Digging deeper: Learning and incentive theory predictions for variation in technology licensing across nations in an era of global standardization of intellectual property rights.

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David F. Robinson
University of Wisconsin - Madison
School of Business
1249 Grainger Hall
975 University Avenue
Madison, WI 53706

Phone: (608) 265-8928
Fax: (608) 265-5372

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I. Introduction and Theory

In recent years, great progress has been made in establishing a global framework for intellectual property rights. An example is the agreement across major patent systems of a 20 year life for patents. The World Intellectual Property Organization, World Trade Organization and the General Agreement of Tariffs and Trade have all contributed to the global effort to place increased priority on establishing and standardizing intellectual property rights (WIPO, 1995; Chang, T.K. 1996; Takenaka, 1995). Firms with intellectual assets to sell or those firms wishing to increase their technological knowledge base from outside sources stand to benefit from increased willingness and capability to enter into licensing agreements. Firms which survive by copying or pirating the protected technology of others will find it increasingly difficult to avoid regulation and enforcement of intellectual property rights (IPRs) as nations develop institutional capabilities to operate and enforce their IPRs (Chang, 1993; Faison, 1996).

However, in spite of significant progress in the adoption of intellectual property rights around the world, there is still great variation in the implementation of these rights leading to tremendous variation in the context in which licensing between firms takes place. This is hardly a surprising statement given the diverse country-level institutions that form the basis for the enactment and enforcement of IPRs. These institutions are deeply embedded with the legal traditions and social policies of their respective governments. Many have been in existence only a few years or have had radical changes made in their ability to enforce IPRs as their governments adapted their policies to fit the increased protections expected by the leading industrial nations. Firms would do well to keep in mind that even the existence of familiar sounding IP rights, procedures, practices and institutions there is great variation in the actual practices.

This paper specifically addresses licensing of patented technology. Patents are a form of legal protection provided by a nation to inventors giving the inventor the right to control who has the right to

use the new discovery. Licenses are legal contracts which allow people or organizations limited rights to use of patented inventions usually in exchange for a monetary fee (a royalty) (Merges, 1992).

I address these variations through organizational learning, institutional and economic incentive theories and develop predictions regarding the effects of the IPR context on licensing behavior. Organizational learning and knowledge management have become increasingly important in organization and strategy theory (Levitt and March, 1988; Huber, 1991; Prahalad and Hamel, 1990). Understanding how organizations learn new competencies has gained importance in recent years as competition among firms has been characterized as increasingly based on unique capabilities or core competencies (Prahalad and Hamel, 1990). These competencies are described as being crucial to firm success in an environment of accelerating technological and competitive change (D'Aveni, 1994).

Traditional learning research has focused primarily on explaining how organization learn from their own experience (Cyert and March, 1963). However, contemporary organizational learning scholars have emphasized vicarious learning by organizations and processes of *interorganizational learning.* Interorganizational learning is specifically concerned with how knowledge moves across organizations. Aspects of interorganizational learning have been examined by strategy, organizational and technology management scholars through studies of joint ventures (Lyles, 1988), mergers and acquisitions (Haunschild, 1996) and research consortia (Aldrich and Sasaki, 1994). This research has emphasized two determinants of interorganizational learning: (1) the capabilities of the firms involved in knowledge exchange and (2) the nature of the knowledge being exchanged. For example, Cohen and Levinthal (1990) provided indirect empirical evidence that research and development expenses may create firm-level differences in terms of their absorptive capacity -- their ability to recognize, interpret and import vital new scientific knowledge.

At the same time Winter (1987) and Teece (1987) and more recently, Spender and Grant (1996) have emphasized the crucial impact on learning of the nature or characteristics of the knowledge being

exchanged. Explicit knowledge (e.g. a recipe) is more easily codified and transferred but is also subject to spillovers and unauthorized appropriation (Jaffe, Trajtenberg and Henderson, 1993; Kogut, 1991). Tacit knowledge (e.g. the feel or texture of the ingredients when properly mixed) offers the advantage of being harder for others to imitate, but the disadvantage of being difficult to convey across firms.

