Disentangling the Theories of Firm Boundaries: A Path Model and Empirical Test

Melissa A. Schilling • H. Kevin Steensma[1]
Management and Organizational Behavior, New York University, Tisch Hall, 40 West 4th Street, Suite 7-30, New York, New York 10012
University of Washington, School of Business, Mackenzie Hall, Box 353200, Seattle, Washington 98195
mschilli@stern.nyu.edu • steensma@u.washington.edu

Abstract

Theories on the motivation underlying firm boundaries have recently sparked renewed debate. What best explains whether a firm relies on market control or hierarchical control to secure required resources? How do the characteristics of the resources come into play? In this study, we consider a comprehensive path model of the governance mode decision for sourcing technological know-how. By integrating different perspectives on firm boundaries, including transaction cost economics, a resource-based view, and an options perspective, we link characteristics of the technology (i.e., uniqueness, barriers to imitation, commercial uncertainty, technological dynamism) to the perceived threat of opportunism, the potential for sustainable advantage, and the pursuit of a licensing agreement vis-à-vis the outright acquisition of the firm that possesses the desired know-how. We use structural equation modeling to analyze 127 sourcing arrangements. Our results show that technological dynamism and barriers to imitation indirectly influence the governance mode decision by increasing the perceived threat of opportunism. Commercial uncertainty directly influences the governance mode and decreases the likelihood of an acquisition vis-à-vis a licensing agreement. Although uniqueness and barriers to imitation are also positively associated with the perceived potential for sustainable advantage, the potential for sustainable advantage had no direct effect on governance mode. Implications and suggestions for further research are offered.

(*Technology*; *Acquisitions*; *Licensing*; *Resource-Based View*; *Transaction Cost Economics*; *Options*)

Introduction

There has been renewed debate on the determinants of firm boundaries and their implications for performance (e.g., Ghoshal and Moran 1996). The widely accepted framework of transaction cost economics has come under scrutiny as a comprehensive theory for firm scale and scope (For example, in her review of the various schools of thought, Conner (1991) posed the question of whether the resource-based view provided a more comprehensive theory of the firm. Others have proposed an options perspective, whereby the uncertainty of a venture shapes governance mode choice (Folta 1998, Kogut 1991).

At the heart of this debate is whether the underlying mechanism determining firm boundaries is a fear of opportunism (as posited by transaction cost economists), a quest for sustainable advantage (as posed by resource-based view theorists and others), a desire for risk-reducing flexibility (as has recently gained increased attention in work on options), or a combination of factors. Although perspectives on firm boundaries such as transaction costs or the resource-based view are based on fundamentally different motivations for pursuing hierarchical control over market contracts, they rely on common resource or context attributes as antecedents (i.e., uniqueness, barriers to imitation, uncertainty) (Conner 1991, Sutcliffe and Zaheer 1998). Though often utilizing different terminology (e.g., rarity versus small numbers, barriers to imitation versus information transmission constraints), the basic dimensions underlying many of these antecedents are the same across the different theoretical perspectives. This congruity has made disentangling these three perspectives problematic and, consequently, has rendered existing empirical results inconclusive in the debate between the various camps. Indeed, depending on personal biases, the same empirical results may be interpreted in very different fashions. For example, barriers to imitation (such as resource tacitness) have been shown to lead to hierarchical arrangements as opposed to market transactions (Kim and Hwang 1992, Kogut and Zander 1993). Advocates of the transaction cost perspective would in all likelihood suggest that tacitness renders contract formation troublesome and potentially exposes the firm to opportunistic behavior. Contrarily, a sponsor of

1047-7039/02/1304/0387/$05.00
1526-5455 electronic ISSN

the resource-based view would claim that resource inimitability prompts the firm to attempt to control the resource as a vital source of sustainable advantage and above normal returns. The result is that any theoretical conclusions are, for all intents, indeterminate and questionable.

While previous work has looked at resource or context attributes and the governance mode chosen (e.g., Poppo and Zenger 1998), the manager perceptions or motivations mediating the relationship between resource attribute and governance mode chosen are often assumed to be unobservable, and are left to be inferred (Godfrey and Hill 1995). We argue here, however, that given the congruity of several contextual antecedents across competing theories, we must search out explanations as to why these antecedents work or risk spurious explanation (Sutton and Staw 1995). Do certain technological attributes lead to a fear of opportunism, a desire for flexibility, or a quest for sustainable advantage? As elaborated by Conner and Prahalad (1996), reliable theories on firm boundaries are necessary building blocks for ultimately addressing performance differences between firms.

We attempt to gain insight into the underlying mechanisms driving these decisions, and to tease apart competing theoretical explanations of firm boundary choice. Specifically, we create a path model linking the perceived attributes of technological know-how that are shared among these theories, including uniqueness, barriers to imitation, and uncertainty; the potential mediating factors of the threat of opportunism and opportunity for sustainable advantage; and governance mode choice. We begin by providing some definitions and reviewing three perspectives on firm boundaries in relation to specific resource attributes. Utilizing a path framework, we assess an overall model of the sourcing mode decision. We conclude with some general discussion and implications.

Sourcing Technological Know-How

There have been numerous attempts to characterize the domain of what is referred to as "technology." For the purpose of this study, we adopt an R&D-based definition of technology as provided by Abetti (1989). Technology is a body of knowledge, tools, and techniques (know-how) derived from both science and practical experience that is used in the development, design, production, and application of products, processes, systems, and services.

In general, organizations have three basic options for acquiring technological know-how: (1) develop the technology independently; (2) acquire another company that already possesses the technology; or (3) enter into a technology-sourcing agreement with an outside party (Lambe and Spekman 1997). Often, however, firms lack the requisite capabilities to "go it alone." If a firm lacks the requisite capabilities to develop the technology independently, and other organizations already have the technology, management can consider various external sourcing alternatives. Leonard-Barton (1995) developed a continuum of external sourcing methods based on the level of mutual commitment between the firm that has the technology (source firm) and the firm that desires the know-how (sourcing firm). These techniques ranged from arms-length licensing contracts, to more tightly coupled codevelopment partnerships and joint ventures, to the outright acquisition of the source firm. We focus on the two extremes of Leonard-Barton's continuum: market contracting through licensing versus the use of firm hierarchy through acquisition. It is possible to consider other arrangements, such as spot market transactions for technology (and others), to be even more extreme (Alchian and Woodward 1987), but for our purposes the dichotomy between licensing and acquisitions should provide an adequate range of governance mode choice. As Conner and Prahalad (1996, p. 478) argued, "the polar cases are basic particles from which more elaborate arrangements are constructed." Thus, insights gained from studying the polar cases can potentially be applied to a broader realm of governance modes that include the more complex hybrid structures (Conner and Prahalad 1996).

For our purposes, an acquisition is defined as one firm buying another for the intent of gaining access to the acquired firm's technology. The sourcing firm can then apply hierarchical control over the technology, personnel, and other assets of the acquired firm, and can enhance or apply the technology to its current needs at its discretion (Folta 1998). The level of commitment between the two previously independent firms is high because their success is fully intertwined.

Licensing represents a market contracting option for technology sourcing (Mowery et al. 1996, Robertson and Gatignon 1998, Shane 1994). Licensing occurs when a sourcing firm purchases the rights to another organization's patents or technology for a lump sum payment and royalties. A formal contract between the firms specifies the terms of the arrangement. Licensing provides the sourcing firm with somewhat limited control over the technology (compared to an acquisition) because the rights to the technology may be limited by the contract, and because the firm does not control the human capital that created the technology. Moreover, the mutual commitment between the two firms is minimal because the source of the technology has a low stake in the success of the sourcing firm (relative to when a source firm is acquired).

