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FIRMS' TECHNOLOGICAL RESOURCES AND THE PERFORMANCE EFFECTS OF DIVERSIFICATION: A LONGITUDINAL STUDY

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While agency theory claims managerial self-interest creates a diversification discount, strategic theory explains that firms with certain kinds of resources should diversify. Longitudinal data on 227 firms that diversify between 1980 and 1992 reveal that the sample firms invest less in R&D and have greater breadth of technology (based on patent citations) than their industry peers prior to the diversification event. Also, acquiring firms may appear to have lower performance because of accounting conventions and because firms that use internal growth rather than acquisition pursue less extensive diversification. These findings help explain how diversification and financial performance are endogenous. Copyright © 2004 John Wiley & Sons, Ltd.

A central theme of research in corporate strategy over the last 30 years has been the relationship between diversification and performance. Some of the most widely recognized findings are that related diversifiers outperform unrelated diversifiers (Palich, Cardinal, and Miller, 2000), many diversified firms have lower financial performance than that of comparable single-business firms (Rumelt, 1982), and the lower performance is partly due to less innovation in diversified firms, particularly those that have diversified through acquisition and implemented stringent financial controls in an M-form structure (Hitt *et al*., 1996). The primary explanation for related diversification is a combination of insights from transaction cost economics (Williamson, 1975) and the resource-based view of the firm (Barney, 1986; Peteraf, 1993; Wernerfelt, 1984). Since knowledge resources are subject to market failure, managers apply those resources to new products through diversification (Teece, 1980). On the other hand, agency theory explains why managers would overdiversify (Amihud and Lev, 1981; Jensen, 1986; Jensen and Meckling, 1976; Jensen and Murphy, 1990), and eschew investment in risky projects such as R&D (Hoskisson and Hitt, 1988; Baysinger and Hoskisson, 1989).

From a resource-based perspective, agency theory can be seen as focusing on firm heterogeneity in a particular capability—corporate governance—to explain variation in managerial behavior. The inability or unwillingness to provide appropriate incentives and oversight to managers allows them to destroy value by pursuing diversification inappropriately (e.g., Lang and Stulz, 1994). Yet if the fundamental value creation in diversification comes from economies of scope in knowledge resources, then surely it is important to understand the heterogeneity in those resources that exists at the time of the diversification decision. Consider firms in R&D-intensive industries, engaged in a race for innovation. Variance of technological resources across firms emerges from

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firms' other capabilities, management, and governance, but also the inherent uncertainty in the innovation process (luck). Thus, some firms in R&D-intensive industries may pursue diversification because they already dominate the industry, while others seek new markets because their efforts in the current industry have failed. Regardless of the reason for the outcome of an innovation race, failing to account for the prevalence of leaders vs. laggards that diversify could bias conclusions about the relationship between the mode and extent of diversification and outcomes such as innovation or financial performance. Therefore, the purpose of this paper is to clarify and test how firms' technological resources affect both the decision to diversify and the firm's ensuing performance. After a brief review of the literature, a theory about competition within knowledge-intensive industries follows, offered as an alternative or complement to agency theory. The empirical sections then explore whether diversifying firms have reduced scale or broader scope of technological resources (compared to the industry norm) before a new segment is added.

LITERATURE REVIEW

Strategic vs. managerial reasons for diversification

At least as far back as Chandler (1962) and Penrose (1959), students of business strategy have understood that firms with valuable know-how can profitably extend their activities through diversification. According to the resource-based view of the firm, corporate diversification is able to generate economic profits when it takes advantage of economies of scope in valuable, rare, and inimitable resources (Barney, 1986; Peteraf, 1993; Prahalad and Hamel, 1990; Wernerfelt, 1984). Rumelt (1982) clarifies that economies of scale yield to economies of scope only when there are limits on the amount of any single product that can be made and sold from the resource. Teece (1980) argues that economies of scope are a necessary, but not sufficient condition for multi-product firms, since such economies can be attained through cooperation of distinct businesses; however, certain types of resources, such as know-how or physical assets that are both specialized and indivisible, are subject to market failure. The reduced transaction costs of governing these resources under common ownership drive diversification and the frequent adoption of the M-form structure (Williamson, 1975). Although theories differ as to the most important economies of scope, and various empirical approaches have generated somewhat contradictory findings, the overarching result is that related diversifiers achieve superior performance compared to single-business firms (Palich *et al*., 2000). Moreover, various forms of a 'relatedness hypothesis' hold that, among diversified firms, those that constrain non-core businesses to a small percentage of the firm's overall sales (Rumelt, 1982), that operate in industries sharing similar technologies (Robins and Wiersema, 1995) or human resource profiles (Farjoun, 1998), that use a dominant logic (Prahalad and Bettis, 1986), or that otherwise create synergy may be expected to increase returns on investment more than unrelated diversified firms (Markides and Williamson, 1994).

Of course, the strategic approach does not preclude other reasons for diversification. For example, there can be tax benefits of increased debt capacity (Lewellen, 1971) and internal capital markets may be more efficient than external markets, particularly in developing countries (Khanna and Rivkin, 2001). Thus, the real contrast to related diversifiers is firms that diversify for the wrong reasons. Agency theory assumes managers act to maximize their utility, not shareholder wealth (Jensen and Meckling, 1976). Managerial compensation and perquisites are tied to firm size more than performance (Jensen and Murphy, 1990; Tosi *et al*., 2000), and diversification is one way to build the size of the firm.[1] Also, managers have a large amount of human capital tied to a specific firm. They may wish to diversify away some of the risk of that investment by moving the firm into multiple industries (Amihud and Lev, 1981, 1999). Agency problems may be especially prevalent when substantial free cash flow (Jensen, 1986) allows managers to finance acquisitions without the discipline of financial markets. Markides (1995) summarizes other reasons why firms may overdiversify. For example, firms that diversified in the 1960s may

[1] While most studies of pay-for-performance rely on data that pre-exist recent emphasis on governance reform, the problem of inappropriate executive pay and perks is still the subject of much popular criticism. Perhaps one reason the problem persists is because the alignment of incentives from offering executives stock options is not the same as if they owned stock (Sanders, 2001). Incentive contracts are still difficult to write and enforce.

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have been trapped by changes in capital and product markets that removed the benefits of diversification. Nevertheless, the reluctance of managers to refocus is still an agency problem.

Theorists in the management literature have also used arguments about managerial self-interest to explain problems in diversification, specifically related to innovation. Hitt *et al*. (1996) summarize a stream of research that links diversification behavior, organizational control systems, innovation, and performance. In general, higher acquisition intensity is associated with greater use of financial vs. strategic controls, leading to less internal innovation, while higher divestiture intensity has opposite effects (Hoskisson and Johnson, 1992). While managers may wish to diversify to gain economies of scope, the typical implementation of an M-form structure with emphasis on financial vs. strategic controls reduces division managers' incentives to invest in worthwhile but risky projects such as R&D (Hoskisson and Hitt, 1988; Baysinger and Hoskisson, 1989). Moreover, the acquisition process commands managers' attention and adds debt, taking resources away from internal innovation (Hall, 1994; Hitt, Hoskisson, and Ireland, 1990; Hitt *et al*., 1991a, 1991b). The increased emphasis on short-term performance may result in lower organizational effectiveness. Empirical evidence shows adoption of the M-form structure has a more positive effect on ROA for unrelated diversifiers than related diversifiers, and a negative effect for vertically integrated firms (Hoskisson, 1987).[2] Agency problems related to innovation may be reduced by active, institutional owners. Hoskisson *et al*. (2002) demonstrate that public pension fund ownership is more positively related to internal innovation (and to inside directors with equity, who also emphasize internal innovation) than is professional investment fund ownership. These findings support agency theory in that managerial decisions about risky investments are aligned with the governance provided by boards, incentive contracts, and active shareholders.

[2] The relationship between diversification strategy and structure is explored further by Raynor (2000), who finds that 'hybrid' firms diversifying along multiple dimensions—related, unrelated, and vertical—outperform pure diversifiers in time of economic growth. Thus, Raynor concludes another type of synergy might be the 'real option' value of flexibility to alter the firm's strategy depending on the resolution of uncertainty in the environment.

