ($p > 0.05$), thus providing no support for an indirect effect; the z score for ROA3 is 2.00 ($p < 0.05$) and for ROA5 is 2.01 ($p < 0.05$), providing support for the presence of an indirect effect. In terms of magnitude,

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Table 2. Results of GEE regression analysis

	Model 1 ROA1	Model 2 ROA3	Model 3 ROA5	Model 4 ROA1	Model 5 ROA3	Model 6 ROA5	Model 7 Action complexity	Model 8 Action deviance	Model 9 ROA1	Model 10 ROA3	Model 11 ROA5
Intercept	−1.15***	−0.87***	−0.39*	−1.12***	−2.68***	−2.85***	0.21***	0.16**	−1.29***	−3.14***	−3.65***
	(0.17)	(0.17)	(0.18)	(0.28)	(0.66)	(0.52)	(0.04)	(0.06)	(0.18)	(0.66)	(0.92)
Firm age	0.01	−0.01	−0.01	0.01	−0.01	−0.03	−0.01***	0.00	0.02†	−0.01	−0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.00)	(0.00)	(0.01)	(0.03)	(0.05)
Slack	0.03***	0.01	0.00	0.03*	0.06*	0.06**	0.00	0.01†	0.03**	0.05†	0.06
	(0.01)	(0.00)	(0.01)	(0.01)	(0.03)	(0.02)	(0.00)	(0.00)	(0.01)	(0.03)	(0.04)
Firm size	0.001	0.00	−0.01	0.01	0.06	0.06	0.01*	0.01*	0.01	0.03	0.01
	(0.01)	(0.01)	(0.01)	(0.02)	(0.05)	(0.04)	(0.00)	(0.00)	(0.01)	(0.05)	(0.07)
Average patent age	0.01	0.04	0.00	−0.02	−0.03	−0.01	−0.00	0.02*	−0.02	−0.04	0.09
	(0.02)	(0.02)	(0.03)	(0.04)	(0.02)	(0.08)	(0.01)	(0.01)	(0.02)	(0.09)	(0.04)
Prior performance	0.01**	0.01**	0.02**	0.01*	0.03*	0.07***	0.00	0.00	0.01**	0.04*	0.07**
	(0.00)	(0.00)	(0.01)	(0.00)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)	(0.02)	(0.02)
Resource breadth				0.62*	1.60*	1.22*	0.11*	0.14*	0.53**	1.22†	0.86
				(0.32)	(0.75)	(0.62)	(0.05)	(0.07)	(0.19)	(0.75)	(1.09)
Action deviance	0.33*	0.41**	0.27†						0.28*	1.16*	1.95**
	(0.14)	(0.15)	(0.16)						(0.14)	(0.54)	(0.76)
Action complexity	0.59***	0.84**	0.66**						0.53**	2.05**	2.99**
	(0.18)	(0.20)	(0.22)						(0.18)	(0.71)	(1.01)
Wald chi-square	579.3***	368.3***	299.3***	286.29***	1012.53***	475.04***	395.86***	411.90***	576.75***	959.48***	1431.61***
Observations	205	171	147	205	171	147	239	239	205	171	147

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; all two-tailed tests. Standard errors listed below coefficients

Table 3. Results of Sobel test[a] and effect ratio[b,c]

Mediator: action deviance	c	a1	SEa1	b1	SEb1	Z	Effect ratio
ROA1	0.62	0.14	0.07	0.28	0.14	1.60	n.a.
ROA3	1.60	0.14	0.07	1.16	0.54	1.96*	0.12
ROA5	1.22	0.14	0.07	1.95	0.76	1.99*	0.25
Mediator: action complexity	**c**	**a2**	**SEa2**	**b2**	**SEb2**	**Z**	**Effect ratio**
ROA1	0.62	0.11	0.05	0.53	0.18	1.76	n.a.
ROA3	1.60	0.11	0.05	2.05	0.71	2.00*	0.14
ROA5	1.22	0.11	0.05	2.99	1.01	2.01*	0.28

[a.] $Z = a \times b/\sqrt{(SE_b{}^2 a^2 + SE_a{}^2 b^2)}$ (Baron and Kenny, 1986)
[b.] Effect ratio $= a \times b/c$ (indirect effect/total effect)
[c.] * $p < 0.05$; all two-tailed tests.

effect ratios of 0.14 and 0.28 for ROA3 and ROA5, respectively, also indicate a partial mediation relationship. These results further support the prior results but offer a more fine-grained understanding. Thus, we conclude that Hypotheses 4 and 5 are supported, and that the nature of the mediation effect of competitive activity is partial as opposed to full.

DISCUSSION

We argue that by focusing on one driver at the expense of the other, both the RBV (resources) and competitive dynamics (actions) have offered an incomplete model of superior performance. We suggest that our understanding of superior performance can be improved through the integration of both perspectives. That is, understanding the linkages between resources and actions will greatly enhance our understanding of why some firms experience higher performance. In fact, this effort brings to fruition the calls by several researchers for conceptual integrations of these influential theories (e.g., Grimm *et al*., 2006; Sirmon *et al*, 2007).

