



New ventures' inward licensing: examining the effects of industry and strategy characteristics

Shaker A Zahra¹, Thomas Keil², Markku Maula³

¹University of Minnesota, Minneapolis, USA;

²York University, Toronto, Canada;

³Helsinki University of Technology, Helsinki, Finland

Correspondence:

SA Zahra, Center for Entrepreneurial Studies, Department of Strategic Management & Organization, Carlson School of Management, University of Minnesota, Room 3-428, 321 19th Ave. South, Minneapolis, MN 55455, USA.

Tel: +1 612 626 6623;

Fax: +1 612 626 1316;

E-mail: szahra@csom.umn.edu

Abstract

New ventures compete by creating innovative products. Liabilities of newness and inexperience, limited resources, rapid technological obsolescence and constantly changing market conditions often encourage new ventures to license other companies' technologies to complement and augment their internally developed innovations. Building on the knowledge-based view of the firm, we propose that the intensity of new ventures' use of inward licensing reflects the demands of their industries and competitive strategies. The results of an empirical study of 361 US new ventures show that industry characteristics and competitive strategy influence their inward licensing as a means of lowering costs and maintaining strategic flexibility while building their capabilities.

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Introduction

The knowledge-based view (KBV) of the firm offers an important framework for understanding the sources of competitive advantage (Kogut and Zander, 1992; Grant, 1996a, b). The KBV asserts that firms are communities that develop, integrate and exploit diverse types of knowledge in pursuit of competitive advantage. Companies may develop this knowledge internally through sustained investments in R&D or use external sources to assemble different types of knowledge and integrate them to create new products, goods and services (Zahra and Nielsen, 2002). New ventures, companies 6 years or younger, is a group of firms that need to use both internal R&D and external sources to assemble the knowledge necessary to survive and even prosper.

New ventures are themselves a major source of innovation and technological progress (Bhide, 2000). Yet, they may lack organizational, financial, production and marketing resources necessary to develop and commercialize their products (Allen, 2003). This encourages some new ventures to license other companies' technologies, thus lowering their own costs while focusing their scarce resources on

expediting the commercialization of their discoveries. Licensing also enables new ventures to avoid costly investments in technologies with uncertain futures and, instead, concentrate on those activities that differentiate their products from those of their rivals. Licensing is also the only way for these ventures to access other companies' intellectual property, especially when these companies are unwilling to sell their technologies. This is important because most new ventures have strong technological capabilities in one or a few areas (McGrath *et al.*, 1992) but often lack the complementary technologies necessary to commercialize their innovations (Zahra, 1996). New ventures might experience 'liabilities of newness' where customers, suppliers, creditors and other companies are reluctant to collaborate with them (Stinchcombe, 1965). These liabilities constrain these ventures' efforts to gain access to the broad set of capabilities needed to develop new products, goods or services (Grant, 1996a, b; Miller, 2003). Reducing costs while retaining strategic flexibility requires access to diverse knowledge that can be integrated and deployed to create value for customers. Licensing fills

gaps in new ventures' skill bases and allows them to assemble different capabilities inexpensively (Allen, 2003). The liabilities of newness extend into these ventures' internal operations, where managers and employees may not have the skills or experiences needed to build complex technologies and quickly commercialize them.

Companies across industries and even within the same industry vary considerably in their use of inward licensing. This variability arises from the distinct characteristics of new ventures' external environments (Zahra and Bogner, 2000). Where these differences create opportunities for these companies to exploit, the successful commercial exploitation demands different bundles of skills and capabilities through access to distinct and varied types of knowledge through licensing and other means. Another source of the differences in new ventures' inward licensing is their competitive strategies. Different strategies require multiple knowledge bases to build the various skills that underlie capabilities, defined as the set of competencies that new ventures use to accomplish their goals. The KBV posits that different skills and capabilities are developed by integrating diverse types of knowledge acquired from internal and external sources such as inward licensing. Researchers have examined alliances, acquisitions and joint ventures. Yet, despite its importance for success (Clegg, 1990; Hill, 1992), limited research exists on the factors that influence new ventures' use of licensing (Atuahene-Gima, 1993).

In this study, we examine the effect of the strategic context on new ventures' use of inward licensing. Strategic context refers to the demands of a new venture's industry characteristics and competitive strategy. Applying the KBV, we use data from 361 US new ventures in multiple industries. We believe that the analyses enrich our understanding of the variables that influence the definition of a firm's boundaries, a topic of interest to entrepreneurship and strategy scholars (Jarillo, 1989; Lee *et al.*, 2001; Bommer and Jalajas, 2004; Mota and deCastro, 2004).

Firm boundary decisions define those business activities to be performed internally *vs* externally. Traditional analyses of inward licensing have applied transaction cost economics (Williamson, 1985, 1991) while ignoring the potential long-term advantages and disadvantages of these decisions. Clearly, cost is important not only because of these ventures' limited financial resources but also the trial-error quality that characterizes their investment decisions. This is especially true in high technology industries where a constantly changing competitive landscape compels managers to improvise, possibly increasing the errors associated with various investment choices. Licensing can reduce new ventures' irreversible and costly investments, while lowering their initial costs.

Some new ventures can also learn from licensing other companies' technologies. Although licensing does not always enhance organizational learning, some ventures can capture important knowledge from the various licenses they obtain. Consequently, exposure to external sources of technology through licensing could fuel organizational learning (Grant and Baden-Fuller, 2004). New ventures sometimes learn from studying and observing the technologies that other companies have developed, especially as they begin to apply these technologies in their operations.

KBV scholars hold that this learning can enhance and protect a firm's competitive advantage (Coff, 2003). Therefore, applying the KBV, we explore the role of licensing in new ventures' accessing external knowledge. Thus, we contribute to the ongoing discussion of the variables that determine a firm's boundary decisions.

The next section of the paper discusses new ventures' potential gains from inward licensing. Invoking the KBV, we introduce the study's hypotheses on the effect of the firm's industry characteristics and competitive strategy on new ventures' inward licensing. The paper then presents an empirical study that tests these hypotheses. The final section of the paper summarizes the results and discusses their implications for effective managerial practice and future research.

Theory and hypotheses

The KBV asserts that knowledge is the firm's most important productive resource (Grant, 1996a, b). It views firms as social communities that are conducive to the creation and transfer of different types of knowledge (Kogut and Zander, 1996). New ventures, especially those created in young high technology industries, are such entities. They are usually established to capitalize on the new knowledge and discoveries created by scientific advances. These new ventures often have very different knowledge bases and skills from existing companies. Exploiting this knowledge can be an important source of a company's competitive advantage (Liebeskind, 1996).