The 'diversification discount' research

However, a more complete picture of firm heterogeneity beyond differences in governance mechanisms is necessary to properly interpret research in financial economics that finds support for the agency theory of diversification. Using various methodologies, time periods, and samples, these studies have documented that diversified firms have a market value significantly below that of portfolios of matched, single-business firms (Berger and Ofek, 1995; Denis, Denis, and Sarin, 1997; Lang and Stulz, 1994; Lins and Servaes, 1999; Rajan, Servaes, and Zingales, 2000). Other papers have tied the 'diversification discount' explicitly to governance mechanisms such as managerial equity ownership (Denis *et al*., 1997) and the market for corporate control (Berger and Ofek, 1996), providing greater support for agency theory arguments. The conflicting assumptions and methodologies (e.g., market-based vs. accounting-based measures of performance) between the finance and strategy literature have been the subject of debate (Amihud and Lev, 1999; Lane, Canella, and Lubatkin, 1998, 1999). However, the key finding of a diversification discount is common to both research streams. Rumelt's (1982) results show diversified firms overall have a 1.7 percent lower (industry-adjusted) mean return on invested capital than single business firms (0.66% unadjusted). Nearly all the strategy studies since Rumelt (1982) have involved samples of only diversified firms. In a notable exception, Amit and Livnat (1988) conclude that related diversifiers do not outperform single-business firms.

A second wave of finance research on the diversification discount has sought to refine the methodology and take a more strategic approach. A common problem with cross-sectional studies is that firms are not assigned randomly to strategies (Masten, Meehan, and Snyder, 1991; Shaver, 1998). The diversification choice is endogenous to performance since value-maximizing firms would choose a diversification strategy based on pre-existing characteristics of the firm (Campa and Kedia, 2002; Maksimovic and Phillips, 2002) and industry structure (Burch, Nanda, and Narayanan, 2001). Thus, it may not be the act of diversification itself that destroys value, but some underlying trait that determines both diversification strategy and performance (Villalonga, 2002). For example, one explanation for the diversification discount is

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that firms in declining industries diversify (Lang and Stulz, 1994). In the face of an industry-wide demand shock, some firms may diversify as a way to escape the industry (Rumelt, 1974) or lessen the firm's dependence on the markets served by the industry. Thus, in cross-sectional studies that do not properly control for these industry effects, such as through a selection equation (Burch *et al.*, 2001), diversified firms will appear to have lower performance, even though managers may be making optimal investment decisions. Furthermore, the act of diversification, particularly through acquisition, introduces accounting changes that may bias the dependent variable without really affecting performance (Graham, Lemmon, and Wolf, 2002).[3] Controlling for endogeneity econometrically, the second wave of finance studies demonstrate that the diversification decision is driven by *ex ante* performance, but the act of diversification does not necessarily drive *ex post* performance (Campa and Kedia, 2002).

While finance scholars' recognition of competitive strategy is welcome, these studies continue to focus on industry characteristics and governance mechanisms to explain performance differentials. Yet, controlling for industry effects, strategy scholars have provided a more detailed and believable mechanism for the value loss in diversified firms by linking the multidivisional structure and acquisition activity to reduced investment in innovation (e.g., Hitt *et al.*, 1996). Could lack of investment in R&D and other aspects of technological competition also drive the poor firm performance that leads to the decision to diversify? The key question is not whether a particular diversified firm creates more value than firms that are not diversified, but whether it creates more value than if it had not diversified at all, and that depends on the resources it controlled prior to diversification. For example, the popular business press in the 1980s argued that extensive diversification and restructuring was associated with a decline in the R&D intensity of American business (Hall, 1988, 1993). However, Hall's research demonstrated that firms with low R&D investment were more likely to leverage or diversify than firms with higher R&D expenditures (Hall, 1990). Leveraged buyouts and going private transactions occurred primarily in industries where R&D focused on process technology, leading to overinvestment and excess capacity when these domestic firms were faced with foreign competition (Hall, 1994). Also, diversified firms appear to be as efficient as single-business firms at turning R&D into new products, perhaps because diversified firms use central R&D facilities to minimize interdivisional conflict over R&D allocations (Cardinal and Opler, 1995). This evidence suggests the reduction in R&D intensity was a strategic action, not inefficient investment.

By considering innovation-based competition, the resource-based theory of diversification provides a mechanism for the endogeneity of diversification and performance observed in the second wave of finance research on the diversification discount. Specifically, while the strategic theory implies firms with superior technological resources may diversify to gain economies of scope in knowledge assets, the logic developed below implies that firms with valuable but inferior technological resources will diversify as well, and more often than the firms with superior resources.

DIVERSIFICATION AND PERFORMANCE UNDER INNOVATION-BASED COMPETITION

The innovation process is risky even before a firm diversifies, and subject to the same governance issues. Moreover, in certain industries, technology forms the primary basis for competition. Thus, it is important to consider how a firm's status in the innovation race affects its decision to diversify, as well as its financial performance before and after diversification. For simplicity, consider two firms competing to develop valuable inventions for the same target market. Through either superior capabilities or luck, at some point one firm may well gain an advantage over the other, commercializing an innovation that increases both profitability and market share.[4] Firms that invest more in R&D should expect to gain greater knowledge and develop greater capabilities than firms that invest less (Dierickx and

[3] Additional evidence that the diversification discount is an artifact of methodology is presented by Villalonga (2004) and Mansi and Reeb (2002), who identify problems with using Compustat segment data and using the book value of debt to compute firm value, respectively.

[4] Following accepted language, the term 'invention' is used to mean a new idea and 'innovation' to mean the product brought to market based on that invention (Ahuja and Lampert, 2001).

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Cool, 1989; Kogut and Zander, 1992; Yeoh and Roth, 1999). Repeated production and large scale may move a firm down a learning curve (Scherer, 1980), while development of routines (Nelson and Winter, 1982) and human resources (Lado and Wilson, 1994) can build capabilities. The ability to innovate (Hargadon and Sutton, 2000; Nonaka and Takeuchi, 1995) and manage knowledge (March, 1991; Cohen and Levinthal, 1990) are 'higher-order' or 'dynamic' capabilities (Teece, Pisano, and Shuen, 1997) that may be particularly difficult for competitors to imitate. While firms vary in their history and resources that affect the ability to innovate, the basic research and development process is also inherently uncertain, leaving some room for luck. For example, a simple probability model can generate the typical pattern of R&D intensities within industries (Cohen and Klepper, 1992), in which most firms are at or near zero R&D intensity, with the frequency of firms declining monotonically as R&D intensity increases. In other words, the luck involved in the innovation process can affect both investment in more R&D and diversification strategy (Matsusaka, 2001). Similarly, Lippman and Rumelt (1982) provide a model of how randomness in the accumulation of valuable resources can lead to economic rents in equilibrium. Whether due to superior capabilities, luck, or a combination of the two, eventually one firm may introduce an innovation that is more valuable in the specific market than its competitor's product.

Diversification by leading firms

One branch of the resource-based view of diversification explains how the industry-leading firm may use its superior resources to extend its activities into other markets. A capability that is valuable, rare, and costly to imitate can be a source of sustainable competitive advantage (Barney, 1991), and if it has the potential to be applied across multiple markets it forms a core competence (Prahalad and Hamel, 1990). Montgomery and Wernerfelt (1988) surmise that the most valuable innovations will often be more specialized to the industry than are less valuable innovations; that is, the leading firm's R&D will define the market. Thus, the firm's core competence will bring the greatest returns on core products, but with possible application to other products. In contrast, Prahalad and Hamel (1990) imply that the greatest benefit of a core competence may be the ability to introduce unanticipated products, creating new markets in which competition is lower. In either case, the leading firm would have higher values of technological inputs and outputs than its lagging competitor prior to diversification, and in the former case have superior financial performance as well. Thus, diversification and financial outcomes are endogenous, although not necessarily consistent with a diversification discount.

Alternatives for lagging firms

The innovation race will affect the lagging firm's performance and behavior as well. Faced with lower profits and limited market share, the lagging firm's managers have several options. Selling the firm may be a possibility. Laggards in an innovation race may often be targets for acquisition. For instance, Hitt *et al*. (1991a, 1991b) compared the R&D intensity of the combined acquirer and target firms to the weighted average of R&D intensity by dominant industry for each firm. They found the merging firms' R&D intensity was lower than the industry average after acquisition, as they predicted. However, they also found the combined firms to have lower-than-average R&D intensity in the period approaching the merger or acquisition. This *ex ante* difference could be because acquiring firms had low R&D, target firms had low R&D, or both. The emphasis here is on the acquiring firms—to understand why lagging firms that survive may diversify rather than continuing to pursue competition in a single industry.