In this paper, I argue that the *context* of interorganizational learning can affect its occurrence and its outcomes. I first suggest that in addition to the experience of participating organizations, experience of other social actors and of broader social systems will influence interorganizational learning (Freeman, 1987; Kogut, 1991; Nelson and Rosenberg, 1993). Following institutional theorists, I suggest that these other social actors may create and transmit scripts, routines and standard operating procedures that make interorganizational learning more likely (Suchman, 1994). For example, I hypothesize that the existence of an experienced patent bar or a long-standing intellectual property system will influence the chances that an invention will be licensed in a particular nation. In addition, I suggest that learning will also be influenced by external factors that influence the degree of information sharing that occurs at different points in interorganizational learning. In particular, I argue that some features of intellectual property laws and systems will influence the degree and timing of information exchange, which will in turn impact the nature and effectiveness of interorganizational learning.

I also suggest, however that prior learning theory has sometimes neglected important contextual features that impact interorganizational learning. In my second set of arguments, I hypothesize that both formal intellectual property laws and informal features of their interpretation and enforcement will influence interorganizational learning because they can shape the value of knowledge and incentives for different modes of acquisition (Ordover, 1991; Matutes, et al 1996; Merges, 1988). These legal practices, capabilities and informal structures will vary across countries. For example, a firm operating in a country with strong enforcement of patent laws and/or whose legal system tends to

interpret patents very broadly has stronger incentives to license an invention than the same firm in a country with weaker enforcement or narrower interpretations.

This second set of hypotheses emphasizes the impact of context in terms of shaping the *incentives* for knowledge acquisition, rather than the interorganizational learning *processes* themselves. These hypotheses build on basic concepts from economic and legal literatures concerning intellectual property law (Klemperer, 1990; Merges and Nelson, 1994) with the goal of integrating some of these considerations more deeply into a theoretical approach to interorganizational learning.

I examine these ideas by exploring hypotheses and data related to the commercial adoption of university inventions that have been patented in more than one country. This setting offers the important advantage that I can examine the fate of a single 'bundle' of knowledge (one invention) that has been codified and made available for adoption in several distinct contexts (countries).

The objectives of this paper, then, are to contribute to theories of interorganizational learning by proposing specific hypotheses concerning contextual factors that influence (a) processes of such learning, as well as (b) general incentives for such learning. In addition, I seek to integrate more fully into learning models considerations developed in economic and legal approaches to intellectual property systems, and to contribute in the long run to our understanding of managerial and public policy concerns related to the commercialization of inventions.

In the following section, I propose specific hypotheses. Next, I discuss the methods, measures and analysis to be used in testing these hypotheses using. The actual analysis will be performed as part of my dissertation on this same subject. Finally, I discuss the anticipated contributions of the research.

II. Hypotheses

I argue in this paper that contextual factors play an important role in affecting the nature and outcomes of interorganizational learning processes. Contextual factors also shape the nature of the

incentive structure for interorganizational learning. I first develop hypotheses related to learning processes, and then discuss hypotheses relating to incentives.

In each section, I develop predictions using two theoretical lines of reasoning. Within the learning section, I develop ideas about (1) experience and (2) information exchange. Within the incentives section, I develop predictions exploring the impact of (1) the formal and (2) the informal aspects of the intellectual property system on incentives.

Within each theoretical section, I first address factors that I propose will influence whether or not a specific invention is licensed at all (licensing likelihood). I present these hypotheses grouped by independent variables that will influence licensing outcomes. (Figures 1 and 2 summarize variables and effects discussed in the hypotheses below.)

Learning processes In this section, I argue that contextual factors will combine with features of the participating organizations to influence learning in two broad ways. First, I suggest that the *prior experience* of not only the participants, but external actors will influence the chances of a license occurring. Second, I propose that two features of the intellectual property system will influence *information exchange* processes which constitute part the interorganizational learning process. Finally, I propose that learning about the intellectual property through past licensing experiences is a cumulative process that will lead to a greater likelihood of licensing in the future.

