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Diversification and firm performance in dynamic environments: the role of the firm?s dynamic capabilities and absorptive capacity.

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Abstract

Competing theories of the firm?s diversification behavior have been less than clear in projecting its effects on performance, especially when firms operate in dynamic environments. We propose that diversification performance can be modified by organizational mechanisms that can increase the efficiency of internal markets in allocating resources and maximize the uses of resource bundles, which are necessary conditions for firms operating in dynamic environments. We argue that these mechanisms are embodied in the firm?s absorptive capacity and dynamic capabilities. The mediating impact of these mechanisms on the effects of related and unrelated diversifications on firm performance is examined based on a sample of 150 large ICT firms traded in the USA between 1975 ? 2010. On average, the sample firms benefit from dynamic capabilities and absorptive capacity. Dynamic capabilities moderate the negative impact of unrelated diversification and absorptive capacity strengthens the positive impact of related diversification.

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Diversification and firm performance in dynamic environments: the role of the firm's dynamic capabilities and absorptive capacity.

Corporate diversification represents one of the most important lines of research in the field of strategic management (Hoskisson & Hitt, 1990; Wan, Hoskisson, Short, & Yiu, 2010). Following Rumelt (1974)'s seminal work, several strategic management scholars were attracted to the study of corporate diversification as a gateway to understanding variance in firm growth and performance, spawning a large array of subsequent studies (Miller, 2006; Palich, Cardinal, & Miller, 2000; Piscitello, 2004). A great preponderance focused on investigating the differential effects of related and unrelated diversification on firm performance (Hoskisson & Hitt, 1990; Markides, 1995; Miller, 2006; Palepu, 1985; Robins & Wiersema, 1995).

Diversification's proponents argue that it should reduce the total risk of earnings variability, yield increasing growth and profit, accelerate adaptation to environmental change, and allow for economies of scale in general management expertise and R&D to materialize. By extension, diversification in all its forms should induce higher financial performance compared to the conservative single-business. Another key argument in support of the multi-business firm is that it can realize positive synergies (between businesses) that can produce super-additive value and sub-additive costs that jointly induce improved financial performance (Tanriverdi & Venkatraman, 2005). An important source of such a synergy is the resource relatedness – the existence of similar activities, knowledge, and shared resources – across constituent businesses (Farjoun, 1998; Markides & Williamson, 1994; Robins & Wiersema, 1995). Use of these resources within the same industry entails minimal costs and likely substantial benefits, thus casting support on strategies of related than unrelated diversification and single-business firms.

From the very early studies on the matter, performance differences among different categories of corporate diversification were associated more closely with the way new businesses were related to existing ones than the overall diversity of the corporation. For instance, Rumelt (1974) found that Related-Constraint and Dominant-Constraint firms, were the best performers. Both types reflected the pursuance of business activities that related to and could derive strength from

products, skills, or market characteristics that were common to all businesses within the firm (Rumelt, 1974).

Moreover, the complementary nature of independent but mutually supportive related resources further advocates the super-additive value synergies that can be captured through resource combinations (Tanriverdi & Venkatraman, 2005). The use of related resources in discrete or complementary combinations has been posited as a prime inducement for growth (Penrose, 1959) and has largely rendered related diversification the dominant mode of organizational expansion (Wan *et al.*, 2010). In accord with the early studies on diversification, recent studies find related diversification to achieve superior performance than unrelated diversification (Palepu, 1985; Palich *et al.*, 2000; Rumelt, 1974; Tanriverdi & Venkatraman, 2005).

Nevertheless, empirical evidence unveils that organizations diversify more broadly than envisaged by the relatedness arguments (Argyres, 1996; Mayer & Whittington, 2003) and often achieve premium performance (Campa & Kedia, 2002; Chatterjee & Wernerfelt, 1991; Khanna & Palepu, 2000; Villalonga, 2004). For example, between 1949-1969, Rumelt (1974)'s study period, the prevalence of major US industrial companies with a previously narrow product-market scope gradually moved into more unrelated businesses. The overarching logics behind unrelated diversification are grounded in that in conditions of market failure the firm has increasing incentives to expand into unrelated businesses with the expectation that the deliberate formation of an "internal capital market" will constitute a more efficient environment for resource and knowledge allocation than the external capital market (Chatterjee & Wernerfelt, 1991; Hill, Hitt, & Hoskisson, 1992). Hence, the Resource Based Theory (RBT)'s rationale of relatedness-induced synergies and path dependence (Barney, 1991; Wernerfelt, 1984) is too narrowly defined to account for such behaviors and loses its explanatory power in circumstances of market failure (Eisenhardt & Martin, 2000; Ng, 2007).

