ABSORPTIVE CAPACITY AND RELATIVE DIVERSIFICATION: JOINT AND INDIVIDUAL PERFORMANCE EFFECTS

Abstract

We study the interdependence of absorptive capacity and diversification strategy and its impact on firm performance. We distinguish the three component abilities of absorptive capacity (i.e. acquiring, assimilating, and exploiting external knowledge) and posit that firms' relative diversification (i.e. the relative prominence of firms' diversification in related and unrelated domains) moderates the effects of the component abilities of absorptive capacity on firm performance in different fashions. We use a unique panel of 89 large US-traded ICT firms from 1975-2010 to test our hypotheses. We find all of our hypotheses to be supported, suggesting that absorptive capacity and diversification are interdependent strategic tools that should not be designed and implemented in isolation.

Keywords: Absorptive capacity; Acquisition ability; Assimilation ability; Exploitation ability; Diversification

INTRODUCTION

Firms seek out new contexts where current organizational capabilities can be further employed to allow the firm to grow. However, growth strategies exert pressures on organizational capabilities for adjustment to new technological and market conditions and pose pressing challenges for the ability of the firm to benefit from new competitive positions. Failure to adapt organizational capabilities can negatively affect firm performance so that growth strategies must be both co-aligned with current organizational capabilities. Therefore, a fuller understanding of the impact of growth strategies on the effectiveness of organizational capabilities is paramount for the firm. We shed some light on this issue by looking into the interdependence of absorptive capacity and diversification strategy and its impact on firm performance. We focus on the component abilities of absorptive capacity and examine how the firm's relative diversification – the relative prominence of firms' diversification in related and unrelated domains – modifies their effects on performance.

Absorptive capacity reflects the firm's abilities to recognize the value of new external information; assimilate it; and apply it to new commercial ends (Cohen & Levinthal, 1990; Lane & Lubatkin, 1998). First, the ability of the firm to identify and value external knowledge hinges on active engagement in R&D activities that enable it to develop organizational knowledge about specific technological areas and how these areas relate to its products and markets. Second, the development of processes, procedures and policies that facilitate knowledge sharing across organizational units help the firm build its ability to assimilate external knowledge. Last, the firm's exploitation ability pertains to the development of skills of employing this knowledge to create new knowledge and products and to anticipate future technological trends (Zahra & George, 2002).

Two major mechanisms underpin the components of absorptive capacity: knowledge diversity and the organization's communication structure. Knowledge diversity describes the degree of relatedness in existing knowledge and between existing and newly acquired external knowledge. Related and therefore less diverse knowledge allows the firm to seek out valuable external resources (Vasudeva & Anand, 2011), to understand them, and to transfer them from other organizations (Lane, Koka, & Pathak, 2006). It enables sharing and transferring of externally acquired knowledge across business units and organizational departments and thus contributes to the development of the assimilation ability. Moreover, it determines the promptness and ease of knowledge retrieval (Zahra & George, 2002), the demand for establishing common interfaces between diverse knowledge vectors (Garud & Nayyar, 1994), and knowledge transferability (Kogut & Zander, 1992), which are important prerequisites for effective knowledge exploitation. On the other hand, the communication structure reflects the coordination capabilities that a firm possesses, which help teams from different divisions combine their skills, backgrounds and knowledge to learn, assimilate and share new knowledge (Barkema & Vermeulen, 1998; Helfat & Raubitschek, 2000).

These mechanisms and the effectiveness of the component abilities of absorptive capacity are likely to interact with the firm's diversification strategy; namely, its expansion into new product markets and business areas (Wan, Hoskisson, Short, & Yiu, 2010). We posit that relative diversification exerts a differential impact on the component abilities of absorptive capacity and moderate their effect on performance in distinct fashion. Related diversification refers to the growth of the firm in businesses within the firm's major industry that share related knowledge, resources, products, skills, or market characteristics (Bettis, 1981; Farjoun, 1998; Markides & Williamson, 1994; Robins & Wiersema, 1995). The diversification type matters as it alters the

equilibrium of existing knowledge diversity and exerts pressures on the structure of communication.[1] Its modifying power is expected to play an important moderating role in the relationship between absorptive capacity and firm performance.

We examine this moderating role on a sample of 89 large US-traded firms operating in the information, communication and technology (ICT) sector in 1975-2010. Our results suggest that the baseline impact of the component abilities of absorptive capacity are moderated by the firm's relative diversification in distinct ways.

We contribute to the understanding of the interdependence of organizational capabilities and growth strategy and its impact on firm performance. First, we extend past empirical research on absorptive capacity by splitting up absorptive capacity into its underlying abilities. This offers a fine-grained study of the impact of the component abilities on firm performance. Second, by considering absorptive capacity a dynamic capability (Teece, 2007), we show that it helps firms adapt to changing environments by supporting growth strategies and that absorptive capacity itself is affected by growth strategies. Hence, organizations should design the two in tandem. Third, our panel setup lets us establish causal relationships among the focal variables and extends empirical work based on cross-sectional studies. The ICT context adds to research on absorptive capacity set in uncertain and evolving high technology industries and suggests the importance of dynamic capabilities to respond to change (George, Zahra, Wheatley, & Khan, 2001; Nicholls-Nixon, 1995).

[1] The incentives that drive firm diversification are beyond the scope of this paper. Whereas learning or knowledge transfer is not always sought after in diversification strategy, the eventual outcome will be a change in knowledge diversity and increasing pressures on the communication structure which we study.

THEORY AND HYPOTHESES

Absorptive capacity's strategic value for firms has received wide attention by the literature (e.g. Lane, Salk, & Lyles, 2001; Narasimhan, Rajiv, & Dutta, 2006; Rothaermel & Alexandre, 2009). Several studies have theorized about and empirically supported absorptive capacity's role in product portfolio management (Fernhaber & Patel, 2012), firm performance (George *et al.*, 2001; Narasimhan *et al.*, 2006; Rothaermel & Alexandre, 2009; Stettner & Lavie, 2014), interorganizational learning (Lane & Lubatkin, 1998; Schildt, Keil, & Maula, 2012; Vasudeva & Anand, 2011), and innovation (Lichtenthaler & Lichtenthaler, 2009; Tsai, 2001), inter alia. However, how absorptive capacity has been conceptualized and treated in empirical work has led to increased criticism. Researchers tend to disregard the underlying assumptions of the concept and "*treat it like a general-purpose solution to an increasing number of problems*" (Lane *et al.*, 2006). Absorptive capacity's reification restrains our understanding of its complex role in organizations and underlies the fallacious equivalence between the individual component abilities and absorptive capacity as a whole (Jansen, Van Den Bosch, & Volberda, 2005). This has important implications for firm behavior and performance. Firms may excel learning from outside sources when transferring external knowledge into the organization but may not be adept at applying the knowledge to creating new products and processes (Bierly, Damanpour, & Santoro, 2009). Also, firms that develop their acquisition and assimilation abilities to benefit from knowledge stock renewal may be left with the costs of acquisition and unexploited knowledge. Additionally, firms that concentrate on knowledge exploitation may capture short-term profits, but be stuck in a competence trap (Leonard-Barton, 1992; Prahalad & Hamel, 1990) that restrains their responses to environmental changes. Most importantly, absorptive capacity's reification hinders organizations from

identifying contingency factors that challenge the effectiveness of absorptive capacity by affecting its component abilities (Lane *et al.*, 2006).