The rapid pace of technological change and the growing complexity of products compel new ventures to connect to external sources of knowledge and use them in their operations (Kessler, 2003). This is especially true among new ventures that typically have limited internal knowledge and skills. The liabilities of newness these firms experience in assembling resources and capabilities would encourage them to license other companies' technologies. Newness also limits new venture managers' capacity to develop all the skills needed and quickly commercialize their technologies. Over time, licensing connects new ventures to 'knowledge networks' (Powell, Koput and Smith-Doerr, 1996) and gives them new knowledge that enhances their innovativeness (Henderson and Cockburn, 1994).

New ventures can also employ licensing to reduce their costs by lowering R&D spending (Hamilton, 1985), offsetting the limitations of their inexperience and newness. Licensing gives new ventures access to other companies' capabilities, instead of investing in uncertain R&D that may not generate these capabilities. This is important in view of the great technological and market uncertainties that characterize new ventures' markets. The need for flexibility, time compression diseconomies in capability building (Dierickx and Cool, 1989) and the uncertainty that surrounds internal R&D suggests that new ventures should seek licensing and other external sources to augment their internal capabilities. Inward licensing can help new ventures to upgrade their products (Kotabe *et al.*, 1996); overcome weaknesses in their product designs, manufacturing and marketing skills (Killing, 1977); and build the skills necessary for speedy product commercialization (Teece, 1986; Ogbuehi and Bellas, 1992; Allen, 2003).

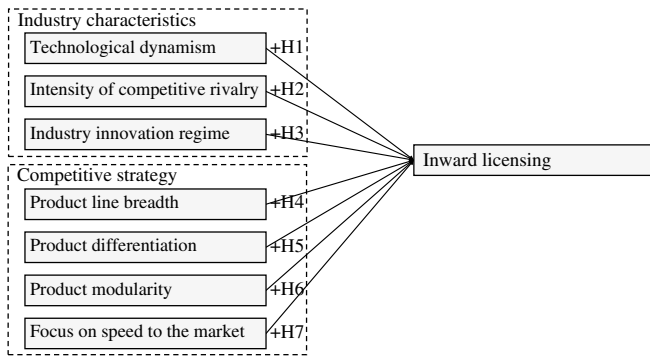


Figure 1 Hypothesized model.

The KBV also holds that the value of knowledge varies from one industry type to the next, reflecting the competitive forces and structures of these industries. Therefore, Figure 1 highlights two sets of variables that could influence new ventures' inward licensing. The first refers to industry-specific variables while the second covers competitive strategy variables. Each industry requires different types of knowledge for successful performance (Zahra and Bogner, 2000). Therefore, in Figure 1, we include three industry-related variables that influence new ventures' inward licensing: technological dynamism, intensity of competition, and dominant regime of innovation. Firm-specific variables also define the knowledge required to execute the venture's strategy, shaping the choice of internal vs external sources (Hambrick and MacMillan, 1985). These needs reflect a new venture's product line breadth, focus on speed to the market, product differentiation, and product modularity (Figure 1). We emphasize these variables because their successful execution demands different skills that require an integrated mix of knowledge bases. These variables are also among the widely recognized dimensions of a new venture's competitive strategy (Porter, 1980; Carter et al., 1994). By recognizing and evaluating the effects of industry and competitive strategy variables, our study connects the positioning school (Porter, 1980, 1985) and KBV of competitive strategy.

Industry context and inward licensing

Different industries pose different competitive challenges for new ventures. Addressing these challenges requires assembling different types of knowledge using internal R&D or accessing external sources (Leonard-Barton, 1995; Powell et al., 1996). One consequence of the 'liabilities of newness' is that new ventures' internal R&D activities are usually narrow in scope and therefore have to go beyond their limited and focused internal R&D by accessing external sources (Allen, 2003). New firms do not always have the resources or experiences to manage a large portfolio of R&D projects. New ventures are not only constrained by resources but also by their founders' motivation to exploit their inventions or discoveries (Bhide, 2000). These motivations are likely to vary from one industry to the next. The KBV asserts that the types of knowledge needed and their strategic importance vary across industries (Leonard-Barton, 1995). Figure 1 high-

lights three industry characteristics that could shape new ventures' inward licensing decisions: industry technological dynamism, intensity of competitive rivalry, and the innovation regime that dominates the industry.

Technological dynamism

Clegg (1990) observes that a firm's propensity for inward licensing is positively associated with its industry's technological dynamism. Dynamism refers to an industry's rapid technological change, evidenced in growing R&D investments, increased patenting, and the proliferation of new products. In industries characterized by technological dynamism, knowledge advances exponentially but also quickly becomes obsolete than in more stable environments (Zahra and Bogner, 2000). Dynamism challenges new ventures to update their knowledge bases frequently, using either internal or external knowledge sources. While new ventures often capitalize on opportunities opened by such rapid technological changes (Bhide, 2000), their products also experience rapid obsolescence. New ventures that fail to have the necessary skills to adapt to these changes are doomed to fail. Ironically, new ventures' potential high risk of failure in dynamic industries might discourage banks and other sources of capital from supporting their operations. Still, to evolve with the industry, these ventures have to update their products or add new items to their product portfolio (Jones, 2003). The KBV suggests that these additions demand strong R&D capabilities as well as inward licensing in order to shorten their product development cycles.

Rapid product development and successive product upgrades encourage new ventures to use and integrate diverse types of knowledge, much of which is not available internally. New ventures often have limited knowledge bases and cannot always wait to develop this knowledge internally. The knowledge needed to capitalize on technological changes and benefit from them is usually specialized and few firms have it. Even if new ventures have this specialized knowledge, the dynamism of their environment can quickly alter the skills required for success. Licensing ensures the flow of new knowledge into new ventures' operations, possibly expediting their product development and commercialization. Not surprisingly, Mowery et al. (1996) report that inward licensing is widespread in those industries that are experiencing rapid technological changes.

