

**Knowledge attributes, knowledge management practices and governance choice:
Towards reconciling transaction-cost and knowledge-based views of the firm**

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Abstract

Working in an inter-firm collaborative context, this paper proposes a theoretical framework whereby existing tension between the knowledge-based view of the firm and the transaction-cost economics view are reconciled. After reviewing the existing literature of these two views, our model accounts for the effects of both the KBV and TCE in a manner that acknowledges a role for both schools of thought. We propose a plausible chain of causality, which posits knowledge management practices as the mediating factor between knowledge attributes of transactions and governance choice.

Keywords: transaction-cost economics, knowledge-based view, collaboration

“...‘Knowing’ is something that only humans can do.” (Nelson & Winter, 1982, 105)

Introduction

The topic of knowledge is the focal point of a growing debate in the literature on the theory of the firm. What role does knowledge play in governance choice? Theorists espousing a knowledge-based view (KBV) of the firm (e.g. Conner 1991; Kogut & Zander 1992; Conner & Prahalad 1996; Kogut & Zander 1996) maintain that bounded rationality acts *sans* regard for opportunism as it influences managerial choice of governance for a particular transaction. Theorists relying on transaction cost economics (TCE) reasoning (e.g., Williamson 1985, 64-7; Foss 1996a, 1996b) maintain that organization mode decisions cannot be explained without relying on the additional behavioral assumption of opportunism.

This paper contributes to the debate and potentially resolves certain aspects of it by extending transaction cost economic analysis of governance choice to encompass certain knowledge-based attributes of transactions. We argue that knowledge attributes of the transaction, relating to various aspects of the need to create and transfer knowledge, lead to the adoption of efficiency-enhancing knowledge management practices, KMPs, which economize on bounded rationality. Employing knowledge-management practices economizes on bounded rationality by lowering the cost of transferring or creating knowledge --a choice that we equate to choosing the most cost-efficient production technology. However, the knowledge-management practices adopted on cognitive and “production” efficiency grounds give rise to appropriation or hold-up and maladaptation contracting hazards once the behavioral assumption of opportunism is considered. We argue that governance choices are made directly with respect to these contracting hazards. Thus, knowledge-based attributes indirectly have governance choice implications.

Our main contributions are threefold. First, we construct a plausible chain of causality that integrates factors from both the TCE and KBV perspectives. Previous work which claimed such integration offers little more than a dismissive discussion of the critical assumption of the threat of opportunistic behavior (e.g. Madhok 1996). Unlike prior work, we show that knowledge attributes of the exchange indirectly lead to governance choice based on

the need to safeguard against opportunism threats engendered by knowledge management practices. We do this by specifying novel, distinct knowledge attributes of transactions (knowledge tacitness and knowledge complexity), which present efficiency challenges to cognitively limited actors engaged in knowledge transfer or creation activities. Second, in describing knowledge attributes of transactions, we posit the existence of knowledge-management practices which are chosen by managers to address the cognitive limitations of actors engaged in transactions. Knowledge-management practices represent transaction-specific, non-governance adaptive mechanisms, and have implications for the efficacy of knowledge-sharing activities. Knowledge-management practices, however, are not without their own twists; specifically, their adoption gives rise to opportunism hazards that need safeguarding against via economizing choice of governance. Rather than starting with hazards and exploring patterns of efficacious governance choice, we step back in the causality-chain (Figure 1 A, B, C) and look at precursors to hazards, knowledge-management practices, and their precursors, problematic knowledge attributes of transactions. Third, we extend and refine the work of Oxley (1997), who explores the governance implications of the need to safeguard against appropriation of largely codified, legally protected (e.g., patented) knowledge. Our work, by contrast, probes variation in unprotected, uncoded, embedded knowledge and the implications for governance choice.

Insert Figure 1 here

The second section explores in more detail the boundary choice debate between the knowledge-based view of the firm and TCE. In this manner, we establish that there exists a tension between the two approaches in the literature (we cite two prominent discussions of the debate). In order to begin to resolve this tension, the third section introduces (defines) KMPs and, taking cues from the literature, posits the connection between problematic knowledge attributes and the use of remedial knowledge management practices (a knowledge-based view). We then describe KMPs and predict how KMPs introduce or amplify a threat of opportunism. This threat subsequently drives (economizing) remedial governance choices (a TCE view). Implications for the theory of the firm and future extensions are discussed in the final section.

The Debate I: The Knowledge-Based View

The debate between scholars researching the knowledge-based view of the firm (KBV) and transaction cost economics (TCE) erupted in the September 1996, issue of *Organization Science*. In that issue, Foss (1996a, 470) argued that knowledge-based theories for the existence of a firm, put forward by Conner (1991) and Kogut & Zander (1992), “erred in the specific way in which they claimed that a distinct theory of ... the firm can be constructed on the basis of a theory of organizational knowledge or from resource-based insights.” Acknowledging a role for bounded rationality in the theory of the firm, Foss (1996, 473) stated that “the kernel of truth in technological determinism is that different technologies yield different constellations of transaction and information costs, and therefore loosely influence economic organization ... But the influence is indirect and the linkage is not tight.” Thus, Foss (1996, 473) describes Conner & Prahalad’s and Kogut & Zander’s work as symptomatic of Williamson’s (1985, 87) technological determinism, which neglects the possibility of opportunistic behavior. A theory of boundary choice, Foss asserts, rests additionally on the possibility of opportunistic behavior.

In contrast to Foss, Conner & Prahalad (1996) and Kogut & Zander (1996) essentially argue that governance decisions, such as the canonical choice between market and hierarchy, can indeed pivot on bounded rationality alone. This claim is tantamount to saying governance choice does not hinge on the additional behavioral assumption of opportunism. Nonetheless, both articles astutely assert the importance of tacit, local, but locally dispersed (embedded) knowledge. Actors and organizations frequently possess knowledge that others lack.

Conner & Prahalad (1996, 477) directly “assume that opportunistic behavior will not occur;” and that contracting problems may remain solely owing to bounded rationality. They aver that because “some of each person’s knowledge necessarily remains private...honest persons may disagree about the best course of joint (or even individual) action, or the division of gains. Indeed, objections may never be surmounted, despite the originator’s best (i.e., lengthy and costly) efforts (483).” Hierarchy, they claim, offers knowledge-substitution and flexibility advantages. Conner & Prahalad further assert that knowledge-substitution

arises when one actor in an authority relationship directs another's actions.¹ Flexibility advantages arise from "the relative cost, under the two organizational modes, of altering the parties' duties and responsibilities on an ongoing basis, in order to incorporate learning or unexpected opportunities arising during the course of the work" (Conner & Prahalad 1996, 486, emphasis added).² While laudable for treating the firm as a bundle of employment contracts which depend on comparative discrete cost differences, Conner & Prahalad neglect to account for the possibility of guileful behavior arising from opportunism hazards present in the transactional setup.³

Kogut & Zander (1992, 1996), employ a logic different from that of Conner & Prahalad, but also pursue an explanation of boundary choice without reference to guile or opportunism. They argue "that a firm be understood as a social community specializing in the speed and efficiency of creation and transfer of knowledge" (Kogut & Zander 1996, 503). This view is consistent with their earlier article (Kogut & Zander 1992, 384) where they claim that "firms exist because they provide a social community of voluntaristic action structured by organizing principles that are not reducible to individuals." They assert that "the central competitive dimension of what firms know how to do is to create and transfer knowledge efficiently within an organizational context ..." (Kogut & Zander 1992, 384).