The efficiencies of internal capital markets depend on existence of a competitive internal environment in which protagonists are the autonomous businesses (Ng, 2007). It turns out that internal competition may preclude business units from collaborating and forming novel resource combinations. In addition, due to resources heterogeneity internal markets cannot project the value of existing resources in all their possible uses. Therefore, a promising direction to understanding the premium performance of unrelated diversification is by recognizing those

organizational processes and mechanisms that can reinforce the internal market efficiencies through maximization of the uses of the firm's resource bundles. While the resource-based logic is limited in its explanation of the premium performance of unrelated diversified firms, the reconciliation of the notions of internal markets and resource sharing among competing businesses within the firm becomes critical for shedding light on the issue.

We put forward the decisive moderating roles that the absorptive capacity and dynamic capabilities of the firm can have on the reconciliation. On one level, absorptive capacity enables the firm to identify the value of novel information, assimilate it, and apply it to new commercial ends (Cohen & Levinthal, 1990). On another level, the importance of dynamic capabilities can be attributed to their enabling the unrelated multi-business firm to deploy and redeploy internal and external resources in a diverse array of products (Eisenhardt & Martin, 2000; Helfat & Eisenhardt, 2004). The moderating roles of absorptive capacity and dynamic capabilities can facilitate the firm discover the uses of heterogeneous resources in incomplete markets (Ng, 2007), either internal or external. Under these circumstances, unrelated diversifications can be advantageous as they can provide growth options and first mover advantages in unchartered business markets.

The modifying effects of absorptive capacity and dynamic capabilities on the differential impact of related and unrelated diversifications on firm performance can be better elucidated in dynamic environments. Dynamic environments are construed as situations where there are rapid changes in technology and market forces and "feedback" effects on firms (Teece, Pisano, & Shuen, 1997) which in turn give rise to conditions of incomplete markets (Ng, 2007). The industries involved in information and communications technologies (ICT) are a prominent exemplar. The ICT industries exhibit intense competitive, co-opetitive, and restructuring activity empowered by an evolving phenomenon of convergence that can be attributed to broad market deregulation, advances in digitalization, and explosive managerial creativity (de Boer, Van Den Bosch, & Volberda, 1999; Duysters & Hagedoorn, 1998; Gambardella & Torrisi, 1998; Greenstein, 2000; Rao, Vemuri, & Galvin, 2004). Technological convergence facilitates firm entry to and exit from adjacent and distant markets, energizes extensive retaliatory behavior and experimentation, which continuously lead to the blurring of industries boundaries.

Leveraged by this contemporary phenomenon firms pursue extensive resource and product diversification despite its high uncertainty. Moreover, technologically advanced industries encompass knowledge and techniques that may be widely applicable to a multitude of products, materials, or processes, facilitating diversification. Extensible technologies (Chandler, 1962; Rumelt, 1974) can find application in areas far remote from those to which they were first applied. Firms may invest in such strategies so as to construct the general background knowledge that would permit them exploit emergent technological knowledge and opportunities proactively, through own innovations, or reactively, as "fast-seconds" when rival firms introduce important advances (Cohen & Levinthal, 1990; Zahra & George, 2002).

Fierce global competition in high-technology industries demonstrates the need for an expanded paradigm to understand how competitive advantage and firm performance is achieved. The competitive behavior of firms in these industries often follows a resource-based pattern of mustering valuable technology assets, which is nevertheless insufficient to produce a sustainable competitive advantage (Teece *et al.*, 1997). That is because firms often lack the absorptive capacity and dynamic capabilities that can allow them to assimilate knowledge from varying sources and adapt, integrate, and reconfigure internal and external organizational competences and resources to respond to changing environments. Changing environments arise in external markets due to rival strategic behavior and the emergence of "destructive" technologies (Schumpeter, 1943) or can be fictitiously generated within the firm's boundaries and "internal market" by the firm's diversification strategy.

Such evolving and vigorous market environments are very likely to encourage unrelated diversifications that often fail to attain higher performance. As the unrelated firm lacks the requisite administrative systems built around major synergistic clusters of core skills, resource allocation across business units is sub-optimal and managers are unable to capitalize on shared knowledge as a means to explore new knowledge. Unrelated diversification on the other hand requires an appreciable increase in the organization's competences. Contingent on the relatedness of the organization's existing activities with the new business activities, varying forms of pressures are exerted on the organization to understand progressive technologies, marketing concepts, planning and control to secure smooth assimilation. Hence, performance

differences should not be really related to diversity per se, but how the corporation deals with growth and diversity (Rumelt, 1974).