An Opportunism-Driven Explanation

The central argument of transaction cost economics proposes that the organization of economic activities is driven by the minimization of not only production costs, but also the associated transaction costs (Williamson 1985). Transaction costs include expenditures for activities such as search, negotiation, bargaining, writing and enforcing contingent contracts, and monitoring performance (Joskow 1987; Williamson 1975, 1985). Transaction cost economics treats market contracting as more efficient than integration a priori due to the benefits of market competition and the costs of organizing within the firm (Alston and Gillespie 1989). Under competitive market contracting, potential parties to each exchange must compete to be selected for a transaction, thereby driving potential suppliers and buyers to the most efficient pricing and quality achievable given their particular technology and market circumstances. Furthermore, market contracting avoids the bureaucratic costs of coordinating activities within a hierarchy. As stated by Alston and Gillespie, ". . .unless there are costs associated with using the market, transactions will not be organized through firms. Organization through a firm creates depreciation, agency, coordination, and shirking costs which will not be incurred unless there are larger costs associated with market transactions" (1989, p. 199). Market exchange, and in the present application, licensing agreements, thus provide the "default option" as well as the starting point of transaction cost analysis.

Transaction cost theory is grounded in the notion of bounded rationality and the potential for opportunistic behavior on the part of some individuals or firms (Foss 1996, Hill 1990, Simon 1961, Williamson 1985). The perceived risk of opportunism leads to ex ante transaction costs (contractual safeguards) and the recognition of possible ex post transaction costs (contract enforcement, loss of rents). To avoid excessive transaction costs, firms may internalize the potentially troublesome technology market contract through either internal development or the acquisition of the source firm. This internalization, however, is not expense free as bureaucratic costs are likely to increase. In the case of acquisition, the acquiring firm may have to put in place additional coordination devices and monitoring procedures, as well as utilize technical expertise to ensure that its goals are met. Management may have to contend with altering the culture of the acquired organization in order to be effective. Yet, transaction cost economics maintains that when the potential for opportunism in the market is high, employment contracts and authority-based relationships (employer-employee) may be more efficient than market contracts.

Actual estimation of transaction costs, however, has been problematic. The costs of searching out partners, negotiating contracts, and enforcing compliance are often difficult to observe. Due to this difficulty, much attention has been given to situations and contingencies where transaction costs are likely to arise from the potential for opportunistic behavior. Three commonly considered sources of transaction costs include (1) the extent to which the technology is rare or specific to the exchange; (2) the information asymmetry associated with the technology and the difficulty with which technological knowledge may be transmitted; and (3) the uncertainty associated with the technology.

Uniqueness and Small Numbers Bargaining. Transaction cost advocates argue that when there is a small number of existing firms from which a resource can be procured (as can arise when the resource is rare or somehow specific to the exchange), higher switching costs and increased opportunism on behalf of the provider can occur (e.g., Pisano 1990). When there are few suppliers available for a resource, the supplier, aware that the firm has few alternatives, can exploit the buyer's dependence. This is known as the "small numbers bargaining" problem (Williamson 1975, 1985). Asset specificity can also create a small numbers bargaining problem; even if there were initially many suppliers available for the technology, once the supplier or buyer has made relationship-specific investments for the exchange (as when technology has to be customized for transfer to a particular buyer), both the buyer and supplier find themselves in a small numbers bargaining situation (Williamson 1985).

These considerations are particularly relevant for technology sourcing as there are often a limited number of players in the marketplace capable of developing and providing state-of-the-art technology. Indeed, Contractor (1980) found that, on average, there were only five alternative global suppliers of a similar technology to which a prospective licensee could have turned. Such conditions provide limited options for the procuring firm and are likely to increase dependence on the source firm. Moreover, in many cases a procuring firm has to invest in customizing the technology for use within its own firm (increasing the technology's asset specificity), making the technology still more unique and exposing the procuring firm to even greater contracting hazards.

Because of the uniqueness of the technology, the supplying firm may demand excessive rents and take advantage of the sourcing firm unless stringent contracts and monitoring are used. To avoid these expenses, sourcing firms may pursue higher levels of internalization. For example, Pisano's (1990) examination of the biotechnology

industry found very few research and licensing agreements; instead there was a general reliance on firm organization. He attributed the prevalence of firm organization over market contracting to the small number of potential source firms capable of performing the unique tasks. According to Pisano's rationale, these firms chose to forgo contracting with each other to avoid being subject to potentially opportunistic behavior.

Barriers to Imitation and Information Costs. Barriers to imitation (such as tacitness or social complexity) pose information transmission problems between the source and sourcing firms, creating information asymmetry and information costs (Alston and Gillespie 1989). Technological know-how that is tacit in nature may be difficult to measure and even harder to transfer (Zander and Kogut 1995, Polanyi 1958). As Alchian and Woodward (1987) point out, the more difficult it is to determine the quality of a good or service, the more difficult and expensive it is to utilize market mechanisms for its exchange. Hennart (1988) describes these difficulties:

> The seller does not know how much it will cost him to effect the transfer. New technical or human problems are likely to arise which could not be foreseen when the contract was drafted. It is often difficult for both parties to distinguish ex post between poor luck or poor performance. In those circumstances, parties may exploit contract incompleteness and the difficulty of assessing performance to their own advantage. (1988, p. 366)

Technological know-how that is socially complex may not only have tacit elements, but might also not be encapsulated within a single (or few) person(s) who could facilitate its exchange. As eloquently stated by Foss, ". . .the knowledge is produced and reproduced in a social setting, is inseparable from this setting, and is not fully reducible to individuals" (1996, p. 471). In such a circumstance, information transmission constraints may make it virtually impossible to transfer the technological know-how through an arms-length contract. The conclusion is that under these conditions, common ownership and managerial directives will be more efficient than market contracts, which are likely to be subject to opportunism.

Uncertainty and Incomplete Contracts. Transaction cost scholars argue that technical and commercial uncertainty may also be a source of inefficiency in market contracts (Pisano 1990, Walker and Weber 1984). Conditions of high uncertainty make it difficult to write, execute, and monitor contractual arrangements (Teece 1986). The likelihood of the technical know-how leading to a workable innovation with market potential may be unknown. Other developing technologies may turn out to be more effective, rendering the chosen technology less valuable. Because the future of the technology is uncertain, establishing a complete contract accounting for all the possible contingencies is problematic. Combining uncertainty with market contracts often leads to a series of renegotiations and contingency clauses as disputes arise and the uncertainty is resolved (Pisano 1990). Naturally, these renegotiations open the contracting parties up to self-serving behavior, opportunism, and excessive transaction costs. In accordance with a transaction cost perspective, firm organization may be preferred to market contracts under these conditions because hierarchy and related incentive structures may be more efficient than market contracting. In sum, a transaction cost perspective suggests that certain technology attributes, including uniqueness, barriers to imitation, and uncertainty, influence the governance mode that is used for sourcing. The underlying mediating process between these attributes and governance mode is the threat of opportunism and subsequent transaction cost expenditures.

HYPOTHESIS 1A. *The uniqueness of the technology to be sourced will be positively associated with the perceived threat of opportunism.*

HYPOTHESIS 1B. *The barriers to imitation of the technology to be sourced will be positively associated with the perceived threat of opportunism.*

HYPOTHESIS 1C. *The uncertainty associated with the technology to be sourced will be positively associated with the perceived threat of opportunism.*

HYPOTHESIS 2. *The perceived threat of opportunism will increase the likelihood of a technology being sourced through an acquisition as opposed to a licensing agreement.*

A Sustainable Advantage Explanation

The primary contribution of the resource-based view is that it offers an explanation for long-lived differences in profitability among firms in the same industry. According to the resource-based view, the sustainability of a competitive resource and its associated Ricardian rents depends on the resource's uniqueness and limited imitability (Barney 1991). Technological resources that are hard to acquire or imitate are more likely to provide their owner with a sustainable competitive advantage and above-normal economic rents (Dierickx and Cool 1989, Reed and DeFillippi 1990). One underlying assumption of the resource-based view is that the strategic factor markets for these resources are inherently imperfect (Peteraf 1993). Without such imperfections, firms could only hope

for normal returns because above-normal returns would be competed away in the market.