A handful of studies recognize the distinctiveness of the component abilities of absorptive capacity and propose alternative conceptualizations of the concept and linkages between its components. For example, Liao, Welsch, and Stoica (2003) posit that absorptive capacity consists of two major components, external knowledge acquisition and intra-firm knowledge dissemination, whilst they view the third original component – knowledge exploitation – as organizational responsiveness. Moreover, Bierly *et al.* (2009) conceive absorptive capacity to be a two-step process – external knowledge transfer and external knowledge application. Among the most influential reconceptualizations is that proposed by Zahra and George (2002) who emphasize two types of absorptive capacity – potential and realized – where the former consists of the acquisition and assimilation abilities and the latter of the transformation and exploitation abilities. In our study, we adopt the three original component abilities of absorptive capacity (Cohen & Levinthal, 1990) for several reasons. First, various alternative conceptualizations have received strong criticism over theoretical concerns. For example, Todorova and Durisin (2007) argue that Zahra and George's (2002) proposed components are ambiguous. Second, the original components and their direct impact on observable outcomes have been substantiated by empirical evidence (Schleimer & Pedersen, 2013). Conversely, scant empirical support exists for alternative conceptualizations. Lastly, the entrenchment of the original components in the strategy literature enables us to identify contingency factors that influence their impact and thus the concept's impact on firm outcomes.

An integral contingency factor for absorptive capacity's effectiveness is a firm's diversification strategy. Diversification rests on the organization's ability to absorb new

external resources while it concurrently enables firms to expand their knowledge breadth over time in the search for new knowledge combinations to generate novel products, services, and capabilities (Miller, Fern, & Cardinal, 2007). Through related diversification firms center their attention on a bounded set of knowledge and technologies that enable them to exploit existing and new related knowledge to benefit from economies of scope and produce valuable and commercially viable products. Firms that exploit by acquiring closely related knowledge and technologies rely on their familiarity with these technologies and leverage their integration with extant firm knowledge. Through unrelated diversification that most typically leads to boundary spanning, firms explore novel bodies of external knowledge that may serve the development of future technologies. Firms that explore by acquiring knowledge and technologies beyond their industry boundaries may learn how to assess unfamiliar knowledge characterized by uncertainty and information asymmetry (Stettner & Lavie, 2014).

From early studies on diversification strategy (Rumelt, 1974), the use of related resources in discrete or complementary combinations has been considered a prime lever for growth (Penrose, 1959) and has rendered related diversification the dominant type of organizational expansion (Wan *et al.*, 2010). Yet, several studies find that organizations diversify more unrelatedly than anticipated or employ both related and unrelated diversification with varying intensity (Argyres, 1996; Mayer & Whittington, 2003). This is in stark contrast to dominant theories that predict that resource similarity creates value and is the one most typically pursued. Instead, firms may seek path-breaking change and maintain resources that depart from their core with the expectation that they will enable the organization to further develop its core competencies and dynamic capabilities through unique synergies with existing resources (Kim, Arthurs,

Sahaym, & Cullen, 2013). For example, Karim and Mitchell (2000) found that beyond related acquisitions, diversified firms make acquisitions that stretch beyond existing absorptive capacity seeking resources distant from their existing ones.

This evidence leaves us with two important insights. First, there is constant interaction between absorptive capacity and diversification strategy. Treating the two as seemingly exogenous detached from one another can have serious implications for firm performance. The overarching logic is that firms' abilities to acquire, assimilate and exploit external knowledge are contingent on firms' knowledge diversity and communication structure (Cohen & Levinthal, 1990). On the other hand, different diversification types alter firms' resource and knowledge bases diversely and pose varying adjustment challenges for firms' communication structure, which are at the heart of the component abilities of absorptive capacity.

Second, the strategic implications of the interaction between absorptive capacity and diversification strategy can be better understood by examining the pragmatic strategy of 'relative diversification': the relative prominence of a firm's diversification in related and unrelated domains. This is grounded in the fact that organizational renewal directs firms to adopt more of one diversification type or the other based on their particular context, which may be shaped by their initial founding conditions, capabilities, and environment and how their capabilities and environment evolve (Miller *et al.*, 2007). Relative diversification is pertinent to the study of absorptive capacity because different combinations of diversification strategies suggest varying ability to value and acquire external knowledge. Moreover, as we discuss below, in strategy's interaction with internal structure (Arora, Belenzon, & Rios, 2014; Schleimer & Pedersen, 2013), relative diversification affects intra-firm knowledge sharing and

collaboration that underpin the abilities of assimilating and exploiting external knowledge.

Diversification leads firms away from the functional organizational structure towards variations of the multidivisional (M-form) structure (Hill & Hoskisson, 1987; Rumelt, 1974; Williamson, 1975) partly to deal with bounded rationality (Cyert & March, 1963) and the limits of the amount of information that decision makers can process (Hoskisson & Turk, 1990). Internal structure underlies the direction of knowledge flows, reflects a firm's allocation of decision rights to subunits completing distinct jobs, and the coordination among those subunits (Van Den Bosch, Volberda, & De Boer, 1999; Weigelt & Miller, 2013). It underpins a firm's knowledge processing activities (Van Den Bosch *et al.*, 1999) and delineates the incentives subunits have to share knowledge (Helfat & Eisenhardt, 2004). Once acquired, new knowledge is managed by semi-autonomous business units in corporate systems of varying degrees of decision making centralization and cross-business coordination. Whether and when the acquired knowledge is integrated or recombined depends on the potential synergies with existing knowledge and affects the future autonomy of the business unit that possesses the relevant knowledge. Thus, diversification is co-aligned with centralization and interdivisional coordination, regardless of the direction of causality (Arora *et al.*, 2014; Schleimer & Pedersen, 2013).

Existing research recognizes fundamental structural differences between related and unrelated diversifiers (Hill, Hitt, & Hoskisson, 1992; Hill & Hoskisson, 1987; Hoskisson, 1987; Hoskisson & Turk, 1990). Hill *et al.* (1992) noted that related diversified firms are more likely to bolster cross-divisional coordination and knowledge sharing by employing integrating mechanisms such as cross-division teams that improves the ability of firms to share resources across divisions to obtain economies of

scope. Interdivisional sharing of technological resources has been shown to go hand in hand with greater centralization (Hoskisson & Turk, 1990; Schleimer & Pedersen, 2013) that can help identify opportunities for resource sharing and ensure that division managers seek to exploit these opportunities. Indeed, Arora *et al.* (2014) report a number of notable firm histories throughout which firms' structure and strategy coevolve along complementary paths. They show that centralization and inter-business coordination are prominent in firms that adopt more related diversification strategy, whereas decentralization and business unit autonomy are dominant in unrelated diversification strategies.

