An Empirical Study of Restricted Rights in Technology License Contracts

Chae Un Lim *
Stephen Carson **
Mrinal Ghosh ***
George John ****

* Professor of Marketing, Sogang University, Seoul, Korea
** Assistant Professor of Marketing, University of Utah, Salt Lake City, UT, USA
*** Assistant Professor of Marketing, University of Michigan, Ann Arbor, MI, USA
**** Professor and Pillsbury-Gerot Chair in Marketing, University of Minnesota, Minneapolis, MN, USA

Please address all correspondence to:

Professor George John
Marketing Department
Carlson School of Management
University of Minnesota
321, 19th Avenue South
Minneapolis, MN 55455
e-mail: gjohn@csom.umn.edu
ph: 612 624-6841

An Empirical Study of Restricted Rights in Technology License Contracts

ABSTRACT

Although the disabilities of contracting out technology have been documented, this practice is growing is popularity. We need to understand the microstructure of these agreements to unpack the reasons for their success. We work out of the TCE tradition to argue that restrictions on licensee discretion create simulated hierarchies that govern intellectual property transactions effectively. This governance view is tested alongside the alternative view that such restrictions reflect the market power of the licensor. We find strong support for our governance matching hypotheses. Restrictions on licensee discretion are more pronounced as it becomes more difficult for licensors (a) to articulate/specify technology adequately via documentation, (b) evaluate the licensee's performance, and (c) predict potential applications of the technology. Conversely, greater licensee discretion is observed when the focal technology’s evolutionary path is more uncertain. We find no support for alternative hypotheses based on the market power of the licensor. Implications for research and practice are discussed.

INTRODUCTION

Marketable technology can be defined as knowledge that is useful or productive in a economic sense. Capon and Glazer (1987) identify two fundamental options open to marketers to generate revenue from technology assets. One option is the "make/downstream" option wherein the technology is embedded into a tangible product, which is then sold. The second option is the "sell/upstream" option wherein it markets the technology directly as an intangible item through licensing or outright sale.[1] Licensing occurs in many different forms, but the core idea is that another party is permitted to use or exploit the focal firm's knowledge in return for some compensation. The conventional view is that the downstream route is the historic norm. There is some indirect evidence that bears on this issue. For instance, royalty revenues are but a negligible fraction of total R&D expenditures in the economy (e.g., Wilson, 1971; as reanalyzed by Von Hippel, 1987). Evidently, R&D expenditures that generate technology assets are being recouped largely through tangible product sales. The disabilities of contracting for knowledge are cited among the reasons for relying on the downstream route(e.g., Taylor and Silberston, 1973; Teece, 1986).

Pre contract problems include the fact that a buyer can value intellectual property best after they have acquired it. Of course, sellers are loath to permit buyers to "try it out" this since knowledge that has been acquired cannot be returned or "forgotten". Another problem is that the use or possession by one licensee/buyer does not diminish its availability to a subsequent party. The original seller can sell unlimited "copies" later at nearly zero "reproduction/ incremental" cost. Promises not to sell elsewhere or at lower prices are not credible per se. This makes it more difficult for the first buyer to safeguard his or her own investments in marketing the acquired technology. In turn, this makes it more difficult to arrive at a mutually satisfactory deal.

Post contract problems also abound. For instance, a buyer may "sit" on a technology to protect its own (obsolete) technology. Even termination is not sufficient because the buyer still retains knowledge of the relevant technology. These difficulties are all exacerbated in weaker property rights environments such as international trade with multiple legal jurisdictions and other political hazards (e.g. Henisz and Zelmer, 2004)

Despite these difficulties, the available data show that contractual licensing arrangements are increasingly used to transfer technology across national and firm boundaries (Hennart 1989, Kotabe, Sahay and Aulakh, 1996). Clearly, it is of interest to understand the manner in which the traditional weaknesses attributed to these contracts are being overcome.

Purpose and Scope

Our basic theoretical postulate is that restricting a licensee's discretion over the use of a transferred technology is a governance mechanism for overcoming the disabilities of market exchange. More precisely, such restrictions "simulate" a hierarchy/authority relationship across the boundaries of nominally independent firms (Stinchombe, 1985). Deterrence against the hazards outlined earlier obtains as a consequence. We capture these arguments in the form of refutable propositions.