These concepts are readily applicable to the study of firm boundaries. Those who have recently made efforts to look beyond transaction cost economics for a theory on firm boundaries tend to question the prevailing assumption that firms exist merely to internalize problematic market transactions (e.g., Conner and Prahalad 1996, Eisenhardt and Schoonhoven 1996, Madhok 1996, Peteraf 1993, Poppo and Zenger 1998). They view the firm as a repository of knowledge, where competitive advantage is the primary motivating factor of firm behavior. Thus, the firm is a seeker of unique and expensive-to-copy resources, and firm integration is driven by the quest for sustainable competitive advantage that is potentially independent of opportunism. As Conner (1991, pp. 139–140) suggests:

> Put differently, instead of viewing the firm as an 'avoider of a negative,' the resource-based literature tends to see the firm as the 'creator of a positive,' as creator of unique productive value. The literature's direction suggests a need to ascertain whether a case can be made that firms (as compared to collections of market contracts) exist for reasons primarily related to 'creating positives,' with or without opportunistic considerations.[2]

Both the resource-based view and the closely related "knowledge-based theory of the firm" posit that asset specificity may lead to internalization not necessarily because of the threat of opportunism, but because such internalization facilitates the coordination of asset-specific activities (Poppo and Zenger 1998). The shared knowledge, language, and routines that are developed within firms act as more efficient governance mechanisms (than market control) for resources that are unique, tacit, or otherwise difficult to imitate (Grant 1996, Kogut and Zander 1992, Moran and Ghoshal 1996, Poppo and Zenger 1998, Rumelt 1995).

As argued by Leonard-Barton (1995), acquisitions offer greater potential for core technological capability development that bestows a competitive advantage than do license agreements. An acquisition gives the purchasing firm direct access to, and control over, the technology and those individuals possessing the desired knowledge. In this way, the development and maintenance of high-potential technology can be better directed for future competitive advantage. Indeed, as pointed out by Alchian and Demsetz (1972) and Conner (1994), the fundamental sources of firm heterogeneity and high economic rents are resources and know-how that cannot be separated from the firm, but rather can only be bought or sold through the buying or selling of the business unit itself. Such know-how is resistant to imitation due to its strong tacit dimension and social complexity.

It is often argued that assets that are easily transferred through a licensing agreement are unlikely sources of Ricardian rents because (1) firms are unlikely to license out technological know-how that is the source of a competitive advantage, and (2) if the assets are traded on the market, the market will compete away above-normal rents (Dierickx and Cool 1989, Hill 1992). Furthermore, as a vehicle for sourcing capabilities, licensing is limited because license agreements involve relatively little interaction among firms. The recipient firm typically receives highly compartmentalized technology and may not fully comprehend the underlying knowledge. As a result, the organization is unable to determine how that technology should change over time, and the sourcing firm may grow increasingly dependent upon its source for the maintenance of that technology. Developing unique asset linkages may be difficult. If the technology is anticipated to provide significant future advantage, an acquisition will be more attractive.

In sum, the resource-based view suggests that resources that are unique and difficult to imitate offer the potential for sustainable competitive advantage. A firm may only be able to obtain such resources from another source firm through acquisition, and control by hierarchy will better enable the firm to direct and further develop such resources. Hierarchical control over resources that offer the potential for sustainable competitive advantage is thus posited to yield gains in excess of savings in transaction costs and the avoidance of market opportunism.

HYPOTHESIS 3A. *The uniqueness of the technology to be sourced will be positively associated with the perceived potential for a sustainable advantage.*

HYPOTHESIS 3B. *The barriers to imitation of the technology to be sourced will be positively associated with the perceived potential for a sustainable advantage.*

HYPOTHESIS 4. *The perceived potential for a sustainable advantage will increase the likelihood of a technology being sourced through an acquisition as opposed to a licensing agreement.*

An Options Perspective

The impact of technological uncertainty on firm boundary choices has received abundant attention over the years (e.g., Balakrishnan and Wernerfelt 1986, Thompson 1967). Though Thompson (1967) argued that rapid technological uncertainty might prompt an organization to increase its vertical integration to buffer the organization's core activities, more recent research typically argues that technological uncertainty provides a disincentive for integration, as asset investments are at risk of rapid obsolescence. According to an options perspective, the greater

the uncertainty associated with a particular technology, the better off a firm is to enter a flexible, low-commitment arrangement (Folta 1998, Kogut 1991). When uncertainty is low, maximum returns may be found through focusing resources in one direction and allowing the firm to advance down the learning curve faster or, perhaps, derive first-mover advantages. Under high uncertainty, however, the firm seeks the flexibility to increase or decrease its commitment as more information becomes known (McGrath 2000). In essence, this flexibility allows the firm to hedge its bets and increase its chance of survival. The greater the uncertainty associated with the technology, the larger the value of this flexibility.

Alternative external technology-sourcing modes provide the firm with variance in flexibility through which it can establish a portfolio consistent with its analysis of uncertainty. Though licensing contracts are not options in a literal or financial sense, they provide a higher level of flexibility than hierarchical control and restrict a firm's losses. Licensing agreements give the firm a limited stake in the technology, yet can enable it to increase its commitment at a later date. Firms use these modes as transitional governance forms to gain an early window on emerging technologies to which they may want to commit more fully in the future as the threat of commercial failure subsides (Mitchell and Singh 1992).

Although hierarchical control gained through acquisitions offers benefits (as discussed previously), it is also more difficult to reverse than market contracts and is thereby less effective at hedging against the threat of commercial failure (Folta 1998). Hierarchical control relies on employee contracts that can be costly to retract or difficult to sell to another firm if commercial expectations are not met (Duhaime and Schwenk 1985). An acquisition represents the highest level of commitment (Roberts and Berry 1985) and, in a sense, is the ultimate "strike" of a strategic option. Thus, contrary to a transaction cost perspective, the basic tenets of an options perspective as applied to this study suggest the following:

HYPOTHESIS 5. *The uncertainty associated with the technology to be sourced decreases the likelihood that the firm will pursue an acquisition as opposed to a licensing arrangement.*

Methods

Sample

The unit of analysis for our study was the external technology-sourcing decision. We identified specific instances of technology licensing agreements and technology-driven acquisitions in public announcements made through the newswires. The online *Dow Jones News Retrieval Service* was the primary search tool. To identify licensing agreements, we used the keywords "licensing agreements" and "technology" during the years of 1993–1994. Likewise, we used the keywords "acquisitions" and "technology" to identify acquisitions.[3] The announcements were subsequently downloaded and the content analyzed. We limited the sample to sourcing arrangements involving United States-based publicly traded firms as the sourcing firm. We took care to ensure that the motivation of the sourcing arrangement was indeed technology driven as opposed to marketing or market growth related. A respondent from the acquiring firm subsequently verified the motivation.

To ensure adequate representation of each of the two sourcing methods, we used a stratified sampling technique. We first stratified the population of sourcing arrangements for the years 1993 and 1994 according to governance mode (licensing or acquisition), and then 140 were randomly selected from each category.

We developed a questionnaire to measure the perceived decision context. The questionnaires were sent to two executives within each firm who were asked to respond in reference to the *specific* relationship cited in the public announcement and the technology gained through the relationship. One executive was the person cited in the public announcement, typically the CEO, president, or vice president. The other executive was the director of research and development or chief technology officer, as specified in the *Corptech Directory* (1995) of technology-intensive firms. Consistent with the logic of John (1984) and Huber and Power (1985), who argued for selecting knowledgeable informants, our choice of these respondents was based on the assumption that such individuals would have been involved in or very much aware of the context of the respective decision. We used the *Corptech Directory* (1995) to obtain the addresses and telephone numbers of the selected firms in the overall sample. We made telephone calls to each firm to verify information about the targeted executives.

Returns

We administered the survey in the early part of 1995. Questionnaires pertaining to 129 decisions were returned, for a total return rate of 46%. Two of those questionnaires were unusable because of missing data or because company policy prevented the executive from participating. Hence, the usable return rate was 44%. Fifty-two were returned from executives associated with licensing agreements and 75 from those associated with acquisitions. Dual responses were received for 29 sourcing arrangements, with both executives responding independently.