Technological changes often foster specialization and prompt companies to focus their internal resources on a few technologies. An important quality of new ventures is their resourcefulness in overcoming the limitations of their own resources. In fact, Stevenson and Gumpert (1985) suggest that new ventures thrive by using others' resources, rather than owning or controlling these resources. Consistent with the KBV, new ventures can use inward licensing to catch up quickly with their competition in areas that fall outside their expertise (Wilkinson, 1985). Few firms have the knowledge to compete in these dynamic industries. This is in contrast with stable industries where knowledge is widely diffused and might even reside in the quasi-public science base of those industries. Thus, changes in an industry's technological base and customers' needs pres-

sure new ventures to seek external knowledge through inward licensing (Grant, 1996a, b). Technological dynamism also creates new market segments, with unique customer needs and expectations. Licensing allows new ventures to quickly target and build strong market niches by capitalizing on emerging market segments. These observations suggest the following hypothesis:

H1: Industry technological dynamism is positively associated with new ventures' use of inward licensing.

Intensity of competitive rivalry

Industries also vary in the intensity of their competitive forces. Some industries have a few, well-established companies that dominate the market and therefore new ventures have to target niche markets. Other industries may have many competitors with different objectives, resources, capabilities and competitive strategies (Porter, 1980, 1985). In these latter industries, the risks of failure are high and new ventures must work hard to simply stay alive. In these competitive industries, new ventures have less leeway in developing those technologies they lack internally and therefore need to use external sources of knowledge such as inward licensing.

Given the risks of potential leapfrogging, some companies might not license their technologies to rivals. Others might want to simply swap licenses and assemble a broader set of skills. Still, others might use these licenses to access complementary assets and develop their own products. Other new ventures may not develop the products embodied in their licenses and instead use these licenses to generate the cash flow needed to sustain their operations.

The KBV suggests that, when competitive rivalry is high, firms have to seek the knowledge necessary to develop capabilities from external sources (Grant and Baden-Fuller, 2004). Inward licensing gives new ventures easy and fast access to new knowledge, offsetting the limitations of their inexperience and newness. Licenses are relatively easy to use, and frequently the knowledge they contain could be integrated into new ventures' knowledge bases without much adaptation. Following the KBV, inward licensing enables new ventures to customize and differentiate their product offerings from those of their rivals. Knowledge-based customization also ensures the distinctiveness of new ventures' products, facilitating targeting viable niches and achieving market success. Thus, as competitive rivalry increases, new ventures' use of inward licensing is likely to increase (Clegg, 1990; Gold, 1982; Hill, 1992). These observations suggest the following hypothesis:

H2: Intensity of the competitive rivalry in an industry is positively associated with new ventures' use of inward licensing.

Industry innovation regime

Industries emerge, grow and evolve because of innovation (Porter, 1980, 1985). These innovations could be incremental (additive) or disruptive (Christensen, 1997). Incremental innovations build upon, reinforce and extend the industry's existing technologies and therefore are known as 'creative accumulation' (Malerba and Orsenigo, 1997). Successive innovations generate knowledge that augments the industry's existing knowledge. Therefore, companies

can more easily foresee the future trajectory of a particular technology. These innovations and the ability to forecast changes in them help companies to grow with the technology either through internal R&D or external sources. These innovations are common in industries that build on mechanical engineering, which are known as M-type (Kotabe *et al.*, 1996).

Disruptive innovations typically signal radical shifts in the way the industry is structured and are the source of creative destruction in an industry (Malerba and Orsenigo, 1997). They are characterized by systemic-ness, a quality that encourages inward licensing because system-wide changes span a wide range of technologies. Creative destruction renders the knowledge that companies have obsolete, hampering their ability to exploit emerging opportunities. The knowledge essential to success in these industries differs qualitatively from an industry's prior knowledge structures. These innovations are widespread in biology-based (B-type) industries. New ventures that compete in these industries must use inward licensing to gain access to radically new knowledge, otherwise risk market failure. Disruptive changes also shorten the time available for these ventures to adapt, pressuring them to license and fill any gaps in their technological base.

Incremental innovations can intensify inward licensing to upgrade new ventures' products, reduce costs, retain flexibility, and expand product variety. However, inward licensing is expected to be higher when innovations are disruptive in nature. These innovations frequently originate from outside the industry (e.g. Tripsas, 1997), demanding new capabilities. Inward licensing might be the only way for new ventures to obtain this new knowledge. Disruptive innovations also encourage the formation of new ventures that specialize in narrow technological subfields, harvesting unique and often tacit knowledge. KBV scholars believe that learning this specialized knowledge is difficult and time consuming. With their survival in question, new ventures cannot afford taking the time to decipher, comprehend and assimilate this complex and tacit knowledge. With such specialized knowledge bases, new ventures may not have the requisite capacity to understand the knowledge obtained from their external environment (Zahra and George, 2002). Successful technology commercialization also requires a range of complementary knowledge (Teece, 1986; Henderson, 1994), which many ventures may not have because of their newness and specialization. Following the KBV, responding to disruptive innovations, however, could be achieved through inward licensing that brings new knowledge into the industry, fostering new ventures' capacity to expand their capabilities over time. This is most likely to occur in B-type industries where innovations do not build cumulatively on prior discoveries (Kotabe and Swan, 1995; Kotabe *et al.*, 1996). These observations suggest the following hypothesis:

H3: Disruptive regimes of innovation in new ventures' major industry are positively associated with new ventures' use of inward licensing.

New ventures' competitive strategy and inward licensing

While the industry context could significantly influence new ventures' inward licensing (Figure 1), firms within an

industry also vary in their competitive strategies because of differences in resources, especially their knowledge endowments. Competitive strategies provide the context within which new ventures determine and assemble the various capabilities they need to pursue their goals. Consistent with the KBV, to build strong market positions, new venture managers often have to combine their internal R&D with external sources of knowledge (e.g. licensing) to develop strong technological capabilities (Leonard-Barton, 1995). While a venture's competitive strategy might have multiple dimensions (e.g. Carter *et al.*, 1994), four in particular influence their inward licensing decisions: product line breadth; product differentiation; product modularity; and emphasis on speed to the market. These issues are as discussed next.

Product line breadth

Most ventures create and market one or a few products, but some compete by offering a broad product line (McDougall *et al.*, 1994). Serving a broad product line requires access to, and skill in, multiple technological fields that few new ventures have (Zahra and Bogner, 2000). Inward licensing can fill voids in these ventures' knowledge bases, shorten their development cycle, upgrade their products, and/or introduce new products. New ventures that offer a broad product line need diverse types of knowledge that could be obtained through licensing. In fact, a study by Atuahene-Gima (1993) of Australian companies reports a positive association between inward licensing and the number of technologies the firm sells. The same study reports that the desire to broaden the firm's product range is a key motivation for inward licensing. These results reinforce prior findings that product diversification increases inward technology licensing (Davidson and McFetridge, 1985; Clegg, 1990). Supporting diverse product lines often requires a multitude of knowledge-based resources that young and inexperienced ventures do not have internally. Consistent with the KBV, licensing gives new ventures access to the complementary assets needed to maintain a broad product line (Teece, 1986). Entrepreneurship centers on creatively recombining resources to add value (Schumpeter, 1934), and new ventures excel in this integration. These observations suggest the following hypothesis:

H4: The breadth of the product line is positively associated with new ventures' inward licensing.