Theory and Hypotheses

Dynamic environments and convergence

Extensive deregulation, advancements in technology, managerial creativity, and escalating similarity of needs across groups of market participants have led to conditions of convergence: a growing tendency towards increased unification in the boundaries between firms and previously disjointed industries (Greenstein, 2000). Convergence increases the substitutive and complementary natures of organizational resources[1] due to the emergence of unanticipated capabilities for which there is little precedent. It perplexes the effectiveness of firms' responses to consumers' needs and creates discontinuities in firms' competitive behavior. These discontinuities present extraordinary strategic challenges for firms must act within dynamic market conditions associated with amplified risk.

As a disequilibriating process, convergence causes the blurring of industry and knowledge boundaries inducing lateral entries of firms from adjacent technologies and industries (Duysters & Hagedoorn, 1998). The emergence of industrial inflection points gives rise to complexes of interrelated industries and disruptive management paradigms (Hacklin, Marxt, & Fahrni, 2009). These radical transitions ask for organizational renewal of existing and new component knowledge related to products, processes, and markets, to create innovative configurations (de Boer *et al.*, 1999) and new product-market combinations (Henderson & Clark, 1990). The breadth of component knowledge that innovative configurations draw upon and the extent to which the innovative configurations can access additional component knowledge and integrate existing component knowledge (de Boer *et al.*, 1999) become the dominant

[1] From a supply perspective, existing organizational resources and products convergence in substitutes when they become interchangeable, whereas they converge in complements when they come together to create new functionalities or improve efficiency of existing resources and products. From a demand perspective, they converge in substitutes when market participants increasingly consider any previously distinct resources or products sufficient to satisfy the same need. When convergence in complements takes hold, market participants recognize a set of distinct though related needs as capable of being satisfied in a single transaction because of technology bundling or fusion (Greenstein, 2000; Yoffie, 1997).

requirements of the knowledge integration process. This renders firms with strong combinative capabilities the only capable for organizational renewal and survival (de Boer *et al.*, 1999).

The dominant paradigm in strategic management (RBT) advises firms to be "coherent" with their industries (Teece, Rumelt, Dosi, & Winter, 1994) and "related" in their accumulation of resources, knowledge (Wernerfelt, 1984), and diversifications (Wan *et al.*, 2010). Yet, convergence leads to a tension with coherence and relatedness because it compels firms to converge by gaining access to requisite competencies to enable their operation in adjacent industries and technologies or reaction to prospective rivalry. Firms lacking the requisite competencies attempt to extend essential technological knowledge and resources through the acquisition of knowledgeable companies (Lee & Lieberman, 2010). When the acquirer does not have an already sufficiently developed level of technological knowledge, acquisition of external knowledge is hampered making it extremely difficult to absorb the acquired knowledge into its own technological core (Duysters & Hagedoorn, 1998).

In effect, the relatedness arguments of strategic diversification appear to be too simplistic to suggest ways of dealing with the effects of diversification when firms are confronted with phenomena of disruptive power over established paradigms, new ways of problem solving, and new rules of conducting business. Firms that possess the salient mechanisms of absorbing, developing, and using new knowledge not necessarily related to their existing knowledge to create innovative reconfigurations are more likely to prosper in such dynamically-competitive environments. Below we argue that these mechanisms are strategic in nature and are embodied in the firm's absorptive capacity and dynamic capabilities.

Dynamic capabilities and corporate diversification

The RBT, the motivating precedent for the dynamic capabilities framework, emphasizes the importance of differences in resources and capabilities among firms. Rare, valuable, inimitable, and difficult to substitute resources and capabilities can give rise to a competitive advantage, while they are difficult to acquire from or sell to the external market. Since the marginal cost of their allocation and deployment within the same industry is often minimal and benefits can be substantial (Ng, 2007), the RBT posits that the firm can achieve superior performance through related rather than unrelated diversification or a focused strategy. By extension, valuable and rare

resources and capabilities should greatly determine the choice of businesses for the firm (Wan *et al.*, 2010).