Experience effects Over time, actors in systems learn to operate the mechanics of the system to accomplish tasks assigned to that organization. Experience points out actions that are inconsistent with the operation of the system and generally makes the system easier to understand and more predictable to use. More importantly, over time different social actors generate recipes, scripts, and standard contracts that make interaction easier. These routines or recipes can then be used or accessed by participants in interorganizational learning in ways that facilitate knowledge exchange (Suchman, 1994; Granovetter, 1985)

Concentration of skilled intellectual property attorneys The patent systems in many industrialized nations have evolved over hundreds of years. Institutional and learning scholars have observed that over time, populations of organizations develop routines or scripts that can be used by many different actors (Dimaggio and Powell, 1983; Zucker, 1987; Suchman, 1994; Miner and Haunschild, 1996). For example, Suchman (1994) found evidence that attorneys used standard scripts when structuring legal agreements used in the founding stage of high technology venture firms in Silicon Valley. These scripts make it much easier for interorganizational knowledge transfer to occur because the process does not have to be re-invented each time it occurs, it becomes standardized.

If there are more actors who are capable of using these routines then the routines will be more easily available for organizations to use. Specifically, the availability of attorneys skilled in dealing with intellectual property matters may affect the ease and extent of using license agreements to transfer technology across organizations. For example, shortages of patent attorneys are blamed for some difficulties in implementing Singapore's newly enacted patent system (personal interview with Singaporean official, 1997). Relatively large numbers of patent attorneys relative to their population would facilitate using licensing routines to effect technology transfer across organizations.

H1: *Licensing will be more likely in nations with a higher concentration intellectual property attorneys.*

Age of entire patent system It takes time for the patent authorities, the legal system and businesses to learn how to coordinate work on intellectual property rights, contracts and enforcement. For example, The US system is one of the oldest patent systems in the world, with some roots in the Constitution over 200 years ago. Patent law has been taught in law schools for decades. There is an established bureaucracy that administers the patents (Merges, 1992). Like the routines described in the previous hypothesis, the intellectual property administrative system and organizations that interact with it have developed standardized routines that facilitate intellectual property transactions. There has been

considerable effort by the World Intellectual Property Organization (or WIPO) to export these routines to countries that are new adopters of intellectual property protection laws (WIPO, 1995). However, it will still take considerable time to develop coordinated routines that are well known in a complex integrated system of business and government actors like an intellectual property system. A mature patent system will lead to greater likelihood of licensing than relatively young patent systems because the older system will have stabilized procedures, definitions and had time to create and understand legal precedents through actual patent experience.

H2: *Licensing will be more likely in older patent systems.*

Office of Technology Licensing (OTL) experience with foreign country licensing system The licensing transaction requires a negotiated agreement between the licensee and the licensor (the OTL). An early task for the OTL in licensing is to find potential licensees that would be interested in the invention. Organizations engage in search behavior (Cyert and March, 1963) and at the same time seek to minimize transaction costs (Williamson, 1975). Experience in the country will create higher likelihood that the OTL will search effectively through familiarity with the local business environment and legal requirements of licensing. For example, increased contact between the OTL and local intellectual property attorneys or patent office functionaries may provide leads on firms that might be interested in licensing technology from the OTL. These private and government contacts may also provide working knowledge as to how to repatriate royalties, conduct negotiations and other local customs necessary to implement a licensing agreement. This search may also yield more productive technology matches for both licensee firms and the OTL. Learning would come as both the OTL and licensee firms became more aware of the needs and capabilities that each offered.

H3: *Greater numbers of prior licensing experiences by the OTL in a country will lead to increased chances of licensing for the current invention.*

Incentive structures In this section, I consider a different kind of impact of the intellectual property system: its role in shaping the incentives faced by those involved in such learning. In the first set of hypotheses, I consider how aspects of the formal intellectual property system may influence whether licensing occurs.

Formal features of the intellectual property system Patent systems have certain structures, procedures and legal definitions which guide the patent granting and enforcement processes (Merges, 1988; 1992). Some of these features grant greater or lesser opportunity to market or enforce patents against infringement which may affect the value that can be received for particular patented technologies. For example, Shapiro and Switzer (1993) examined the fluctuation in pharmaceutical company stock prices due to changes in Canadian policy on royalties for licensing of pharmaceuticals.