One option that preserves the firm's independence is to find alternative uses for existing assets, whether the knowledge was generated through R&D, the human capital of people with experience in the firm, or physical assets with excess capacity. There may well be profitable applications of existing knowledge to other products, especially if the lagging firm's inventions are in fact less specialized to the core industry. Thus, firms with poor performance relative to industry peers will diversify. Application of existing assets should proceed in the order of declining returns, so the projects with the best return will be taken first (Montgomery and Wernerfelt, 1988), and diversification and performance are negatively related. A crucial assumption here is that additional uses of intangible assets will require further investment in tangible assets. This would not be the case with licensing, for

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example; but generally occurs in diversification, whether pursued through acquisition or internal growth.

Otherwise, the lagging firm's managers may investigate alternate sources of innovation. If the firm's own researchers or systems are subpar, perhaps outsourcing R&D will allow the firm to regain competitiveness. Given the problems of transferring knowledge across firm boundaries, a merger or acquisition is likely to be the means of acquiring outside R&D help. Technological acquisition can procure substantial knowledge under the right conditions (Ahuja and Katila, 2001). This vertical integration will also appear as diversification. Sometimes the firm's managers will believe they are only missing some piece to the puzzle, and would be able to compete against the leading innovator if they could acquire some different type of technology. The search for new combinations of knowledge may lead them through a pattern of acquisitions, restructurings, and divestitures (Chang, 1996). The evolution of the firm's knowledge may involve participation in other industries along the way. While the firm's search may result in an innovation which will give it pre-eminence in the core industry, that effort is still characterized by uncertainty. In fact, the lagging firm has an incentive to try even more risky investments in R&D, because that may be the only way to overcome the leader (Aron and Lazear, 1990). While the risk–return relationship is complex (McNamara and Bromiley, 1999; Miller and Bromiley, 1990), research based on prospect theory (Fiegenbaum and Thomas, 1988) and the behavioral theory of the firm (Bromiley, 1991) has generally found that firms with a level of performance lower than the target level take more risky investments, yet rarely see improved performance. Moreover, managers faced with loss due to environmental threats tend to use more risky, externally directed actions rather than internally directed actions, especially if the firm has substantial slack resources (Chattopadhyay, Glick, and Huber, 2001). Even before financial performance has actually begun to suffer, managers perceive the threat and take action. Again, firms with poor expected performance relative to industry peers choose to diversify, thus leading to a discount measured after diversification.

Yet another alternative is to divert investment away from the existing track of innovation and toward other assets. For example, a firm may choose to bow to the competitor's innovation leadership and further develop its strength in other segments of the value chain. So long as the market is rewarding innovation, the move away from investment in R&D is not likely to provide competitive advantage. However, the lagging firm may at least reduce some of its competitive disadvantage and stage for successful entry into other markets. Capabilities based on relationships with a few large customers, highly trained service workers, and made-to-order production are among those most applicable across industry boundaries (Markides and Williamson, 1994). Moreover, the returns to product innovation may diminish over time as product functionality exceeds market demand (Christensen, Verlinden, and Westerman, 2002), with a switch to process-based competition driven by heterogeneity in demand (Adner and Levinthal, 2001). Thus, the emergence of an industry standard or disruptive technology can provide a breakpoint for lagging firms to switch strategy. If advances in process technology require less research and more tangible assets than creating the product in the first place, then seeking an advantage on the process side would still be associated with a drop in R&D expense as well as exploration of new technologies. Also, in a disintegrating market structure, a firm may choose to focus its technology on those components whose functionality has yet to exceed customer expectations (Christensen *et al*., 2002) even as competition for sales of the end product requires greater investment in advertising for brand image and awareness. Of course, positioning decisions based on firm capabilities and customer demand may be settled before any competition occurs. One or a few firms may pursue a differentiation strategy through high investment in R&D, while others may pursue alternative strategies based on their existing capabilities.

In fact, any of the three decisions described here as ongoing responses to realized innovations in an uncertain process may be pursued proactively based on the anticipated difficulty of matching the leader's innovativeness. First, from the time of inception, firms may decide to pursue broadly applicable technology (e.g., more basic research) less likely to give clear advantage in any one industry but likely to be valuable in some industry. For example, Corning maintained investment in optical fiber for years before it became clear which

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businesses would use it to greatest advantage[5] (Nanda and Bartlett, 1990). Likewise, biotechnology firms have competed indirectly with pharmaceutical companies by researching molecules with various potential benefits, rather than experimenting with an existing library of synthetic chemicals to solve a particular health problem. Over time, observers may assign a firm with broadly applicable technology to a different industry since its output is not the end product itself, yet there is still a sense in which the technologies are competing. Second, firms may never implement internal R&D, preferring to outsource as the need arises. Finally, firms may recognize the technological superiority of an existing industry participant and enter with an intent to compete based on other capabilities. Thus, while the development of these strategies may be observable over time, they may be difficult to untangle because managers forecast winning strategies in the presence of highly innovative competitors, and some strategies will not work as planned. The lagging firm may even pursue all of them at once.

Implications for R&D investment

Nevertheless, any of these options means that a lagging firm that diversifies will have a lower R&D intensity than a leading firm. This may occur because the lagging firm intended to invest less in R&D, or because after an initial innovation race the lagging firm cuts R&D to fund the other options. The implication for the performance effects of diversification is clear, as R&D intensity is related to financial performance. R&D is even more strongly related to economic returns in related diversifiers than unrelated (Bettis, 1981). This relationship may occur because the market correctly values intangible assets (Chan, Lakonishok, and Sougiannis, 2001; Lev and Sougiannis, 1996), because performance measures such as Tobin's q or ROA do not fully account for intangible assets in their denominators (Rotemberg and Saloner, 1994), or because spending on R&D and advertising can affect industry structure and increase profits for all firms in an oligopoly (e.g., Sutton, 1991). In any case, the *ex post* diversification discount measured in cross-sectional studies may be an artifact of *ex ante* differences in firm resources apart from diversification strategy.

However, in looking to explain the mean effects of diversification, it is important to note a few reasons why the laggards will outnumber the leaders, even if both leaders and laggards pursue diversification strategically. First, in any industry with multiple competitors, there may be only one leader. Unsuccessful firms may drop out of the race along the way, choosing a diversification strategy that takes advantage of their resources. Second, however, a core competence is defined or measured, it is hard to achieve. Third, countering the drive toward extension of core competencies is the fact that the innovation leader has incentives to focus its R&D investments. For example, Hill and Hoskisson (1987) explain how the information-processing requirements of managing synergy across even related projects can constrain growth. When a firm has a profitable, growing business, it may eschew diversification of businesses or technologies in favor of focusing limited managerial attention (Penrose, 1959) on economies of scale. While the adoption of the M-form structure may enable better managerial coordination, it is also associated with lower investment in R&D than in U-form firms (Hoskisson and Hitt, 1988). Similarly, Rotemberg and Saloner (1994) develop a model of incomplete contracts showing that firms may benefit from narrow business strategies because it may be more difficult to provide optimal incentives to knowledge workers in diversified firms. Since lagging firms will be more prevalent than leading firms, on average, diversifying firms should have lower R&D than competing firms that do not diversify.

> *Hypothesis 1: Prior to the diversification event, diversifying firms have lower R&D intensity than matched firms that stay focused.*

Implications for the breadth of knowledge assets

Some firms have a broader range of knowledge due to accidental discovery of additional uses for existing technologies or intentional investigation of related technologies. If, along with the extent of investment in technology, the breadth of technology is determined primarily before the act of diversification, then the strategic theory implies specialization of a firm's knowledge resources may

[5] Corning eventually partnered with Siemens to make fiber optic cable for telecommunications when it could not convince existing copper cablers to produce an alternative to AT&T's internally sourced product (Nanda and Bartlett, 1990).

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also explain performance differentials *ex post*. The relationship of technology specialization to financial performance has been less studied than the relationship between R&D intensity and performance. Broad knowledge may actually be more valuable than narrow knowledge because breadth relates to the fundamental nature of the knowledge—a patent on a chemical process may be more defensible and applicable to more products than a patent on a machine that manufactures only one product. On the other hand, specific knowledge may create greater competitive advantage in a high-return industry (e.g., Roberts, 1999). Further, Robins and Wiersema (1995) find that diversified firms whose segments are in industries linked by high technology flows, as defined by patent crossover and inter-industry sales (Scherer, 1982), have higher return on sales than diversified firms in various markets not linked by technology.