The emphasis of the RBT on development, protection, and combination of unique resources within a strategy of related diversification rather than on resources' dynamic regeneration and reconfiguration (Helfat & Eisenhardt, 2004) lessens the firm's performance potential (Farjoun, 1998; St. John & Harrison, 1999). Unlike this tradition, the dynamic capabilities view goes a step further to establish the requisite condition that the firm can exploit those resources to generate new related and unrelated uses (Døving & Gooderham, 2008; Eisenhardt & Martin, 2000; Helfat & Eisenhardt, 2004; Teece *et al.*, 1997). When control over scarce resources is the source of economic rents, skill acquisition, learning, and accumulation of organizational and intangible assets gain increasing importance (Helfat & Peteraf, 2003). Dynamic capabilities not only can they enable the firm to skillfully combine different related resources (Farjoun, 1998), but can also increase the resource-relatedness and stretch the ease of transferability and extensibility of unrelated resources and capabilities (Ng, 2007), which ultimately drives firm performance.

The essence of dynamic capabilities in enabling the multi-business firm, irrespective of the firm's coordinates on the diversification continuum, is embedded in organizational processes. Organizational processes are shaped by internal and market resources that the firm possesses such as technology endowments, complementary resources, intellectual property, and customer base (Teece *et al.*, 1997). They are conditioned by the evolutionary path the firm has followed that constrains its future behavior. So long as resources are distinctive (i.e. difficult to replicate and imitate) there is no market for them and they must be built internally (Teece *et al.*, 1997). Dynamic capabilities confer on the firm the capability to coordinate and integrate internal and external activities, resources and knowledge. They are bound up with organizational learning that enables new production opportunities to be identified and the firm's capability to reconfigure its resource structure to achieve congruence with rapidly changing dynamic environments.

Ng (2007) posits that a weak form of dynamic capabilities allows the creation of new resource and knowledge uses from the organization's existing resource pool. Namely, the firm will tend to focus on the exploitation of slack resources that are intimately close to its core resources and additionally explore historical experiences to reduce the cost of developing additional related resources. On another level, strong

form dynamic capabilities introduces new resources to effect a change in the existing resource bundle and discover new resources and uses through innovative experimentation. This form is often the output of organizational phenomena such as cross-functional teams, prompt responses to market feedback and extensive commercial innovation (Eisenhardt & Martin, 2000). Overall, the organization's strength of dynamic capabilities is a response to inefficient markets as it facilitates the revelation of the value of new resource combinations and uses that otherwise could not be attained through the (inefficient) market valuation process (Ng, 2007).

The power of the framework of dynamic capabilities of explaining competitive outcomes lies in that it considers competition as a process involving the development, accumulation, combination, and protection of unique skills and capabilities (Leiblein, 2011). It is most appropriate in situations where competitors do not have deep-seated competitive advantages and where firms' advantages are built on organizational attributes that competitors cannot replicate (Teece *et al.*, 1997). Particularly in dynamic environments, such as the technologically convergent ICT industries, the rise of competitive advantages are more likely to stem from deep organizational attributes than from strategic asymmetries such as first-mover advantages.

The overall prediction of the relationship between diversification and firm performance can be improved by incorporating in the analysis the interactions between resources and capabilities (Markides & Williamson, 1994) and elements of change and interdependence (Helfat & Eisenhardt, 2004). Dynamic capabilities can comprise an important supporting mechanism for both related and unrelated diversifications and determine their outcome. We suggest the following hypotheses:

H1: Dynamic capabilities have a positive modifying effect on the relationship between related diversification and firm performance.

H2: Dynamic capabilities have a positive modifying effect on the relationship between unrelated diversification and firm performance.

Absorptive capacity and corporate diversification

Cohen & Levinthal (1990)'s seminal study on the concept of absorptive capacity sparked a conversation about the firm's ability to exploit external knowledge, which they characterized as a critical component of innovative capabilities. Absorptive

capacity is highly shaped by the level of prior related knowledge that may revolve around basic skills or knowledge of recent technological developments (Vasudeva & Anand, 2011). Its importance lies in that it confers the ability to the firm to recognize the value of new information, assimilate it, and apply it to commercial ends. It can be developed either indirectly, as a byproduct of a firm's R&D investment or manufacturing operations, or directly, by investing in staff technical training(Zahra & George, 2002).

The breadth of categories into which prior knowledge is organized, the differentiation of those categories, and the linkages across them can permit firms to make sense of them and subsequently acquire new knowledge (Volberda, Foss, & Lyles, 2010). Yet, absorptive capacity is not limited to the assimilation of existing knowledge (developed or acquired) but extends to the capacity to exploit it and create new knowledge (problem solving). Moreover, mere exposure to prior knowledge is insufficient to give rise to the development of absorptive capacity. Intensity of effort expanded on the solving of problems using existing and new knowledge is paramount (Cohen & Levinthal, 1990).