Doctrine of equivalents Existence of a legal policy or interpretation similar to the doctrine of equivalents should strengthen patents against imitators (Ordover, 1991; Merges, 1992). In the US, court decisions have in some cases granted patents more technological space than the literal meaning of the claims of the patented invention would require (Merges, 1992). The purpose of this was to ensure that an imitating product cannot make insubstantial changes" which add nothing but take the imitating product outside the literal claim of the patent. To allow this would encourage copying and according to Justice Jackson in a landmark case *'[W]ould deprive the inventor of his invention and would foster concealment rather than disclosure of invention, which is one of the primary purposes of the patent system.'* (Merges, 1992 pg. 659). By enacting a doctrine of equivalents there will be more incentive to engage in licensing agreements as the underlying patent should be more enforceable against close imitators.

H4: *Stronger enforcement of a doctrine of equivalents or similar legal policy will increase licensing likelihood.*

Opposition permitted Many countries, the US is a notable exception, allow interested parties to mount opposition to patent applications before they are granted (Ordover, 1991) These regimes typically publish the patent after it has been submitted to the patent authority but before it has been granted. Interested firms (usually competitors) may use published and other information to mount a challenge to the patent. To diffuse this opposition, patentholders are often encouraged to cross-license the new technology in exchange for lower opposition to the patent, or to invent around the new technology. Competitors are not as fearful of potentially broader patent claims if they know they will have access to the technology. Inventors often revise their applications to make them more able to survive opposition by, for example, restricting patent applications to only their strongest claims (Ordover, 1991). In general, patents which are prepared in anticipation of possible opposition or which have survived opposition and been granted should be more enforceable than patents in non-opposition systems. Patents that are more enforceable should be more attractive to licensees.

H5: *Patents in regimes that allow opposition will experience higher licensing chances.*

Implementation and interpretation Patent systems also consist of less rigid structures that are often open to interpretation by legal and administrative authorities. The effectiveness of protection afforded patents and their license derivatives depends in part on how these interpretations are directed.

Enforcement Nations may allow patents but not provide for meaningful enforcement of those patents (Faison, 1996). Failure to enforce the patents effectively renders the intellectual property protection worthless. In theory, what motivation would there be to license a patent if that license is unable to restrict use of the technology to only authorized users? There will be stronger demand for licenses because potential infringers will have to license or face litigation. Failure to pay license royalties could be difficult to enforce if the patent holder cannot readily seek enforcement of the patent against the abusing licensee. Unless there is significant tacit knowledge unavailable to the potential licensee there is little recourse for the patent holder to force payments short of using the enforcement system of

the licensee firm's nation (Chang, 1996). This protection may vary somewhat in relation to the particular invention and its technological base if, for example, the country provides effective protection to drugs but not to medical devices.

H6: *Strong enforcement of patent rights will lead to increased likelihood of licensing.*

Breadth of claims scope Patent claims spell out the boundaries of the technology space granted to the each particular patent (Merges, 1992). Even in well established patent systems there is great variation in the way legal authorities interpret the patent claims themselves (Takenaka, 1995). If the intellectual property authorities allow broad interpretation of claims this should in effect protect more downstream applications of the patented invention for the licensee to exploit (Matutes, et al, 1996; Merges and Nelson, 1994). Narrow interpretation will allow close imitators to avoid literal infringement and leave the patented invention subject to relatively easy substitution (Merges, 1992). The value of any useful invention should be increased by broad claims in that there will be fewer competing equivalent inventions as each new invention will have to be substantially different from existing technology (see Klemperer, 1990). More potential applications should make the patent attractive to a wider variety of potential licensees increasing the chances the invention will be licensed. Broader claims should increase demand for available inventions and discourage infringement of patents leading to increased royalties.