The foundation of their argument is that "[f]irms provide the normative territory to which members identify" (Kogut & Zander 1996, 506, emphasis added), which has two implications. "First, it defines conventions and rules by which individuals coordinate behavior and decision making. ... Second, identification sets out the process by which learning is developed socially through the formation of values and convergent expectations" (506). Hierarchy, in their view, offers advantages over markets because the former can create an identity, which leads to social arrangements that support coordination and communication, which the latter cannot (502). These "hierarchy-enhanced" coordination and communication capabilities allow firms to create and internalize complex, difficult-to-codify knowledge.

Kogut & Zander (1996) found "reasonable support for the proposition that more tacit knowledge is slower to be transferred and that firms tend to transfer tacit knowledge within the firm instead of through the market" (503). We readily acknowledge that tacit knowledge

is difficult to transfer, but take issue with other parts of their logic. In particular, Kogut & Zander (1996) advance the firm (or its identity) as the unit of analysis over the transaction. In so doing, they assert that "...we stress the costs of communication, coordination, and new combinations, not those of transactions, as the primary metric that influences the boundary decisions of firms" (503). Consider, however, that knowledge to be transferred or created necessarily implies a transaction, as does any inter-firm collaborative activity. In the course of doing business, a firm may exchange different knowledge-sets which embody varying degrees of particular knowledge attributes, which often renders communication, coordination, and new combinations of knowledge highly specific to a particular transaction.⁴

Kogut & Zander (1995) divide knowledge into two simple types: know-how and information, but admit to complications. "First, knowledge, since it is both individual and shared, exists in the social relations among cooperating members in a community" (417). This observation evokes Granovetter's (1985) concept of network embeddedness with respect to knowledge, which we concur is important. The embeddedness of knowledge is a function of its distribution across a network of actors. Kogut & Zander (1992, 384) emphasize the importance for performance of linkages given embedded knowledge: "By examining first personal expertise and then social knowledge, the capabilities of the firm in general are argued to rest in the organizing principles by which relationships among individuals, within and between groups, and among organizations are structured." Kogut & Zander (1996) characterize firms as repositories of knowledge such that transfer and recombination problems increase as knowledge develops in a dispersed, embedded manner within social networks that occur by design or spontaneously, a view with which we are largely sympathetic, as it provides some explanation of the dynamics of responses to problematic properties of knowledge. Unlike Kogut & Zander (1996), we do not aver a direct connection to governance mode choice.

In a critical response to both papers, Foss (1996b) decries Conner & Prahalad's (1996) arguments, which distil to an assertion that "[f]irms exist when they can beat the market in terms of knowledge substitution and flexibility" (520). Foss points out that both the knowledge-substitution and flexibility effects also can be achieved in market relations. The

problem with Conner & Prahalad's approach, says Foss (520), is "...the existence of an employment contract seems to sufficiently characterize the firm. ... [O]wnership of (physical) assets is just as important--in fact, indispensable--for understanding the firm, and that the allocation of ownership rights to assets will, among other things, reflect the underlying potential for opportunism ... [T]o rationalize the existence of employment contracts is not to give a sufficient and satisfactory treatment of the firm [*sic*]." Foss concludes by admitting that, while opportunism-independent bargaining costs, flexibility, and knowledge-substitution have explanatory value, the neglect of opportunism leaves Conner & Prahalad's approach far short of a coherent theory of the firm.⁵

In a less persuasive response, Foss (1996b, 520) asserts that after boiling down the arguments, one sees that "[t]he ultimate argument for firm organization in Kogut & Zander's reasoning is some postulated wish to belong to [identify with] a moral community; firms exist because they fulfil this desire." Even granting this "specific preference" for a moral community, an essentially non-economic explanation, Foss (1996b, 520) states "it is not at all clear in this story why firms are necessary for realizing moral communities and bringing shared identities" (emphasis in the original).

The Debate II: A Transaction Cost View

Generally speaking, TCE, like the knowledge-based view of the firm, is concerned with bounded rationality and the cognitive limits of man. Williamson (1985, 46), in fact, makes broad provisions for the effects of bounded rationality on governance choice:

Comprehensive contracting is not a realistic organizational alternative when provision for bounded rationality is made. If mind is the scarce resource (Simon, 1978, 12) then economizing on claims against it is plainly warranted...Confronted with the realities of bounded rationality, the costs of planning, adapting and monitoring transactions need to be considered ... Ceteris paribus, modes that make large demands against cognitive competence are disfavored...

Nevertheless, Williamson subsequently (1985, 66) insists on the need to also consider opportunism: “[B]ounded rationality notwithstanding, contracting would be ubiquitous in the face of non-opportunism--that is, if simple self-interest seeking is assumed.”

Regarding bounded rationality associated with knowledge creation and transfer, Oxley (1995, 57-58) likewise casts doubt on a “pure” resource- or knowledge-based orientation:

...[T]he advantages of hierarchy in reducing the costs of technology transfer do not appear to hinge on the features of incentive alignment and administrative controls per se, but rather on communication, labor mobility and organizational routines. Closer examination suggests that the feasibility problem in technology transfer is not unrelated to appropriability, however. If we delve into reasons why the activities needed to effectively transfer the technology cannot be achieved via contract between autonomous parties, the main problem seems to be in fully specifying the transaction and preventing leakage of the know-how embodied in the personnel (other than that which is specified for transfer by the contract).

Oxley (1995, 58) subsequently identifies factors affecting knowledge transfer: “The most important factors affecting technology transfer costs ... include [1] the complexity and age of the technology (since new technologies tend to be less well codified), [2] the technological capabilities of the recipient firm, or the firm’s “absorptive capacity” (Cohen and Levinthal 1990) and [3] the amount of previous experience the firms have with technology transfer.” Each of these factors maps to “associated contractual hazards” (58), which Oxley shows affect governance mode choice. Of these, [1] complexity, is a factor which we argue matters greatly at the level of the transaction.⁶

Nevertheless, the TCE literature on appropriability is nascent, particularly with respect to the empirical aspects of tacit, unprotected (e.g., unpatentable) knowledge. TCE also does not provide a clear explanation for Kogut & Zander’s (1993) empirical observation that firms are faster and more efficient than markets at transferring knowledge. Moreover, TCE has yet to cogently link knowledge-related transaction attributes with behavioral (opportunism) hazards.