Business unit autonomy reflects the firm's internal control systems. Baysinger and Hoskisson (1989) reviewed the relevant literature and report that the more unrelated diversified the firm the more emphasis is given by corporate management to financial controls of the business unit. When corporate managers have little first-hand knowledge of the operating affairs of an industry or technology, they tend to focus attention almost exclusively on divisions' financial results such as the rate of return on invested capital (Hoskisson & Hitt, 1988). Cash flow allocation is competitive encouraging managers to avoid any cooperation with other units resulting in greater division autonomy (Hill *et al.*, 1992). In contrast, related diversifiers employ greater subjectivity when assessing the performance of division executives. They tend to employ strategic controls, such as rewarding cooperation between divisions and ability to innovate, thereby providing incentives for cross-division integration to achieve economies of scope. Indeed, Gupta and Govindarajan (1986) found that the greater the degree of resource sharing between divisions, the greater the reliance on subjective criteria when assessing the performance of divisional managers.

Collaborative and competitive organizational arrangements are suggested to be incompatible and raise doubts about the ability of any firm to simultaneously pursue diversification by both routes. That is because for the realization of economies of scope, related diversifiers tend to employ organizational arrangements that stress cooperation between divisions while for the realization of governance economies unrelated diversifiers tend to emphasize competition between divisions. Yet, studies that examine the case of firms that fall between the two extremities of diversification indicate that firms align themselves at an intermediate position with respect to the structural continuum (Helfat & Eisenhardt, 2004). Empirical evidence even shows that firms that mix these two strategies can be high-performers (Gupta & Govindarajan, 1986; Pitts, 1977; Rumelt, 1974).

Hypotheses

Within the narrow strand of the literature that breaks absorptive capacity down into its components (Jansen *et al.*, 2005; Lane *et al.*, 2001; Volberda, Foss, & Lyles, 2010), we aim to better understand the interdependence of strategic decisions and firm capabilities; in this particular context, relative diversification and the component abilities of absorptive capacity. We try to fill this void by examining how relative diversification strategy modifies the baseline effects of the component abilities on firm performance.

The acquisition of external knowledge and relative diversification

The firm's ability to acquire externally held knowledge is bound up with its ability to recognize, value, and understand potentially valuable new knowledge outside the firm (Lane *et al.*, 2006). The acquisition ability reflects firms' ability to identify trends in

their external environment and internalize that knowledge in order to avoid path dependence and competence traps (Zahra & George, 2002). It also plays an important role in renewing a firm's knowledge base and the skills necessary to compete in changing markets. As the organization gathers more information through the search process, it creates more options for identifying changes in the environment that induce organizational responsiveness and contribute to better performance (Liao *et al.*, 2003). Resource base rejuvenation enables the firm to capitalize upon emerging strategic opportunities that may help it to sustain superior performance because of first mover advantages or other strategic advantages (Zahra & George, 2002).

The acquisition ability reflects the firm's function of identification of external environment signals on which information and knowledge is gathered and transferred within the organizational boundary (Liao *et al.*, 2003). A firm's active listening and learning about its environment is shaped by prior knowledge, basic skills and technological developments (Vasudeva & Anand, 2011). As parts of external knowledge in complex processes and routines may be tacit, knowledge relatedness makes it easier to acquire (Simonin, 1999; Van Wijk, Jansen, & Lyles, 2008). The tacit nature of some knowledge may prevent organizations from becoming aware of its presence and also hampers transmission of the knowledge once it is identified because it is often imperfectly understood (Miller *et al.*, 2007). Greater relevance of new external knowledge to prior knowledge facilitates its understanding, appraisal, and transfer (Cohen & Levinthal, 1990; Phene, Tallman, & Almeida, 2012). In fact, Lane *et al.* (2001) found that in international joint ventures the relatedness of partners' businesses and similarity of the problems they dealt with mattered most in recognizing new knowledge. Moreover, Van Wijk *et al.* (2008) found that relatedness facilitates knowledge transfer between organizations.

However, deep experience with highly specific and strictly related knowledge domains progressively defines a narrow and path-dependent acquisition ability (Zahra & George, 2002). This may lead firms to overemphasize on refining and improving existing knowledge, hinge on reliable and predictable outputs, and fall into a myopic assessment of radical shifts in the industry. Additionally, the firm will be prevented from exploring alternate knowledge sources distant to its existing expertise and will thereby confine its cognitive schemas. Blindsided by its familiarity, maturity, or propinquity traps (Ahuja & Lampert, 2001), the firm will be deprived of radical innovations that could otherwise transform its industry and risks missing the window of opportunity during industry upheaval, culminating in firm failure (Zajac & Bazerman, 1991).

A more effective acquisition ability suggests that the breadth of categories into which prior knowledge is organized, their differentiation, and linkages must increase over time to permit firms to identify and acquire new and fairly diverse knowledge (Volberda *et al.*, 2010). Cohen and Levinthal (1990) draw specific attention to the diversity of the knowledge held by a firm because it increases the prospect that incoming information will relate to what is already known. Thereby, continually acquiring a diverse and novel body of knowledge through distant search can serve as the seed for future technological developments (Miller *et al.*, 2007). Diverse externally acquired knowledge may embody heuristics that differ significantly from the existing knowledge base within a firm, which may minimize the risk of familiarity traps (Wales, Parida, & Patel, 2013). Schildt *et al.* (2012)'s findings support this as they show that at the beginning of an alliance, experience with diverse knowledge prepares companies to understand knowledge from external partners. Moreover, knowledge and technological

diversity prepare companies for collaboration by increasing their long-term ability to identify and acquire valuable resources from collaborators more thoroughly.

Because technological and knowledge diversity and product-market diversification are codetermined (Miller *et al.*, 2007) the degree of diversity becomes a strategic choice variable and a central aspect of many firms' strategies (Schildt *et al.*, 2012). Thus, relative diversification, which reflects the firm's emphasis in unrelated *vis-a-vis* related market domains, modifies the firm's balance between unrelated and related knowledge and technologies. On the one hand, diversification into related technological and knowledge domains sustains a sufficient level of knowledge overlap between existing and new knowledge (Lane & Lubatkin, 1998). Hence, diversifying in broader related areas will reinforce a firm's acquisition ability and its positive impact on firm performance. On the other hand, because the acquisition ability is cumulative (Cohen & Levinthal, 1990), as it grows through knowledge recombination or simple acquisition, the firm must look progressively further afield to find novel knowledge (Wales *et al.*, 2013). Firms that increasingly emphasize unrelated diversification they expand the breadth of their internal knowledge base that underpins their acquisition ability. Thus, even without major knowledge recombination required, firms should manifest higher ability to identify, appraise, and acquire new external knowledge, due to their business units' possession of a cumulatively diverse range of knowledge. Thus, as firms deviate from purely related towards unrelated diversification, the effectiveness of their acquisition ability on performance should increase. Formally, we hypothesize that:

H1: The positive effect of a firm's acquisition ability on performance increases as the firm's unrelated diversification disproportionately increases relative to related diversification.