Various operationalizations of technological diversification have found support for the idea that firms first diversify their technology in predictable ways, and then launch into new markets on that basis. Scott and Pascoe (1987) use FTC Line of Business data from the 1970s, including reports of R&D expenditure by manufacturing categories for each surveyed firm. They document purposive diversification of R&D, finding that firms pursuing related technologies also tend to do more R&D overall than firms with less technological diversification. Pavitt, Robson, and Townsend (1989) count commercialized innovations by industry. Using patent classes, Argyres (1996) creates a concentric measure of technological diversification within multidivisional firms to relate firm structure to characteristics of its knowledge portfolio. Silverman (1996) builds on this approach by incorporating a concordance to relate patent classes to the industries in which the respective products are manufactured and used. Silverman (1999) shows that the classes of technology in a firm's patents predict which industries it will enter in ensuing diversification. This evidence confirms that investments in knowledge assets prior to diversification are strategic in their breadth.

The core competence story highlights firms that create distinctive innovations with value beyond a single industry, while the excess capacity argument focuses on firms that lag behind in knowledge-intensive industries. A firm's core competence is actually another kind of unused capacity separate from excess capacity. This 'extended capacity' is not created by over-investment in physical plant or through technological obsolescence, but by the formation of new knowledge-based capabilities with broad application. As noted already, Montgomery and Wernerfelt (1988) argue that the drive to satisfy customers and differentiate products will mean that those firms with the knowledge most specific to an industry will also be the most successful. This presumes some knowledge is more applicable to multiple products than is other knowledge. Firms with core competencies can be expected to target related markets, and will likely investigate possible extensions of existing technology prior to adding new business units. To the extent that lagging firms can predict the need to diversify, they may also pursue intentional diversification of technology prior to diversification of businesses. Managers may investigate whether they have sufficient internal knowledge in a related area prior to deciding on an acquisition of a firm with related technology. The lagging firm may also seek to protect its distinctive approach by patenting inventions that relate more to the process or service than to the core product technology of the industry. In either the extended capacity or excess capacity paths to diversification, there is reason to expect firms to pursue greater technological diversification before embarking on corporate diversification.

Hypothesis 2: Prior to the diversification event, diversifying firms have less specialized knowledge assets than matched firms that stay focused.

METHODS

The sample consists of 227 large firms that undertake diversification over a range of recent years for which patent data are available. From 1980 to 1992, 451 firms having at least $50 million in assets (in 1992 dollars, measured in the year of diversification) change from reporting one business segment to reporting two or more in the Compustat database. The SEC requires firms to report any segment that accounts for at least 10 percent of revenues for a given year. 86 firms are missing a stock price for the year prior to or the year of the event. Also eliminated are 28 listings of American Depository Receipts and 30 majority-owned subsidiaries of other firms. In addition, 31 other firms have missing information. Most diversified some time after the year in which multiple

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segments first appear in Compustat, but the files currently available record the restated or backfilled segment data. Each of the 276 firms is matched to industry peers, defined as publicly traded, single-segment firms drawn from the same 2-digit SIC code as the sample firm, and within 70–130 percent of the sample firm's asset size in the year prior to the diversification event.[6] Since some diversifying firms have no peers meeting these criteria, the final sample consists of 227 diversifying firms.

Lexis/Nexis articles, information on acquisitions from SDC, and annual reports confirm whether each firm uses an acquisition/merger to diversify. This categorization yields 169 firms in the 'acquisition' category and 58 denoted as 'internal growth.' Of the latter, only 23 announce the strategy behind their expansion, whereas the remaining 35 firms began reporting multiple segments without announcing any rationale in press releases or the annual report. A few firms in the 'unannounced' group begin reporting multiple segments because an existing division surpasses the threshold of 10 percent of sales revenue, and the origin of that division may be in a past acquisition. While there may be no explanation for the change in segment reporting, other news relating to financial difficulty or market pressure may coincide with the change, such as the announcement of a stock repurchase program or rumors of potential mergers. The breakdown by mode of diversification is reported where possible, with implications covered in the discussion of the results. In all, 52 percent of the sample firms are in manufacturing industries, with 11 percent in transportation and utilities, 11 percent in services, 10 percent in mining, 10 percent in wholesale and retail trade, and 6 percent in other industries. Since the theory developed in the previous section applies primarily to research-intensive industries, an R&D subsample is also created, in which the sample firm and at least one matched peer report positive R&D expense. Of the 72 firms in the R&D subsample, 93 percent are in manufacturing industries, with 60 observations that reflect acquisition and 12 internal growth (eight of which are unannounced). *R&D Intensity* is current year R&D expense divided by assets.

Prior research has operationalized a firm's knowledge resources and capabilities in terms of its innovative outputs, whether new product introductions (Pavitt *et al*., 1989) or patents (Hitt *et al*., 1991a). Simple counts of patents yield some information and are highly correlated with R&D expense (Griliches, 1981). However, weighting each patent by the number of citations it receives in subsequent patents reveals the relative importance of the innovation and even its contribution to profitability (Harhoff *et al*., 1999; Hall, Jaffe, and Trajtenberg, 2000; Jaffe, Trajtenberg, and Fogarty, 2000). In this paper, patent data are used to reveal the breadth of a firm's knowledge. *Technology Breadth* is measured as a continuous index using data from firms' patents (see Appendix). Each patent's International Patent Class (IPC) is used to generate a distribution of 'patent equivalents' across industries. The resulting measure is a concentric index of diversification of the patent portfolio across industries, with the focal industry defined as the primary segment SIC code of the firm. Greater specialization appears as a lower value for this index.

Some additional measures are necessary for the discussion linking the scale and scope of technological resources to firm performance. A *Share Leader* is identified as any firm that has the highest market share in its 4-digit SIC code, using revenue data from the Compustat Industrial Segment files for the year just prior to diversification. These firms are most likely to have exhausted economies of scale before turning to economies of scope, and may embody core competencies. This is a rough proxy for the winner of a race for innovation or other capabilities, but it provides a convenient distinction between firms that were performing adequately prior to diversification and those that were already underperforming. The use of this measure implies the learning race has already been decided and had time to impact performance before managers at lagging firms could adapt their corporate strategy. The *Extent of Diversification (Relatedness)* is defined using a Herfindahl index based on segment assets in the first year after diversification (Acar and Sankaran, 1999). The two measures of financial performance are *Return on Assets* and *Tobin's q*. Current-year firm ROA is defined as

[6] Barber and Lyon (1996) show that matching by 2-digit SIC code and size provides more reliable tests of long-run abnormal performance than matching by 4-digit SIC code, since the latter method excludes many firms without adequate peers. The historical SIC code identifier comes from the Compustat Industry Segments tapes, rather than the Industrial Annual file (research files used in both cases to include subsequently delisted firms), where only the most recent SIC code appears.

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Table 1. Subgroup means for firms eliminated from the sample

	Subsample of excluded firms			All excluded firms	All sample firms
	Subsidiaries and ADRs	No close matches	Other firms		
Year 0					
Tobin's q (MTB ratio)	1.11	1.03	1.27	1.12	1.25
Oper. profits/assets	6.77%	9.01%	10.99%	8.81%	7.81%
Assets (in thousands)	4601	4576	388	3457	880
R&D/Assets (missing R&D set = 0)	0.032	0.010	0.014	0.018	0.013
Year 1					
Tobin's q (MTB ratio)	1.07	0.99	1.11	1.05	1.01
N	34	42	28	104	227

net income over total assets and segment ROA is segment operating profits over segment assets, as reported in Compustat. While the 'relatedness hypothesis' can clearly be stated in terms of ROA, a drawback of many management studies using accounting measures of performance is that they do not control for risk (a critique offered by Hoskisson *et al*. (1993) among others), or use questionable measures of risk, such as variability of ROA (Ruefli, Collins, and Lacugna, 1999). The studies that do control for risk are generally less conclusive about the benefits of diversification (Bettis, 1981; Bettis and Hall, 1982; Bettis and Mahajan, 1985; Chang and Thomas, 1989; Amit and Livnat, 1988). Thus, the finance literature (Berger and Ofek, 1995; Lang and Stulz, 1994), which uses market-based measures of financial performance such as Tobin's q, provides an important complement to the strategy studies. The market-to-book ratio or q is a forward-looking measure that adjusts for risk, and has been used in several influential studies of diversification (Montgomery and Wernerfelt, 1988; Lang and Stulz, 1994; McGahan, 1999).[7]

The measures of financial performance offer one way to evaluate potential bias from the process of sample selection for this study, which excluded nearly half of the firms that reported a switch to multiple segments in Compustat from 1980 to 1992. As seen in Table 1, the eliminated firms show patterns of Tobin's q and ROA remarkably similar to the sample firms. Table 1 continues to omit firms dropped because they did not report enough data to figure a market-to-book ratio, possibly indicating financial distress or acquisition. The lower performance for firms with no close matches may be due partly to size. The unmatched may be quite diversified already (i.e., GM prior to its acquisition of Hughes) or may be pursuing an unusual strategy (i.e., New World Entertainment, which purchased Marvel Comics, only to sell it off a few years later). The subgroups of subsidiaries and ADRs are controlled by domestic or international companies that can make decisions without consulting the holders of the minority of shares that trade in public markets. Thus, it may not be appropriate to compare the performance of these companies to a set of focused industry counterparts.