Product differentiation

Some ventures compete by being low cost producers, stressing efficient manufacturing and distribution. Licensing helps these ventures by lowering their costs, while upgrading their products. Other new ventures offer distinctive products, a strategy that demands multiple skills and the ability to deploy them effectively to upgrade products and add new features (Porter, 1985). A product differentiation strategy centers on using new and perhaps unique knowledge in engineering or manufacturing than a strategy of offering standardized products. Differentiation could be in product attributes, function and ease of use. These various dimensions require different types of knowledge that new ventures may not have internally. While many new ventures excel in innovating, few have the

engineering and production skills to create these attributes. Therefore, new ventures may import some of the needed knowledge through licensing. Infusion of this external knowledge into these ventures' operations can spur radical product development by combining different knowledge bases, as argued by KBV scholars (Kogut and Zander, 1992). As such, new ventures can use inward licensing to complement their capabilities (Atuahene-Gima, 1993). These observations suggest the following hypothesis:

H5: Product differentiation is positively associated with new ventures' use of inward licensing.

Product modularity

Some new ventures follow a strategy of product modularity, where multiple components are assembled in different configurations (Kotabe *et al.*, 1996). Modularity gives these ventures flexibility in their operations, reduces their costs, offers customers a wide variety of products (Sanchez, 1995), facilitates rapid product upgrades, and lowers customers' switching costs. Upgrades also keep products current, differentiate them from the competition, enhance product performance (Garud and Kumaraswamy, 1993), and help new ventures to gain market share. Upgrades also safeguard against obsolescence that causes customers to resist buying these ventures' products. Modularity allows these ventures to more easily utilize external sources of knowledge because the linkages or interfaces between different components are standardized. This is important for those ventures that do not have significant expertise in and resources for producing diverse components but can license them from other companies. New ventures that follow this strategy benefit from inward licensing in upgrading their products' various components and protecting their market positions, while lowering their costs. KBV scholars (Grant, 1996a) observe that integration of such diverse knowledge is crucial to creating and sustaining firms' competitive advantage. New ventures often excel in this integration (Zahra *et al.*, 2000). These observations suggest the following hypothesis:

H6: Product modularity is positively associated with new ventures' use of inward licensing.

Focus on speed to the market

The importance of speed to the market also varies across industries and product lines (Ittner and Larcker, 1997), determining the value of different types of knowledge. New ventures' emphasis on speed to the market as a tool for building a competitive advantage also varies. Some ventures value agile responsiveness to the market, addressing customers' changing needs quickly and exploiting lucrative opportunities quickly. These ventures may seek 'first mover' advantages by reaching the market ahead of their competition. This is frequently accomplished by developing and effectively deploying capabilities (Zahra and Nielsen, 2002). Achieving market responsiveness and first mover advantages demand a set of knowledge-based skills that few ventures can build internally (Leonard-Barton, 1995). Internal knowledge development is too slow when compared to accessing this knowledge externally through licensing. Developing capabilities internally might

also be prohibitively expensive. The KBV recognizes that the process of building new capabilities also suffers from competence accumulation diseconomies (Dierickx and Cool, 1989). The KBV holds that, when expediting capability development, the costs might increase exponentially. Consequently, new ventures may use inward licensing to access these capabilities from others (Wilkinson, 1985). These observations suggest the following hypothesis:

H7: A focus on speed to the market in a new venture's competitive strategy is positively associated with inward licensing.

Method

Research design and sample

To test our hypotheses, a mail survey was conducted in 1998 and sent to firms that had been in business for up to 6 years (Zahra *et al.*, 2000). These ventures competed in eight high and eight low technology industries, using the US four-digit SIC. High technology industries were electronic components, chemicals, surgical appliances and appliances, machine tools, electro-medical equipment, process control equipment, measuring and testing devices, and surgical equipment. The low technology industry group included frozen food processing, textile and clothing, rubber and plastic products, basic metals, nonferrous metals, fabricated metal products, pulp and paper, and building and repairing of ships and boats. Given cost and time constraints, we focused on companies in Georgia, Virginia, Alabama, North Carolina, South Carolina, and Tennessee. These states have tried to diversify their economies by fostering the creation of new businesses.

In defining the study's target population, we did not restrict the size of the ventures and targeted both corporate and independent ventures. We obtained names and addresses from Hoover's (2005) Online (<http://www.hoovers.com>). In many cases, addresses were checked using company websites and state directories. A total of 2023 companies were identified. Two mailings, 1 month apart, targeted these firms' CEOs or highest ranking officers. In total, 91 questionnaires were undeliverable. We received completed responses from 361 new ventures, for a response rate of 18.7%. This rate is similar to other studies (e.g. Gartner and Thomas, 1993; Zahra, 1996; Zahra and Bogner, 2000).

We checked for potential nonresponse bias in the sample by comparing responding and nonresponding companies based on age and size (total number of employees). *T*-tests revealed no significant statistical differences between the two groups. The X^2 -test also showed no significant associations between responding and non-responding firms by state or industry type. At 3 months after data collection from the most senior managers, we mailed a shorter version of the survey to a second manager in each of the responding companies. We received 187 replies, which were then correlated with the responses received from the CEOs or highest-ranking officials. The two sets of responses on the study's variables were significantly correlated ($r = 0.73$, $P < 0.001$), indicating significant inter-rater reliability. We performed orthogonal factor analysis on the study's

variables, generating eight significant factors with eigenvalues above 1.0. Following Podsakoff and Organ (1986), we concluded that source bias was not a serious problem in this study.

Using the sample of 361 responding young ventures, we also collected data from several secondary sources. This included data about the licensing agreements announced by the firms in the sample from *Lexis-Nexis* (e.g. Pennings and Harianto, 1992; Steensma and Corley, 2000, 2001; Zahra *et al.*, 2000). Terms used to identify licensing agreements are listed in the Measures section below. Data for the strategy variables were collected through the mail survey and where possible validated through secondary data, as reported below. Data for industry variables came from Dun and Bradstreet: Industry Norms and Key Business Ratios (1992–2003) and Statistical Abstract of the United States (1990–2001). The use of multiple sources of data further reduced concern over source bias.