Our model emphasizes efficiency motives, and is at considerable odds with the traditional view wherein limiting licensee discretion serves monopoly purposes such as market foreclosure or price discrimination (e.g., Long 1981). We control for market power, age of technology, and country of origin of the technology to account for the these alternative views.

We seek to build a middle-range explanation of contract features limited to *manufacturing technology licenses between unaffiliated firms in international markets*. As such, our work does not extrapolate immediately to (1) non-manufacturing "technologies" such as brand names, or (2) contracts between affiliated firms in different countries, or (3) development contracts. By limiting the scope of our work, we exclude several governance mechanisms that are no longer relevant. Excluding brand name licenses obviates the need to consider termination, which is an effective safeguard for brand-names. Likewise, related-firm transfers are excluded so that the wide range of internal protective devices that are available can be ruled out. Development contracts are excluded as they are chiefly concerned with motivating and safeguarding specific investments to ensure quality outcomes. Finally, we focus on international contracts because the magnified trading hazards present increase the sensitivity of our empirical work.

BACKGROUND

Technology Contracts Between Unaffiliated Firms

Both TCE (e.g., Williamson, 1985) and the property rights stream in the tradition of Grossman and Hart (1986) emphasize that firms can increase by crafting contract structures that a) allocate property rights to safeguard exchanges against opportunistic appropriation of specific investments, b) build adequate adaptation capabilities, and c) minimize performance measurement difficulties. Among the wide array of contract devices that have been studied, we focus on the utility of "unfair" or one-sided contractual restraints between nominally independent firms first studied by Klein (1980) and the de facto ("simulated") hierarchical arrangements reported by Stinchombe (1985). At their core, these arrangements empower one party, and restrict the other one.

In our context, such devices act as *restrictions on the discretion of the licensee*. The fundamental efficiency rationale for these restrictions is as follows. In a frictionless world, the economic value of a technology to a prospective licensee is greatest when no restrictions on its subsequent use are imposed, all else equal. The standard Coasian notion is that firms are always better off bargaining over the maximum total pie, regardless of their relative bargaining power, thus, it follows that no restrictions should be imposed even by a powerful firm. Of course, this presumes no impediments to transactions (i.e., complete contracting is feasible). Thus, we need to trace those impediments that make it desirable to both parties to impose such restrictions. We turn to this task below.

Defining Licensee Discretion

Like all contracts, licensing contracts specify each party's rights over a range of business activities normally under their control, including such matters as area(s) of use, manufacturing methods, marketing practices and management decisions about the subject matter of the exchange. The licensor as the lawful, prior owner of the technology delegates usage rights to a licensee, but retains certain rights. Our notion of licensee discretion goes beyond this normal specification of rights in a contract. We use discretion to refer to the right to direct or constrain the activities of the other party in ways that mirror employer-employee exchanges. For us, lack of licensee discretion refers to rights that accrue to the licensor when it would normally accrue to the licensee.

Borrowing from Stinchcombe (1985), we identify the locus of decision-making, surveillance and enforcement as the essential aspects of the domain of this construct. Decision-making is an obvious indicant of hierarchy/authority, and a more concentrated locus of decision-making indexes a stronger hierarchy. Surveillance is also a defining characteristic of hierarchy, and greater ability to monitor indexes a stronger hierarchy. Finally, surveillance is coupled with enforcement so that sanctions can be imposed when deviations from the expected norms are detected. A greater scope and variety of enforcement devices indexes a stronger hierarchy.

Evidence of Hierarchy from Contract Documents

We sought evidence that technology license contracts do incorporate restrictions on licensee discretion in the fashion posited above. To this send, we examine a collection of contracts from a three year period (a total of 2252 contracts) from Korea.

Data Collection The Korean Industrial Research Institute (KIRI) is a government-sponsored research organization that maintains data on contract licenses between foreign and Korean firms. KIRI maintains the identities of licensors and licensees, contract duration, payment conditions and a brief description of the licensed technologies. After eliminating agreements covering brand licensing and/or agreements between affiliated firms, KIRI’s International Technology Cooperation department provided us with their data on 1757 agreements involving manufacturing technologies licensed by foreign firms to unaffiliated Korean firms.