The makeup of the respondents was 12% chairmen, 16% CEOs or presidents, 13% senior vice presidents, 36% vice presidents, 18% R&D directors, and 5% other. The usable sample ($N = 127$) represented firms in 11 different industry segments based on the two-digit Standard Industrial Classification (SIC) codes. Eighty-seven percent of the sample firms were in one of five industry segments: chemicals, industrial machinery, electrical equipment, instruments, and software. Average annual sales for the participating firms was $2.54 billion.

We examined nonrespondent bias by comparing industry, sales, and R&D intensity (R&D expenses/sales) between firms that responded and those that failed to respond to the survey. We used cross-tab analysis to determine industry differences at the two-digit SIC-code level and found no significant industry differences between respondents and nonrespondents. Likewise, using a one-way analysis of variance, we found no significant differences between responding and nonresponding firms in terms of sales and R&D intensity.

Instrument Development

Survey items for the constructs described were developed from commonly accepted theoretical definitions and were partially influenced by the efforts of other researchers who had attempted to operationalize similar constructs (e.g., Kim and Hwang 1992, Souder and Shrivastava 1985). Many of the constructs had not been operationalized previously, however, or if they had, their application was restricted in terms of industry and context. Therefore, we used past research to obtain general insights into the operationalization, rather than specific construct items. We used business school professors and doctoral students who were familiar with the literature on which the empirical measures were based or who had sufficient expertise in survey design to critically assess the content validity of each item. We then pilot tested the instrument on a preliminary sample using 30 responses from executives who had made recent sourcing decisions. Those executives were identified through the sampling technique previously described. We then revised the measures on the basis of the pilot test. Given that the respondents were executives with significant time constraints, we made an effort to limit the number of items per construct while maintaining an appropriate level of reliability and content validity.

The resulting constructs and their individual items are available upon request. Items were measured using seven-point Likert scales. *Uniqueness* is captured in three items that assess the degree to which the technology in question is uncommon in the industry, or the degree to which competitors had fundamentally similar technology. *Barriers to imitation* is measured by three items questioning the perceived difficulty of imitating or reverse engineering the technology. *Commercial uncertainty* is evaluated with five items that assess the degree to which managers were confident the technology would meet technical and/or commercial expectations. *Dynamism* is captured in two items that assess the length of time for which the technology was anticipated to be valuable, or the length of its life cycle. *Threat of opportunism* includes three items that assess the degree to which managers perceived that there was a risk of being taken advantage of, or the likelihood of partners and suppliers behaving dishonestly if given an opportunity, and the amount of oversight that would be required in the exchange. *Potential for sustainable competitive advantage* is measured in three items that capture the degree to which managers felt the technology would differentiate the firm, or the degree to which managers felt that competitors would be able to reap similar strategic benefits within a short period of time.

Data Reliability

Incomplete recall and retrospective rationalization may confound results of surveys based on executives' recall of past events (Golden 1992). We used several means to limit the bias of results. First, virtually all of the respondents were from the top management team, and we were careful to determine that they had been involved in the specific decision. As pointed out by Miller et al. (1997), focusing respondents on a concrete event is less likely to generate biases or lead to impression management. Our identification of the dependent variable also limited the possibility of common method variance since the dependent and independent variables were derived from separate sources. Second, in our survey design the items specific to a given construct were separated from each other to minimize consistency bias and reduce any sense of repetitiveness. Additionally, each measure included at least one reverse-coded item. We motivated the respondents to provide accurate information by describing the usefulness of the project and guaranteeing them confidentiality. Eighty-three percent of the respondents requested a summary of the results by sending in a separate postcard, indicating their interest in the subject and recognition of its importance. Finally, to increase saliency, we asked the respondents to reflect on relatively recent decisions, thus minimizing bias due to the passage of time as well as retrospective rationalization based on a long-term performance evaluation.

Interrater reliability was calculated from the 29 procurement arrangements for which two independent responses were received. We estimated reliability by two statistical techniques. First, we assessed the correlation

between the ratings of the first and second respondent for each variable. The Pearson correlation coefficient was used for the normally distributed variables characterizing the technology, whereas Spearman's rank correlation coefficient was calculated for the sourcing history variables that were nonnormal. Correlation coefficients ranged from 0.63 to 0.88, with an average of 0.78. We also calculated the coefficient of agreement for each of the constructs. This agreement measure has advantages over correlation coefficients because it measures the level of identical agreement as opposed to proportionality (Robinson 1957). Agreement coefficients ranged from 0.61 to 0.88, with an average of 0.74. The performance appraisal literature suggests that interrater reliability should be above 0.60 to warrant a high level of confidence in the reliability of the measure (Latham and Wexley 1982). All six constructs derived from survey responses exceeded this benchmark. The responses from the multiple raters were averaged for each construct for the final sample.

Finally, to ensure that the original coding of the governance mode derived from the public announcement was correct, we asked each executive to verify the nature of the agreement (licensing, acquisition) and that the underlying motivation was technology driven.

Model Specification

Structural equation modeling is particularly effective when testing models that (1) are path analytic with mediating variables, and (2) contain latent constructs that are being measured with multiple indicators. Structural equation modeling allows for the simultaneous estimation of the relationships between the exogenous variables and the various levels of endogenous variables. Moreover, it provides for more purified measures of latent constructs that have been measured with multiple indicators. A structural equation program (e.g., LISREL, AMOS, EQS, Mplus) estimates the parameters in the model to get the best possible fit between the covariance structure of the observed data and the covariance structure of the conceptual model. Because our model of governance mode choice contains several latent variables and involves mediating variables, structural equation modeling was deemed appropriate.

Note that the final dependent variable in our model, governance mode, is dichotomous. Estimation of models involving endogenous categorical variables using structural equation modeling has been problematic in the past because of the necessary assumption of normality. However, Muthen and Muthen (1998) recently introduced Mplus, a comprehensive structural equation modeling program designed to estimate models that contain both continuous latent constructs and endogenous categorical variables. In essence, this program integrates linear regression modeling and Probit analysis in a structural equation framework. Mplus uses a weighted least-squares estimator with robust standard errors, and mean- and variance-adjusted chi-square test statistics. These statistics have been proven viable with relatively small samples (Muthen et al. 2002). Therefore, we used Mplus to test our model.

Initial confirmatory factor analysis indicated that our overall construct of technological uncertainty had two dimensions—commercial uncertainty and technical dynamism. The first dimension relates to the uncertainty associated with product design and the market's acceptance of those products and processes. The second dimension relates to the uncertainty of whether the underlying technology will be of ongoing value in the midst of a changing technological environment (Clark and Wheelwright 1993). Thus, the six latent constructs in our model are (1) commercial uncertainty, (2) technical dynamism, (3) barriers to imitation, (4) uniqueness, (5) threat of opportunism, and (6) potential for sustainable advantage. Governance mode was coded as a dichotomous variable (0 = license agreement, 1 = acquisition).

In addition to the variables of theoretical interest, we controlled for firm size and organizational slack. The overall size of the organization is typically controlled for in studies of decision making within an innovation and technology context (e.g., Tyler and Steensma 1995). It stands to reason that larger firms may have a greater ability to pursue acquisitions than smaller firms. Thus, the natural log of annual sales was included in the model. To account for industry differences, we normalized the average annual sales figure for each firm by dividing it by the average sales for firms within each firm's primary four-digit SIC industry.

The relative availability of slack is also thought to influence strategic behavior and risk taking (Wiseman and Bromiley 1996). We used accounting-based slack measures normally associated with recoverable and potential slack. Recoverable slack represents the level of discretionary resources absorbed in a firm's operations and was measured by the combination of accounts receivable/sales and inventory over sales. We combined two ratios for potential slack: equity/debt and the interest coverage ratio (income before interest and taxes/interest expense). Data for each firm in our sample came from Compustat for the fiscal year prior to the licensing agreement or acquisition. Because ratios that are normal in one industry may be at the high or low extreme in another, we indexed our firm-level ratios against the median industry values by dividing each firm's ratios by the four-digit SIC median ratios. These ratios were then standardized and combined accordingly.