H7: *Broad patent claims interpretation will lead to increased licensing likelihood.*

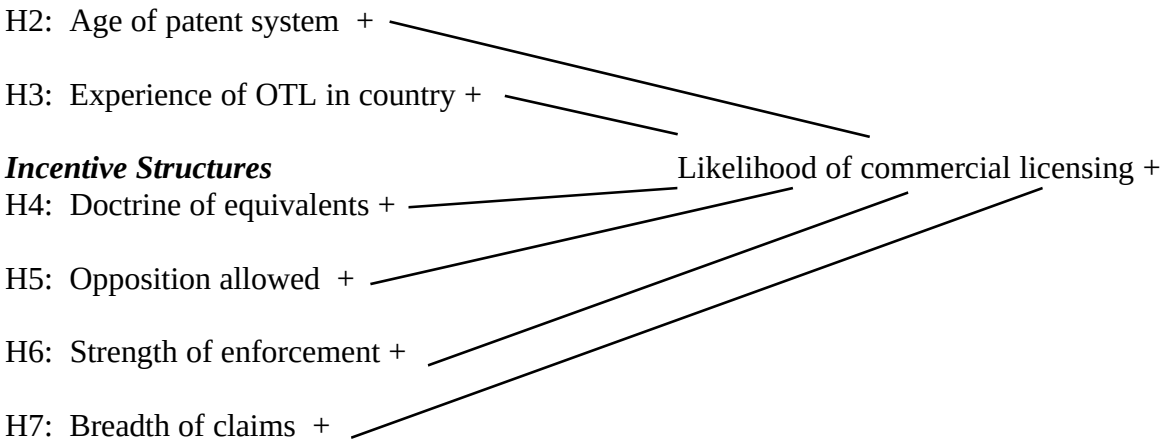
Note: Table 1 below summarizes the hypothesized relationships between the independent variables and the dependent variable (unobserved hazard rate of licensing likelihood).

Table 1
Hypothesized relationships between independent variables and licensing likelihood

('+' designates an increase in the independent variable leads to increased likelihood of licensing)

Experience Effects

H1: Concentration of patent attorneys +



III. Methods

Setting This paper will examine interorganizational learning that occurs when a firm licenses an invention from a university. This section describes key features of this unique setting and provides background information for the hypotheses and variables described below. This study uses data from inventions discovered and patented at a large research university in the United States. A faculty inventor discloses the invention to the university through the Office of Technology Licensing (the OTL). The OTL then evaluates the patentability and licensability of the new discovery. If the OTL accepts the invention as having commercial value, the faculty member then assigns the rights to the invention to the OTL which then pursues both the patenting and marketing of licenses for the new discovery. (For selected OTL descriptive statistics see Table 2.)

The setting is somewhat different than that of a commercial firm doing research and development. The university is not typically interested in producing goods with the patented technology. Rather, it hopes others will use the technology productively and pay the university for its use (Mitchell, 1991; Trune, 1996). Multiple licenses are possible for the same patented invention. However, these licenses will be negotiated under very different intellectual property regime conditions. One advantage with this setting is that universities have produced the inventions but do not manufacture or make products (Bremer, 1985). Finally, this setting offers the methodological

advantage of providing clear dates when inventions were patented, became formally available for licensing and were licensed (if ever).

Sample The cases that form the basis for this research consist of all faculty inventions patented by the Office of Technology Licensing at a major US research university over a 17 year period. More than 550 faculty inventions were patented during this period. Because a single invention may be patented in more than one country the inventions generated a total of 1,751 patents. Virtually all of the inventions have been patented in the US and from 2 to 4 foreign countries. The OTL has patented inventions in 34 countries or patent entitities and a final decision on which countries to include in the sample has not been made yet. Table 2 summarizes descriptive data on the activity in this system.

Table 2
Office of Technology Licensing Descriptive Statistics

Number of faculty disclosures	2300
Number of Licenses (includes expired)	1319
Total number of patents	1751
US Patents (includes derivatives)	658
Non-US Patents	1093

Various countries and the number of patents from each (In this proposal, for confidentiality reasons, I only show patents for 10 countries out of 34 countries total)

Australia	50
European Patent Office	53
France	103
Germany	83
India	11
Japan	87
Korea	8
New Zealand	18
Soviet Union	4
Spain	15

It should be noted that about 1 out of 4 faculty disclosures leads to a US patent. Only patented inventions are licensed. Not all of the patented inventions were ever licensed. There can be multiple license agreements for each patented invention and the OTL's policy is to avoid granting exclusive licenses. Several patents may be included in a single license agreement (another data analysis issue).