Measures

Data for licensing covered the 1999–2001 period. Data for the remaining variables covered the 1996–1998 period, as described next.

Inward licensing

The total number of technology licensing agreements announced by a venture over the 3-year period served as the study's measure of inward licensing. Marketing and distribution and other types of licensing agreements were excluded because of the focus on technology-related inward licensing. Information about licensing came from *Lexis-Nexis*, following past research (e.g. Steensma and Corley, 2000, 2001; Zahra *et al.*, 2000). To identify these agreements, we searched for the terms 'licensing', 'licensing and new ventures', 'licensing and new firms', 'licensing and small firms', 'technology licensing', and 'technology and licensing.' Data covered the 3-years following the survey data collection (1999–2001), lowering the probability of spurious results due to year-to-year fluctuations in the number of agreements. We validated the inward licensing measure by asking three advanced MBA students to review each announcement separately and ensure that it contained information on technology inward licensing. Raters agreed on 97% of the cases; those cases where disagreements persisted were excluded from the analyses.'

Technological dynamism

We measured technological dynamism using the composite score of three items: change in R&D spending as a percent of industry-wide sales (Kotabe *et al.*, 1996), change in the number of new product announcements in each industry, and change in the number of patents granted to companies in the industry. Changes were calculated over the 3-year period preceding the survey; these figures were standardized and then subjected to a factor analysis that generated a single factor (eigenvalue = 2.03; $\alpha = 0.72$). The average of the three items was used in the analyses. Information about industry R&D spending, patent counts, and new product introductions came from the Statistical Abstract of the United States (1990–2001).

Intensity of competitive rivalry

We measured this variable using the Herfindahl index, employing the Herfindahl-Hirschman Index Calculator (2001). Information about this index appears on the website: <http://www.unclaw.com/chin/teaching/antitrust/herfindahl.htm>. For each industry, we identified the 20 firms with the highest volume of sales in dollars. We then divided individual firms' shares by industry sales, squared each term and summed them across the scores. The higher the score on the index, the lower we expected the level of rivalry in the industry. To construct the industry concentration ratio, we obtained data from Standard and Poor's Compustat (2002) database, Business Week (1992–2001) and Fortune (1992–2001).

Industry innovation regime

Dummy codes captured three types of industry-wide innovation regimes. Following Kotabe and Swan (1995), we identified three such regimes: (a) M-type industries that offered products that were assembled from electronic and mechanical components; (b) B-type industries that included genetic biotechnology, pharmaceutical and chemical products; and (c) O-type industries that did not fit B or M types. O-type industries served as the reference group in the analyses reported later.¹

Product line breadth

We measured this variable by the number of the different products a new venture sold, using survey data. We validated this measure by counting the number of products listed under each venture using web sites and *Hoover's Directory*. Simple correlations between survey and secondary data were positive and significant ($r=0.75$, $n=213$, $P<0.001$).

Product differentiation

This was measured by the simple average of managers' responses to a three-item index ($\alpha=0.71$). On each item, we asked managers to compare their company's products to those offered by their major competitors using a five-point scale (1 = Strongly Disagree vs 5 = Strongly Agree). Items were: 'Our products are more superior to those offered by the competition'; 'Our products are more differentiated from those offered by the competition'; and 'Our products are more innovative than the products offered by the competition'.

If one accepts the positioning school of strategy (Porter, 1980, 1985), then the strategic choices that companies follow are best understood relative to their competitors (e.g. having superior products and spending more on R&D than the competition). Our measures reflect this view. Still, we have validated the results using three other survey items that asked managers to rate their companies' emphasis on various items over the preceding three years (1 = Low vs 5 = High). Items were: offering distinct products; product differentiation; and product innovation. We added the scores on these three items and averaged them (creating an 'emphasis on differentiation' index). We correlated the emphasis index with the score on the relative measure of the 'product differentiation', the simple correlation was 0.87 ($P<0.001$).²

Product modularity

This was measured by the average of managers' responses to a three-item index ($\alpha=0.71$). Responses followed a five-point scale (1 = Strongly Disagree vs 5 = Strongly Agree). Items were: 'Our products embody parts and components that can be mixed and matched in different ways'; 'Our products use multiple components that can be easily replaced by parts made by other companies'; and 'Our products combine multiple parts/components that can be obtained from multiple sources'.

Focus on speed to the market

This was measured by managers' average responses to three survey items that had a five-point scale (5 = Strongly Agree vs 1 = Strongly Disagree). Items were: 'Our strategy emphasizes being among the first to reach the market with new products'; 'Our company is faster than the competition in reaching the markets with new products and technologies'; and 'We have revised our internal systems to reach the market well ahead of our competitors'. Factor analysis of the three items yielded a single significant factor (eigenvalue = 2.01). Therefore, the simple average of responses to three items created an overall 'focus on speed to market' index ($\alpha=0.81$).

Control variables

Analyses also controlled for a new venture's ownership status, slack resources, age, size, technological leadership position, and past licensing agreements, as follows.

Venture ownership status

The analysis controlled for a venture's ownership that could influence the firm's financial and other resources. Independent ventures, those new firms founded by independent entrepreneurs, were more apt to experience more serious shortages in their resources than their corporate-sponsored counterparts. Independent ventures were also likely to have narrowly defined technological portfolios (Zahra, 1996), increasing the need for inward licensing. Ventures sponsored by well-established companies ('corporate ventures') could gain access to a wide range of networks through their parents' established and favorable reputations (Zahra and Bogner, 2000). Thus, we expected corporate ventures to have easier and greater access to licensing technologies from other companies than independent ventures.

Slack resources

New ventures that have high slack resources can use their internal R&D in developing new technologies and offset the limitations of their capabilities. However, capability development is a long and often uncertain process and new ventures might acquire technological knowledge through licensing. Therefore, high slack resources were expected to have a positive association with inward technological licensing. We measured slack resources using the liquidity ratio (e.g. Daniel *et al.*, 2004).

Venture age

The literature offers contradictory predictions on the effect of a company's age on inward licensing. Young start-ups do not have the resources or capabilities to develop their

products internally, possibly encouraging them to engage in licensing. However, as new ventures become more established, they can develop more products, necessitating licensing. New ventures become more proficient in licensing, making it easier for them to enter and manage more licensing agreements. Hamilton *et al.* (1990) reported that earlier in their life cycle, new ventures externalized many of their activities but over time they relied less on inward licensing. Thus, an inverted U-shaped relationship was expected between a new venture's age and use of inward licensing. Age was measured by the number of years a new venture has been in existence. Data came from state directories, company and trade publications, and company websites.