We employed a system of three simultaneous equations to estimate the coefficients of the structural model. The first equation suggests that the threat of opportunism is a function of commercial uncertainty, technical dynamism, barriers to imitation, and uniqueness:

$$\text{Threat of opportunism} = \gamma_{11}\text{*Commercial uncertainty} + \gamma_{12}\text{*Technical dynamism} + \gamma_{13}\text{*Barriers to imitation} + \gamma_{14}\text{*Uniqueness} + \varsigma_1. \quad (1)$$

The second equation states that the perceived potential for sustainable advantage is a function of barriers to imitation and uniqueness:

$$\text{Potential for sustainable advantage} = \gamma_{23}\text{*Barriers to imitation} + \gamma_{24}\text{*Uniqueness} + \varsigma_2 \quad (2)$$

The third equation states that the governance mode is influenced by the threat of opportunism, the potential for sustainable advantage, commercial uncertainty, technical dynamism, firm size, and slack:

$$\text{Governance mode} = B_{31}\text{*Threat of opportunism} + B_{32}\text{*Potential for sustainable advantage} + \gamma_{31}\text{*Commercial uncertainty} + \gamma_{32}\text{*Technical dynamism} + \gamma_{33}\text{*Firm size} + \gamma_{34}\text{*Potential slack} + \gamma_{35}\text{*Recoverable slack} + \varsigma_3 \quad (3)$$

Figure 1 depicts these equations with the empirically derived standardized coefficients.

Data Analysis

We used a two-step approach to analyze the model (Anderson and Gerbing 1988). Confirmatory factor analysis established the validity of the measurement model and our latent constructs. The structural model then estimated the relationships between all constructs.

Measurement Model. An iterative process was used to specify the measurement model on the basis of both content and statistical considerations (Anderson and Gerbing 1988). Maximum likelihood parameter estimation was used and a satisfactory fit was achieved ($\chi^2 = 269.72$, $df = 197$, $p < 0.01$, RMSEA = 0.05, CFI = 0.92). The ratio of chi-square to degrees of freedom is 1.37; a value of less than three for the ratio indicates a good fit (Carmines and McIver 1981). A CFI value of 0.9 or above is also considered an indication of good fit (Bentler and Bonett 1980). Although the chi-square statistic is still significant, we considered the measurement model acceptable given the other supportive indexes (Anderson and Gerbing 1988). We further verified the discriminant validity of our scales by comparing the shared variance between any two constructs and the variance extracted from each. In all cases, the shared variance between two constructs was less than the variance extracted from each of the constructs, providing some evidence for construct validity. Moreover, none of the confidence intervals for the correlation coefficients between any two constructs contained 1.0, providing support for the discriminant validity of the scaled constructs (Anderson and Gerbing 1988).

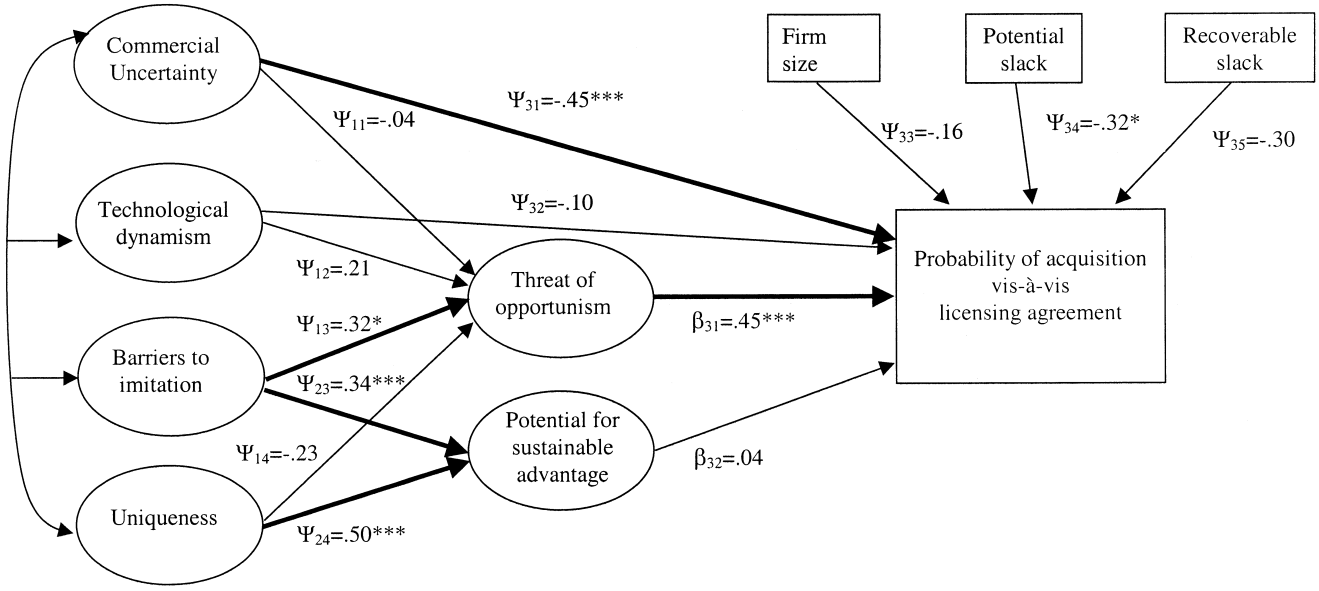
Table 1 reports the standardized coefficient for each item and composite reliability for each construct. These reliability estimates ranged from 0.60 to 0.86 for the six latent constructs in the model; all are above the 0.6 cutoff value suggested by Bagozzi and Yi (1988). Overall, the results indicate that the measurement model is appropriate for use with the full structural model. The final measures used for the various constructs are reported in the Appendix.

Structural Model. Figure 1 is the structural model that we tested and includes parameter values for the various linkages. Based on the preliminary bivariate correlation coefficients (Table 2), certain exogenous constructs were correlated at a level that was significantly different from zero. The paths between the exogenous constructs were freed to be estimated in the final model. A weighted least-squares parameter estimation was used, and the value for the chi-square statistic with 43 degrees of freedom was 68.11 ($p < 0.01$). The ratio of the chi-square statistic to the degrees of freedom was 1.58, indicating a good fit and allowing for the testing of the structural linkages among the constructs. CFI and RMSEA are not defined for models with categorical outcomes and are estimated using weighted least squares (Muthen and Muthen 1998). Of the 10 linkages proposed in the a priori model, 6 are significant at the 0.05 level and are in the expected direction.

Results

Table 2 reports means, standard deviations, and correlations between each composite construct. Table 3 summarizes the relationships tested in our model. In Hypotheses 1A, 1B, and 1C, we predicted that the uniqueness of the technology, its barriers to imitation, and its uncertainty would be positively associated with the perceived threat of opportunism. The relationships involving uniqueness, commercial uncertainty, and technological dynamism were not significant. The barriers to imitation of the technology, however, had a significant and positive

Figure 1 Structural Model with Obtained Standardized Coefficients



Bold indicates significance and anticipated direction.

influence on the perceived threat of opportunism ($\gamma_{13} = 0.32$, $p < 0.05$), lending support for Hypothesis 1B. In Hypothesis 2, we predicted that the perceived threat of opportunism would increase the likelihood of an acquisition as opposed to a licensing agreement. This relationship was significant in the direction predicted ($B_{31} = 0.45$, $p < 0.001$). Hypothesis 2 is supported.

In Hypotheses 3A and 3B, we suggested that both the uniqueness of the technology and its barriers to imitation would be positively associated with the perceived potential for sustainable advantage. The coefficient associated with uniqueness was significant and in the direction hypothesized ($\gamma_{24} = 0.50$, $p < 0.001$). The coefficient associated with barriers to imitation was also significant and in the predicted direction ($\gamma_{23} = 0.34$, $p < 0.001$). Thus, Hypotheses 3A and 3B are both supported. We argued in Hypothesis 4 that the perceived potential for sustainable advantage would increase the likelihood of the technology being sourced through an acquisition as opposed to a licensing agreement. This hypothesis was not supported.