The organization's absorptive capacity depends on one level on the structure of communication between the organization and its external environment and, on another level, on transfers of knowledge across and within organizational subunits (Volberda *et al.*, 2010). Unlike situations in which information flow is definite and is clear where in the firm or subunit a piece of information can be applied, the effectiveness of knowledge transfer is challenged. Under such circumstances, the ideal knowledge structure for the organizational subunit should reflect a good balance between overlapping knowledge and non-overlapping diverse knowledge. The organization as a whole must have some level of relevant background knowledge commensurate with the level of differentiation of newly acquired knowledge (Leiblein, 2011).

Since learning is a cumulative process shaped by pre-existing knowledge, organizations can achieve better learning performance when the new knowledge domain objective is related to what is already known (Zahra & George, 2002). To assimilate new information, some degree of overlap is required between an organization's previous knowledge and the new and external information (Cohen & Levinthal, 1990; Zahra & George, 2002). By extension, prior knowledge diversity plays a critical role as it increases the possibility that newly acquired and inherently

uncertain knowledge will relate to the existing domains of firm knowledge. Organizations without diverse foundations of technological knowledge cannot acquire one readily and may overlook emergent developments in areas they do not invest.

Prior knowledge also determines how absorptive capacity affects innovative performance in rapidly changing technological environments (Lichtenthaler, 2009). The relevance of knowledge already possessed to newly acquired knowledge permits the organization to more precisely comprehend the potential merits of new technological advances and develop informed expectations. In an uncertain, dynamic environment, absorptive capacity's features of cumulativeness and expectations formation permit the organization to predict more accurately the nature and commercial potential of technological advances and increase their exploitation prospect. Corporate diversification decisions will be thus more informed and aimed to the right direction. In turn, we can expect that absorptive capacity to have a positive modifying effect on the relationship between diversification (both related and unrelated) and organizational performance.

H3: Absorptive capacity has a positive modifying effect on the relationship between related diversification and organizational performance.

H4: Absorptive capacity has a positive modifying effect on the relationship between unrelated diversification and organizational performance.

Methods

Performance Measure

Performance was measured using a firm's return on assets (ROA) (Miller, 2004; Robins & Wiersema, 1995). ROA has been shown to be related to a variety of other indicators of firm financial performance and has been widely employed in the diversification-performance literature. Despite the existing debate over the use of accounting versus market performance measures, Robins & Wiersema (1995) report a number of advantages for the former, including their close connection to the decision variables controlled by managers and their enabling direct comparison with a

substantial body of research on diversification and performance in strategic management.

Measures of relatedness

Hitherto, relatedness operationalizations center on certain functional resources such as product relatedness (Rumelt, 1974), technological relatedness (Robins & Wiersema, 1995; Silverman, 1999), managerial relatedness (Prahalad & Bettis, 1986), human resources relatedness (Farjoun, 1998), or a combination (Tanriverdi & Venkatraman, 2005). Evidently, the direct measurement of the relatedness of a firm's strategic resources at the firm level has been quite onerous in the literature. Researchers resort to indirect measures that capture the industry participation profiles of firms and the resource similarities of industries (Tanriverdi & Venkatraman, 2005).

In this study, we use such an indirect measure for corporate diversification by adopting a widely used entropy measure of diversification developed by Jacquemin & Berry (1979) which allows for the calculation of a firm's total, related, and unrelated diversification. Total diversification (DT) is computed as follows:

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

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 the total sales of the firm. 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:

$$DR = \sum_{i \varepsilon j} P_i^j \ln\left(\frac{1}{P_i^j}\right) \tag{2}$$

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) derives from the difference between equations (1) and (2). According to Palepu (1985) the entropy measure considers three important elements of diversification: the number of segments in which a firm operates, their degree of relatedness, and their relative importance for the firm's total sales.

We consider this measure sufficient for the purposes of our study as we view relatedness from a product perspective as the extent to which a firm's different lines of business share a common market or purpose (Døving & Gooderham, 2008; Rumelt, 1974). Our purpose is to examine *ex post* whether the performance outcomes of the firm's strategic decision to diversify into related or unrelated product markets are conditioned by the magnitude of the firm's absorptive capacity and dynamic capabilities. Although relatedness of the diversified firm from a resource perspective is not the main focus our measures of dynamic capabilities and absorptive capacity can capture some of the complex and dynamic relationships of corporate resources and capabilities.