We located 81% of the Korean recipients (1425 agreements), and questionnaires were mailed to a key informant at each recipient as follows. A cover letter from KIRI's chairman requested the presidents of the Korean licensee firms to forward the questionnaire to the individual(s) within their company knowledgeable about the technology agreement(s) identified in the letter. The information about the focal agreement from the KIRI database was reproduced at the front of the questionnaire. Our informants were asked to complete the questionnaire for that specific licensing contract. As an incentive, firms who returned completed questionnaire were offered a copy of KIRI's annual report on technology licensing and a summary of our survey results.

The survey was closed out one month after the initial mailing, and we received 322 questionnaires (23% response rate). This response rate is within the range of response achieved in similar organizational studies in channels and industrial marketing. KIRI analysts also noted that this was quite reasonable in their experience. Of the questionnaires returned, 34 questionnaires were screened out because the respondents indicated that the licensors held an equity position in their firms. All of the remaining 288 questionnaires fell within the desired sampling frame. After deleting questionnaires with excessive missing values, we had 260 usable observations for further analysis.

Sample Representativeness Table 2 shows a diverse set of technology transactions in the sample. We assessed non-response bias comparing early with late respondents as per Armstrong and Overton (1977) who argue that the latter group is more similar to non-respondents, and thus proxy for them. Comparing these two groups, no significant differences were found on contract length, royalty rate and number of contract clauses. However, significant differences were found on two size related variables (sales volume and number of employees). Evidently, our sample over-represents smaller firms. How serious are these differences?

One possibility is that these differences resulted from our data collection method. Recall that our questionnaires were distributed to informants through internal mail after the company management approved them. It probably took more time for larger companies to make a decision and to distribute the questionnaire to relevant individuals. However, such a bias is relatively benign as it should not influence the conceptual variables.

A less benign interpretation is that the size related response rate differences are proxying technological sophistication differences. Since this correlates with the ability to absorb transferred technology, our hypotheses tests might be compromised. We tested this possibility as follows. If technological sophistication differences exist between early and late respondents, then the ratio of R&D to sales should differ as well across these groups. Thankfully, this is not the case.

Licensee Restrictions as Simulated Hierarchy Recall that we are positing that contractual elements that restrict licensee discretion constitute a syndrome or continuum of greater hierarchical control. We sought psychometric evidence about these items as indicants of an unobservable trait as follows. We asked our informants to examine the formal contracts for the license agreement at hand for each of the 20 contractual elements in Table 3. These had been identified earlier through preliminary fieldwork. Notice that each item does not commit the licensor to do anything. It only limits the licensee from doing something. As such, it transfers discretion away from the licensee.

We fit these observations of the number of restrictive elements present in each contract to a Rasch latent trait model. This model expresses the likelihood of the presence of a restrictive contract item, *i*, as a function of the latent trait (restrictiveness) β_j in that contract, *j*, and a parameter δ_i that locates that item on the trait continuum. Thus, contracts containing a large amount of the trait would evoke more affirmative responses to items. Formally, the model is $\text{Logit } \Pr(y_{ij} = 1 \mid \beta_j) = \beta_j - \delta_i$. We obtained maximum likelihood estimates of the parameters as well as fit statistics with the SYSTAT package (Wilkinson, 1986). Table 3 reports the estimated parameters of the items. The fit statistic, C, (Cohen, 1979) for Rasch models lies between 0 and 1, and our computed value (0.03) is close to the zero benchmark, which suggests a good fit of the data to the model.

The three "most" restrictive items as described by the highest δ_is in Table 3 are the presence of the licensor's employees at the licensee's location followed by the licensor's participation in management and the licensors' limitations on the prices of the end products. At the other end of the spectrum, the three least restrictive items are secrecy obligations, followed by sub-licensing restrictions and export restrictions.