The assimilation of external knowledge and relative diversification

The ability to interpret and comprehend externally acquired knowledge with existing cognitive structures as well as the processes, policies, and procedures that facilitate sharing and transferring this knowledge within the organization represent the organization's assimilation ability (Cohen & Levinthal, 1990; Lane *et al.*, 2006). The assimilation ability has important implications for both organizational performance and innovativeness (Gupta & Govindarajan, 2000; Lyles & Salk, 2006; Van Wijk *et al.*, 2008). First, effective knowledge learning and transfer contribute to the development of difficult to imitate and profitable organizational capabilities (Lane *et al.*, 2001; Szulanski, 1996). Second, it helps organizations understand the nature and value of knowledge and technological advances (Cohen & Levinthal, 1990), stimulate the combination of knowledge (Jansen *et al.*, 2005) and generate novel ideas (Tsai, 2001). Third, networks of knowledge transfer among business units enable the firm to reduce units' operating costs and to better differentiate their products (Hill *et al.*, 1992; Tsai, 2001).

The assimilation ability requires a balance between overlap and diversity in prior and new knowledge. Knowledge overlap is necessary because as learning is a cumulative process shaped by pre-existing knowledge, organizations can achieve better learning performance when the new knowledge domain is related to what is already known (Zahra & George, 2002). Yet, Lane and Lubatkin (1998) and Schildt *et al.* (2012) find that knowledge and technological similarity between firms in joint ventures

only moderately increases the ability of firms to rapidly transfer knowledge between partners, while it restricts the technological domain of the partnership, reducing learning opportunities. It follows that sufficient knowledge diversity is also important to allow for complementarities between different or dissimilar, yet interdependent and mutually supportive knowledge resources (Tanriverdi & Venkatraman, 2005), stimulating synergistic combinations.

Todorova and Durisin (2007) postulate that when acquired knowledge cannot be assimilated firms make adjustments to their knowledge structures. Thereby, the assimilation ability enables organizations to perceive new knowledge to some extent incompatible with prior knowledge, to build new cognitive structures, and to cope with path dependency. The transformation of knowledge structures necessitates that acquired knowledge be within the firm's search zone and compatible within the existing context, and it involves complementary assets close to its prior knowledge. This follows because learning tends to be local and is a process of trial, feedback, and evaluation (Teece, Rumelt, Dosi, & Winter, 1994). If many aspects of a firm's learning environment change simultaneously, learning is impaired. As search for distant knowledge intensifies, firms are more likely to encounter knowledge sources with which they do not share a common language. This lack of commonality contributes to distortion and loss of information when firms attempt to decode, interpret, and ultimately assimilate the information they acquire leading to missed opportunities (Wales *et al.*, 2013).

Knowledge assimilation is contingent on informal and formal mechanisms of social integration, which determine employee interaction, problem solving and creative action (Zahra & George, 2002). Informal mechanisms, such as social networks, are useful in exchanging ideas, but are less effective than formal mechanisms for being less

systematic. Formal mechanisms, such as coordinated participation in cross-project teams (Puranam, Singh, & Chaudhuri, 2009), facilitate the distribution of information within the firm, the gathering of interpretations and identification of trends. In the context of alliances, Schildt *et al.* (2012) observed that alliance partners develop a variety of dedicated knowledge transfer structures across companies, such as shared interpretations, joint language, mutual trust, and various formal and informal network ties that facilitate communication and mutual problem solving. The development of partner-specific knowledge transfer structures enable companies to learn from a partner over time causing an increase in a firm's assimilation ability.

The underlying issue is how diversification strategy interacts with the firm's knowledge base and supporting mechanisms that enable the firm to assimilate new knowledge. We argue that relative diversification modifies the effectiveness of the assimilation ability on firm outcomes by altering knowledge diversity within the firm and determining the magnitude of knowledge sharing and integration that can occur between business units. In essence, familiarity and similarity with a technology obtained through local search should lead to a stronger ability of the diversifier to assimilate this knowledge. As a firm pursues more distant diversification it becomes more challenging to know which combinations of existing and new knowledge are plausible. Information processing needs escalate and it becomes increasingly difficult to understand how technologies beyond the core can be applied to and integrated with current knowledge creating inefficiency in developing innovation (Kim *et al.*, 2013).

Further, it becomes challenging to extend this more distant knowledge to all of the diversified firm's business units (Kim *et al.*, 2013). Whereas inter-unit knowledge transfer provides opportunities for mutual learning and cooperation that stimulate the creation of new knowledge and ability to innovate, not every unit can learn from all

others (Tsai, 2001). Given heterogeneity in business units' internal knowledge and learning capabilities, the strategy literature documents the importance of inter-unit links. Knowledge is difficult to spread across different units within an organization in which preexisting relationships among units are absent (Szulanski, 1996). Moreover, the potential for synergistic benefits from resource sharing depends on how effectively linkages between business units are promoted by the diversified firm (Gupta & Govindarajan, 1986, 2000). Firms that disproportionately expand unrelatedly should be challenged in ensuring sufficient inter-unit linkages. This is because in the unrelated firm, social integration mechanisms, such as cross-posting of staff or joint management of a shared salesforce that enable efficient knowledge sharing and transfer, appear to be lacking (Markides & Williamson, 1996). In the absence of internal conduits competences are confined within their source divisions and are deprived of being utilized elsewhere in the firm (Prahalad & Hamel, 1990).

Moreover, relative diversification as a means to organize resources and knowledge internally creates great tensions to the corporation, because the assimilation of acquired knowledge requires a good balance of routines that enable both the exploitation of related and thus less diverse existing-new knowledge combinations and additionally exploration routines that will enable the firm to assimilate unrelated and thus diverse existing-new knowledge combinations. According to Stettner and Lavie (2014), employing both routines simultaneously is unlikely to nurture consistent assimilation practices and may impair learning.

Lastly, Williamson (1975) argues that with increasing unrelated diversification firms organize current and new knowledge within independent divisional boundaries that separate groups of people with different knowledge from each other. Two insights are important here. First, interdivisional knowledge sharing is impaired because

researchers from one divisional group will not have the capacity to readily identify and transfer the others' useful knowledge (Cohen & Levinthal, 1990). Second, the potential of opportunism, the incomplete or distorted disclosure of information with the intention of benefiting oneself in a situation of information asymmetry, is great (Camerer & Knez, 1996; Miller *et al.*, 2007). We therefore hypothesize that:

H2: The positive effect of a firm's assimilation ability on performance decreases as the firm's unrelated diversification disproportionately increases relative to related diversification.

The exploitation of external knowledge and relative diversification

The exploitation ability pertains to the organization's transformation capabilities. Through a process of simultaneous association of knowledge and technologies across fields, often not regarded as related, these transformation capabilities enable firms to develop new perceptual schema, make changes to existing processes, and introduce novel products that enhance performance and competitive advantage (Todorova & Durisin, 2007; Zahra & George, 2002). The exploitation ability also increases the firm's economic performance by refining, extending, and leveraging existing competencies or creating new ones by incorporating external knowledge into its operations (Lane *et al.*, 2006; Volberda *et al.*, 2010).