In Hypothesis 5 we proposed that higher levels of uncertainty associated with the technology would decrease the likelihood that the technology would be sourced using an acquisition as opposed to a licensing agreement. Technological dynamism was not significantly related to governance mode. Commercial uncertainty, however, was significant and in the predicted direction ($\gamma_{31} = -0.45$, $p < 0.001$). Thus, partial support is found for Hypothesis 5.

Discussion

In this study, we explored how the various attributes of technology to be sourced influence the governance mode chosen, and the intermediate mechanisms by which they do so. We find that uniqueness and difficulty of imitation are significantly related to the perceived potential for sustainable advantage. However, we do not find that the perceived potential for sustainable advantage is significantly related to governance mode choice. We also find that technological dynamism and difficulty of imitation are significantly related to the perceived threat of opportunism. In turn, consistent with a transaction cost perspective, the threat of opportunism increases the probability of acquisition vis-à-vis licensing. We find, in addition, that consistent with an options perspective, commercial uncertainty significantly decreases the likelihood of sourcing through acquisition.

These findings suggest that the resource-based view, transaction cost economics, and an options perspective may play complementary roles in explaining firm technology-sourcing decisions: Firms may pursue resources that are unique or inimitable because of their potential to create a sustainable competitive advantage, but the uniqueness and inimitability may also create a potential for opportunism. The potential for opportunism and the degree of uncertainty associated with the technological resources then heavily influence the governance mode chosen. In sum, the results imply that the resource-based view explains why a firm pursues particular

resources rather than others, but transaction costs and an options perspective better explain the governance mode undertaken for accessing the resources once they are chosen.

Another interesting finding is that the two different types of uncertainty (commercial, technological dynamism) have distinct effects on governance mode. Consistent with an options perspective, commercial uncertainty directly decreased the likelihood of an acquisition vis-à-vis licensing. In contrast, technological dynamism did not influence the threat of opportunism or governance mode. These findings complement the work done by Sutcliffe and Zaheer (1998) on the different forms of uncertainty and their influence on governance modes. Using experimental data collected from 308 managers, Sutcliffe and Zaheer found that technological uncertainty led to a preference for arms-length arrangements, whereas supplier uncertainty led to a preference for hierarchy.

The overall message of our results is that the resource-based view, transaction costs, and options perspectives each explain only a portion of managerial motivation (Tyler and Steensma 1995). The rationale supporting the choices firms make regarding technology sourcing is multidimensional; firms are not only seeking potential sources of competitive advantage, but are also seeking to avoid opportunism and to preserve or create flexibility. Constraining explanations of firm behavior to only one perspective may produce some confirmatory results, but may obscure the more complex motivations underlying firm actions. More broadly, these results also indicate the importance of including the mechanisms by which independent variables are posited to impact dependent variables in both theory building and empirical testing. Many competing theories may yield outcomes that are equifinal, and inferring causal mechanisms from them without explicitly measuring and testing such mechanisms may prevent us from advancing our understanding.

Table 1 Coefficients, *Z* Statistics, and Reliability Values for the Measurement Model

Construct/ Indicator	Standardized Coefficient	Estimate/ St. Error	Reliability[a]
Commercial uncertainty			0.86
v3	0.55	–[b]	
v7	0.70	5.74***	
v8	0.86	6.35***	
v11	0.73	5.89***	
v13	0.72	5.83***	
v15	0.71	5.77***	
Technical dynamism			0.65
v1	0.53	–[b]	
v22	0.85	4.07***	
Uniqueness			0.72
v30	0.87	–[b]	
v44	0.53	5.61***	
v49	0.63	6.60***	
Barriers to imitation			0.81
v5	0.66	–[b]	
v14	0.77	7.11***	
v18	0.87	7.46***	
Threat of opportunism			0.60
v17	0.82	–[b]	
v42	0.44	2.86***	
v43	0.43	2.84***	
Potential for sustainable advantage			0.81
v34	0.81	–[b]	
v52	0.83	9.08***	
v53	0.64	7.05***	
Firm size	1.00	–[b]	
Potential slack	1.00	–[b]	
Recoverable slack	1.00	–[b]	

[a]Denotes composite reliabilities.
[b]Coefficients of leading indicator for each construct were set to 1.0 to establish scale.
*** $p < 0.001$.

Limitations and Directions for Future Research

Some authors have suggested that the resource-based view is more focused on a firm's creation of positives, while transaction cost economics is more focused on a firm's avoidance of negatives (e.g., Conner 1991). Others have contested such a distinction (e.g., Foss 1996). An interesting extension to these findings that might lend insight into the gains-versus-loss debate would be to consider under which conditions management is more influenced by threats of loss or opportunities for gain. Research has shown that individuals vary in their risk aversion, which may influence the decision calculus used in such decisions as governance modes (Schneider and Lopes 1986, Shapira 1995). Previous research also indicates that the willingness of managers to take risks is partially determined by the context of the organization and its policies (Baird and Thomas 1985, McNamara and Bromiley 1997, Sitkin and Pablo 1992, Steensma and Corley 2001). For example, the firm's incentive system (Eisenhardt 1989, Hill and Snell 1989), existing firm

Table 2 Intercorrelation Matrix for Dependent, Independent, and Control Variables

	Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9
(1) Acquisition vs. licensing	0.59	0.49	–									
(2) Firm size	3.76	2.67	0.05	–								
(3) Potential slack	0.00	1.51	−0.21*	−0.08	–							
(4) Recoverable slack	0.00	1.72	−0.16	−0.18*	0.02	–						
(5) Potential for sustainable advantage	14.19	4.01	0.11	−0.13	−0.08	0.05	–					
(6) Threat of opportunism	11.53	3.30	0.27*	0.14	−0.14	−0.11	0.02	–				
(7) Barriers to imitation	13.83	4.36	0.20*	−0.05	−0.06	0.03	0.47*	−0.04	–			
(8) Uniqueness	19.51	5.19	−0.08	−0.25*	−0.08	0.16	0.54*	−0.23*	0.44*	–		
(9) Technological dynamism	2.64	2.05	−0.22*	−0.08	0.09	−0.01	−0.32*	0.07	−0.31*	−0.30*	–	
(10) Commercial uncertainty	15.75	5.99	−0.42*	−0.27*	0.16	0.01	0.01	−0.06	0.08	−0.03	0.33*	

*$p < 0.05$.

Table 3 Magnitude and Significance of Hypothesized Structural Relationships[a]

Following/Leading Constructs	Expected Sign	Parameter	Stand. Direct Effect	Estimate/St. Error
Threat of opportunism				
Commercial uncertainty	+	γ_{11}	−0.04	−0.36
Technical dynamism	+	γ_{12}	0.21	1.23
Barriers to imitation	+	γ_{13}	0.32*	1.86
Uniqueness	+	γ_{14}	−0.23	−1.32
Potential for sustainable advantage				
Barriers to imitation	+	γ_{23}	0.34*	3.11
Uniqueness	+	γ_{24}	0.50*	4.63
Likelihood of acquisition vis-à-vis licensing agreement				
Threat of opportunism	+	B_{31}	0.45*	3.40
Potential for sustainable advantage	+	B_{32}	0.04	0.35
Commercial uncertainty	−	γ_{31}	−0.45*	−4.92
Technological dynamism	−	γ_{32}	−0.10	−0.79
Firm size	+	γ_{33}	−0.16	−0.02
Potential slack	+	γ_{34}	−0.32*	2.26
Recoverable slack	+	γ_{35}	−0.30	1.03

*$p < 0.05$.
[a]based on a one-tailed test.

wealth (e.g., Bromiley 1991, Singh 1986, Wiseman and Bromiley 1996), and the overall culture of the firm (Douglas and Wildavsky 1982) may significantly influence managerial risk-taking behavior. Integrating managerial risk preferences into a multitheoretical model of governance mode choice would provide much-needed insight into whether transaction cost rationale or the alternative perspectives provide a stronger explanation for the determination of firm boundaries.