Kogut & Zander (1996) assert that the central competitive dimension of firms is an advantage over markets for creating and transferring knowledge. To its credit, Kogut & Zander's treatment is articulate, has many merits in its treatment of bounded rationality, and directly confronts governance choice issues.^{7, 8} Rather than espouse the effects of knowledge on governance choice, our impression of Kogut & Zander's strongest points might be expressed as follows:

Proposition 1: Knowledge attributes of transactions influence managerial decisions and action in transactions so as to affect the cost-efficacy of knowledge-related activities.

Note that while asserting that knowledge attributes are a fundamental, underlying part of transactions, we intentionally do not assert a direct effect on governance choice, which leaves a role for opportunism hazards in our sequential chain of causality (Figure 1). Using the terms knowledge tacitness and knowledge complexity (joint problem-solving complexity) we subsequently introduce more specific, testable hypotheses by relying on the literature for cues.⁹ The former term corresponds to unilateral knowledge sharing, which we call knowledge transfer activities. The latter term refers to joint problem-solving activities which combine partner-specific knowledge to create new knowledge. Joint problem-solving in collaborations is a bi- or multi-lateral knowledge sharing activity.

Governance Choice and Knowledge Attributes in a Collaboration Context—

The Ends of our Causal Chain

Details of governance choice in response to appropriation hazards (Oxley 1995, 1997) and specific investments (Williamson 1985; 1991; 1996) have been discussed at length in the literature and are not repeated here. Nevertheless, we discuss the need to adopt governance structures which employ increasingly costly safeguards, culminating in hierarchy-like modes in response to knowledge-related contracting hazards. Williamson (1985, 293-4) states:

[w]here the requisite information is distributed among a number of individuals all of whom understand their specialty in only a tacit, intuitive way a simple contract to transfer the technology cannot be devised... A more harmonious and efficient exchange relation--better disclosure, easier recognition of differences, more complete cross-cultural adaptation, more effective team organization and

reconfiguration--predictably results from the substitution of internal governance structure for bi-lateral trading under those recurrent trading circumstances where assets, of which complex technology transfer is an example, have a highly specific character.

More generally, hybrid structures (Williamson 1991, Oxley 1995) may be employed for intermediate levels of specificity. Following and expanding on Oxley (1995, 1997), we hypothesize that efficient governance structure choices will increasingly adopt more specialized and hierarchical features, ultimately culminating in hierarchy, as appropriation hazards increase.

Oxley (1995, 63-64) describes the benefits of specialized governance:

The governance features of hierarchy work to mitigate appropriability hazards in several ways: lower-powered incentives (and alignment of incentives with the seller) reduce the likelihood that the buyer will violate the terms of the agreement; the administrative controls available within hierarchy increase the ability to monitor the activities undertaken in the course of the agreement and allow greater direction of those activities; and the reduced reliance on court ordering for dispute resolution (in the limit, forbearance) decreases the requirements for third party verifiability.

The benefits of specialized governance do not come without certain costs. Oxley (1995, 64) maintains:

Attenuated incentives mean that the technology may not be exploited in its best use, or to its fullest extent. Thus, internal organization will be reserved for cases in which contractual hazards are at their height, and a hybrid governance structure may be the preferred solution for transactions with 'mid range' appropriability hazards.

Based on this view of governance, we predict the relationship between our knowledge-based transaction attributes and governance choice, including and especially for “midrange” governance choices, which may correspond to specific midrange hazards. Indirectly, as the degree of severity of each knowledge-based transaction attribute increases, an economizing logic suggests increasingly hierarchy-like governance choices. This leads to a general expression of our thesis, which tests the ends of our causal chain: As knowledge attributes increase in their severity, governance is chosen in order to safeguard against the threat of opportunistic behavior. More specifically, we can restate this proposition as two testable hypotheses:

Hypothesis 1: As knowledge tacitness increases in a transaction, increasingly stringent governance modes will be chosen to safeguard against the hazard of opportunism.

Hypothesis 2: As problem-solving complexity increases in a transaction, increasingly stringent governance modes will be chosen to safeguard against the hazard of opportunism.

The above-hypotheses, however, assert claims about the ends of our proposed causal chain, which is one way to state our claims. In the following sections, we develop testable hypotheses regarding the middle portions of our causal chain, in order to subsequently test the veracity of our claims using additional empirical tests.

KMPs--Remedies to Problematic Knowledge Attributes

Defining KMPs

To define knowledge management practices in the context of inter-firm collaborations, we first state what they are not; KMPs are not governance in a strict sense. That is, KMPs are remedial, non-governance, economizing measures adopted by collaboration managers facing problematic degrees of knowledge tacitness or joint problem-solving complexity. KMPs facilitate knowledge transfer or creation processes by, generally speaking, mitigating cognitive barriers introduced by the existence of bounded rationality in the form of knowledge tacitness or joint problem-solving complexity. KMPs may be discussed *ex ante* and *ex post* a transaction; they are regularly planned for *ex ante*, and implemented *ex post* a

transaction in response to a need for non-governance, in-stream adaptation. More simply, they are “internal-to-the collaboration” adjustment measures taken by participants and managers of collaborations. Examples of KMPs include (1) unidirectional & (2) bi-directional high-bandwidth interactions, (3) co-location of collaborative teams, and (4) co-specialization of knowledge.

Uni- and bi-directional high-bandwidth interaction.

An example of a unidirectional high-bandwidth interaction would be an in-person meeting where one partner asks questions, which the other answers. High-bandwidth interactions provide a high degree of rich context, high-affect, high-transparency in communications between partners. Low-bandwidth interactions are characterized by low-context communications measures, for example, email, faxes, letters. Unidirectional high-bandwidth interaction is employed when a one-way transfer of knowledge is impeded by tacitness. For example, uncodified knowledge of a particular automated manufacturing line’s yield-enhancing nuances and yield-impairing operational quirks is difficult to transfer to a partner, whose people lack operating experience with similar automated production lines. Closer interactions (frequent in-person meeting, multiple plant tours, and in-depth discussions) facilitate the transfer of this knowledge to the extent possible.

Bi-directional high-bandwidth interactions are reciprocal. For example, an in-person meeting in which people from all partner firms share knowledge freely in order to jointly complete a project (overcome joint problem-solving complexity). Bi-directional high-bandwidth interactions occur as a response to joint problem-solving complexity. These interactions combine existing partner-knowledge and thereby create new knowledge (evidence of complexity).