Each hypothesis compares a firm's value for a variable to that of its industry peers. Standard regression techniques do not capture the matched pair design. One solution is to use the industry average (typically the median) as a control variable on the right-hand side. Subtracting the industry median from the firm value to create a relative measure of R&D intensity (Hitt *et al*., 1991a) or performance (Lang and Stulz, 1994) as the dependent variable presents problems due to measurement error (Bergh and Fairbank, 2002). Another appropriate statistical technique is the Wilcoxon signed-rank test, which is demonstrated

[7] Specifically, data from Compustat are used to create the ratio [(market value of common stock + book value of preferred stock + book value of debt)/book value of total assets], where market value of common stock equals price at year-end times shares outstanding. The market-to-book value (MTB) is highly correlated with more complex estimates of q (Chung and Pruitt, 1994; Lindenberg and Ross, 1981; Perfect and Wiles, 1994). Also, q and MTB are theoretically equivalent (Varaiya, Kerin, and Weeks, 1987) and marginal q is greater than one if and only if the accounting return less the cost of capital is positive.

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Table 2. Nonparametric Wilcoxon tests on R&D intensity of sample firms and industry peers

		Mean sample	Mean of industry[a] peers'		Signed-rank test statistic[b]	*N*
			Median	Mean		
Only reported R&D > 0						
Year[c]	−3	0.038	0.055	0.058	−1.735*	34
	−2	0.043	0.055	0.059	−2.276*	44
	−1	0.048	0.054	0.058	−2.525**	61
	0	0.040	0.055	0.058	−3.749***	72
	+1	0.034	0.054	0.059	−4.814***	74
	+2	0.042	0.055	0.060	−3.754***	72
	+3	0.039	0.055	0.062	−4.008***	68
Year 0 acquisition		0.040	0.056	0.060	−3.526**	60
Year 0 non-acquisition		0.040	0.048	0.050	−1.255	12
Year 0 share leader		0.027	0.047	0.046	−3.265**	11
Year 0 not share leader		0.060	0.056	0.061	−1.956*	61
Missing R&D set $= 0$						
Year	−3	0.012	0.016	0.021	−2.006*	138
	−2	0.014	0.016	0.021	−1.776*	163
	−1	0.015	0.016	0.021	−2.107*	200
	0	0.013	0.016	0.020	−2.866**	227
	+1	0.011	0.017	0.021	−3.953***	230
	+2	0.014	0.017	0.021	−2.761**	223
	+3	0.013	0.017	0.022	−2.719**	210

[a] The industry is the sample firm's industry in year 0, but the asset size for matching varies by year.
[b] All reported signed-rank tests are based on the difference between the sample firm's value and the industry median. Results are similar when using the industry mean instead.
[c] The diversification event occurs after the end of year 0 and before the end of year 1.
† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

to be powerful and stable in a study using similar data (Barber and Lyon, 1996).[8]

RESULTS

Hypothesis 1 states that diversifying firms invest less intensively in innovation prior to diversification than non-diversified firms competing in the same industry. As shown in Table 2, the R&D intensity of a diversifying firm is lower than the median single-segment firm in the same 2-digit industry, as measured at the year-end prior to the diversification event (denoted Year 0). This comparison holds when only reported R&D is used, or when missing data on R&D expense are assumed to be zero. The difference in R&D intensity persists at least from Year −3 (three years prior to the event) to Year +3 (3 years after the event). The matched group in each year consists of single-segment firms in the firm's industry in Year 0, just prior to diversification. The difference is greater for firms that acquire vs. firms that do not acquire, and for share leaders vs. those that are not the largest firm in the industry. Share leadership is not significantly correlated with the mode of diversification. Regression methodology confirms that status as an eventual diversifier is negatively related to R&D intensity, even after controlling for the industry mean R&D intensity, in the same set of years. Coefficients, *t*-statistics, and sample sizes are reported in Table 3. The sample size changes over time as either the sample firm or its industry peers report or do not report R&D expense. Results are robust to using R&D over sales or R&D expense rather than intensity.

As in many other studies, R&D intensity is positively correlated with Tobin's *q* in this sample, even controlling for the industry median R&D intensity and size (p-value <0.001 for the coefficient on R&D intensity in models for either

[8] The signed-rank test is a nonparametric test that assumes only that the components of each pair are well matched, and that each pair's outcome is independent from that of other pairs. If so, the differences form a continuous distribution which is symmetric, but not necessarily normal. As the sample size increases, the test statistic converges from a *t* distribution to a normal distribution, making statistical significance easy to determine.

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Table 3. OLS regressions of R&D intensity on diversifier status[a]

Year	−3	−2	−1	0	+1	+2	+3
Constant	0.025***	0.022***	0.011†	0.009†	0.014**	0.015*	0.012†
	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.007)	(0.007)
Median industry R&D intensity	0.675***	0.787***	0.924***	0.957***	0.888***	0.922***	0.975***
	(0.080)	(0.089)	(0.078)	(0.066)	(0.078)	(0.094)	(0.095)
Diversifier status	−0.024**	−0.023**	−0.013†	−0.021**	−0.028***	−0.024**	−0.027**
	(0.008)	(0.008)	(0.007)	(0.007)	(0.006)	(0.007)	(0.009)
Adjusted R^2	0.19	0.16	0.19	0.22	0.19	0.13	0.13
Sample size	350	497	667[b]	856	718	816	818
Diversifying firms	34	44	61	72	74	72	68

[a] Regression models include all single-segment firms in industries in which both the sample firm and at least one industry peer report positive R&D, as well as the diversifying firms. Results are similar for an alternative methodology in which the residuals from a model relating R&D intensity to the industry median are regressed on diversification (Bergh and Fairbank, 2002). Results are also robust to using the industry mean or controlling for firm size. Standard errors appear in parentheses underneath coefficient estimates.
[b] Five outliers with unusually high R&D intensity were eliminated based on DFFITS analysis.
† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 4. Comparison of technology breadth of sample firms and industry peers

Year 0 (prior to diversification)	Mean sample	Mean of industry peers'		Signed-rank test statistic[a]	*N*
		Median	Mean		
Herfindahl index based on International Patent Class					
All firms	0.438	0.476	0.482	−1.385†	54
Concentric index around primary segment 4-digit SIC code[b]					
All firms	2.921	2.815	2.791	1.761*	54
Acquisition	2.952	2.811	2.788	2.399*	45
Non-acquisition	2.763	2.841	2.818	−1.007	9
Share leader	3.176	2.905	2.903	2.497*	10
Not a share leader	2.863	2.795	2.768	0.864	44

[a] All reported signed-rank tests are based on the difference between the sample firm's value and the industry median. Results are similar when using the industry mean instead.
[b] Results hold using 3-digit SIC codes.
† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

the entire sample or the R&D subsample). R&D intensity is negatively correlated with firm ROA in the year prior to diversification, as would be expected since ROA reflects R&D expense in the numerator (see Appendix, Table A1).

The evidence is also supportive of Hypothesis 2, which predicts that diversifying firms have broader technology than matched, focused firms. Here the set of matched firms is restricted to those with similar levels of R&D expense to the sample firms, as well as similar industry and size.[9] Looking at the dispersion of citation-weighted patents across classes gives some evidence of a difference between the sample and matched firms. Table 4 reveals the diversifying firms to be less concentrated across patent classes than the matched firms, measured by the difference on a Herfindahl-type index. Some patent classes are more closely tied to a particular industry than are other classes, so using the Silverman (1996) concordance allows the transformation of patent classes into distributions of patent equivalents across industries. As shown in Table 4, tests using the new concentric index measure show the typical

[9] Signed-rank tests indicate no significant difference in level of R&D between sample firms and the median of the more restricted comparison group, even for the acquisition or other subsets. The diversified firms' level is still slightly lower than the mean for the comparison group. Also, there is no difference in the number of patents or citations between the sample firms and the closely matched firms.