Several things are worth noting. First, the inclusion of a contractual clause does not mean that it is enforceable. Indeed, according to KIRI, several items in Table 3 are not enforceable under Korean law. Nevertheless, they are found in these contracts. Furthermore, even if a clause is enforceable, it may not be a binding constraint on the licensee. For instance, an export restriction clause is not a binding restraint on a firm that does not intend to export or is unable to do so for other reasons. It is a useful reminder not to equate contractual governance analysis solely with the formal language of the contract documents. Instead, they are observable indicants of an unobservable trait. We turn now to unpacking the predictors of stronger simulated hierarchies.

Comparative Governance Hypotheses

Specificity of Complementary Assets In the case at hand, the technology is completely non-specific as it exists at the time of the deal, and we specifically excluded technology development contracts. What, then, is the role of specific investments for contract design here?

Licensors might make investments to support a technology exchange relationship with a particular licensee where it is supplemented or adapted to local conditions or the production infrastructure of the receiving firms. These *complementary investments* evoke familiar hazards in that the productive value of these investments depends on the continuation of exchange with that particular licensee. Were that relationship to break down, it would be costly to redeploy the complementary assets for other purposes. Although specific contractual protections are incomplete for all the reasons indicated earlier, the simulation of hierarchy via restrictive contractual elements safeguards the investing party. Accordingly, we hypothesize:

H1: Increased levels of investments by the licensor in complementary specific assets evoke diminished licensee discretion.

Behavioral Uncertainty Also called performance ambiguity, it describes the degree to which one party cannot rely on ex post output inspection to verify performance to a third party's satisfaction. Such third-party verification is essential to enforce contractual sanctions. For instance, licensees might falsify the scope of use of a manufacturing process technology to reduce their royalty payment below expected levels. Such malfeasance is difficult to verify to a third party since ex post inspection of output is not very informative. It is also difficult to use third parties for real-time monitoring. To the extent that contractual sanctions are ineffective because of such difficulties with third-party verification, the licensee can appropriate some fraction of the value of the intellectual property of the licensor.

Stronger hierarchical content mitigates this problem via enhanced surveillance capabilities, and reduced reliance on third-party contractual enforcement. How so? First, it affords early warning signals of problems so steps can be taken to head off problems. We emphasize that hierarchy does not work by reducing the verifiability problem of third-party enforcement. Rather, it increases the potency of the "private ordering" crafted by the parties themselves by enlarging the scope of sanctions that can be brought to bear by the controlling partner. For instance, if the licensor reserves the right to inspect and change the licensee's production process, disallowed uses of the technology are less likely even if such breaches could not proved satisfactorily to a court. The party with the discretionary authority could order a costly (to the licensee) change to the production process. Accordingly, we hypothesize:

H2: Greater difficulties in ascertaining the licensee's performance or compliance via ex post inspection of output evoke diminished licensee discretion.

External uncertainty Williamson (1975) originally described it as unforeseeable contingencies that make it difficult to write completely specified contracts. This is a remarkable broad definition, and has led to multiple interpretations, and conflicting results in the literature (see Rindsleisch and Heide, 1997). We capitalize on work that distinguishes different types of uncertainty to advance our hypotheses.

End Product Market Uncertainty End product market uncertainty describes demand fluctuations and unanticipated changes in marketing activities for the product(s) that use the technology in question. When the product market in question is volatile, unstable, and unpredictable, the ability to predict relevant contingencies is diminished, and it is more difficult to renegotiate agreements in light of changed circumstances. For instance, a licensee may “sit” on the licensed technology in order to buy time to develop its own technology. Hansmann and Kraakman (1992) show that “hands-tying” contracts that limit the discretion of book publishers (as licensees of the intellectual property of a novelist) mitigate such problems. Accordingly, we hypothesize:

H3: Increased end product market uncertainty evokes diminished licensee discretion.

Application Uncertainty The difficulty of ascertaining the economic value of the applications of the technology at the time of the agreement is unique to technology license transactions. It arises from uncertainty about the licensee's technological absorptive capabilities, as well as their marketing ingenuity. It underlies the often-told story of Japanese licensee firms’ creative applications of American industrial technologies whose future values were unforeseen by their American originators.