Venture size

Some have suggested that smaller companies were more likely to use inward licensing (McDonald and Leahey, 1985) and avoid investing in uncertain technologies. However, larger ventures might have better name recognition, target several market segments and offer several products, which might increase their inward licensing. In fact, researchers have found a positive relationship between firm size and inward licensing (e.g. Parry and Watson, 1979; Reid and Reid, 1988). We expected a similar positive association between a venture's size and inward licensing. Therefore, we used the log of a firm's full-time employees to measure size. We obtained the data from annual reports, state publications, and web page information.

Emphasis on technological leadership

We used a three-item index to capture a new venture's emphasis on technological leadership. Managers' responses

to the three items were averaged to develop an overall index ($\alpha = 0.64$). Items followed a 5-point response format (1 = Strongly Disagree vs 5 = Strongly Agree). Items were 'We compete by being the first to introduce new products or technologies to the market'; 'We are widely recognized in our industry for our technological leadership'; and 'Our company is known for setting the industry technological standard'.

Past licensing

The analyses also entered a venture's past inward licensing, thus controlling for 'path dependence' in these decisions. New ventures that used licensing were expected to become more proficient in licensing (Zahra and Nielsen, 2002), perpetuating their propensity to license others' technologies. The average annual number of inward licensing agreements completed between 1996 and 1998 captured past inward licensing. In those cases where a venture existed for less than 3 years at the time of the survey, we counted the number of technologies licensed from other companies and divided this figure by the number of the years since the venture's founding.

Analysis and results

Table 1 presents the means, standard deviations and inter-correlations among the study's variables. On average, new ventures announced 6.1 (SD = 13.9) inward licensing agreements over the study's 3-year time frame. These ventures were on average 3.9 years old, had 41 employees, and invested 8.1% of their annual sales on internal R&D. The correlations observed among the study's variables were consistent with theoretical expectations, reaffirming the

Table 1 Descriptive statistics and correlations

Variables	X	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Venture size ^a	41.03	67.91														
2 Venture age	3.92	1.89	0.31													
3 Slack resources ^a	1.71	3.27	0.23	0.15												
4 Corporate venture	0.41	0.48	0.33	-0.09	0.22											
5 Tech leadership position	3.09	1.08	0.12	0.04	-0.09	-0.16										
6 Past inward licensing	2.09	1.89	0.16	0.20	0.27	0.21	0.20									
7 Technological dynamism	0.69	0.53	0.12	-0.14	-0.09	-0.07	0.17	0.19								
8 Intensity of rivalry: Herfindahl Index	1109	629	0.16	-0.09	0.12	0.06	0.08	0.15	0.23							
9 Industry innovation regime type M	0.37	0.31	0.25	0.18	-0.05	0.26	0.17	0.20	0.29	0.21						
10 Industry innovation regime type B	0.46	0.40	-0.13	-0.09	0.17	0.15	-0.09	0.20	-0.09	-0.08	-0.18					
11 Product line breadth ^a	2.17	3.02	0.20	0.23	0.16	0.30	0.05	0.19	-0.08	0.14	0.11	-0.24				
12 Product differentiation	2.89	1.03	0.26	-0.09	0.15	0.14	0.31	-0.05	0.23	0.20	0.15	0.10	0.11			
13 Product modularity	2.94	1.35	0.18	0.19	-0.15	0.28	0.12	0.34	0.19	0.20	0.13	-0.20	0.23	-0.07		
14 Focus on speed to the market	3.11	0.87	0.15	0.21	0.18	0.12	0.19	0.22	0.26	0.27	0.28	-0.06	0.06	0.16	0.23	
15 Inward licensing ^a	6.10	13.90	0.19	0.20	-0.09	0.27	0.23	0.40	0.31	0.33	0.22	-0.12	0.29	-0.25	0.29	0.28

^aVariables were logged before calculating intercorrelations and performing the analyses reported in Table 2. All variables in the table were standardized before correlations were calculated and analyses reported in Table 2 were performed.

study's basic arguments. Variable inflation factors were also below 2.38, indicating that multicollinearity was not a serious problem.

Our dependent variable (number of inward licenses) has three important characteristics that influence the choice of the appropriate analytical method: it is nonnegative; it is integer-valued, denoting counts of inward licenses; and it exhibited over-dispersion. When the outcome variable is nonnegative and integer-valued, Poisson models are more appropriate than ordinary least square (OLS) models (Greene, 2003). When the data are over-dispersed, the standard distribution used is the negative binomial distribution, in which the Poisson assumption of equal mean and variance is relaxed (Hausman *et al.*, 1984; Cameron and Trivedi, 1998). Therefore, we employed the negative binomial regression model to estimate the number of inward licensing. Yet, an overdispersion of zeros in the licensing count might render the results of negative binomial regression unstable. Therefore, we followed Greene's (2003) modification of the variance structure, which accounted for such overdispersion. This modification made it possible to use a logit model to estimate whether a new venture engaged in licensing (set at 1) or not (set at zero). Thus, we used the zero inflated negative binomial (ZINB) technique to examine the hypotheses (Greene, 2003). For the sake of completeness, however, we report the results of negative binomial and ZINB regressions in Table 2. We employed the Vuong (1989) statistic to establish the appropriateness of ZINB over the negative binomial technique. This statistic has a normal distribution and the large positive values indicate the superiority of ZINB over the negative binomial model (Long, 1997).

The results from negative binomial regression and ZINB were fairly consistent (Table 2). Coefficients for some independent and control variables were somewhat different, however, reflecting the adjustments made when we

used ZINB. The Vuong statistic, however, suggested that ZINB better captured the relationships examined than negative binomial regression analysis. Next, ZINB showed that several industry variables had positive and significant effects on licensing count: technological dynamism ($P < 0.001$), intensity of rivalry ($P < 0.01$), and M-type or cumulative regime of innovation ($P < 0.05$). The following strategy variables had positive and significant coefficients: product line breadth ($P < 0.01$), product modularity ($P < 0.05$), and focus on speed to the market ($P < 0.05$). Product differentiation was significant ($P < 0.001$) but had a negative coefficient. Finally, three of the six control variables examined in the study had positive and significant coefficients. They were: being a corporate venture ($P < 0.05$), past inward licensing ($P < 0.001$), and emphasis on technological leadership ($P < 0.01$). Venture size, age and slack resources were not statistically significant.