It is also interesting to note that results indicate that barriers to imitation are related to both the perceived threat of opportunism and the perceived potential for sustainable advantage. There has been significant debate as to whether inimitability of know-how influences governance mode because of (1) the market failure and opportunism associated with tacit or socially complex know-how (Hennart 1988, Hill et al. 1990), or (2) the differential advantage derived from maintaining tacit or socially complex know-how within firm boundaries independent of opportunism (Kogut and Zander 1993). Both rationales lead to the same prediction: The more difficult it is to imitate the know-how, the more likely it is for firms to

rely on hierarchy. It would be useful for future research to explore exactly when particular barriers to imitation (e.g., tacitness, social complexity, etc.) are more likely to lead to a sense of potential opportunism and when they may lead to a sense that the firm may be able to derive a sustainable advantage with such know-how. That is, although we have examined opportunism and potential for sustainable advantage as mediators of the relationship between barriers to imitation and governance mode, it would also be interesting to conduct a finer-grained study of the relationship between different barriers to imitation, potential opportunism and potential sustainable advantage, and any moderators that may influence these relationships.

One limitation of the current study is that our measures of opportunism might have been perceived differently by the two subsamples, those who made acquisitions versus those who had formed license agreements. Specifically, those who have made acquisitions might be addressing the opportunism questions as a "what if" scenario, and speculating on the threat of opportunism that would have been present had the technology been obtained through an arm's-length contract. In contrast, those who licensed the technology can base their answers on their actual experience with the exchange. This difference has the potential to introduce some degree of bias into the responses.[4] To help assess the degree to which differences in the subsamples impacted their perception of the threat of opportunism (or, for that matter, the potential for sustainable advantage), we ran OLS-moderated regression models using the dummy variable (licensing versus acquisition) as a moderator on the relationship between the antecedents and (1) potential for opportunism and (2) potential for sustainable advantage. The results indicated no significant moderator effect, suggesting that the structure of the relationship between resource characteristics and perceived potential for opportunism or sustainable advantage did not vary depending on whether the know-how was acquired through licensing or acquisition. This finding provides some reassurance that the differences in the subsamples did not introduce significant bias.

While this research provides a more complete picture of the antecedents and motivation underlying firm boundaries, future work is needed to explore the implications of these choices in terms of firm performance. All three perspectives on firm boundaries are based on the premise that these decisions are made in attempts to optimize firm performance. Work has only begun to link the various theories on firm boundaries to performance outcomes (e.g., Steensma and Corley 2000). For instance, Poppo and Zenger (1998) found an empirical link between a transaction cost perspective and satisfaction with outsourcing activities for information system services. In contrast, Ghoshal and Moran (1996) argued that basing governance mode decisions on transaction cost logic is bad for practice and can lead to a self-fulfilling prophecy in which opportunistic behavior increases. Clearly, additional work is needed in this area.

Acknowledgments

The authors would like to thank the Helen Moore Gerhardt Faculty Fellowship at the University of Washington for their generous support and several anonymous reviewers whose suggestions improved the paper substantially.

Endnotes

[1]Authorship is listed alphabetically; both authors contributed equally.

[2]Foss (1996) argues that the distinction between "creating positives" and "avoiding negatives" does not genuinely separate transaction cost economics and resource-based perspectives because the creation of positives is important in contractual approaches also. He further notes that any theory of organization must include opportunism, for if there were no moral hazard, then cospecialization of resources would have no implications for ownership. Any gains achievable from the combination of resources could be realized through market transactions.

[3]Noted limitations of this method include the reliance on arrangements that have been made public, a bias toward large firms, and an underreporting of the more casual forms such as licensing (Hagedoorn and Schakenraad 1994).

[4]The authors are grateful to an anonymous reviewer for pointing this out.

References

Abetti, P.A. 1989. Technology: A key strategic resource. *Management Rev.* **78**(2) 37–41.

Alchian, A., H. Demsetz. 1972. Production, information costs, and economic organization. *Amer. Econom. Rev.* **62** 777–795.

——, S. Woodward. 1987. Reflections on the theory of the firm. *J. Institutional and Theoret. Econom.* **143** 111–136.

Alston, L., W. Gillespie. 1989. Resource coordination and transaction costs: A framework for analyzing the firm/market boundary. *J. Econom. Behavior and Organ.* **11** 191–212.

Anderson, J. C., D. W. Gerbing. 1988. Structural equation modeling in practice: A review and recommended two step approach. *Psych. Bull.* **103** 411–423.

Bagozzi, R. P., Y. Yi. 1988. On the evaluation of structural equation models. *J. Acad. Marketing Sci.* **16** 74–94.

Baird, I., H. Thomas. 1985. Toward a contingency model of strategic risk taking. *Acad. Management Rev.* **10** 230–243.

Balakrishnan, S., B. Wernerfelt. 1986. Technical change, competition and vertical integration. *Strategic Management J.* **7** 347–360.

Barney, J. 1991. Firm resources and sustained competitive advantage. *J. Management* **17** 99–120.

Bentler, P. M., D. G. Bonett. 1980. Significance tests and goodness of fit in the analysis of covariance structures. *Psych. Bull.* **88** 588–606.

Bromiley, P. 1991. Testing a causal model of corporate risk taking and performance. *Acad. Management J.* **34** 37–59.

Carmines, E., J. McIver. 1981. Analyzing models with unobserved

variables: Analysis of covariance structures. G. Bohrnstedt and E. Borgatta, eds. *Social Measurement: Current Issues*. Sage, Beverly Hills, CA, 65–115.

Clark, K. B., S. C. Wheelwright. 1993. *Managing New Product and Process Development*. Free Press, New York.

Conner, K. 1991. A historical comparison of resource-based theory and five schools of thought within industrial organization economics: Do we have a new theory of the firm? *J. Management* **17** 121–154.

——. 1994. The resource-based challenge to the industry-structure perspective. *Acad. Management Best Papers Proc.* 17–21.

——, C. K. Prahalad. 1996. A resource-based theory of the firm: Knowledge versus opportunism. *Organ. Sci.* **7** 477–501.

Contractor, F. J. 1980. The profitability of technology licensing by U.S. multinationals. *J. Internat. Bus. Stud.* **11** 40–63.

Dierickx, I., K. Cool. 1989. Asset stock accumulation and sustainability of competitive advantage. *Management Sci.* **35** 1504–1514.

Douglas, M., A. Wildavsky. 1982. *Risk and Culture*. University of California Press, Berkeley, CA.

Duhaime, I. M., C. R. Schwenk. 1985. Conjectures on cognitive simplification in acquisition and divestment decision making. *Strategic Management J.* **5** 301–318.

Eisenhardt, K. M. 1989. Agency theory: An assessment and review. *Acad. Management Rev.* **14** 57–74.

——, C. Schoonhoven. 1996. Resource-based view of strategic alliance formation: Strategic and social effects in entrepreneurial firms. *Organ. Sci.* **7** 136–150.

Folta, T. 1998. Governance and uncertainty: The trade-off between administrative control and commitment. *Strategic Management J.* **19** 1007–1028.

Foss, N. 1996. Knowledge-based approaches to the theory of the firm: Some critical comments. *Organ. Sci.* **7** 470–477.

Ghoshal, S., P. Moran. 1996. Bad for practice: A critique of the transaction cost theory. *Acad. Management Rev.* **21** 13–47.

Godfrey, P. C., C. W. L. Hill. 1995. The problem of unobservables in strategic management research. *Strategic Management J.* **16** 519–533.

Golden, B. R. 1992. The past is the past—Or is it? The use of retrospective accounts as indicators of past strategy. *Acad. Management J.* **35** 848–860.