To the extent that a more diverse pool of applications exists for a given technology, the parties would be harder pressed to reach agreements covering all of the applications. Since the difficulty is attributable to bounded rationality, one resorts to stronger adaptation mechanisms, such as the use of authority or residual control. For instance, by restricting fields of use, the licensor can wait to set valuations later for more uncertain fields of use. Of course, this reduces current revenue streams, but this trade-off becomes worthwhile as it gets more difficult to spell out all possible fields of use. Reserving the right to veto a particular application can facilitate such adaptation. Accordingly, we hypothesize:

H4: Increased application uncertainty evokes diminished licensee discretion.

Technological Uncertainty First introduced by Balakrishnan and Wernerfelt (1986), it describes the inability to forecast accurately the direction and extent of future development of the technology itself. Improvements in technology are path-dependent in that they occur in those areas of previous success that are then subject to further study and effort. The licensor may not have enough time to explore potential uses of improved versions of his technology beyond his core business at the time of his decision to license the technology in question. Applying the technology to different product lines or new market opportunities requires effort and time, which is harder for the licensor in technologically uncertain environments. An immediate consequence of technological uncertainty is greater application uncertainty.

H5: Increased technological uncertainty evokes greater application uncertainty.

The subsequent effect of application uncertainty on licensee discretion is already spelled out in H4. Thus, increased technological uncertainty diminishes licensee discretion through its effect on application uncertainty. However, there is also another, more direct causal path.

In an uncertain technological environment, changes in technology can occur so rapidly and dramatically that today's state of the art technology soon becomes tomorrow's norm. When the likelihood of obsolescence increases, firms need to maintain flexible arrangements that can readily change with technological shifts. However, efficient adaptation with *existing* partners is not the issue. Tearing down old ties and building *new* ties quickly is the required capability. Thus, loosely coupled and less durable ties are warranted as first shown by Balakrishnan and Wernerfelt (1986) and confirmed by Heide and John (1990). In the current context, the net effect is that the licensor is less concerned about future problems with *current* partner(s). Even if things don’t work out, take down costs are lower because new opportunities turn up with the continuing evolution of the technology. Accordingly, we hypothesize:

H6: Increased technological uncertainty evokes greater licensee discretion.

In sum, technological uncertainty has two opposing effects. It *diminishes* licensee discretion indirectly through its influence on application uncertainty, (H5 and H4) but *increases* licensee discretion directly (H6).

Tacitness. Polanyi (1967) coined this term to describe knowledge that is more felt, or intuited, rather than articulated in documents. For instance, the "art" of maintaining a chemical process at a certain level is highly tacit technology. Licensing it to one facility might lead to its use at another (unauthorized) facility. Unfortunately, such abuse can be discovered only via direct inspection of the rogue plant since inspection of the output is not very informative. More generally, greater tacitness makes it more difficult to rely on documentation and ex post audits to assess performance. Accordingly, we hypothesize:

H7: Greater tacitness of the technology evokes greater behavioral uncertainty.

The subsequent effect of greater behavioral uncertainty has already been described previously (H2). Briefly, third-party verification problems weakened contractual sanctions so stronger hierarchies are used instead. Thus, the net effect of tacitness is diminished licensee discretion.

There is also a direct effect. Previous work has documented the difficulty of transferring tacit knowledge across firm boundaries, and suggests that higher control modes are more desirable (e.g., Hill, Hwang and Kim 1990). The logic is that higher levels of tacitness make it more difficult to rely on the licensee's interpretation of documentation, and blueprints to effect transfer. Rather, there is a need to "direct" the licensee in the most effective use of the technology. Accordingly, we hypothesize:

H8: Greater tacitness of the technology evokes diminished licensee discretion.

Market Power Hypotheses

This perspective assumes that the organization of economic activity between business firms reflects the desires of those who possess power in relation to others. In our context, the relative scarcity of suppliers for a given technology provides the potential licensor with substantial leverage, especially at the time of contracting. The purpose of exercising leverage is to redirect profits towards the licensor. Accordingly, we hypothesize:

H9: Greater market power of the licensor evokes diminished licensee discretion.