Absorptive capacity

We measure a firm's absorptive capacity by its diversity of distinct areas of research/technological specializations, since increases in an organization's diversity of experiences can promote the commercialization of new products the firm may pursue through diversification (Ng, 2007). To measure technological diversity, we calculated a concentric measure of diversification originally used by Caves, Porter, and Spence (1980) using firm patents, which we translated to four-digit SIC codes using the concordance index developed by Silverman (1999). The index is given by:

$$Abs\_Capacity_t = \sum_i p_i \sum_j d_{ij} p_j \qquad (3)$$

where p_i = the proportion of patent applications in 4-digit SIC i in year t; p_j = the proportion of patent applications in 4-digit SIC j; and d_{ij} = 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. Patents assigned to more than one SICs were treated as different applications in order to better capture firm-level technological diversity. The index compares each patent with every other patent in the firm's portfolio measuring the "distance" between patents concentrically (Argyres, 1996).

Dynamic capabilities

Since an organization's dynamic capability leverages both prior internal organizational experiences and external third-party experiences it can be measured by the diversity in the firm's patent citations (Ng, 2007). Similarly to our measure of absorptive capacity we calculated a concentric measure of diversification using patents and patents citations, which we translated both to four-digit SIC codes using the concordance index developed by Silverman (1999). The index is given by:

$$Dyn\_Capability = \sum_i p_i \sum_j d_{ij} p_j \quad (4)$$

where p_i = the proportion of patent applications in 4-digit SIC i; p_j = the proportion of patent citations in 4-digit SIC j; and d_{ij} = 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. The index compares each patent with its citations measuring the "distance" between patents and citations concentrically.

Controls

Firm size

Firm size has been considered as an indicator of market power and scale economies. Empirical evidence exists linking size to profitability (Bettis, 1981; Robins & Wiersema, 1995). Market power may allow control over pricing and economies of scale can allow cost reductions. Combined they can enable large firms to achieve high levels of profitability. We control for the firm's size with the log of the number of firm employees and expect it to have a positive relationship with performance.

Industry concentration

From the early works in industrial organization (Bain, 1956) industry concentration has been considered as a strong indicator of barriers to entry. In highly concentrated industries, market power enjoyed by firms may allow them to sustain high levels of profitability. This 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:

$$Ind\_concentration_t = \sum CR4_i P_i \quad (5)$$

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 empirical evidence in strategy (Markides, 1995) suggests 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. A weighted measure of industry profitability can be estimated 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:

$$Ind\_profitability = \sum ROA_i P_i \quad (6)$$

where ROA_i is the average return on assets for industry i and P_i is the proportion of a firm's sales in SIC i. Industry profitability is expected to have a positive relationship with 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. In effect, the firm's debt burden compels 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 investments

We control for the firm's capital investments, an indicator of the firm's tangible nature of assets used in firm growth, which may result in higher total factor

productivity and higher performance not attributable to diversification (Miller, 2006). Capital investments is measured as the firm's capital expenditures as a percent of sales. We expect it to have a positive relationship with firm performance.

Investments in intangible assets

Prior research demonstrates a ubiquitous, positive relationship between investment in intangible assets and measures of firm performance (Miller, 2006). Investment in intangible assets has also been included in models of the relationship between diversification and performance. Prior research has operationalized a firm's knowledge resources and capabilities in terms of its innovative outputs, patents (Hitt, Hoskisson, Ireland, & Harrison, 1991). Moreover, simple counts of patents are highly correlated with R&D expense (Griliches, 1981). We control for the firm's investment in intangible assets by taking the ratio of the firm's yearly number of patents to its sales.

Sample selection

The sample consists of 150 large firms traded in the United States operating in the information, communication and technology (ICT) industries. Sample firms were randomly selected based on a minimum amount of $1billion sales for 2010. The ICT industries are characterized by a dynamic environment with rapid technological change and intense restructuring activity that gives rise to the emergent phenomenon of technological convergence. Technological convergence can be viewed in the parallel occurrence of related phenomena such as firms' consolidation through industry alliances and mergers, the combination of technology and network platforms, and the integration between services and markets (Bum Soo, Choi, Barnett, Danowski, & Sung-Hee, 2003; Greenstein, 2000; Wirtz, 2001). The integration among computer software, hardware, data processing services, film, telecommunications, publishing, broadcasting, and cable creates conditions of market failure (Gambardella & Torrisi, 1998). In such conditions, organizations have incentives to diversify on the expectation they will benefit from an "internal capital market" that is more efficient in trading and sharing resources, knowledge and technology (Chatterjee & Wernerfelt, 1991; Hill *et al.*, 1992). This unearths the importance of mediating mechanisms that can facilitate the efficient exchange and development of resources across the businesses of the diversified organization. In this

study, we posit that these mechanisms are operationalized in the firm's absorptive capacity and dynamic capabilities.