The exploitation ability is primarily determined by the firm's knowledge diversity and communication structure (Grant, 1996) manifest in the speed of knowledge retrieval (Zahra & George, 2002), the demand for common interfaces between available knowledge vectors (Garud & Nayyar, 1994), and the transferability of 'know-how knowledge' (Kogut & Zander, 1992). The swift retrieval of firm

knowledge helps firms respond to shortened product cycles (Garud & Nayyar, 1994) and exploit emergent market opportunities (Zahra & George, 2002). It hinges on the intensity of using existing and new knowledge for problem solving (Cohen & Levinthal, 1990), the recentness of knowledge use, and the proximity of new knowledge to the organization (Garud & Nayyar, 1994). Moreover, combining resources from multiple business units requires a firm-wide communication structure with common interfaces. These common interfaces facilitate information processing among diverse groups through lateral information processing mechanisms such as personal meetings and job rotation (Garud & Nayyar, 1994). Lastly, know-how knowledge refers to the transformation of knowledge inputs into outputs, the commercialization and management of new product portfolios. Transferring know-how knowledge across business units allows firms to reach new knowledge combinations.

It follows from above that for a given level of the firm's exploitation ability related external knowledge will be more readily integrable into existing knowledge. Moreover, as the firm diversifies disproportionately in unrelated markets the common interfaces across divisions decrease and the pass on of 'know-how knowledge' across business units becomes increasingly difficult. The issue at hand is whether a strong emphasis on related diversification is indeed the most conducive setting for the firm's exploitation ability. For reasons we give below, we expect that a greater emphasis on unrelated diversification should bolster the effectiveness of existing acquisition ability.

Firms acquire external knowledge of varying overlap with internal knowledge. According to Sears and Hoetker (2014), when the firm acquires a knowledge pool it understands well, it may find it easy to transfer the knowledge internally and exchange it within organizational boundaries, but the novelty of innovations accruing from the combination of new and existing knowledge would diminish. This is because the

acquired knowledge and capabilities offer few opportunities to create value. Conversely, when knowledge overlap is low there is little basis for conflict arising after the knowledge has been internalized (Sears & Hoetker, 2014). Because the overlapping (and therefore redundant) knowledge represents a small portion of internal knowledge base the potential competition between internal and external knowledge workers will be correspondingly low. Additionally, with lower knowledge overlap complementarity between internal and external capabilities and knowledge is more likely to exist increasing the incentive for cooperation and the likelihood of novel recombinations and synergy realization. These arguments are reinforced by research focusing on individuals, which suggests that the more diverse the knowledge base of a firm, the more accustomed its employees are to collaborating with individuals with different technological specializations (Schildt *et al.*, 2012).

Within the single organization, the hierarchy may establish interfaces between functional teams across diverse business units, simplifying coordination and promoting flexibility, thereby facilitating the exchange of knowledge necessary to execute job tasks (Kogut & Zander, 1992). At any level of relative diversification many firms may sustain a number of divisions pursuing independent lines of research related to different product markets. Although divisional boundaries create a structure for specialization, these boundaries do not preclude the occasional transfer of knowledge when firms seek radical innovation through distant search (Miller *et al.*, 2007). Since divisional boundaries may exist for reasons unrelated to R&D concerns, at times the knowledge pool of one division may be of use in the problems faced by another division. When market opportunities emerge and firms aim to respond by introducing innovative products through new combinations of knowledge, research teams can use some of the benefits of the firm's hierarchy to access knowledge in other divisions (Miller *et al.*,

2007). Arguably, when two divisions possess vastly different knowledge, one group of researchers will not have the capacity to readily identify and transfer the other's useful knowledge (Cohen & Levinthal, 1990). However, so long as underlying disciplines demonstrate some overlap, the shared communication codes and access facilitated by hierarchy ease transfer within organizational boundaries (Kogut & Zander, 1992).

We therefore argue that diversification with a greater emphasis on unrelated than related diversification is expected to influence the effect of the exploitation ability on firm performance positively. Formally,

H3: The positive effect of a firm's exploitation ability on performance increases as the firm's unrelated diversification disproportionately increases relative to related diversification.

METHODS

Data and Sample

Our sample consists of 89 large firms traded in the United States operating in the information, communication and technology (ICT) industries. ICT industries are characterized by a dynamic environment with rapid technological change and intense restructuring activity. These make it an appropriate context for the examination of the interdependence of absorptive capacity and diversification type and its impact on performance. Following previous empirical studies we examine the relationship between strategy-performance in a fine-grained study within a focused set of industries as opposed to across highly diverse industries (Palich, Cardinal, & Miller, 2000). Therefore, along with the explicit control for industry effects and the incorporation of industry and concentration effects that can have a strong influence on firm performance,

our sample implicitly renders our research findings robust to industry structure. Sample firms were randomly selected among the 100 US-traded ICT firms that had a minimum of $1billion sales for 2010.

Data were collected from multiple sources. Thomson Reuters' Derwent database, one of the world's most comprehensive databases of patent documents, was used for the collection of patent data. Since large multi-business firms frequently assign patents to subsidiaries, we used Bureau Van Dijk's Orbis database to identify every subsidiary – domestic and foreign – of each firm in the sample. We were thus able to search the Derwent database for patents assigned to any of these parent or subsidiary names, and aggregate all patents at the parent level. We collected a total of 485,001 patents assigned to the sample firms and their subsidiaries between 1966 and 2010. Each patent and its cited patents are identified by International Patent Class (IPC). We translated all patents and their cited patents to industry applications using the concordance index by Silverman (1999), which assigns each patent to four-digit SIC codes.

We used Compustat for the financial,[2] industry, and segment data. Davis and Duhaime (1992) note that the use of Compustat for the study of diversification offers some advantages. The assignment of business activities to Compustat segments is conducted by respondents in firms and the data thus reflect managers' views of relationships among businesses. This can be valuable in research using the entropy index of diversification (Robins & Wiersema, 1995). Data from Compustat span from 1975 to 2010. Sample firms fall in seven 2-digit industries: 35 - Industrial And Commercial Machinery And Computer Equipment; 36 - Electronic And Other Electrical Equipment And Components, Except Computer Equipment; 37 - Transportation Equipment; 38 - Measuring, Analyzing, And Controlling Instruments;

[2] Financial data were deflated and converted to constant US$ of 2005 using the CPI.

Photographic, Medical And Optical Goods; Watches And Clocks; 48 - Communications; 50 - Wholesale Trade-durable Goods; and 73 - Business Services. The complete dataset used in the analysis comprises an unbalanced dataset of 1,419 firm-year observations with 89 firms as 11 firms were dropped from the sample due to missing data.

Dependent variables

We measure performance by a firm's return on assets (ROA) (Miller, 2004; Robins & Wiersema, 1995). ROA is related to a variety of other indicators of firm financial performance and is widely used in the strategy-performance literature (Hoskisson & Hitt, 1990). Despite the debate over accounting versus market performance measures, Robins & Wiersema (1995) report a number of advantages for the former, including their close connection to decision variables controlled by managers and the direct comparability with a substantial body of research on diversification and performance in strategic management.