Discussion and conclusions

The KBV of the firm asserts that companies can develop and sustain their competitive advantage by creating and exploiting new knowledge (Grant, 1996a,b; Grant and Baden-Fuller, 2004). This is especially true in the case of new ventures. Although widely considered an important source of innovation and technological progress, many new ventures do not possess all the capabilities necessary to transform their inventions into profitable products, goods or services. To overcome the limitations of their knowledge and internal capabilities, some ventures have made use of inward licensing. Yet, we know little about the factors that determine these ventures' inward licensing.

In this paper, we have invoked the KBV to suggest that competitive strategy and industry variables define the strategic context within which new ventures make their licensing decisions. This reflects the types of knowledge

Table 2 Negative binomial and zero inflated negative binomial (ZINB) regressions for new ventures' number of inward licenses

Variables	Model 1: Negative binomial		Model 2: ZINB	
	Coefficient	SE	Coefficient	SE
Venture size	0.09	0.013	0.03	0.008
Venture age	0.11	0.051	0.05	0.021
Venture age ²	-0.03	0.005	-0.07	0.013
Slack resources	0.07	0.012	-0.04	0.009
Corporate venture	0.15*	0.041	0.19*	0.058
Past inward licensing	0.29**	0.127	0.38***	0.093
Technological leadership	0.23*	0.085	0.29**	0.074
Technological dynamism	0.30***	0.112	0.49***	0.231
Intensity of rivalry: Herfindahl Index	0.20*	0.083	0.31**	0.129
Industry innovation regime type M	0.18*	0.052	0.18*	0.076
Industry innovation regime type B	0.1	0.051	0.05	0.021
Product breadth	0.25**	0.098	0.44***	0.205
Product differentiation	-0.18*	0.074	-0.30***	0.154
Product modularity	0.19*	0.054	0.22*	0.118
Focus on speed to the market	0.18*	0.079	0.19*	0.065
Log Likelihood	-103.07		-149.21	
Vuong Statistic	0.18		1.73*	

*** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$, $N = 361$. SE refers to robust standard errors.

needed to compete and the speed at which the accumulation of this knowledge should occur to develop a competitive advantage. Our results contribute to the literature on the KBV in the context of new ventures, especially regarding firm boundary decisions. By integrating the competitive strategy positioning school and KBV, our paper moves discussions of boundary decisions beyond cost transaction considerations (Williamson, 1985, 1991). The results show that inward licensing could be a valuable complement to other technology sourcing modes when new ventures need to quickly gain access to multiple and varied technologies, as discussed next.

Industry characteristics

Different competitive landscapes require different skills and capabilities for companies to survive and prosper. These requirements vary according to the characteristics of a firm's environment. Our results indicate that new ventures engage in inward licensing when their industry's technology changes rapidly, supporting hypothesis 1. Inward licensing also intensifies when competition in a venture's industry is high, supporting hypothesis 2. The results also indicate that new ventures employ inward licensing more frequently in industries where innovations grow in a cumulative fashion, building on prior knowledge and discoveries (i.e. M-type industries). In these industries, new ventures use other companies' innovations to complement their own home-grown technologies. We cannot say the same thing about B-type industries in which disruptive innovations are more frequent. The analysis suggests that the effect of this innovation regime on new ventures' use of inward licensing is positive but not significant, failing to support hypothesis 3. Perhaps, disruptive industry changes compel new ventures to utilize other external sources to gain new knowledge in order to better understand the logic behind technological changes.

Competitive strategy

The KBV suggests that the success of a firm's strategy rests on the firm's knowledge-based assets and resources (Kogut and Zander, 1992, 1996). Following this logic, different dimensions of a new venture's strategy would be expected to encourage companies to develop, hone and deploy different types of knowledge (Zahra and Nielsen, 2002). If this argument is correct, then new ventures would use different external sources to access this knowledge. Therefore, our study has sought to empirically link new ventures' competitive strategy dimensions to the use of inward licensing.

The results highlight the effect of competitive strategy variables in explaining new ventures' inward licensing, evidenced by the significant results in Models 2 and 4 (Table 2). Specifically, inward licensing increases when new ventures offer broad product lines, supporting our KBV explanations and hypothesis 4. These results may reflect our measures. A broad product line means that more diverse technologies are necessary, increasing opportunities for inward licensing.

We find also that emphasis on product differentiation is negatively but insignificantly associated with inward licensing, contradicting hypothesis 5. Thus, new ventures

that place a premium on differentiating their products from the competition may be reluctant to use others' technologies, erecting a significant barrier to potential imitation. Frequently, new ventures that compete as technological leaders adopt a differentiation strategy and seek to establish an industry standard in terms of new product attributes. Frequently, the change makers in their industries, these new ventures consistently push the frontiers of technological development to enhance product functionality and performance. These firms invest heavily in their internal R&D activities and obtain important knowledge from others. Still, creating and introducing radically new products demand multiple skills that these ventures may not have internally. New ventures that adopt this strategy need to master different technological fields, which is a daunting task. These ventures cannot afford sustaining an aggressive internal R&D program that covers multiple technological fields and may use licensing to complement their internal R&D. Of course, those ventures that compete as technological followers might license other companies' technologies to complement their own knowledge bases. Given that technological leaders and followers need different types of knowledge, these ventures might pursue different types of licenses. Our analyses do not explore this issue and future researchers would benefit from delineating the potential differences between technological leaders' license portfolios.

Consistent with the KBV, new ventures that use modular product designs and emphasize speed-to-market are more actively engage in inward licensing, supporting hypotheses 6 and 7, respectively. The results on product modularity (hypothesis 6) signal that product development choices might affect a firm's governance modes. Modular product architectures facilitate and perhaps expedite the integration of external technologies. Thus, rather than entering into time-consuming inter-firm collaborations that call for the tight integration of external technologies, new ventures can gain access to ready made solutions through inward licensing and then integrate them into their products.