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diversifying firm has a patent portfolio that is more widely dispersed across industries, as compared to the dispersion for the matched, focused firm. That is, the median matched firm has patented technology that is more concentrated around a single 4-digit SIC code than the technology of the diversifying firm. Since the specialization variables are undefined for firms with no patents (or citations), these tests are based on a sample size of only 54 matched pairs. Parceling out the mode and leader status results in even smaller sample sizes, but it appears the higher technology breadth is restricted to those firms that acquire or those firms that are share leaders.

The hypothesis implies that technology breadth will matter to diversification research because it will be related to financial performance. Indeed, the concentric index is a significant regressor in models explaining Tobin's q, even after controlling for firm size and R&D intensity. The coefficient is positive and significant beyond the alpha $= 0.05$ level in all specifications. Similar tests show no relationship between technology breadth and ROA in the year prior to diversification (see Appendix, Table A1).

Since prior research has sometimes claimed that the act of diversification causes a discount, Table 5 summarizes q and ROA for various categories of firms in the year prior to and the year after diversification. Taking the sample as a whole, the diversifying firms have a market-to-book ratio that is insignificantly different from their matched peers in Year 0, but after the diversification event a significant discount arises. The same is true for the R&D subsample and for the observations where patent citation data allows comparisons. Likewise, there is no discount in ROA for all firms until after the diversification event. The R&D subsample shows no significant difference in ROA between sample firms and their industry peers even after diversification. Further distinctions between subgroups shown in Table 5 provide the basis for the following discussion about the diversification discount.

DISCUSSION

In summary, the evidence supports both hypotheses. Firms that diversify are less innovative and have more broad-based patent portfolios than matched firms that stay focused. Studies controlling for the endogeneity of the diversification decision imply that the performance problems of diversified firms begin prior to the act of diversification. This paper has built on resource-based and transaction cost theory to link those performance issues to firms' technological resources in the context of competition for valuable capabilities. Given the longitudinal data, it can now be seen how the diversification discount arises.

Why does the discount arise? One explanation is that many diversifying firms have inferior financial performance prior to diversifying. As a first look, consider the split of the sample in Table 5 into those firms that had performance below the industry median in Year 0 and those firms that had superior performance. For both q and ROA, the set of firms with subpar *ex ante* performance continue a strong discount in the year after diversification, and the premium persists for the other set, although both the discount and premium grow smaller. However, this distinction is somewhat *post hoc*. Another approach is to use data on revenue to relate performance in market share to leader vs. laggard status prior to diversification. Neither share leaders nor the remainder of firms have a significant discount *ex ante*, but those that are not share leaders develop the discount *ex post*. The revenue leaders may embody strengths such as core competencies that are valuable when applied to other markets, as revealed by the borderline significant test result for Year 0 ROA. However, as the discount for laggards is not evident *ex ante*, either some other dynamic is at work or these firms see their performance continue to decline. Another category of firms that could have low performance prior to the diversification event is the unannounced category. These firms may be restructuring or even emerging from bankruptcy. In any case, they do not offer any explanation for their change in reporting, which one would expect if it represented good news to investors.[10]

[10] Since segment reporting is subject to some managerial discretion, part of the unannounced diversification may reflect ongoing performance problems. For example, U.S. Home Corporation sold off a subsidiary in 1988 to refocus and divest some bad mortgages. U.S. Home reported an additional segment to stage for the sale of the underperforming subsidiary. This caused the firm to appear diversified for 1 year's reporting, when in fact it had been diversified and was becoming less so. Industry segment reporting was ruled by SFAS 14 since 1976. Under SFAS 131, beginning in 1997, firms are to report 'operating segments' which may be based on different locations, internal structure, or other factors besides product market activity.

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Table 5. Firm performance by category

Panel A: Tobin's *q*

	Sample mean	Mean of medians	Test stat.[a]	*n*	Sample mean	Mean of medians	Test stat.[a]	*n*[b]
	Year 0 (ex ante)				*Year 1 (ex post)*			
All firms	1.25	1.07	0.59	227	1.00	1.02	−1.99*	218
Ex ante discount	0.74	1.12	−9.47***	119	0.74	1.04	−7.32***	114
Ex ante premium	1.81	1.01	9.02***	108	1.30	1.00	4.53***	104
Share leader	1.29	1.05	0.41	31	1.09	1.07	−0.25	31
Not share leader	1.24	1.07	0.53	196	0.99	1.01	−2.07*	187
Acquisition	1.27	1.10	0.46	169	1.00	1.06	−2.19*	162
Internal growth	1.17	0.98	0.41	58	1.01	0.90	−0.15	56
Unannounced	1.02	0.88	−0.34	35	0.85	0.87	−2.49*	34
Announced	1.41	1.12	0.73	23	1.24	0.95	0.18	22
R&D subsample	1.40	1.25	−1.22	72	1.01	1.12	−2.35*	66
Acquisition	1.42	1.27	−1.09	60	1.03	1.14	−1.82*	55
Internal growth	1.25	1.13	−0.55	12	0.92	1.03	−1.78†	11
Both have citations	1.18	1.20	−1.29	54	0.97	1.09	−2.29*	51

Panel B: Return on assets

	Sample mean	Mean of medians	Test stat.[a]	*n*	Sample mean	Mean of medians	Test stat.[a]	*n*[b]
	Year 0 (ex ante)				*Year 1 (ex post)*			
All firms	0.08	0.07	1.09	227	0.05	0.06	−2.57**	218
Ex ante discount	−0.00	0.09	−3.39***	103	0.00	0.08	−4.52***	98
Ex ante premium	0.14	0.06	3.75***	124	0.08	0.05	1.49†	120
Share leader	0.13	0.08	1.31†	31	0.08	0.09	−0.18	31
Not share leader	0.07	0.07	0.62	196	0.04	0.06	−2.70**	187
Acquisition	0.09	0.07	1.86*	169	0.05	0.07	−2.27*	162
Internal growth	0.04	0.07	−0.73	58	0.03	0.05	−0.65	56
Unannounced	0.01	0.06	−0.41	35	0.03	0.04	−0.91	34
Announced	0.10	0.09	−0.73	23	0.04	0.07	0.76	22
R&D subsample	0.07	0.11	−0.99	72	0.07	0.08	−1.08	66
Acquisition	0.11	0.10	0.24	60	0.07	0.08	−0.62	55
Non-acquisition	−0.13	0.12	−2.43*	12	0.02	0.08	−1.33	11
Both have citations	0.07	0.11	−1.05	54	0.06	0.09	−1.56†	54

[a] All reported signed-rank tests are based on the difference between the sample firm's value and the industry median and use one-tailed significance values.

[b] Sample sizes may vary because there are no industry and size-matched peers from Year 0 that report the relevant value in Year 1. All sample firms report data for both listed years. Computing the Year 1 industry values using the lagged value of the dropped matches leads to similar results.

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

The unannounced category of firms has a significant discount after the event, although this is only significant for *q*, not ROA, in the full sample.

A second explanation for the *ex post* discount is found in the substantial drop in relative performance for acquiring firms. There are both theoretical and methodological reasons to believe that firms diversifying through acquisition should perform worse than firms diversifying through internal growth. Early strategy theory suggested that the choice between internal development and acquisition is driven both by industry structure (e.g., acquisition can overcome barriers to entry; Yip, 1982) and internal consistency (e.g., acquisition works for divisional organization but not functional structure; Pitts, 1977). Lamont and Anderson (1985) clarified that firms pursuing a strategy of both acquisition and internal growth fare just as well financially as those that restrict themselves to one mode. Finally, Chatterjee and Wernerfelt (1991) argued that the mode of diversification does not matter to financial performance directly,

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but that firms that match the appropriate mode to their resources or competitive context should be expected to outperform firms that fail to achieve that match. More recent research using larger samples and more refined methods finds some evidence for the expected links between resources, mode, and strategy type (unrelated vs. related). Busija, O'Neill, and Zeithaml (1997) review the arguments that internal growth is better aligned with related diversification, while acquisition fits unrelated diversification and its emphasis on financial controls. They conclude that firms that rely exclusively on the 'wrong' mode suffer lower performance than firms that use the 'right' mode or a mix. The mix of modes may take different forms or have different purposes. For example, in a longitudinal study, Vermeulen and Barkema (2001) explain how firms strike a balance between acquisition and greenfield investment over time to expand and then exploit the firm's knowledge. Chatterjee and Singh (1999) create a simultaneous equation model to clarify that resources matter more to the extent of diversification (change in a continuous measure over time) than to the mode. Nevertheless, firms implementing internal development tend to pursue more related diversification than do firms that acquire in their study. Likewise, using similar patent data to that of this paper, Silverman (1996) found that, for high-R&D firms, greater applicability of technology to a new industry was positively associated with internal growth mode rather than acquisition.