Independent variables

Acquisition ability

Several studies have operationalized the unified construct of absorptive capacity as R&D intensity (R&D expenditure to sales) (e.g. Meeus, Oerlemans, & Hage, 2001; Rothaermel & Alexandre, 2009). However, R&D spending, as a non-core skill (Teece, 2007), cannot reflect the quality of the firm's ability to integrate and combine assets including knowledge, which refer to core skills (Grant, 1996; Kogut & Zander, 1992). Moreover, knowledge depositories and diversity can differ greatly among firms with similar R&D spending (Schildt *et al.*, 2012). The limitation of employing R&D intensity as a proxy for overall absorptive capacity shows in the low explanatory power

of R&D spending on performance (Lane *et al.*, 2006), calling into question R&D intensity as measure of absorptive capacity (Lane & Lubatkin, 1998).

We instead use R&D intensity as measure of the knowledge acquisition ability of the firm. According to Cohen and Levinthal (**1990**), a firm's ability to acquire knowledge from its external environment is a byproduct of its own R&D. R&D efforts provide an in-house technical capability that can keep firms abreast of the latest technological developments and facilitate the identification, valuation, and acquisition of new technology developed elsewhere (Lane *et al.*, 2006). Moreover, R&D can be considered search for new knowledge that allows the firm to sense what is going on in its business ecosystem (Teece, 2007).

Assimilation ability

Assimilation ability refers to a firm's ability to understand technological advances and make fresh associations and linkages between existing and newly acquired knowledge. We expect the assimilation ability to be reflected in the diversity of knowledge resources the firm utilizes to produce new knowledge. We rely on patent data to identify a firm's knowledge resources and analyze their technological activities (Nasiriyar, Nesta, & Dibiaggio, 2014). A firm's patents constitute a representation of the output of its research efforts and the technological knowledge it has created during the inventive process. Although patent data measure codified rather than tacit knowledge, using patents to indicate technological resources is common in the literature (Miller, 2006; Silverman, 1999). Patent data provide detailed information, are systematically compiled, and are available continuously across time (Almeida, Song, & Grant, 2002). Detailed information exists concerning every patented innovation. Among the data

available is a classification code that identifies the type of technology embodied in the patent.

In accord with Zahra and George (2002) who indicated that assimilation "*can be measured by the number of cross-firm patent citations or the number of citations made in a firm's publications to research developed in other firms*", our focus is upon the firm's citations to other patents (Kim *et al.*, 2013; Sears & Hoetker, 2014). We use patent citation data to indicate a firm's assimilation ability of knowledge across technological classes. The firm as a patent applicant must specify in the application any and all of "the prior art" of which it is aware and on which it builds to create the new patent. This is clear evidence that the knowledge contained in cited patents is a part of the firm's knowledge set and demonstrates the distinct elements of knowledge with which the firm has demonstrated familiarity, or mastery of, and revealed a relationship (Ahuja & Katila, 2001).

The list of citations for each patent is made through a uniform and rigorous process applied by the patent examiner and is available on the patent document that allows us to track knowledge associations across technological classes (Almeida *et al.*, 2002). We associated patenting activity with particular industries using a concordance that relates patent classes to industries in which the patented technology is applicable. This allows us to capture the breadth of industries from which firms source knowledge to generate new knowledge. We employ the U.S. Patent Class – U.S. SIC concordance developed in Silverman (1999) to derive probability-weighted assignments to four-digit SICs for each patent in the sample firms' portfolios. This concordance takes advantage of the fact that the Canadian Patent Office (CPO) assigns each granted patent to both a patent class and to SICs in which the patented innovation is likely to be manufactured and used. It uses the frequency with which Canadian patents in each patent class are

assigned to each SIC to create a probability distribution relating U.S. patent classes to U.S. SIC codes.

We operationalize assimilation ability as the diversity in citations the firm draws on to produce patents. We calculated a concentric measure of diversity used by Caves, Porter, and Spence (1980) that compares the firm's SIC-translated issued patents against its SIC-translated citations. We followed Argyres (1996) for calculating the concentric distance between patents and citations using the following formula:

$$Assimilation\ Ability_t = \sum_i p_i \sum_j d_{ij} p_j \ ,$$

where p_i is the proportion of patents in 4-digit SIC i; p_j is the proportion of citations in 4-digit SIC j; and d_{ij} equals 1,2,3,4 if i and j are in the same 4,3,2,1-digit SIC, respectively. The index ranges from 0 to 2 and is increasing in diversity.

Exploitation ability

Exploitation ability refers to the organization's ability to exploit external knowledge for the creation of new knowledge and products. This ability is reflected in the diversity of the firm's technological outputs. To operationalize exploitation ability, we derive a concentric diversity measure of the "distance" between the firm's patents (Argyres, 1996) drawing on issued patents that we first translated to the four-digit SIC concordance (Silverman, 1999). The measure is given by:

$$Exploitation\ Ability_t = \sum_i p_i \sum_j d_{ij} p_j \ ,$$

where p_i is the proportion of patents translated in 4-digit SIC i in year t; p_j is the proportion of patents in 4-digit SIC j; and d_{ij} equals 1,2,3,4 if i and j are in the same 4,3,2,1-digit SIC, respectively. The index ranges from 0 to 2 and is increasing in

diversity. Larger values suggest that the firm produces (intermediate) products and new knowledge that can be applied in a broader range of markets and industries. Patents assigned to multiple SICs were treated as distinct to better capture firm-level technological diversity. This is a fine-grained operationalization of the exploitation ability compared to existing measures that employ simple counts of patent outputs (e.g. George *et al.*, 2001).

Relative Diversification

Existing operationalizations of diversification types center on certain functional resources such as product (Rumelt, 1974), technological (Robins & Wiersema, 1995; Silverman, 1999), managerial (Prahalad & Bettis, 1986), or human resources relatedness (Farjoun, 1998), or a combination of the above (Tanriverdi & Venkatraman, 2005). Researchers use indirect measures that capture the industries a firm is active in and the resource similarities of these industries (Tanriverdi & Venkatraman, 2005). We use such a measure employing the entropy measure of diversification by Jacquemin & Berry (**1979**), which lets us calculate total, related, and unrelated firm diversification. Total diversification (DT) is computed as follows:

$$DT = \sum_{i=j}^{N} P_i \ln\left(\frac{1}{P_i}\right),$$

(0)

where N is the number of industry segments a firm operates in at the 4-digit SIC level and P_i is the share of the ith segment in total firm sales. If we let the N number of industry segments at the 4-digit SIC level aggregate into M industry groups at the 2-digit SIC level, related diversification (DR) can be computed as follows:

$$DR = \sum_{i \varepsilon j} P_i^j \ln\left(\frac{1}{P_i^j}\right),$$

(0)

where P_i^j is defined as the share of segment i of group j in the total sales of the group. Unrelated diversification (DU) is the difference between equations (3) and (4). Following Palepu (1985), the entropy measure captures three important elements of diversification: the number of segments in which a firm operates, their degree of relatedness, and their relative importance for total firm sales. We operationalize relative diversification as the ratio of DR to DT.

Control variables

Firm size

Firm size is an indicator of market power and scale economies. Empirical evidence links size to profitability (Bettis, 1981; Robins & Wiersema, 1995). Market power may allow control over pricing and economies of scale lead to cost reductions. Combined, they enable large firms to be more profitable. We control for firm size with the log of total assets and expect it to have a positive relationship with performance.