Contributions to the KBV

Our analyses help to explain how new ventures' search for diverse and new knowledge can drive their use of external sources – especially licensing. The results contribute to a growing body of research on the KBV, supporting its key tenets. New ventures seeking to achieve survival and successful performance would benefit from enhancing their knowledge base by using licensing. The analyses delineate the industry and competitive conditions that promote new ventures' search for knowledge and use of licensing. It is clear that KBV arguments regarding external sourcing of capabilities have greater validity in dynamic environments where technological evolution is often discontinuous. A key insight from our research is that the strategic choices firms follow increase the strategic relevance of certain types of knowledge. These strategies include creating a broadly defined product line, using a modular product development approach, and employing speed to the market as a strategic weapon. These observations are consistent with our goal of connecting the positional school of strategy (Porter, 1980) with the emerging KBV of the firm. If knowledge is *the*

source of advantage, how new ventures obtain and use this knowledge to develop and implement effective strategies that position them to overcome the liabilities of their newness (Stinchcombe, 1965) and inexperience is an important research question. Answering this question necessitates connecting the positioning and KBV streams of strategy research, as we have attempted to do in this paper.

Limitations

The results should be interpreted with caution because our sample may not represent all manufacturing sectors of the US economy. Consequently, these results may not generalize to all new ventures, which may differ in their goals and strategic priorities. Understanding these goals can help determine how inward licensing may give new ventures new knowledge to develop a competitive advantage. The study does not examine these goals and the press releases we analyzed did not always contain information on these ventures' motivation to license. It is also possible that the nature of the licensing agreement might limit what a firm could do with the license, and our study neither analyzed these agreements nor considered the limits they imposed on new ventures. Finally, inward licensing is only one of the potential avenues to gain access to external knowledge. Firms might also use alliances, joint ventures or acquisitions. Future researchers should compare inward licensing with these alternative governance modes and establish their relative advantages and disadvantages under different industry characteristics and strategy conditions. Given the liabilities of newness that some ventures experience, how these companies gain access to these various sources also deserve attention. These limitations notwithstanding the results identify several areas worthy of future research.

Future research directions

We have examined the number of inward licensing agreements a venture has entered as the dependent variable. Future researchers may consider the number, types and sources of these licenses across a firm's value chain. Different types of inward licensing can give new ventures different types of knowledge, influencing their performance differently. New ventures may also experience different challenges in importing the knowledge contained in their licenses depending on the source of these licenses. These challenges can hinder new ventures' ability to create value through inward licensing.

Our results also indicate that strategic context variables influence new ventures' inward licensing, supporting earlier research into a firm's innovation (Hambrick and MacMillan, 1985) and boundary decisions (Williamson, 1985, 1991; Mota and DeCastro, 2004). These variables are major contingencies that influence managers' decision making regarding the intensity, scope and timing of investments in building technological capabilities. Future analyses would benefit from exploring other important variables that might explain new ventures' inward licensing. These variables might include the firm's culture and disposition toward risk, which might determine managers' support of internal R&D activities *vs* their interest in using external sources.

The firm's own capabilities and complexity of these capabilities might also influence licensing decisions.

The relationships between technological leadership positioning and inward licensing deserve further study. Technology leaders might follow a different approach to inward licensing than technology laggards. Therefore, future studies should explore the effect of using inward licensing on new ventures' innovative capabilities. Does inward licensing increase these ventures' ability to introduce radically new products to their markets? Does it shorten their product development cycle? Is there a threshold beyond which the use of inward licensing becomes detrimental to innovation? Does the excessive use of inward licensing reduce the firm's ability to develop internal sources of capabilities? Answering these questions requires researchers to investigate how new ventures capture, assimilate and exploit the knowledge contained in inward licensing and other external sources (Cohen and Levinthal, 1990; Zahra and George, 2002).

The results using industry variables also suggest several issues for future research. They show that an industry's regime of appropriation is an important dimension of a firm's strategic context. However, we have used a categorical measure to capture these regimes. Even though we have validated our results using the number of patents new ventures had in different technical subfields, future researchers should establish the robustness of the findings. Future researchers can use patent counts and classes across different industries. Another fruitful research avenue is to explore how different industry variables interact to influence a firm's sourcing decisions. Further, it would be insightful to examine the interactions between industry and competitive strategy variables to determine their effect on the use of licensing and other external sources. Given that strategy variables are also important in determining inward licensing, we need to examine the interactions between various strategic choice variables (e.g. speed to market and product modularity). Moreover, to gain a better appreciation of the impact of industry and strategy variables, researchers should consider the different types of licenses new ventures obtain and their motivations to acquire them. Making such fine distinctions can clarify when licensing is sought by (*vs* 'forced' on) new ventures.

The effect of an industry's technological dynamism also deserves attention. Not all dynamism is conducive to innovation. Dynamism might signal that the industry is fast approaching maturity. Companies may sharply reduce their R&D spending and staff, refocus their attention on fewer fields, and generate fewer and fewer patents. Our analyses did not account for this possibility. Future analyses should discern the effects of these changes on new ventures' licensing and other sourcing decisions.

A key question has guided our research: Under what conditions will new ventures need to access licensing? As noted, licensing is a widely used strategy for obtaining outside knowledge. Companies also use other sourcing strategies. Some of these strategies have important implications for ownership and governance, influencing new ventures' willingness to utilize them. These are also expensive strategies and new ventures often have to adjust their operations to integrate externally obtained knowledge with their internal knowledge. These adjustments magnify



the uncertainty associated with alliances and acquisitions. Future researchers would benefit from examining the conditions that lead some new ventures to use these external sourcing strategies such as alliances by simultaneously investigating other external sourcing strategies such as acquisitions.

Our study has analyzed several antecedents of inward licensing by new ventures. Using the KBV, the study has shown that industry characteristics and the competitive strategies that new ventures pursue are important explanations for these firms' use of inward licensing. Of the industry context variables considered, technological dynamism, intensity of competition and competing in an industry with a cumulative regime of innovation are conducive to increased inward licensing. Among competitive strategy variables, product line breadth, product modularity, and focus on speed-to-market are associated with new ventures' inward licensing. These results enrich our understanding of the factors that influence new ventures' licensing decisions. They also connect two important streams of strategy research: the positional school and the KBV of the firm. Our results invite future research to integrate these two streams and delineate how new ventures overcome resource shortages and liabilities of newness by using external sources such as licensing.

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Notes

- 1 Given the categorical nature of regimes of appropriation and the risk of misclassification inherent in analyses using such measures, we reran the analyses using the number of patents held in different technological subfields. We had data for only 198 of these ventures. The results were similar to those found with the categorical measures, indicating the robustness of the analysis.
- 2 We included the emphasis scale in the analyses reported late but the results did not change much from those found with the relative emphasis index. We report the results based on the relative emphasis measure later in the paper.

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