This result appears also for the present sample of firms that move from a single business segment to multiple segments. Correlations and results from a regression of a Herfindahl index of diversification (in the first year after the event) on the mode of diversification are shown in Table 6, Panels A and B. The coefficient on the dummy variables for announced and unannounced internal growth reflect the difference between each mode and the excluded category of acquisition. Both coefficients are positive and significant for the set of all diversifying firms with segment data in year 1. Thus, even for first diversification efforts, internal development leads to more related diversification than does acquisition, and prior research has established that related diversification tends to result in higher performance (Palich *et al*., 2000).

As in other samples (e.g., Chatterjee and Singh, 1999), some of the firms using internal development do pursue unrelated diversification. Kochhar and Hitt (1998) even find a positive relationship between direct entry and increase in unrelated diversification in a system of equations that incorporates capital structure for a sample of large manufacturing firms. This paper adds two insights to their call for more research to understand this relationship. First, researchers should understand that some firms that appear to be diversifying without acquisition may not be entering new markets. Compustat data on segment increases, in particular, include firms that do not announce a diversification effort, perhaps because the diversification had already occurred, but now a non-core segment has exceeded the size in the reporting requirement. Second, and more important, is the idea that researchers should distinguish between leaders and laggards that diversify. Lagging firms diversify technologically to escape competition in a particular market. Any diversification that is too highly related to the core industry will likely be a target for the leading firm, as well. Thus, some firms that enter seemingly unrelated industries are still relying on existing resources, and are making decisions based on competitive dynamics, not just managerial self-interest.

Accounting conventions explain another way acquisition can affect performance measures. Using a broad sample of firms that engage in diversifying acquisitions, Graham *et al*. (2002) find that the industry-adjusted performance of diversifying firms drops after acquisitions, even though the market reaction to those acquisition announcements is positive. They trace about half the value loss to the fact that the target firms, but not the acquiring firms, had a pre-existing discount. Other diversifying firms that increase the number of reported segments due to internal growth or reporting changes do not experience a decrease in value. Graham *et al*. (2002) characterize the acquisitions as efficient, because bidders may pay market value for poor performers, yet the acquiring firms still experience a decrease in 'excess value' because of how the measure is computed (based on multipliers of firm value to sales, assets, or earnings; see Berger and Ofek, 1995). Likewise, any acquiring firm with a market-to-book value (MTB) or Tobin's q above one would suffer a dilution in MTB from acquiring any firm with the purchase method, in which assets are marked to

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Table 6. Mode and extent of diversification

Panel A: Descriptive statistics and correlation matrix ($N = 225$)

Variable	Mean	S.D.	1	2	3	4
1. Herfindahl Index	0.661	0.161				
2. Acquisition	0.751	0.433	−0.257***			
3. Announced Internal Growth	0.098	0.298	0.265***	−0.572***		
4. Unannounced Internal Growth	0.151	0.359	−0.090	−0.733***	−0.139*	
5. Assets (millions)	1.045	4.166	0.065	−0.072	0.112†	−0.006

Panel B: OLS regression of Herfindahl Index of Diversification on mode variables

Announced	0.151***
Internal growth	(0.035)
Unannounced	0.058*
Internal growth	(0.029)
Assets	−0.000
	(0.000)
Constant	0.636***
	(0.012)
Adjusted R^2	0.088

Standard errors appear in parentheses underneath coefficient estimates.
† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

market value.[11] Similarly, in the pooling method, acquiring a firm with a q below one will reduce the q of the acquiring firm, if it was above one prior to the acquisition. Of course, firm ROA is a weighted average of the returns for each division, so an acquirer moving into an industry with lower returns will see a drop in ROA, regardless of the fact that the risk may also be lower in the new industry. Even if the expected ROA is the same for both divisions, the process of marking assets to market could also influence ROA in the short term. Suppose an acquirer buys a target with inferior returns, with market value and price paid reflecting some long-term improvements the acquirer can make or synergies that will take time to achieve. Then, in the first few periods after the acquisition—perhaps years—the poor returns of the new division will decrease the overall ROA of the firm. Longer-term returns could be used to solve the problem, but a company engaged in an ongoing acquisition and improvement program might be continually plagued by this effect. Thus, if a diversification strategy is more often accomplished through acquisition than are other strategies, its performance will appear lower than it actually is, especially for market-based measures of performance used in the finance literature.

A comparison with the internal growth mode elucidates the problem for this sample. Only the acquiring firms see significantly reduced ROA in the first year after diversification (Table 5). Examination of the segment data reveals that this drop is entirely due to the addition of new segments that have very low ROA. The mean ROA in continuing segments for both acquiring firms and announced internal growth firms is 12 percent, similar to the returns prior to diversification. However, the mean ROA in new segments for acquiring firms is only 3 percent and an even worse −5 percent for announced internal growth firms. It is not surprising that a new business has a period of investment prior to generating positive returns. However, both modes add new businesses with much lower ROA than in the firm's core industry, yet only the acquiring firms are penalized using Tobin's q. This apparently occurs because assets in underperforming targets are marked to

[11] As an example, consider a firm with a market value of $100 and replacement cost or total assets worth $50. This firm has a q of 2. If it acquires a firm for $50 at fair market value, the combined firm will have a q of 1.5. The market value of the combined firm will also reflect the market's estimate of whether the firm paid more or less than fair market value, but the denominator will include that positive or negative goodwill in total assets.

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market value in the purchase method or pooled in the alternate accounting method. Also, the median new segment from acquisition is one-fifth the size of the continuing segment, whereas new segments added through internal growth only represent a 10 percent increase. Therefore, the difference in *ex post* performance of related and unrelated diversifiers could be partly due to the fact that unrelated diversifiers use acquisition more often than internal growth.[12]

The evidence is consistent with a strategic theory of diversification that does not rely on agency costs. Although the assumptions underlying agency theory and resource-based theories may be at odds, both dynamics can be at work in the economy. Rather than offer a simplistic distinction between firms with good and bad governance, however, further theoretical development should consider when firms are most likely to create value through diversification, and when value is most likely to be destroyed. On the other hand, agency problems may explain why performance suffers prior to diversification. Self-interested managers may divert investment from long-term R&D projects and begin to lag behind, which will eventually lead to diversification. Poor governance may allow the firm to reach such a point of competitive disadvantage that diversification becomes an attractive option. Perhaps the diversification at that point is beneficial to investors, because it makes use of excess capacity or gains new returns from valuable, yet inferior intangible assets. The diversification may also be especially beneficial to managers of the struggling firm, who are now faced with the downside of having their human capital tied to a particular firm. The observation that diversifying firms have inferior assets does not preclude the agency theory proposition that managers might overdiversify to hedge their employment risk (Amihud and Lev, 1981).[13] Similarly, regardless of the motivation for initial diversification, the adoption of particular structures and controls could still further depress investment in R&D (Hoskisson and Hitt, 1988). Previous research that studied the effects of acquisition and divestiture among already diversified firms is another part of the puzzle. The benefit of looking at firm resources prior to the adoption of a particular strategy such as diversification is that it places the emphasis back on the ongoing operations of the firm, and how it has developed competitive advantage or disadvantage through its unique history. If it is indeed firms with poor innovation that diversify, then the normative implication is not to install governance devices whose primary effect is to prevent managers from diversifying, but rather those governance mechanisms (e.g., managerial equity ownership), organizational structures, culture, or other factors that will improve innovation.