The unit of analysis will be a single patent in a single country. However, inventions patented after 1992 may not included for the licensing outcome analysis due to a policy change in the way the OTL patented inventions internationally. Until that time the OTL's general policy was to patent in many countries without specifically determining whether or not a potential licensee existed. However, in more recent years, legal cost concerns led to efforts to avoid patenting unless a specific potential licensee had been identified. The correct cutoff date will need to be determined through review of patent records and interviews with OTL personnel.

I expect important variation across individual cases in terms of multiple study and control variables. For example, a single invention may be characterized by a study variable that shows the OTL has little experience in one country, and a great deal of experience in another country. Similarly, the same invention may be associated with an old industry in one country, but a newer industry in another country. However, it is clear that the cases are not fully independent. Thus it may be necessary to explore alternative methods for assessing whether problems with independence are affecting my results, and to consider alternative analytic approaches to deal with potential problems.

Table 3: Variables

Dependent Variable

D1 Likelihood of commercial licensing: The first dependent variable is the unobserved hazard rate of a licensing event. This can be thought of as the underlying likelihood that a patented invention will be licensed (Tuma and Hannan, 1984) The 'event' in this study is the creation of a licensing agreement between the OTL and the licensee firm. The length of time until licensing is measured from the date the invention was disclosed to the university office of technology and licensing (OTL) until a license agreement is signed (if ever). Measurement will follow the method used in Tang, Robinson and Miner (1995; 1996)

Independent variables

I1. Concentration of patent attorneys: To measure the maturity of the patent system, I will compute the number of patent attorneys per 1000 people in each country in the study.

I2. Age of patent system: Measured as time elapsed since major shift in patent system that would affect patentability of invention or enforcement of the patented technology.

I3. Prior OTL licensing experience in foreign country: Measured by a simple count of licensing agreements for inventions patented and licensed in the particular nation prior to the patenting of the current invention.

I4. Strength of Enforcement: This variable captures whether there exists an effective enforcement mechanism. Using informed experts and published sources each relevant system will be categorized on a likert-like scale as ranging from very strong to very weak or non-existent. Enforcement may vary somewhat in

relation to the particular invention and its technological base. For example, if the country provides effective protection to drugs, it may not extend that enforcement to medical devices.
I5. Doctrine of equivalents: This variable will be evaluated by experts or from published sources as to whether the country follows a doctrine of equivalents (or an equivalent legal principle) and assess the strength of enforcement of the doctrine.
I6. Opposition to patent allowed prior to grant: Indicates whether legal opposition to proposed patents is allowed. Coded 1 if practiced by national patent office and 0 if not practiced.
I7. Breadth of claims scope granted: Countries will be categorized by an expert panel and secondary sources (Takenaka, 1995 for example) on a scale ranging from very broad claims to very narrow claims.

Control variables are grouped according to whether they represent national/industry level conditions or traits of the invention. Explanations are very limited due to space limitations for this submission.

Control Variables

National/Industry control variables
C1. Exclusive licensing allowed.
C2. National patent policy on the number of claims allowed.
C3. Economic Activity (Gross domestic product or similar).
C4. Size of market(based on the particular industrial sector of the invention).
C5. Licensing common practice in the industry.
C6. Licensing common practice within the country.
C7. Licensing common practice within the local industry.
C8. Amount of prior experience in patenting in a particular country.
C9. Licensing firm has prior experience licensing with the OTL.
C10. Trade secret laws in place.
C11. Compulsory licenses required or used as a common remedy for dispute resolution.