Co-location and co-specialization

Co-location, which occurs when two partners share a common collaboration site, is a response to tacitness; it may be interpreted as an extreme case of fomenting high-bandwidth interactions. Extensive co-location was observed by von Hippel (1994) in response to problems with “sticky” information. Co-specialization of knowledge refers to the transfer of important contextual knowledge from one partner to another, for instance, an unfamiliar

technical jargon might be defined for one partner. Co-specialization may occur in response to tacitness or complexity.

The choice of particular knowledge-management practices is an economizing response to problematic knowledge attributes, for example, knowledge tacitness. We interpret the adoption of any knowledge-management practice(s), which offer cost-efficiency advantages for the transfer or creation of knowledge when certain knowledge attributes are problematic, as analogous to choosing a cost-efficient production technology.

Proposition 2: Problematic knowledge attributes lead managers to choose remedial knowledge management practices based on their discrete competences as to the mitigation of bounded rationality (cognitive) limitations in transactions.

We do not claim to have created an exhaustive list of KMPs, nor do we claim perfect one-to-one mappings of a particular remedial KMP to a knowledge attribute. Each transaction is treated as unique; we suspect that most transactional setups are unique owing to the distribution of varying degrees and types of problematic knowledge attributes. We have tried to differentiate between which KMPs are most likely to be deployed for knowledge tacitness and problem-solving complexity, our central knowledge attributes of transactions. KMPs are deployed with the goal of facilitating knowledge-related activities in transactions in an economical fashion; generally speaking, their use increases the amount of knowledge readily available to partner-teams in collaborations.

The Need to Remedy Bounded Rationality Problems with KMPs

Knowledge tacitness

Having briefly defined knowledge tacitness, we briefly examine how the literature has treated tacitness in inter-firm collaborations. The importance of the tacitness dimension of knowledge in determining the success of collaborative ventures is reasonably well-documented. For example, Borys and Jemison (1987) acknowledge the impact of tacitness on the instability of cooperation by noting that technology transfer agreements whose purpose is the transfer of tacit knowledge and expertise tend to break down comparatively more often than those involving the exchange of readily codifiable (non-tacit) technology. Lam (1997) goes a step further by showing that differing cultural settings influence the degree of

difficulty associated with the transfer of tacit knowledge. Additionally, she shows that strategic alliances involving firms from different national cultures frequently fail as a result of the substantial asymmetries in knowledge transfer, implicating tacitness. These studies (among others) establish the need for remedial measures (KMPs) by alliance managers when the degree of tacitness is high.

KMPs are non-governance measures adopted by managers in response to problematic degrees of particular knowledge attributes, in this discussion, knowledge tacitness. Generally speaking, problematic knowledge attributes engender managerial response via knowledge management practices. For example, the degree of tacitness of knowledge involved in a collaboration influences remedial use of knowledge management practices. This leads us to a testable hypothesis which is more specific than our selective distillations of Kogut & Zander (1996) in Propositions 1 and 2.

Hypothesis 3: When the degree of tacitness associated with knowledge in a transaction is high, actors utilize knowledge management practices to mitigate resulting problems with efficacious knowledge transfer.

Complexity

So far we have considered the case of uni-directional transfer of knowledge wherein knowledge is transferred from one partner firm to another *sans* reciprocity or other action. However, in many collaborations, knowledge is transferred bi- or multi-directionally for the purpose of creating new knowledge. Distinct knowledge from all partners may be necessary to solve a specific (business or technical) problem. More specifically, in a complex collaborative transaction, all partners make a contribution in order to create a body of distinct, new knowledge that can be applied to solve a problem. This new body of knowledge is the result of sharing and applying the knowledge contributed by each partner. As discussed earlier, we use the proxy of the creation of a distinct, new body of knowledge to empirically specify complexity. Joint problem-solving complexity is deemed low when the combination of knowledge-inputs is simple or trivial (no new knowledge results).

Having defined complexity briefly, we examine the (surprisingly sparse) existing evidence that a high degree of complexity impedes the efficient use of knowledge in

collaborations. Speier et al. (1999) show, through a series of experiments, that for highly complex tasks, disruptions negatively impact task performance. As frequency of interruptions and dissimilarity of content between the primary and interruption tasks increase, a significant decrease in decision making performance occurs. Speier et al's study supports the contention that a high degree of complexity affects performance of tasks, at least in an artificial environment.

Using clever thought-experiments, Radner (1992) demonstrates the extraordinary sensitivity of problem-solving complexity to small changes in work practices. Efficiency-impairing task-performance difficulties rapidly ensue when executing tasks inside hierarchy, even given stylized, small teams, simple tasks and simple structures. Problems quickly become less tractable when team size or structural complexity is increased, even to a small extent. Radner's work leads us to expect that problem-solving complexity will act strongly on choice of knowledge management practice.

Simonin, (1999), in the course of an exploration of causal ambiguity, discusses complexity as "expected to affect the comprehension of the totality of a [knowledge-] asset and to impair its transferability (600)." Simonin offers a somewhat broader definition of complexity that roughly echoes our own: "Complexity refers to the number of interdependent technologies, routines and individuals linked to a particular knowledge or asset [*sic*] (600)." Simonin also notes that complexity has impairing effects on performance as established by Kogut & Zander (1993) wherein they observe a preference for in-firm transfer of complex knowledge over inter-firm transfer. Rather than accept Kogut & Zander's leap from problematic knowledge directly to governance choice, for collaborations, we assert that high problem-solving complexity influences knowledge management practices, namely that as complexity increases, remedial knowledge management practices will be deployed:

Hypothesis 4: When the degree of problem-solving complexity associated with knowledge in a collaborative transaction is high, actors utilize knowledge management practices to mitigate problems introduced by complexity.

KMPs and Behavioral (Opportunism) Hazards

We previously argued that certain knowledge-transfer practices are adopted to economize on bounded rationality with respect to knowledge-based transaction attributes. In this section we explore how knowledge-transfer practices give rise to important contracting hazards when the behavioral assumption of opportunism is added to the model. In general, we argue that adoption of knowledge management practices either (1) severely limits the ability to specify, monitor, and enforce property rights of the knowledge to be transferred, which gives rise to knowledge appropriation hazards (Oxley1997), or (2) relies on specific investments, which are subject to hold-up and maladaptation costs. Thus, contracting hazards arise because specialized practices (KMPs) are adopted to economize on knowledge transfer and creation problems; solving one problem (cognitive limits of bounded rationality) leads to another, opportunism..