Industry concentration

Industry concentration has long been considered a strong indicator of barriers to entry (Bain, 1956). In concentrated industries, market power enjoyed by firms may allow them to sustain high profits. Our measure reflects a firm's relative sales in different industries by multiplying the proportion of firm sales in a focal industry with the concentration ratio of the industry and aggregating as follows:

$$Industry\ Concentration_t = \sum CR4_i P_i,$$

(0)

where $CR4_i$ is the four-firm concentration ratio for the 2-digit SIC industry i and P_i is the proportion of a firm's sales in the 2-digit SIC industry i. Prior work in strategy (Markides, 1995) finds a positive relationship between industry concentration and firm profitability.

Industry profitability

We account for the profitability in a firm's industries to control for any industry effect not captured by industry concentration. According to Robins & Wiersema (**1995**) the interrelationships between the firm's businesses may have an impact on performance. We construct a weighted measure of industry profitability by computing the average profitability of each 4-digit SIC industry in which a focal firm operates, multiply it by the proportion of firm sales in the industry and aggregate for the firm as follows:

$$Industry\ Profitability = \sum ROA_i P_i, \qquad (0)$$

where ROA_i is the average return on assets for industry i and P_i is the proportion of firm sales in SIC i. Industry profitability is expected to be positively related to firm profitability.

Debt burden

Managerial discretion in the allocation of organizational resources across the organization's operations can be reduced in the face of high debt level. The firm's debt burden forces management to invest wisely and be more efficient (George, 2005). We measure debt burden as the firm's debt to shareholder equity ratio (Markides, 1995).

Capital investment:

We control for the firm's capital investment, a proxy of the firm's tangible assets used in firm growth. Tangible assets may result in higher total factor productivity and higher

performance not attributable to absorptive capacity or diversification (Miller, 2006; Palich *et al.*, 2000). Capital investment is measured as the firm's capital expenditures as percent of sales. We expect it to be positively related to firm performance.

Technological output: Prior research finds a positive relationship between technological output and firm performance (Miller, 2006). We control for the effect of technological output by incorporating in the analysis the logarithm of the firm's number of patents.

Labor Productivity: Changes in labor productivity attributed to renegotiated labor contracts, new investments in technology, and improvements in the monitoring from firm managers during the study period can have an important effect on firm performance (Markides, 1995). We control for labor productivity using the ratio of the number of employees to firm sales, with higher productivity expected to have a positive relationship with performance.

Foreign sales: The literature on international diversification suggests a positive relationship between foreign operations and profitability (Capar & Kotabe, 2003; e.g. Hall & Saias, 1980; Hill & Hoskisson, 1987; Kotabe, Srinivasan, & Aulakh, 2002; Lu & Beamish, 2004; Wan & Hoskisson, 2003). We control for the firm's foreign to domestic sales ratio to account for the part of variation in firm performance attributed to variations in the firm's internationalization.

Time Effects: Because our study examines performance effects over the years, we use year dummies to control for possible unobserved time-specific effects and the effects of serial correlation (Phene *et al.*, 2012).

Industry Effects: Following Hoskisson and Hitt (1990) and Palich *et al.* (2000), an important limitation of previous studies of the relationship between strategy and performance is that they do not control for industry effects. Accounting for industry effects may allow unique variance explained by the dimensions of absorptive capacity and its interactions with diversification. To control for performance variations between firms due to industry effects we include 2-digit SIC industry dummies.

- Insert Table 1 about here –

RESULTS

Table 2 presents our regression results. Following existing studies of the effect of firm diversification on performance (Markides, 1995) and studies of the transformative capacity of the firm (Garud & Nayyar, 1994; Makri, Hitt, & Lane, 2010), we tested alternate models that involved the 1- to 2-year lagged effects of relative diversification and the 2- to 3-year lagged effects of the component abilities of absorptive capacity. For the evaluation of alternative model specifications we used the Akaike and Bayesian Information Criteria. The model specification that resulted in the loss of the fewest data points and yielded the lowest AIC and BIC values involved three-year and two-year lags for the effects of the component abilities of absorptive capacity and relative diversification, respectively. Several missing values in R&D resulted in dropping 11 firms from our sample. To ensure that our results do not suffer from a possible selection

bias, we tested whether the firms dropped from the model and those preserved for the remaining of the analysis differed in performance, size or industry membership. Our t-tests did not reject the hypotheses of differences across the two groups of firms. To account for potential selection bias we estimated our models applying Heckman's selection technique of estimating the inverse Mill's ratio and including it in the models as an additional variable.

We estimated our models with generalized least-squares regression (FGLS) that accounts for the problem of heteroskedasticity we diagnosed in our data (Baum, 2006). The Base Model presents the results of ROA regressed on the levels of the main variables. In the subsequent models we introduce the interaction terms separately in each model.

- Insert Table 2 about here -

The last model incorporates interaction effects between the component abilities of absorptive capacity and relative diversification. The interaction effect between acquisition ability and relative diversification is negative and statistically significant, supporting H1 and suggesting that an emphasis on unrelated compared to related diversification reinforces the acquisition ability's underlying mechanisms that contribute to firm performance. This is illustrated in Figure 1, Graph (a) which shows how the marginal effects of the components of absorptive capacity on performance change with varying levels of relative diversification. Relative diversification has a positive moderating effect on the impact of the assimilation ability on firm performance lending support to H2, Graph (b). H3 is also supported as relative diversification has a negative and statistically significant modifying effect on the relationship between the

exploitation ability and firm performance, suggesting that more emphasis on unrelated than related diversification is conducive to the acquisition ability's impact on performance.

- Insert Figure 1 about here -

DISCUSSION

We investigate the interdependence of organizational capabilities and growth strategy and its implications for the firm. We illustrate the interdependence of absorptive capacity and diversification strategy and its impact on firm performance. We posited that relative diversification modifies the main mechanisms underpinning the component abilities of absorptive capacity; i.e. knowledge diversity and the organization's communication structure. We proposed and examined how diversification can influence these mechanisms and consequently moderate the impact that the component abilities of absorptive capacity have on firm performance. Our results show that the effects of the component abilities of absorptive capacity are conditioned by relative diversification.

We make several contributions to the literature. First, by disassembling the construct of absorptive capacity, we empirically find that each component has a distinct effect on firm performance. This suggests that splitting up absorptive capacity helps us uncover deeper mechanisms in their own right. The overarching logic is that firms that invest in developing any of the component abilities independently may attain performance improvements but fall into the fallacy of building absorptive capacity. In effect, firms may focus on the valuation and assimilation of external knowledge and thereby renew their knowledge stock and gain access to unique resources, but remain with the costs of acquisition if they do not convert resources into innovative outputs.

Moreover, the focus on resource exploitation and new products may reduce the firm's resilience and responsiveness to environmental and technological shifts.

Second, by studying the underlying abilities of absorptive capacity and identifying their supporting mechanisms, we recognized important boundary conditions. Specifically, we examined the modifying effects that diversification strategy has on the relationship between absorptive capacity and firm performance by influencing the underpinning mechanisms of its component abilities. Our findings support our expectations, showing that relative diversification moderates the effects of (the component abilities of) absorptive capacity on firm performance in distinct ways.