We emphasize this motive for control contrasts with comparative governance reasoning. No efficiency purpose is served by imposing control just because a firm has the capacity to exercise control. At best, a comparative governance viewpoint would predict that powerful actors will use their power to increase payments without reorganizing the transaction away from an arm's length arrangement. Including "unnecessary" restrictions would only be self-defeating since it would reduce the market value of the technology to the licensee, and thus reduce their ability to pay higher royalties.

Age of Technology Arguing that pioneering firms wish to protect the relatively more significant monopoly profits from their newer technologies, researchers have predicted that older technologies are more likely to be transferred through arm's-length organizational forms. On this point, Mansfield and Romeo (1980) observed that firms tended to transfer their newest technology overseas through subsidiaries rather than licensing or joint ventures. Davidson and McFetridge (1984, 1985) also found a negative relationship between the age of a technology and the probability of internal transfer. The recent literature on durable goods monopoly pricing reviewed by Waldman (2003) makes a parallel point in that older generations are less substitutable with newer generations so there is a smaller gain from distancing the generations through price or non-priuce devices.

H10: Older technologies evoke less restrictive licensing arrangements.

Measures

Seven of the variables above are measured with the questionnaire described above, and sample items are shown in Table 1. We use multiple item scales to the extent possible in order to improve their psychometric properties. All of the items of these seven scales described in Table 1 use a 5-point Likert format ranging from "Strongly Disagree" to "Strongly Agree". For the most part, these variables have been measured in prior work, so we borrow items wherever possible. The three variables below are each measured with a single item.

Market Power. (MKTPOWER) The market power of the licensor was measured as the number of firm that our informants reported could supply the same or similar technology. The following categories were used for this measure: (1) no other firm, (2) 2-5 firms, (3) 6-10 firms, (4) 11-15 firms, (5) 16-20 firms, and (6) more than 20 firms. We reverse-coded it so that larger numbers indicated more market power.

Age of Technology. Our informants were asked to assess the elapsed time from the first commercial introduction of the technology anywhere in the world to the date of their agreement. The following categories were provided as a response format: (1) less than 1 year, (2) 1-3 years, (3) 4-5 years, (4) 6-10 years, (5) 11-20 years, (6) more than 20 years.

Country of Origin. The country of origin of the licensor was captured with three dummy variables for the four categories: United States, Japan, Europe and "Other Asian".

MEASURE VALIDATION

Following standard psychometric practice, we first assessed the unidimensionality of our 7 multi-itme scales For each of our scales, we used adjusted item-to-total correlations to identify unsuitable items and to purify the scales. Exploratory factor analysis was then performed on each set as a second check on the dimensionality of the purified measures. Finally, for the 3 scales that included four or more items, we estimated confirmatory factor analysis (CFA) models.[2] The fit statistics associated with the models are summarized in Table 4. The various fit measures appear to show a reasonable fit for a single-factor representation of each item pool. Observe that the measure (RESINDEX) constructed from contract clauses was assessed in a different way earlier with the Rasch latent trait model.

Following the unidimensionality analysis, we estimated the internal consistency reliability of the summated scales using coefficient alpha. Estimated alpha coefficients (Table 4) ranged from .617 for technological uncertainty (TECHUNCT) to .818 for asset specificity (COMPASSET).[3]

We used factor analyses to assess the discriminant validity of the 6 summated scale measures of the independent variables. First, the results of a common factor analysis indicate that a six-factor solution adequately represents the data (63% of the total variance). The varimax rotation of the resulting six factors showed a clean six-factor solution with all items loading highly on their respective primary factors but with cross-construct loadings less than .30. For completeness, we performed an oblique rotation and found little change in the factor loadings.

Following the norm that that discriminant validity is most rigorously tested across maximally similar variables, we estimated two series of confirmatory factor analysis models by splitting the six scales into two sets. The first set consisted of the three uncertainty scales. Behavioral uncertainty (BVHUNCT), market uncertainty (ENDMKTUNCT) and application uncertainty (APPUNCT) are "similar" in that they represent different facets of the adaptation problem. Furthermore, these variables are all endogenous variables in the hypothesis tests. Although the overall fit statistic ($\chi^2(32)=70.76$, p=.00) is significant, the various fit indices indicate an adequate fit (GFI=.95, AGFI=.92, RMSR=.04, $\Delta=.89, \rho=.91$). Crucially, the incremental fit over a single factor model is significant, which allow us to reject a uni-dimensional representation of these three constructs.