High-bandwidth interactions

The knowledge-management practice of unilateral high-bandwidth interactions is a response to a high degree of knowledge tacitness in a transaction involving knowledge transfer. High-bandwidth interactions, rich with context, not only allow for increased efficacy of knowledge transfer, but also give rise to appropriation hazards. Enforcing and delineating precise property rights for tacit knowledge is generally difficult and costly (Teece 1981). This problem is exacerbated given high-bandwidth interactions which increase transparency of tacit knowledge. As more knowledge flows easily from one partner to another, facilitated by a high-bandwidth setup, the possibility of unintentional over-transfer of information useful to the receiver increases. The partner responsible for transmitting knowledge may unintentionally over-transfer more knowledge than is strictly required by the receiving partner. Opportunism by the receiving partner might take the form of the receiver asking the transmitter questions about knowledge that is useful to the receiver, but not strictly necessary to meet the goals of the collaboration. The transmitting partner, owing to bounded rationality, often has no way to know whether sufficient knowledge has been made available to the receiver. The transmitter relies on the “good intentions” of the receiver for notification that sufficient knowledge has been received. More guilefully, and perhaps more commonly given

the ease of appropriation, the receiver, in the presence of a well-intentioned transmitter, might merely remain silent and let the transmitting partner provide knowledge above and beyond that strictly necessary (just let them talk). The difficulty and cost of monitoring the knowledge acquired during interactions increase with the bandwidth of interactions. We posit that appropriation hazards increase with the extent of unilateral high-bandwidth interactions. As the hazard of opportunism increases, the use of more stringent governance modes, which align incentives and enhance monitoring ability, is likely.

Hypothesis 5: As the extent of unilateral high-bandwidth interactions required to facilitate knowledge transfer increases, increasingly stringent (costly) governance mechanisms will be chosen to safeguard the exchange.

Similar hazards exist for the case of bilateral high-bandwidth interactions, which are employed for knowledge combination and the creation of new knowledge during joint problem-solving in collaborations. The knowledge-management practice of bilateral high-bandwidth interactions, though a response to the need to combine knowledge from actors in a transaction involving joint problem-solving complexity, introduces an appropriability hazard. It is tempting to assert that the safeguarding effects of bilateral dependence via (knowledge) hostages as a mitigating part of the transactional setup which obviates the need for further safeguards (Williamson 1991). In this case, however, neither partner has any way to know, in a timely fashion, definitively whether a partner has opportunistically sought to receive more knowledge than is strictly necessary for the proper functioning of the collaboration. The verification of the existence of another partner's hostage is infeasible. This mutual ignorance of partners as to how much knowledge each has received over and above that strictly necessary defeats the effects of hostages, and may necessitate a safeguarding governance choice. As the appropriation hazard introduced by bilateral high-bandwidth interactions increases, managers may be increasingly likely to choose governance modes which align incentives and facilitate increased monitoring.

Hypothesis 6: As the extent of bilateral high-bandwidth interactions required to facilitate new knowledge creation in a transaction increases, increasingly stringent (costly) governance mechanisms will be chosen to safeguard the exchange.

Co-Location

The knowledge management practice of co-location of partners in a common work environment is essentially an extreme case of facilitating high-bandwidth interactions. Prolonged co-location may foment the creation of informal knowledge-transmission networks to a much greater extent than high-bandwidth interactions not involving shared work space (Granovetter 1985; Powell 1990). The same appropriability hazards as those discussed above for high-bandwidth interactions apply for both knowledge transfer and knowledge creation activities in transactions.

Hypothesis 7: When co-location is employed as a remedy for knowledge transfer problems, a knowledge appropriation hazard arises, which is addressed by choosing an appropriately stringent governance mode as a safeguard.

Hypothesis 8: When co-location is employed as a remedy for knowledge creation problems, a knowledge appropriation hazard arises, which is addressed by choosing an appropriately stringent governance mode as a safeguard.

Co-specialization

The knowledge-management practice of co-specializing knowledge content (e.g., technical jargon), language, or cultural conventions is an economizing response. Such co-specialization comprises an ex ante investment, which faces maladaptation and hold-up hazards described by Williamson (1985, 178):

Complex contracts are invariably incomplete and many are maladaptive. The reasons are two: Many contingencies are unforeseen (and even unforeseeable), and the adaptations to those contingencies that have been recognized for which adjustments have been agreed to are often mistaken--possibly because the parties acquire deeper knowledge of production and demand during contract execution than they possessed at the outset (Nelson & Winter, 1982, 96-136).

Co-specialization of knowledge occurs when languages, technical terms, or cultures are mis-matched such that costs incurred in remedying the situation via, for example, training, positively affect the efficacy of knowledge transfer or knowledge creation. High degrees of

either complexity and tacitness may engender a co-specialization response, which gives rise to a knowledge appropriation hazard.

Metering the benefits of co-specialization to each partner is costly and difficult and poses an appropriation hazard because the co-specialized knowledge could be used in ways unanticipated by one partner without compensating the other. Shuen (1993) shows that two firms in the semiconductor industry make choices as to which knowledge they acquire during a joint, applied research project routinely involving co-specialization of technical knowledge. For instance, using in-depth interviews, in one case study she found that one partner focused on acquiring process aspects of a new production technology while the other partner concentrated on obtaining knowledge pertaining more directly to deliverables. There was little evidence that each partner was explicitly aware of the other's intentions as to knowledge acquisition. While her analysis lacks a discussion of the appropriation issues arising from high-transparency knowledge-management practices, her findings underscore the idea that firms elect to focus on transferring and creating knowledge based on their own goals as well as those of the collaboration. Guile, an important aspect of appropriation, facilitates (uncontracted for) knowledge acquisition--one partner may not be explicitly aware that another partner is attentive to a particular body of knowledge that lies outside the scope required of knowledge transfer that facilitates the collaboration. As in the cases of uni- and bi-directional high-bandwidth interactions, in a collaborative context involving knowledge, guile may take the simple form of politely listening to a transmitter's discourse and not disclosing that particular economically valuable knowledge is not strictly required for a successful collaboration. The evidence leads us to assert that for high degrees of knowledge tacitness and knowledge creation, the KMP co-specialization creates an appropriation hazard which may be best addressed by governance mode choice:

Hypothesis 9: When co-specialization is employed as a remedy for knowledge transfer problems, a knowledge appropriation hazard arises, which is addressed by choosing an appropriately stringent governance mode as a safeguard.

Hypothesis 10: When co-specialization is employed as a remedy for knowledge creation problems, a knowledge appropriation hazard arises, which is addressed by choosing an appropriately stringent governance mode as a safeguard.

Discussion

We offer three main contributions. First, we offer a plausible theoretical construction integrating KBV and TCE which allows for the assumptions of bounded rationality and opportunism. Second, we posit the existence of distinct knowledge attributes of transactions which allows us to explore why actors might enter into transactions knowing they are placing knowledge assets at risk of appropriation. Third, we extend Oxley's (1997) work, whereby we go beyond her primary focus on the need to safeguard against appropriation of codified, legally protected (e.g., patented) knowledge and begin to unpack the realm of unprotected, uncoded, embedded knowledge and the attendant implications for governance choice. We discuss these contributions in some detail below as well as drawbacks and future research directions.