The findings of this paper provide substantial support for the mediated model we theoretically developed. The results show that competitive actions partially mediate the relationship between technological resources and performance. Specifically, via a series of analyses, we see that 1) the breadth of a firm's patent portfolio affects the complexity and deviance of the firm's competitive behavior in the context of technology-intensive firms; 2) the breadth of a firm's patent portfolio affects performance; and 3) the mediation effect of competitive complexity and deviance is substantiated in a complete model.

Support of this mediated model suggests that both technological resources and competitive actions are necessary antecedents to superior performance. Increased breadth of the firm's technological resources allows for greater range and differentiation of competitive actions, which enhance performance. Put another way, greater complexity and deviance of competitive actions more effectively utilize technological resource portfolios with greater breadth to improve performance. Either way, these results suggest that without the requisite resources, firms will be constrained in terms of the range and deviance of competitive actions. Likewise, if firms do not engage such actions, the potential of their resources will not be realized. Prior RBV and competitive dynamics research has shown direct performance effects for resources or actions; however, we offer a more complete understanding of how these performance drivers work together to affect a firm's performance outcomes.

The support of our theory provides several contributions to the literature. First, these results add merit to the growing stream of work related to resource management (Helfat *et al*, 2007; Sirmon *et al*., 2007; Sirmon *et al*., 2011). A major untested assumption within this literature stream is that actions mediate the resource-performance relationship. A similar expectation is put forth by Grimm and Smith's (1997) and Grimm *et al*.'s (2006) 'strategy as action' model. However, such relationships have not been substantiated until now. In the absence of such substantiation, the validity of 'strategy as action' or resource management models, no matter how appealing, were at risk.

This research removes much of that risk. We can more confidently state that what a firm does with its resources is just as important to performance as its possessing those resources (Hansen *et al*., 2004).

Next, this research offers contributions to the RBV and competitive dynamics research streams, both of which continue to offer important insights for strategic management scholars' pursuit of understanding performance differentials between rivals. RBV scholars, who have been challenged to move beyond resource characteristics (Priem and Butler, 2001), could begin by more directly considering how specific types of firm resources influence specific strategies. In this way, future work would build upon Hitt *et al*.'s (2001, 2006) approach of linking resources and various firm strategies. For competitive dynamics, a clearer understanding of the role of resources is important for further advances. Based on this research, it has become apparent that a more vivid conceptualization of the firm's resources is necessary to accurately model the competitive dynamic's 'awareness-motivation-capability' framework.

These contentions raise opportunities for future research. Although our data are panelized, we collapsed resources and actions to annual measurement. However, the timing of actions is potentially relevant to scholars in both resource management and competitive dynamics (e.g., Zott, 2003). It would be interesting to understand whether certain types of resource holdings influence not only the actions taken but also the sequences of actions. Furthermore, future research could also examine the role of internal managerial actions (e.g., Sirmon *et al*., 2007, 2008; Sirmon and Hitt, 2009). We focus on competitive actions that are externally visible. It is possible, however, that some managerial actions in the deployment and utilization of resources, such as financial allocations, are not visible outside the boundaries of the firm. Future research can examine the effect of internal managerial actions on the resources-performance link, especially in the context of performance turnaround situations where many actions can be taken simultaneously (Morrow *et al*., 2007). Similarly, upper echelons theory proposes that the composition of a firms' TMT affects their strategic choices (Hambrick and Mason, 1984). Determining which strategic actions to implement based on a firms' resource profile is a central strategic choice variable for the TMT. Future research examining how TMT composition influences the resource-action link and subsequent performance would enhance the literature.

In addition, the relationship between resources, competitive action, and performance is complex, recursive, and with feedback loops. While we have modeled a causal link from resources to action to performance, actions also enable the firm to build and expand its resource portfolio (Sirmon and Hitt, 2009). Similarly, research has shown performance to influence a firm's subsequent competitive behavior (Smith *et al*, 2001) and resource accumulation. Furthermore, contemporaneous resources and competitive actions could enhance each other, thus creating the potential for moderation effects. Future research would enhance the field by examining these different links in the resource-action-performance relationship.

Finally, additional research could replicate this work and address some of its limitations. For example, we focus on technological resources to examine the relationships we propose. However, there are other types of resources (e.g., human resources and financial resources) that influence competitive advantages (Barney, 1991) and competitive actions that firms adopt. Thus, it is worthwhile to further investigate whether the mediation effect of competitive actions on the relationship between resources and firm performance still holds for other types of resources. Additionally, our sample focuses on a single industry. Characteristics of technological resources may vary from industry to industry. Our results are promising, but samples on more industries with different environmental characteristics (more stable as opposed to technologically driven industries with commensurate uncertainty) may make our results more generalizable.

In conclusion, our empirical results offer greater support for the growing stream of research pertaining to a resource-action-performance model and yield opportunities to advance both the RBV and competitive dynamics perspectives. We hope others use this approach to further our understanding of the drivers of firm performance.

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