Traits specific to the invention
C12. Date of patent.
C13. Date of disclosure to OTL (both C12 and C13 are needed for analyzing the length of time an invention has been at risk for adoption.
C13. Number of product versus process claims.
Product claims are viewed as more objectified and therefore more readily understood than process claims and can be more readily and speedily transferred than more tacit knowledge (Winter, 1987).
C14. Total number of patent claims for the specific invention (The number of claims may represent uses for the patented invention. In this sense the number of claims may actually proxy for the market value of the technology (Tang, Robinson and Miner, 1995; 1996).
C15. Industry of licensing company. (To control for possible industry specific effects in the data.)
C16. Patent classification of the technology (To control for potential technology effects)

IV. Analysis

Event history analysis will be used to model the adoption (licensing) behavior taking into account the various independent variables, interaction terms and control variables described above. The ‘event’ in each case will be the licensing of a particular invention during a period of time. In performing this analysis, the invention will be coded as 0 at each period until it is licensed at which

time it will be coded as a 1 henceforth. This procedure (which follows that used by Tang, Robinson and Miner, 1995; 1996) will model the unobserved hazard rate of licensing an invention. The regression of the time dependent variables then describes how the independent variables affect this rate of licensing.

V. Anticipated contribution of the paper

My paper will contribute to several literatures. The formal hypotheses tests will provide additional understanding of how information sharing and experience (scripts or routines) may influence interorganizational learning. These tests will also increase our understanding of the role of formal social structures (e.g. intellectual property regimes) in interorganizational learning.

There will also be implications for broader perspectives on both learning theories and incentive theories. This paper will provide insight into how learning and incentives interact dynamically and influence outcomes associated with interorganizational learning (i.e. licensing and royalties). In addition, my analyses will help explain the link between technical processes and institutional processes in terms of actual knowledge transfer outcomes. The paper will also contribute insights useful for public policy debate in the US and other countries on intellectual property rights. This comes at a critical moment in the evolution of new intellectual property rights regimes in many developing countries.

VI. Bibliography

Aldrich, H. and Sasaki, T. (1995) R&D consortia in the United States and Japan. *Research Policy,* March, 24 (2): 301-316.

Bremer, H. (1985) Research applications and technology transfer. *Journal of the Society of Research Administrators*, 17(2), pp. 53-66.

Chang, S. (1993) Cracking down on pirates. *Business Korea*, May, Vol. 10, Issue 11: 24-26.

Chang, T. K. (1996) MFN and the art of politics. *The China Business Review* , May, 23, 3: 42.

Cohen, M. and Levinthal, D. (1990) Absorptive capacity: A new perspective on learning and innovation, *Administrative Science Quarterly*, 35, 1 (March) : 128-152.

Cyert, R. M and March, J. G. (1963) *A behavioral theory of the firm*. Englewood Cliffs, NJ. Prentice-Hall.

D'Aveni, R. (1994). *Hypercompetition*. New York: The Free Press.

Dimaggio, P. and Powell, W. (1983) The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, 48: 147-60.

Dunning, J. (1994). Multinational enterprises and the globalization of innovatory capacity. *Research Policy*, 23, pp. 67-88.

Eisenhardt, K. (1989) Building theories from case study research. *Academy of Management Review*. Vol. 14. No. 4: 532-550.

Faison, S. (1996) China says it will retaliate if US imposes trade sanctions. *The New York Times*, May 10th.

Fetterman, D. (1989) *Ethnography*. Applied Social Research Series. Volume 17. Newbury Park: Sage

Freeman, C. (1987) *Technology policy and economic performance*. London: Pinter.

Granovetter, M. (1985) Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, 91: 481-510.

Haunschild, P. (1994) How much is that company worth?: Interorganizational relationships, uncertainty, and acquisition premiums. *Administrative Science Quarterly,* September, 39 (3): 391-412.

Huber, G. P. (1991) Organizational learning: The contribution process and the literatures, *Organization Science*, 2(1): 88-115.

Jaffe, A., Trajtenberg, M. and R. Henderson (1993) Geographic Localization of knowledge spillovers as evidenced by patent citations. *Quarterly Journal of Economics*, August, 577-598.

Klemperer, P. (1990) How broad should the scope of patent protection be?, *RAND Journal of Economics*, Vol. 21: 113-30.

Kogut, B. (1991) Country capabilities and the permeability of borders. *Strategic Management Journal*, 13, pp. 33-47.