A plausible chain of causality

In this paper, we construct a chain of causality that integrates factors from both the TCE and KBV perspectives. Previous work which claimed such integration has ultimately failed to make more than passing mention of the critical assumption of possible opportunistic behavior (e.g., Madhok, 1996). Unlike prior work which connects knowledge problems directly to governance choice, we posit that knowledge attributes of the exchange lead to governance choice based on the need to safeguard against opportunistic appropriation. We do this by identifying novel, distinct properties of knowledge (knowledge attributes of transactions) which present efficiency challenges to boundedly rational actors engaged in knowledge transfer or joint problem-solving activities. An important aspect of our work is the beginning of a taxonomy of transaction attributes related to knowledge: knowledge tacitness (for knowledge transfer) and joint problem-solving complexity (for new knowledge creation). Our sequential model of governance choice operates within a TCE-savvy frame, but incorporates the effects of knowledge-based attributes of transactions on governance. In particular, we

focus on the behavioral hazard of knowledge appropriation in the context of knowledge-transfer and knowledge creation activities. In our sequential approach, knowledge attributes impeding knowledge transfer or creation activities are mitigated by knowledge-management practices, which in turn give rise to behavioral (opportunism) hazards, which are safeguarded against via governance choice. Figure 1 graphically summarizes our arguments regarding the causality of TCE and the KBV and positions our contribution in this context. Linkages (A) and (B) characterize the chain of causality for the knowledge-based view, culminating in deployment of knowledge management practices and linkages (C) and (D) illustrate the role of TCE, culminating in the choice of governance. Although our approach sequentializes causality for simplification, we view decisions regarding knowledge-based attributes and their impact on knowledge-management practices and governance as simultaneous in nature.¹⁰

Our approach offers a reconciliation between the knowledge-based view of the firm espoused by Kogut & Zander (1992, 1996) and TCE (Williamson, 1975; 1985; 1991; Oxley, 1997). Our theory is consistent with Kogut & Zander's (1996) view that knowledge embedded in social relations matters with respect to the efficiency of creation and transfer of knowledge. However, our theory casts a different light on Kogut & Zander's claim that a firm should be understood primarily as an identity-providing social community that specializes in the speed and efficiency of creation and transfer of knowledge. Identity, in our view, might enhance knowledge-sharing interfaces, and thus act as a knowledge management practice, which creates an appropriation hazard. Our discussion of various KMPs might be interpreted as a useful unpacking of the facilitating properties of identity. More stringent organizing modes, in the case of collaborations, firm-like hybrids (e.g., equity joint venture), are chosen in response to transaction-specific, relatively severe appropriation, hold-up and maladaptation hazards created by the adoption of knowledge-management practices.¹¹ The action of interest consistently occurs at the level of the transaction and its attributes, an approach consonant with TCE.

We view Kogut & Zander's organizational features of identity and moral community as not inconsistent with our theory. Specific investments, for example, the KMP of co-

specialized knowledge, language, and culture, may well create identity and moral community. The increased informational transparency afforded by identity, however, introduces an appropriation hazard. Our theory does differ from Kogut & Zander's claim that firms exist because they provide a social community of voluntaristic action. Consistent with TCE, firms exist because they embody governance that economizes on bounded rationality and opportunism. We claim that KMPs provide speed and efficiency advantages for alleviating knowledge transfer and joint problem-solving problems and firms subsequently safeguard the use of knowledge-management practices against contracting hazards. Our view is also consistent with Kogut & Zander's (1993) empirical findings.

Our perspective offers several advantages over the prior knowledge-based view of the firm. Unlike Kogut & Zander (1996), who state that organizing principles and structure are central to a firm's capabilities but do not provide a list of these structures, we provide a parsimonious set of structures--knowledge-management practices--that provide remedial action for problematic knowledge attributes of transactions. We view our knowledge attributes as operationalizable because they can be used to characterize knowledge *sans* complete comprehension of the underlying knowledge. This renders our work empirically tractable.

Our approach also fits well with extant TCE theory on appropriability hazards. For example, our theory is consistent with Oxley's (1995, 1997) treatment of tacit knowledge and the contractual hazard it creates, although our theory unpacks this relationship in a more detailed way and with an emphasis on non-explicit, rather than explicit (codifiable, patentable, protectable) knowledge.

Additionally, Williamson (1985, 366) and Riordan and Williamson (1985) claim that organization choice should be made with reference to minimizing the sum of production and transaction costs; however, much of the extant TCE literature has focused on minimization of governance costs alone. Our theory recognizes this aspect of TCE by more fully developing the logic for making organizational choices that minimize the sum of production and transaction costs, with respect to knowledge creation and transfer. Adopting knowledge-

management practices reflects economizing on bounded rationality and is analogous to choosing the lowest-cost production technology.

The correspondence between knowledge-based transaction attributes and economizing knowledge-management practices, which leads to appropriability hazards or specific investments, suggests a modification to Williamson's governance choice logic. We can expand Williamson's list of transaction attributes to include knowledge attributes and make predictions about the mode of governance and management practices that economize on production and transaction costs. Williamson's (1975, 1985, 1991) governance formulation takes the form

$$G = f(k, u, f),$$

where G is governance mode, k is asset specificity, u is uncertainty, and f is transaction frequency. A formulation which additionally accounts for transactions involving tacit knowledge and joint problem-solving complexity activities adds a term, k_{KA} , and has the form:

$$G = f(k, k_{KA}, u, f),$$

$$\text{where } k_{KA} = f(c_T, c_C),$$

and c_T is the degree of knowledge tacitness, and c_C is the degree of joint problem-solving complexity.

Why risk knowledge asset appropriation?

By identifying and describing knowledge attributes of transactions, we extend the "traditional" question of "Why are certain governance modes chosen?" and explore why actors enter into transactions wherein they may knowingly place specific knowledge assets at risk of opportunistic appropriation. Actors enter into problematic knowledge sharing relations to enhance economic rents subject to an economizing logic. Actors adopt measures to mitigate severe knowledge sharing problems in the form of knowledge-management practices. These practices render certain knowledge sharing activities feasible when they would otherwise be infeasible. Knowledge-management practices address bounded rationality problems posed by the KBV. Though knowledge sharing becomes feasible through the use of knowledge-management practices, they cannot be implemented without

incurring a cost, that of mitigating opportunism hazards. Knowledge management practices introduce significant, costly-to-mitigate, behavioral hazards into collaborative activities which must also be addressed. Behavioral problems are mitigated through the use of efficacious, safeguards in the form of governance mechanism choices.