Third, the moderating impact of diversification strategy uncovers a deeper insight. Namely, absorptive capacity and diversification are strategic tools that cannot be designed and implemented in isolation. On the one hand, absorptive capacity reflects the scale of the ability of the firm to acquire, assimilate, and exploit externally acquired knowledge. On the other hand, diversification moderates the positive impact of (the component abilities of) absorptive capacity on performance, in distinct fashion. The functions of absorptive capacity along with our findings jointly suggest that organizations cannot diversify unreservedly, because absorptive capacity is decisive for the effective implementation of diversification strategy and vice versa. Therefore, according to this reciprocal relationship the existing absorptive capacity of the firm determines the feasible type and magnitude of newly acquired knowledge and resources it can absorb. Moreover, unless the organization pushes the existing frontiers of absorptive capacity through a carefully designed diversification strategy, the firm risks failing to recognize emerging opportunities to create competitive advantages (Zahra & George, 2002).

Future research should consider not only the interdependence of absorptive capacity and diversification strategy, but also how the two evolve over time relative to their initial conditions. In the present study we conceptualized both absorptive capacity and diversification strategy based on the firm's initial industry of operation. However, as growth strategy alters the equilibrium of knowledge diversity within the firm and the relatedness of the firm's industry compared to external industries, future (un)related knowledge conceptualized on present standards may not be as (un)related if knowledge diversity within the firm substantially changes. The same applies to industry relatedness for future (un)related industries based on the firm's initial conditions may not be that (un)related if the firm's market orientation is significantly altered. The incorporation of this dynamic aspect in a study of the interdependence of absorptive capacity and diversification would be an important extension to our current inquiry and extant research.

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Table 1: Summary statistics and correlations matrix

		Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1)	Return on Assets	0.05	0.11	1													
(2)	Acquisition	0.07	0.06	-0.04	1												
(3)	Assimilation	0.88	0.60	0.02	0.00	1											
(4)	Exploitation	0.90	0.66	0.01	0.11	0.42	1										
(5)	Relative Diversification (DR/DT)	0.03	0.02	0.11	0.20	0.06	0.12	1									
(6)	Productivity (Sales to Employees	311631	281188	0.05	0.00	-0.07	-0.03	0.17	1								
(7)	Patents (Log)	3.84	2.92	-0.09	0.11	0.38	0.47	-0.15	-0.05	1							
(8)	Firm Size (Log of Total Assets)	9.16	1.62	-0.11	-0.13	0.10	0.01	-0.28	0.15	0.43	1						
(9)	Industry concentration	0.19	0.21	-0.07	-0.09	0.05	0.01	-0.21	-0.08	0.38	0.41	1					
(10)	Industry profitability	0.80	7.55	0.02	-0.04	-0.06	-0.07	-0.00	-0.01	0.05	0.05	0.20	1				
(11)	CAPX to sales	0.08	0.07	0.05	-0.20	-0.02	-0.07	0.02	-0.13	-0.15	0.09	-0.11	-0.04	1			
(12)	Debt to Shareholders Equity	0.48	6.22	-0.00	0.00	0.04	0.02	0.01	-0.01	0.04	0.06	0.03	0.00	0.00	1		
(13)	Ratio of foreign to domestic sales	0.41	0.27	0.02	0.34	0.11	0.12	0.10	0.15	0.19	0.27	0.18	0.08	-0.22	0.01	1	
(14)	Inverse Mill's ratio	2.09	0.86	-0.07	0.12	-0.32	-0.28	-0.12	-0.12	0.03	0.38	0.42	0.14	-0.20	0.00	0.11	1

* Correlation coefficients greater than |0.06| are statistically significant at the 0.05%

Table 2: Regression analysis results

Dependent: Return on Assets	Base	Acquisition	Assimilation	Exploitation	Interactions
	Coef./SE	Coef./SE	Coef./SE	Coef./SE	Coef./SE
$Acquisition_{t-3}$	-0.0078	0.2106*	-0.0076	-0.0072	0.1611†
	(0.0129)	(0.0839)	(0.0126)	(0.0125)	(0.0841)
$Assimilation_{t-3}$	0.0008	0.0009	0.0044	0.0008	-0.0152†
	(0.0037)	(0.0037)	(0.0051)	(0.0037)	(0.0080)
$Exploitation_{t-3}$	0.0080*	0.0080*	0.0067†	0.0166***	0.0299***
	(0.0035)	(0.0035)	(0.0036)	(0.0050)	(0.0077)
Relative Diversification $(DR/DT)_{t-2}$	0.1434	0.4647**	0.1956	0.4415**	0.5504**
	(0.0984)	(0.1572)	(0.1694)	(0.1599)	(0.2105)
Relative Diversification$_{t-2}$ X Acquisition$_{t-3}$		-5.7046**			-4.4064*
		(2.1643)			(2.1684)
Relative Diversification$_{t-2}$ X Assimilation$_{t-3}$			-0.0764		0.5530*
			(0.1420)		(0.2492)
Relative Diversification$_{t-2}$ X Exploitation$_{t-3}$				-0.3354*	-0.7630**
				(0.1353)	(0.2365)
Productivity$_{t-1}$ (Sales to Employees)	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Patents$_{t-1}$ (Log)	0.0023**	0.0025**	0.0024**	0.0025**	0.0024**
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Firm Size$_{t-1}$ (Log of Total Assets)	-0.0165***	-0.0172***	-0.0162***	-0.0156***	-0.0163***
	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
Industry Concentration$_{t-1}$	-0.0329***	-0.0305***	-0.0352***	-0.0365***	-0.0346***
	(0.0091)	(0.0091)	(0.0093)	(0.0093)	(0.0093)
Industry Profitability$_{t-1}$	0.0001	0.0001	0.0001	0.0001	0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
CAPX to Sales$_{t-1}$	0.0492*	0.0424†	0.0520*	0.0469*	0.0412†
	(0.0227)	(0.0229)	(0.0230)	(0.0234)	(0.0236)
Debt to Shareholders Equity$_{t-1}$	-0.0009**	-0.0009**	-0.0009**	-0.0009**	-0.0009*
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0004)
Ratio of Foreign to Domestic Sales$_{t-1}$	0.0169†	0.0123	0.0158	0.0117	0.0071
	(0.0095)	(0.0096)	(0.0097)	(0.0098)	(0.0099)
Inverse Mill's Ratio[1]	0.0094*	0.0096*	0.0100*	0.0115**	0.0115**
	(0.0039)	(0.0039)	(0.0041)	(0.0041)	(0.0041)
Year Controls	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes
Constant	0.1863***	0.1845***	0.1809***	0.1720***	0.1772***
	(0.0211)	(0.0212)	(0.0217)	(0.0219)	(0.0220)
Observations	1419	1419	1419	1419	1419
Firms	89	89	89	89	89
Chi square	742.57	749.67	707.83	698.00	721.39

† p<0.1, * p<0.05, ** p<0.01, *** p<0.001

[1] Accounts for excluded firms due to missing R&D

Exhibit 1: Graphical presentation of the moderating effects