Data were collected from multiple sources. Compustat was the source for the financial, 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 are thus expected to involve some information about managers' views of relationships among businesses. This additional information can be valuable in research that employs the entropy index of diversification (Robins & Wiersema, 1995). Data from Compustat span from 1975 to 2010. They pertain to firms from the following 2-digit SIC industries: (27) printing, publishing, and allied industries; (35) industrial and commercial machinery and computer equipment; (36) electronic and other electrical equipment and components; (37) transportation equipment; (38) measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks; (48) communications; (50) wholesale trade-durable goods; (51) wholesale trade-non-durable goods; (73) business services; and (78) motion pictures.

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 the 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 1,914,597 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 the distribution of their application across industries using the concordance index developed by Silverman (1999) which assigns each patent to four-digit SIC codes.

The complete dataset used in the analysis comprises an unbalanced dataset of 3,244 firm-year observations with 149 firms since one firm was dropped from the sample due to missing data. Table 1 and Table 2 present summary statistics for and pairwise correlations between our dependent, independent, and control variables.

- Insert Table 1 about here -

- Insert Table 2 about here -

Results

Table 3 presents the results from our analysis. The research hypotheses were examined using generalized least-squares regression models to account for the problem of heteroskedasticity in our data. Estimation of our models using ordinary least-squares would result in inefficient estimates (Cameron & Trivedi, 2009).

- Insert Table 3 about here -

Starting with column 1, we first estimated a model by regressing firm performance on the control variables before we involved the main regressors in the analysis. In the second model we include the two measures of related and unrelated diversification. Consistent with prior research, related diversification has a statistically significant positive effect on performance and unrelated diversification has a statistically significant negative effect on performance. Availability of long time-series in our dataset allowed us to test for lagged effects. On the grounds that the effects of diversification on performance take time before they materialize (Markides, 1995) we used likelihood ratio tests to test for models that account for multiple year-lag effects. The likelihood ratio tests suggested the use of 2-year lags. In the case of the effects of absorptive capacity and dynamic capabilities (model 3), we used 4-year lags following the same procedure. Inclusion of the two new variables did not alter the previous results. Dynamic capability has a positive and statistically significant effect on performance in contrast to absorptive capacity that has a negative but statistically insignificant effect.

The study's hypotheses are tested with model 4 where we additionally include the interactions between the two diversification variables and the two mediating

effects. Inclusion of the interaction effects results in increasing the magnitude and statistical significance of the two diversification effects and dynamic capabilities. Additionally, absorptive capacity becomes positive and gains statistical significance.
The interaction effect of unrelated diversification and dynamic capabilities is positive and statistically significant giving support to H2. This suggests that the negative effect of unrelated diversifications on performance is moderated by the firm's dynamic capabilities. Moreover, the interaction effect of related diversification and absorptive capacity is positive and statistically significant giving support to H3. This finding implies that the positive effect of related diversification on firm performance is greater for higher levels of absorptive capacity. On another level, the interaction effects of related diversification and dynamic capabilities and the interaction effects of unrelated diversification and absorptive capacity are both positive but statistically insignificant, rejecting H1 and H4.

Discussion

In this paper, we shed some light on the ongoing debate in strategy research over the effects of related and unrelated diversification on firm performance, particularly in dynamic environments. On one level, the prevailing resource-based view of diversification postulates that resource relatedness can allow the production of super-additive value and sub-additive costs that improve firm performance. However, the logic of synergies and path dependence of the resource-based view is too narrowly defined to account for unrelated diversifications that are motivated by the firm's efforts to alleviate the risk attached to resource allocation in conditions of market failure. Moreover, the resource-based approach does not consider the firm's ability to develop asymmetries (Miller, 2003) – valuable and inimitable resources that are however unrelated to the firm's core resources – that can yield sustainable economic rents. On another level, unrelated diversifiers' expectation that internal capital markets can be more efficient than external markets for the allocation of resources across business units can be challenged if internal competition precludes business units from sharing resources and projecting the potential value of existing resources.

Existing explanations of the firm's diversification behavior and performance call for an expanded paradigm that also accounts for the organizational mechanisms

that can reinforce the internal market efficiencies and maximize the uses of resource bundles that can allow the firm to achieve superior performance. We argue that these mechanisms are embodied in the firm's absorptive capacity and dynamic capabilities. We empirically test for the mediating role of these mechanisms in the effects of related and unrelated diversification on firm performance. Consistent with the preponderance of existing empirical studies, we find that related diversification has a positive effect on performance whereas unrelated diversification has a negative effect. The average firm in the sample benefits from dynamic capabilities and absorptive capacity. Additionally, dynamic capabilities moderate the negative impact of unrelated diversification and absorptive capacity reinforces the positive impact of related diversification.