Drawbacks and future directions

Our treatment of knowledge attributes of transactions is far from exhaustive. Our perspective awaits empirical confirmation (currently in-process by the authors). We additionally acknowledge that other aspects of knowledge, including for example, firm technological capabilities (Behrman and Wallender 1976; Teece 1977; Nelson and Winter 1982; Winter 1988), absorptive capacity (Cohen & Levinthal 1990) and prior experience with same partners in knowledge transfer (Gulati 1995; Gulati & Singh, 1999) have been shown or imputed to impact the cost of knowledge transfer. While these factors are undoubtedly important, they are firm-specific attributes and not presently addressed in our theory because of its focus on specific transaction activities: knowledge transfer and creation. Additionally, in contributing usefully to this discussion, Oxley (1997) does not detect even one significant firm-level factor that influences governance choice, which supports TCE's unrelenting focus on the transaction as the unit of analysis. Future research should, however, consider these firm-specific attributes as exogenous shift parameters, which may shift either production costs, governance costs, or both at the transaction level. For instance, a recipient firm possessing a high level of absorptive capacity (Cohen and Levinthal 1990) may either lower the cost of knowledge transfer or allow for the use of low-cost, low-bandwidth interactions. However, the same firm with a high level of absorptive capacity may engage in knowledge predation by over-accumulating knowledge from a transmitter, which increases appropriability concerns. The effects of these firm-specific knowledge factors on both knowledge-management practices and governance choice await future investigation and incorporation into our theory.

Closer to our main thrust, this paper identifies and discusses two areas of knowledge-related activities: knowledge transfer and knowledge creation. Other important properties of

knowledge exist, however, which may be tractable to the type of analysis we develop. Notable properties of knowledge not discussed herein include knowledge retrieval (including the potential for knowledge decay over time), potential for distortion, supplantation (replacement of old knowledge by new) and redundancy. These properties of knowledge may engender as yet unidentified knowledge-management practices, which in turn, have governance choice implications in harmony with our logic.

In this paper, we synthesized a set of transaction attributes based on characteristics of knowledge to be transferred or created in an exchange. Instead of influencing governance choice directly, a transaction's knowledge-attributes influence the choice of knowledge-management practice, which economizes on bounded rationality of well-intentioned actors. The adoption of knowledge-management practices engenders behavioral hazards (with accompanying governance choice implications). We contend that KBV and TCE are not at odds once assumptions reflecting actual behavioral aspects of the transaction are considered rather than dismissed (i.e., hazards posed by potential opportunism and guile) and transactions are more completely specified with respect to knowledge attributes. Indeed, we maintain that expanding the list of relevant transaction attributes to incorporate knowledge-related conditions of the exchange provides a more powerful lens for explaining governance choice than either theoretical lens alone.

References

- Behrman, J. N. and H. W. Wallender (1976). *Transfers of manufacturing technology within multinational enterprises*. Cambridge, Mass., Ballinger Pub. Co.
- Cohen, W. M. and D. A. Levinthal (1990). "Absorptive Capacity: A New Perspective on Learning and Innovation." *Administrative Science Quarterly* **35**: 569-596.
- Conner, K. R. (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?" *Journal of Management* **17**(1): 121-154.
- Conner, K. R. and C. K. Prahalad (1996). "A resource-based theory of the firm: Knowledge versus opportunism." *Organization Science* **7**(5): 477-501.
- Demsetz, H. (1988). "The Theory of the Firm Revisited." *Journal of Law, Economics, and Organizations* **4** (1)(Spring): 141-161.
- Granovetter, M. (1985). "Economic Action and Social Structure: The Problem of Embeddedness." *American Journal of Sociology* **91**(November): 481-510.
- Gulati, R. (1995). "Does Familiarity Breed Trust? The Implications of Repeated Ties for Contractual Choice in Alliances." *Academy of Management Journal* **38**(1): 85-112.
- Kogut, B. and U. Zander (1992). "Knowledge of the firm, combinative capabilities and the replication of technology." *Organization Science* **3**(3-August): 383-397.
- Kogut, B. and U. Zander (1993). "Knowledge of the firm and the evolutionary theory of the multinational corporation." *Journal of International Business Studies* **24**(4): 625-645.
- Kogut, B. and U. Zander (1996). "What firms do? Coordination, identity, and learning." *Organization Science* **7**(5): 502-518.
- Madhok, A. (1996). "The organization of economic activity: Transaction costs, firm capabilities, and the nature of governance." *Organization Science* **7**(5): 577-590.
- Mowery, D., J. Oxley, et al. (1996). "Strategic Alliances and Interfirm Knowledge Transfer." *Strategic Management Journal* **17**(Winter Special Issue): 77-91.
- Nelson, R. R. and S. G. Winter (1982). *An Evolutionary Theory of Economic Change*. Cambridge, Belknap Press.
- Oxley, J. (1995). "Dissertation, University of Michigan Working Paper." .
- Oxley, J. (1997). "Appropriability hazards and governance in strategic alliances: A transaction cost approach." *Journal of Law Economics & Organization* **13**(2): 387-409.
- Powell, W. W. (1990). Neither Market nor Hierarchy: Network Forms of Organization. *Research in Organizational Behavior*. B. M. Staw and L. L. Cummings. Greenwich, CT, JAI. **12**: 295-336.
- Radner, R. (1992). "Hierarchy: The Economics of Managing." *Journal of Economic Literature* **XXX**(September): 1382-1415.

Riordan, M. H. and O. E. Williamson (1985). "Asset Specificity and Economic Organization." *International Journal of Industrial Organization* **3**: 365-378.

Shuen, A. (1993). Technology Sourcing and Learning in the Semiconductor Industry, U.C. Berkeley, Haas School of Business.

Simon, H. A. (1978). *American Economic Review* "Rationality as process and as product of thought," 68(May): 1-16.

Simonin, B. L. (1999). "Ambiguity and the process of knowledge transfer in strategic alliances." *Strategic Management Journal* **20**(7): 595-623.

Teece, D. (1977). "Time-Cost Tradeoffs - Elasticity Estimates and Determinants for International Technology Transfer Projects." *Management Science* **23**(8): 830-837.

Teece, D. J. (1981). "The Market for Know-How and the Efficient International Transfer of Technology." *Annals of the Academy of Political and Social Science*(November): 81-96.

von Hippel, E. (1994). "'Sticky information' and the locus of problem solving: Implications for Innovation." *Management Science* **40**(4): 429-438.

Williamson, O. E. (1975). *Markets and Hierarchies: Analysis and Antitrust Implications*. New York, The Free Press.

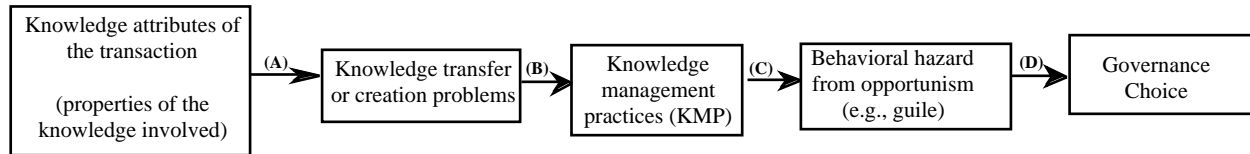
Williamson, O. E. (1985). *The Economic Institutions of Capitalism*.