The second set included the remaining three scales; complementary specific assets (COMPASSET), tacitness (TACIT) and technological uncertainty (TECHUNCT). These scales are "similar" in that they speak to the characteristics of the technology in question. Furthermore, they are all exogenous variables in our hypotheses tests. As above, the overall fit statistic is significant ($\chi^2(32)=94.42$, p=.00), but the other fit indices show a reasonable fit (GFI=.94, AGFI=.89, RMSR=.05, $\Delta=.87$, $\rho=.87$). Also, all the individual t-values for estimated factor loadings were significant in both results. As before, the incremental fit over a single factor model is significant. Overall, the discriminant validity of our measures appears to be adequate to hypothesis testing.

TESTS OF HYPOTHESES

The hypothesized relationships were tested using structural modeling procedures in LISREL (Joreskog and Sorbom, 1989) because it enables us to accommodate unobserved constructs, including the direct and indirect influences depicted in Figure 1. Our measurement sub-models and structural paths are specified as follows.

Measurement sub-models. Of the twelve variables in the model specification, three are measured with single items, viz. market power, age of technology, and the three dummy variables representing country of origin.[4] For each of these latter constructs, the measurement sub-model consists of a single error free indicator.

The other seven constructs in the model were measured with multiple-item scales. Six of them are specified as single fallible indicators. In each case, the loading of the single fallible indicator on its latent trait was set at 1.0, and each of the error variances were set at $[(1.0 - \alpha_{scale}) \times \sigma^2_{scale}]$ as per Joreskog and Sorbom (1982). The measurement sub-model for the last trait (viz. restrictiveness) of this set is specified with two fallible indicators, viz. RESINDEX and RESPERC.

Structural Model. Figure 1 depicts the structural paths corresponding to our hypotheses.[5]

Table 5 displays the maximum likelihood parameter estimates. The overall fit index is significant ($\chi^2(34)=100.17$, $p<.05$), but the other fit indices, especially the incremental indices indicate an adequate fit of the model to the data ((GFI=.95, AGFI=.86, Δ=.92, ρ=.88). The model accounts for a substantial amount of the variance in the focal dependent variable (total coefficient of determination = .62). Likewise, the structural equations for behavioral uncertainty and application uncertainty show that their antecedents explain 20% and 10% of the trait variances in these constructs, respectively. Overall, the model appears to capture the data adequately, and represents a reasonable basis for testing the hypotheses.

Governance Hypotheses. First, of the two effects posited on intermediate dependent variables, we find that both are supported. Tacitness increases behavioral uncertainty significantly (H_7, γ_{11}=.31, t=3.69), and technological uncertainty increases application uncertainty (H_5, γ_{22} = 0.44, t=4.68).

Of the six effects posited for restrictiveness, four (H_2, H_4, H_6 and H_8) are supported. Behavioral uncertainty (H_2, β_{41}=.41, t=4.48), application uncertainty (H_4, β_{42}=.44, t=3.07) and tacitness (H_8, γ_{41}=.30, t=2.94) all *increase* restrictiveness as expected, and technological uncertainty *decrease* restrictiveness (H_6, γ_{42} = –.51, t = – 3.76). However, neither complementary specific assets (H_1, γ_{43} = .01, t = .08) nor end product market uncertainty (H_3, β_{43}=.10, t=.91) were significant. [6]

Market Power Hypotheses. Strikingly, we find no support for these effects. Market power (H_9, γ_{44}=.11, t=1.32), the age of technology (H_{10}, γ_{45}=.12, t=1.56) and the country-of-origin dummy variables are all insignificant factors in explaining the observed contract restrictions.