Others have suggested that the main problem with diversification is not in the intention, but in the implementation (Porter, 1987; Ramanujam and Varadarajan, 1989; Sirower, 1997). If so, better governance might also focus on promoting better acquisition decisions. The process of gaining knowledge through acquisition is fraught with difficulties (Coff, 1999), and firms with multiple divisions face numerous conflicts over sharing of resources, whether financial (Williamson, 1975), technological (Ahuja and Lampert, 2001), or political (Shaffer and Hillman, 2000). Some evidence from this paper is consistent with the view that managers (even with good reasons to diversify) overestimate their ability to achieve synergies, or at least that synergies take time to achieve. For instance, the ROA of new segments is quite low in the first year after diversification. While not all sample firms survive, those that continue through the next few years still have much lower ROA in the new divisions than in the core business. By demonstrating that part of the endogeneity between diversification and performance relates to technological resources, the longitudinal evidence provides a link to knowledge management (Cohen and Levinthal, 1990; Kogut and Zander, 1992) and the development of capabilities over time (Dierickx and Cool, 1989). At least some firms purposefully broaden the scope of their technology prior to embarking on diversification. Perhaps further research at a more detailed level, such as within specific high-tech industries, can clarify when and why leading and lagging firms diversify, and the implications for top management. To the extent that diversification behavior is driven by the luck of an innovation race, existing managers should

[12] Park (2003) also deals with the endogeneity of the decision to diversify and the *ex post* performance differential between different corporate strategies. Among firms making large acquisitions, those that pursue related mergers have *ex ante* profitability that is superior to acquiring firms that pursue unrelated mergers. The related diversifiers' premium comes both from a pre-existing position of leadership within the industry as well as being located in industries with high average profitability.

[13] Thanks to an anonymous referee for clarifying this point.

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have the knowledge and trustworthiness to continue to lead the firm after it diversifies. On the other hand, if lax governance has allowed self-interested managers to undercut innovation efforts, then those managers should not be expected to manage an even larger and more diverse firm more effectively. The appropriate context for the theory and hypotheses in this paper is industries with frequent innovation and barriers to imitation. However, the implication is that the observed relationships can at least partially explain the diversification discount as it is measured for broad cross-sections of firms in many industries.

CONCLUSION

This paper reviews and clarifies strategic theory that explains how transaction costs lead firms to diversify to extend the value of knowledge assets. While the relationships between firm R&D intensity, technology breadth, the extent and mode of diversification, and financial performance have been investigated previously for samples of diversified firms, evidence from the sample of 227 firms when they first diversify (at the segment level) shows that less investment in R&D and broader knowledge assets predate the diversification event. Since these resources relate to firm performance, the lower-level *ex ante* is part of the reason why a diversification discount is observed *ex post*. Moreover, since many of the firms acquire low-performing target companies, the process of marking acquired assets to market or pooling assets decreases the market-based measures of performance even though the firm's managers are pursuing strategies in line with shareholder value.

This study has limitations. A more complex longitudinal design might consider the diversification changes in these firms over time or at a more precise level than is available using annual report data. Also, while patent data are available for all firms that patent, technical knowledge encoded in patents does not fully represent the kind of tacit knowledge on which firms can build competitive advantage. The theory as developed applies to R&D, but could also have implications for investment in any intangible assets, such as human capital. Moreover, prior research has used structural equation modeling to more fully specify the complex relationships among the variables of interest (e.g., Hitt *et al*., 1996). The concepts of this paper could be applied to similar methodology in a cross-sectional study, even incorporating measures of constructs important to agency theory. The longitudinal data cover a similar time period to other studies that have investigated the diversification discount. However, the 1980s and early 1990s did include two recessions and were generally a time when the market for corporate control was an active agent in refocusing firms. Replication on more recent years would be interesting and may shed light on the effects of changes in corporate governance and patenting. Finally, the hypotheses are tested within a given industry, but the relatedness hypothesis may also be applicable to the relative innovativeness or value of assets across industries. The difference in performance between related and unrelated diversifiers is probably due both to the economies of scope that can be created and the average profitability of firms in industries with high R&D intensity. Thus, this paper is only one step toward evaluating whether diversification truly adds or reduces value for a firm in a specific competitive context.

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APPENDIX: CREATION OF THE MEASURE OF TECHNOLOGY BREADTH

A firm's patent portfolio provides an indication of the extent of its inventiveness, and thus its innovation. The measure described here does not assume that patents reveal all valuable knowledge of the firm, but that the breadth of knowledge represented by patents is an accurate indicator of the breadth of the firm's technological resources. One could use the entire set of matching firms to compare technology breadth, but the more patents a firm has, the more likely they will be dispersed across classes or uses. On the other hand, if a firm's core patents are the most valuable, a citation-weighted measure of technology breadth may be lower for more firms with more citations. Thus, it is important to control for the level of R&D to avoid biased tests. On that basis the comparison group for patent data is restricted to no more than five single-segment firms in the same 2-digit industry that are closest to the sample firm in the level of R&D. Some sample firms have fewer than five industry peers fitting the size requirement. This results in a comparison group that, by design, does not differ from the matched firms in R&D level or intensity (or in the number of patents or citations, as it turns out).

Data from the United States Patent and Trademark Office, purchased in searchable format from the MicroPatent Corporation, are used to catalogue all patents issued from 1975 to 1998. Included in the counts are all utility patents to any subsidiary of the firm appearing in *The Directory of Corporate Affiliations* or the annual report for the relevant year. A rolling window covering the 6-year period for patent application prior to the year of diversification avoids problems with censoring. Likewise, citations are counted for each citing patent that has an application date no more than six years after the application date of the cited patent. The rate of citation declines after about the sixth year a patent is in effect (Jaffe, Trajtenberg, and Henderson, 1993). Another approach would be to create a citation stock (Hall *et al*., 2000), depreciating past patents and projecting expected citations to account for the fact that citations are only observable in the data for a few years, but will likely continue (right censoring). However, adding expected citations would always widen the gap between a firm with few patents and one with many. Therefore, tests based on the 6-year window are more conservative than tests based on projected measures. Furthermore, Lanjouw and Schankerman (1999) find 5-year citation measures are highly correlated with 10-year and 15-year measures and carry nearly as strong a signal of patent quality as the measures taken over longer periods.

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Table AI. Relationships between technology variables and performance
Panel A: Descriptive statistics and correlation matrix

Variable	Mean	S.D.	1	2	3	4	5
1. Tobin's *q*	1.593	1.380					
2. ROA	0.060	0.181	0.172***				
3. Assets	4.419	1.008	−0.181***	0.111***			
4. R&D Intensity[a]	0.073	0.060	0.220***	−0.276***	−0.129***		
5. Technology breadth[b]	2.839	0.575	0.137*	0.102	−0.058	−0.128*	
6. Median intensity	0.069	0.028	0.231***	−0.205***	−0.161***	0.460***	−0.115†

[a] Results are similar using R&D over sales rather than assets as the measure of intensity.
[b] $N = 237$ for correlations involving Technology Breadth and 856 otherwise.

Panel B: OLS regressions of performance on technology variables

	I	II	III	IV
D.V.	Tobin's *q*	ROA	Tobin's *q*	ROA
Constant	1.716***	0.097**	0.950*	−0.020
	(0.250)	(0.033)	(0.402)	(0.003)
Assets	−0.191***	0.012*	−0.168***	0.003
	(0.045)	(0.006)	(0.044)	(0.008)
Median intensity	7.203***	−0.583*		
	(1.821)	(0.239)		
R&D intensity	3.058***	−0.676***	7.761***	0.157
	(0.843)	(0.111)	(1.691)	(0.310)
Technology breadth			0.291*	0.034
			(0.112)	(0.021)
Adjusted R^2	0.09	0.08	0.12	0.00
N	856	856	237	237

Standard errors appear in parentheses underneath coefficient estimates.
† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Silverman's (1996) concordance assigns each patent class to an industry of manufacture and an industry of use. Thus, a patent in a class applied half the time to each of two SIC codes is like owning half of a 'patent equivalent' in each industry. Firms with highly specific knowledge might obtain most of their patents within the same patent classes, or at least classes that link to the same industry. Using IPC classes, the measure is a Herfindahl index in which a higher value equals greater specialization across classes (Argyres, 1996). Using the concordance, the new measure is $\Sigma_{j=1,\ldots,k}[\Sigma_{i=1,\ldots,n} p_{ij})/n]^* c_j$, where k is the number of 4-digit SIC codes and n is the number of patents. Each p_{ij} represents a patent equivalent from a particular patent in a given SIC code. The sum of these patent equivalents over the number of patents gives a proportion of the firm's patents in that SIC code. The term c_j is an indicator that equals zero if the SIC code is the same as some focal, 4-digit SIC code, 1 if the SIC codes match at the 3-digit level, 2 if matched at the 2-digit level, 3 if matched at the 1-digit level, and 4 if they are in different industry groups altogether. An alternative construction is based on 3-digit, rather than 4-digit industries. Refer to Table A1 for descriptive statistics and information on the relationship of Technology Breadth with other variables of interest (in Year 0) using correlation and regression analysis.

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