Williamson, O. E. (1991). "Comparative economic organization: The analysis of discrete structural alternatives." *Administrative Science Quarterly* **36**(June): 269-296.

Williamson, O. E. (1996). *The Mechanisms of Governance*. New York, Oxford University Press.

Winter, S. (1988). "On Coase, Competence and the Corporation." *Journal of Law, Economics, and Organization* **4**(1): 163-180.

Figure 1-The proposed chain of causality.



Notes:

¹ Such direction “blends” the knowledge contained by both actors more than if the supplying actor had to internalize all the relevant knowledge, which is called for in a market relation. Anticipation of knowledge absorption difficulties can cause hierarchy, which substitutes direction for education (Demsetz 1988, 72), to be preferred to market contracting.

² Hierarchy “is likely to be preferred [to market] when the cognitive limitations imposed by bounded rationality, which are chief contributors to the unforeseeability of events, and to the parties’ differences in perspectives, may have a large impact on productivity and profitability” (Conner & Prahalad 1996:488).

³ Another problem with Conner & Prahalad’s (1996) work is that engineers sometimes possess more technical knowledge than those for whom they work. If a boss is frequently unqualified to substitute correct fiat (which is purported to replace the need for costly education) for knowledge, then the model does not reflect real situations in an accurate manner.

⁴ For simplicity in this argument, we assume that each transaction is concerned with only one knowledge set, and that transactions involve non-identical knowledge sets. This is a reasonable assumption given the additional reasonable assumption of many different types of knowledge. Every firm’s knowledge-profile will be unique, with large numbers of permutations for unique inter-firm knowledge-combinations in collaborations. In this sense, joint problem-solving complexity may be expected to arise often, and act strongly in practice.

⁵ We can add to Foss’ critique by observing that Conner & Prahalad also fail to identify within their framework how or why hybrid modes of governance might be expected to arise.

⁶ Oxley’s other (admittedly unexplored) factors operate at the level of the firm, [2] firm capability, and [3] firm prior experience, and may act as exogenous shift parameters, but are not central to this discussion.

⁷ Others have also forged ahead into this murky theoretical terrain, with some success, but rarely with explicit acknowledgement of opportunism hazards and the need to safeguard against them in an economizing manner. Cohen & Levinthal (1990) identify absorptive capacity as a critical performance dimension for firms engaged in innovation, though governance is not their main focus. They stop short of considering the potential for predatory absorptive capacity, which may arise if a firm with substantial absorptive capacity and merely consider the implications for well-intentioned (non-opportunistic) collaborative efforts. In a paper that mentions the potential for efficient behavior in the context of collaborative technology sharing, Mowery, Oxley & Silverman (1996, 77) find that “[e]quity arrangements promote greater knowledge transfer, and ‘absorptive capacity’ helps explain the extent of technological capability transfer, at least in some alliances.” They also question the role of equity as essential in transfer of knowledge; because some collaborators may eschew complete absorption of knowledge in favor of transferring and absorbing just enough knowledge to render exploitation feasible. Although these are provocative results, Mowery, Oxley & Silverman (1996) employ the degree of technological resource overlap as their dependent variable, rather than governance mode choice. Oxley (1995) comes closest to testing for opportunism hazard effects given knowledge properties. Her focus, however, is squarely on hazards represented by transfer of codified, legally protectable knowledge, rather than tacit knowledge, though she provides crude controls for

these effects.

⁸Despite laudable efforts, questions remain as to internal consistency, completeness and evidence regarding Kogut & Zander's assertions as well as others seeking to explain governance choice in the context of knowledge transfer and creation. With respect to Kogut & Zander's work, does their formulation apply to all knowledge, and more importantly, does it explain why firms are more efficient than markets at transferring knowledge?

Kogut & Zander (1992, 383-4) define knowledge as "information (who knows what) and know-how (e.g., how to organize a research team)." Transfer of knowledge is seen as problematic owing to its embedded (social) character. Later, they assert that identity (provided by firms) plays a central role in addressing problems of socially embedded knowledge (1996, 515) "What makes a firm's boundaries distinctive is that the rules of coordination and the process of learning are situated not only physically in locality, but also mentally in an identity." They fail to provide a consistent explanation of why identity matters. They are silent, for example, on the issue of whether identity can develop under market organization. Finally, lack of clarity regarding certain important questions limits usefulness: Which types of knowledge necessitate the development of identity? What "types" of identity exist? Is identity continuous or discrete? Multidimensional? Unidirectional? To what extent and how do different degrees of types of identity confer/impose distinctive competences/costs? All these issues obtain in addition to Foss' (1996a, 1996b) observation that Kogut & Zander fail to acknowledge a role for the effects of opportunism threats. While recognizing the importance of knowledge transfer and the likely involvement of social factors (e.g., networks), we question the central role of identity. Our extension of TCE treats identity as something that might be unpacked in terms of knowledge management practices.

⁹In this work, we use the terms complexity, joint problem-solving complexity, and knowledge complexity interchangeably. The second (admittedly unwieldy) term best reflects our intended meaning in the context of our earlier definition of complexity.

¹⁰While considering several important KBV factors, we construct a plausibly ordered chain of causality wherein TCE (safeguarding against behavioral hazards) drives governance choice. We note that no one has proposed a reverse-ordered chain of causality which positions the KBV to drive governance if opportunism is to be admitted. That is, it seems implausible that KMPs would be first chosen along TCE lines, followed by choice of governance modes based solely on knowledge-based factors; the ex post threat of opportunism could readily derail a transaction structured using this logic. Since we contend that a complete consideration of governance causality should treat both knowledge-management practices (analogous to production technology) and subsequent behavioral hazards (opportunism), the transaction cost framework seems most clearly well-suited to the task of framing any integration of the theories (see Williamson, 1985, p. 93, Fig. 4-2). Ceteris paribus, given severely debilitating instances of knowledge attributes (e.g., widely dispersed, tacit knowledge), particular knowledge-management practices and their implications for behavioral hazards drive governance choice in order to minimize the total costs of the transaction.

¹¹Although not discussed here, a firm (or another choice from the "standard" governance continuum of economic entities (e.g., M-X-H) may not be the optimally economizing response. In other instances, the adoption of knowledge-management practices may lead to contracting hazards

against which an “off-continuum” organization mode safeguards. Examples include a professional society, public educational institution, or publicly subsidized industry. In these cases there is often a “political efficiency” element being satisfied, which is not always readily apparent (Williamson, 1996, Ch. 8). Our theory may provide an explanation for the adoption of some knowledge-critical, non-firm modes of organization, which lie outside the normally discussed continua. An in-depth exploration of this line of thought lies beyond the scope of the present work.