Our findings lend support on the strategic use of dynamic capabilities and absorptive capacity by the diversifying organization. This is in congruence with Ng (2007) who discusses the reinforcing nature of the relationship between diversification, absorptive capacity and dynamic capabilities. In particular, the mode of change in organizational resources reflected in the organization's dynamic capabilities can promote its diversification incentives. As diversification broadens the organization's knowledge base, knowledge diversity can expand the organization's capacity to assimilate and exploit a broader range of market information and opportunities, reflected in absorptive capacity that itself can create further incentives to diversify. Whereas the average firm can benefit from a sound level of absorptive capacity and dynamic capabilities, unrelated diversifiers can benefit further from dynamic capabilities and related diversifiers from absorptive capacity.

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Table 1: Summary statistics

Variable	**Mean**	**Min**	**Max**
ROA	0.04	-1.36	2.35
DR	0.45	0	2.34
DU	0.46	0	3.91
Abs_Capacity	1.16	0.09	1.78
Dyn_Capabilities	1.42	0	1.95
Size (log_employees)	3.30	-3.00	6.16
Concentration	0.15	0	0.98
Profitability	0.44	0	93.57
Capx to sales	0.11	0	6.67
DSE	0.66	-155.39	202.95
Patents	948.83	1	17440

Table 2: Correlations matrix

	1	2	3	4	5	6	7	8	9	10	11
1. ROA	1										
2. DR	0.029	1									
3. DU	-0.082*	0.168*	1								
4. Abs_Capacity	0.008	-0.054*	0.124*	1							
5. Dyn_Capabilities	-0.003	0.009	0.008	0.049	1						
6. Size	-0.016	0.213*	0.345*	0.255*	0.036	1					
7. Concentration	-0.034	0.016	0.264*	0.254*	0.044	0.460*	1				
8. Profitability	0.047*	0.113*	-0.006	-0.050*	0.006	0.078*	0.320*	1			
9. Capx to sales	-0.031	-0.031	-0.026	-0.065*	-0.013	-0.063*	-0.144*	-0.038*	1		
10. DSE	0.025	0.033	0.010	0.029	0.004	0.016	0.007	0.000	-0.010	1	
11. Patents	-0.085*	0.062*	0.337*	0.200*	0.030	0.386*	0.391*	0.057*	-0.051*	0.0322	1

* $p<0.05$

Table 3: Results output

Dependent: ROA	**1.**	**2.**	**3.**	**4.**
Size (log)	0.000	0.001	0.001	0.003
	(0.00)	(0.00)	(0.00)	(0.00)
Capx (to sales)	-0.020*	-0.011	-0.007	-0.019
	(0.01)	(0.01)	(0.01)	(0.01)
DSE	-0.001**	-0.001**	-0.001**	0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Intangible_assets (lag)	0.000***	0.000***	0.000***	0.000**
	(0.00)	(0.00)	(0.00)	(0.00)
Concentration	-0.015*	-0.019**	-0.021**	-0.022
	(0.01)	(0.01)	(0.01)	(0.01)
Profitability	0.000	-0.000	-0.000	0.002*
	(0.00)	(0.00)	(0.00)	(0.00)
DR (2 lags)		0.004*	0.005*	0.030***
		(0.00)	(0.00)	(0.01)
DU (2 lags)		-0.003*	-0.003*	-0.022***
		(0.00)	(0.00)	(0.01)
Abs_Capacity (4 lags)			-0.000	0.015**
			(0.00)	(0.01)
Dyn_Capabilities (4 lags)			0.000*	0.003*
			(0.00)	(0.00)
DR X Abs_Capacity				0.033***
				(0.01)
DU X Abs_Capacity				0.006
				(0.01)
DR X Dyn_Capabilities				0.002
				(0.00)
DU X Dyn_Capabilities				0.002*
				(0.00)
Constant	0.053***	0.049***	0.046***	0.037***
	(0.00)	(0.00)	(0.00)	(0.01)
Observations	2912	2696	2587	2587
Firms	149	147	147	147
Log-likelihood	1988.45	1945.12	1941.37	1931.87
Chi-sq	108.54	104.20	105.74	75.98

* p<0.05, ** p<0.01, *** p<0.001
Robust SE in parenthesis