Grant, R. M. 1996. Toward a knowledge-based theory of the firm. *Strategic Management J.* **17**(Winter Special Issue) 109–122.

Hagedoorn, J., J. Schakenraad. 1994. The effect of strategic technology alliances on company performance. *Strategic Management J.* **15** 291–310.

Hennart, J. F. 1988. A transaction cost theory of equity joint ventures. *Strategic Management J.* **9** 361–374.

Hill, C. W. L. 1990. Cooperation, opportunism, and the invisible hand: Implications for transaction cost theory. *Acad. Management Rev.* **15** 500–513.

——. 1992. Strategies for exploiting technological innovations: When and when not to license. *Organ. Sci.* **3** 428–441.

——, S. A. Snell. 1989. Effects of ownership structure and control on corporate productivity. *Acad. Management J.* **32** 25–46.

——, P. Hwang, W. C. Kim. 1990. An eclectic theory of the choice of international entry mode. *Strategic Management J.* **11** 117–28.

Huber, G. P., D. J. Power. 1985. Retrospective reports of strategic-level managers: Guidelines for increasing their accuracy. *Strategic Management J.* **6** 171–180.

John, G. 1984. An empirical investigation of some antecedents of opportunism in a marketing channel. *J. Marketing Res.* **21** 278–289.

Joskow, P. 1987. Contract duration and relationship-specific investments: Empirical evidence from coal markets. *Amer. Econom. Rev.* **77** 168–185.

Kim, W. C., P. Hwang 1992. Global strategy and multinationals' entry mode choice. *J. Internat. Bus. Stud.* **23** 29–53.

Kogut, B. 1991. Joint ventures and the option to expand and acquire. *Management Sci.* **37** 19–33.

——, U. Zander. 1992. Knowledge of the firm, combinative capabilities, and the replication of technology. *Organ. Sci.* **3** 383–397.

——, ——. 1993. Knowledge of the firm and the evolutionary theory of the MNC. *J. Internat. Bus. Stud.* **24** 625–645.

——, ——. 1996. What firms do? Coordination, identity, and learning. *Organ. Sci.* **7** 502–518.

Lambe, C. J., R. E. Spekman. 1997. Alliances, external technology acquisition, and discontinuous technological change. *J. Product Innovation Management*. **14** 102–116.

Latham, G. P., K. N. Wexley. 1982. *Increasing Productivity Through Performance Appraisal*. Addison Wesley, Reading, MA.

Leonard-Barton, D. 1995. *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation*. Harvard Business School Press, Boston, MA.

Madhok, A. 1996. The organization of economic activity: Transaction costs, firm capabilities, and the nature of governance. *Organ. Sci.* **7** 577–590.

McGrath, R. T. 2000. Assessing technology projects using real options reasoning. *Res. Tech. Management* **43**(4) 35–50.

McNamara, G., P. Bromiley. 1997. Decision making in an organizational setting: Cognitive and organizational influences on risk assessment in commercial lending. *Acad. Management J.* **40** 1063–1088.

Miller, C., L. Cardinal, W. Glick. 1997. Retrospective reports in organizational research: A reexamination of recent evidence. *Acad. Management J.* **40** 189–204.

Mitchell, W., K. Singh. 1992. Incumbants' use of pre-entry alliances before expansion into new technical subfields of an industry. *J. Econom. Behavior and Organ.* **18** 347–372.

Moran, P., S. Ghoshal. 1996. Theories of economic organization: The case for realism and balance. *Acad. Management Rev.* **21** 58–72.

Mowery, D. C., J. E. Oxley, B. S. Silverman 1996. Strategic alliances and interfirm knowledge transfer. *Strategic Management J.* **17**(Special Issue) 77–91.

Muthen, B. O., S. du Toit, D. Spisic. 2002. Robust inference using weighted least squares and quadratic estimating equations in latent variable modeling with categorical and continuous outcomes. Forthcoming, *Psychometrica*.

Muthen, L., B. Muthen. 1998. *Mplus: The Comprehensive Modeling Program for Applied Researchers*. Muthen and Muthen, Los Angeles, CA.

Peteraf, M. A. 1993. The cornerstones of competitive advantage: A resource-based view. *Strategic Management J.* **14** 179–191.

Pisano, G. P. 1990. The R and D boundaries of the firm: An empirical analysis. *Admin. Sci. Quart.* **35** 153–176.

Polanyi, M. 1958. *Personal Knowledge: Towards a Post-Critical Philosophy*. University of Chicago Press, Chicago, IL.

Poppo, L., T. Zenger. 1998. Testing alternative theories of the firm: Transaction cost, knowledge-based, and measurement explanations for make-or-buy decisions in information services. *Strategic Management J.* **19** 853–877.

Reed, R., R. J. DeFillippi. 1990. Causal ambiguity, barriers to imitation, and sustainable competitive advantage. *Acad. Management Rev.* **15** 88–102.

Roberts, E. B., C. A. Berry. 1985. Entering new businesses: Selecting strategies for success. *Sloan Management Rev.* **26** 3–17.

Robertson, T. S., H. Gatignon. 1998. Technology development mode: A transaction cost conceptualization. *Strategic Management J.* **19** 515–531.

Robinson, W. S. 1957. The statistical measurement of agreement. *Amer. Sociological Rev.* **22** 17–25.

Rumelt, R. P. 1995. Inertia and transformation. C. A. Montgomery, ed. *Resource-Based and Evolutionary Theories of the Firm*. Kluwer Academic Publishers, Boston, MA, 101–132.

Schneider, S., L. Lopes. 1986. Reflection in preferences under risk: Who and when may suggest why. *J. Experiment. Psych.—Human Perception and Performance* **12** 535–548.

Shane, S. 1994. The effect of national culture on the choice between licensing and direct foreign investment. *Strategic Management J.* **15** 627–642.

Shapira, Z. 1995. *Risk Taking: A Managerial Perspective*. Russell Sage Foundation, New York.

Simon, H.A. 1961. *Administrative Behavior*, 2nd ed. Macmillan, New York.

Singh, J. V. 1986. Performance, slack, and risk-taking in organizational decision making. *Acad. Management J.* **29** 562–585.

Sitkin, S. B., A. L. Pablo. 1992. Reconceptualizing the determinants of risk behavior. *Acad. Management Rev.* **17** 9–38.

Souder, W., P. Shrivastava. 1985. Towards a scale for measuring technology in new product innovations. *Res. Policy* **14** 151–160.

Steensma, H. K., K. Corley. 2001. Organizational context as a moderator of theories on firm boundaries for technology sourcing. *Acad. Management J.* **44** 271–291.

——, ——. 2000. On the performance of technology-sourcing partnerships: The interaction between partner interdependence and technology attributes. *Acad. Management J.* **43** 1045–1067.

Sutcliffe, K. M., A. Zaheer. 1998. Uncertainty in the transaction environment: An empirical test. *Strategic Management J.* **19** 1–23.

Sutton, R., B. Staw. 1995. What theory is not. *Admin. Sci. Quart.* **40** 371–384.

Teece, D. J. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing, and public policy. *Res. Policy* **15** 285–305.

Thompson, J. D. 1967. *Organizations in Action*. McGraw-Hill, New York.

Tyler, B. B., H. K. Steensma. 1995. Evaluating technological collaborative opportunities: A cognitive modeling perspective. *Strategic Management J.* **16** 43–70.

Walker, G., D. Weber. 1984. A transaction cost approach to make-or-buy decisions. *Admin. Sci. Quart.* **29** 373–391.

Williamson, O. E. 1975. *Market and Hierarchies: Analysis and Antitrust Implications*. Free Press, New York.

——. 1985. *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*. Free Press, New York.

Wiseman, R., P. Bromiley. 1996. Toward a model of risk in declining organizations: An empirical examination of risk, performance, and decline. *Organ. Sci.* **7** 524–543.

Zander, U., B. Kogut. 1995. Knowledge and the speed of the transfer and imitation of organizational capabilities: An empirical test. *Organ. Sci.* **6** 76–92.