Levitt, B. and J. March (1988) Organization learning. *Annual Review of Sociology*, 19: 313-340.

Lyles, M. (1988) Learning among joint venture sophisticated firms. *Management International Review*, 28: 85-98.

Matutes, P., Regibeau, P. and K. Rockett (1996) Optimal patent design and the diffusion of innovations. *RAND Journal of Economics*, Vol. 27, No. 1, Spring, pp. 60-83.

Merges, R. P. (1988) Commercial success and patent standards: Economic perspectives in innovation. *California Law Review* , Vol. 76.

Merges, R. (1992) *Patent law and policy: Cases and Materials*. Charlottesville, VA.: The Michie Company.

Merges R. and Nelson, R. (1994) On limiting or encouraging rivalry in technical progress: The effect of patent scope decisions. *Journal of Economic Behavior and Organization*, 25: 1-24.

Miner, A. and Haunschild, P. (1995). 'Population level learning', in Staw, B. and L. Cummings (Eds.) *Research in Organization Behavior*, Greenwich, Connecticut: JAI Press.

Mintzberg, H. (1979) An emerging strategy of "direct" research. *Administrative Science Quarterly*. 24: 580-589.

Mitchell, W. (1991). Using academic teaching: Transfer methods and licensing incidence in the commercialization of American diagnostic imaging equipment research 1954-1988. *Research Policy*, 20, pp. 203-216.

Nelson, R. and Rosenberg, N. (1993) Technical innovation and national systems in Nelson, R. (Ed.) *National innovation systems: A comparative analysis*. New York: Oxford University Press.

Ordover, J. A (1991) A patent system for both diffusion and exclusion. *Journal of Economic Perspectives*. Vol. 5, No. 1, Winter: 43-60.

Prahalad, C. and Hamel, G. (1990) The core competence of the corporation. *Harvard Business Review,* 68: 79-87+.

Shapiro, D. and Switzer, L. (1993) The stock market response to changing drug patent legislation: The case of compulsory licensing in Canada. *Managerial and Decision Economics*, Vol. 14: 247-259.

Spender, J. C. and Grant, R. (1996) Knowledge and the firm: Overview. *Strategic Management Journal*, Winter Special Issue 17: 5-9

Suchman, M. C. (1994) On advice of counsel: Law firms and venture capital funds as information intermediaries in the structuration of Silicon Valley. Unpublished doctoral dissertation, Stanford University, Stanford. CA

Takenaka, T. (1995) Interpreting patent claims: The United States, Germany and Japan. Munich. Max Planck Institute for foreign and international patent, copyright and competition law.

Tang, Ben C., Robinson, David F. and Anne S. Miner (1995) *The role of timing in the adoption of inventions: An exploratory study*. Organization and Management Theory Division, Academy of Management annual meetings, August, Vancouver, Canada.

Tang, Ben C., Robinson, David F. and Anne S. Miner (1996) *A tide which taken at its ebb: The effect of timing on the first commercial adoption of inventions.* Working paper.

Teece, D. J. (1987) Profiting from technological innovation: Implications for integration, collaboration, licensing, and public policy, in *The Competitive Challenge, Strategies for Industrial Innovation and Renewal*. D. J. Teece (Ed.). New York: Harper & Row,

Tirole, J. (1988) *The Theory of Industrial Organization*. Cambridge, MA: The MIT Press

Trune, D. (1996) Comparative measures of university licensing activities. *Journal of the Association of University Technology Managers*, Vol. VIII.

Tuma, N. and M. Hannan (1984) *Social Dynamics, Models and Methods*. New York: Academic Press.

Williamson, O. E. (1975) *Markets and hierarchies: Analysis and anti-trust implications*. New York: Free Press.

Winter, S. G. (1987) Knowledge and Competence as Strategic Assets, in *The Competitive Challenge, Strategies for Industrial Innovation and Renewal*. D. J. Teece (Ed.), Harper & Row, New York.

WIPO (1995) *World Intellectual Property Organization General Information*, Geneva.

Zucker, L. (1987) Institutional theories of organization. *Annual Review of Sociology*, 13: 443-464.