DISCUSSION

We posited the notion that contractual restrictions are usefully viewed as a continuum of a simulated hierarchy. In our data, these restrictions on licensee discretion are fairly well explained by the governance variables, while the market power variables are conspicuous by their lack of significance. To recap, greater behavioral uncertainty, and application uncertainty evoked more restrictive licensing relationships. Tacitness and technological uncertainty display complex relationships to these restrictions in that tacitness increased restrictiveness both directly and indirectly through its effect on increased behavioral uncertainty. Technological uncertainty is particularly complex. It had a *negative* direct influence on restrictiveness directly, but *increased* restrictiveness indirectly through its effect on increased application uncertainty.

What should we make of the insignificant effects of complementary asset specificity and end product market uncertainty? Our position is that they highlight the need to develop further middle-range refinements of the basic transaction cost model similar to the present model. One cannot simply assume that specific investments and external uncertainty are always dispositive in explaining governance. Consider them in turn.

The non-significant effect of complementary specific may be due to the subject matter of the transaction in the current study. Recall that the technology at hand was already developed prior to the contract, and is not specific to the licensee. Unlike Pisano's (1990) investigation of exchanges where one firm contracts to *develop* technology for another firm, we deliberately exclude such exchanges. As such, complementary specific assets variable may be a relatively *unimportant* facet of transactions involving a pre-existing technology.

It is also important to note that the insignificant specific investments effect relates to ex ante transactions costs considerations while the significant effects of application uncertainty, tacitness and behavioral uncertainty effects all speak to ex post transactions costs considerations. Traditionally, most of the explanatory has been placed on ex ante transaction costs (the safeguarding problem). Indeed, in the formal models (e.g., Grossman and Hart, 1986) these ex ante problems are the only ones that matter. However, as Bajari, McMillan and Tadelis (2003) have shown, ex post problems can be the primary driver in many settings, and our setting is one such example. We develop this insight further in the implications section.

Of course, this still leaves us with the matter of the non-significant effect of end market uncertainty variable. It is striking that this variable has been consistently inconsistent in the empirical literature. Remarking on these inconsistent findings, Rindfleisch and Heide (1997) conclude that "... there remains several unanswered questions ... " (about this variable). We echo their conclusion.

The lack of explanatory significance of the market power variables is not altogether surprising. While often asserted in the literature, they have not been subjected to much empirical scrutiny. Although price discrimination and other monopoly arguments are logically consistent, and constitute a plausible motivation for designing licensing contracts, our data show that efficiency considerations are much more influential in explaining actual practice.

Designing License Terms

How can managers use our results to design contracts? Assuming a desire to focus on efficient outcomes is warranted, Figure 2 offers a blueprint for structuring technology transactions.

Decision-Making Framework In order to market a technology, an assessment of the magnitude of ex ante transfer problems (safeguarding investments) is the first step. Sales of products embodying the technology (the downstream option) are the preferred route for high levels of these problems. Absent this, (as in the extant case), the upstream options are considered. Here, an outright sales contract lies at one end of the continuum, while very restricted license contracts represent the other end. In order to locate the proper contract, one assesses the magnitude of ex post transfer problems (of adaptation and measurement). They are larger for technologies that are (a) relatively more difficult to specify via documentation, (b) more difficult to evaluate recipient's actions, and (c) more difficult to predict potential applications. Conversely, they are smaller for technologies that are evolving and obsolescing more rapidly. The contract should limit the licensee's discretion commensurate with the size of these ex post problems.

Limitations

The causal inferences from our cross-sectional design must be treated with caution. Although the empirical results are mostly consistent with theoretical expectations, alternative causal sequences cannot be eliminated without longitudinal data. Another limitation is the lack of dyadic reports on these licensing relationships. Since we don't have data from the licensor side, we cannot assess the degree of convergence across the licensing dyad. Similarly, measurement and systematic errors in our informant reports remain unresolved because of our use of a single informant per licensing contract.

The use of Korean language questionnaires is also an area of caution. Despite the care that was taken to preserve the meaning and intent of the scale items across the English and Korean versions of the questionnaire, there is a chance that questionnaire equivalence was not achieved. No direct assessment of such convergence was attempted (Douglas and Craig 1983).

Finally, the sample of Korean firms limits our generalizability of the findings particularly as it relates to unobserved interactions between the legal system and efficient governance.

Replication across different countries would alleviate some of this difficulty. Hopefully, future work will focus on these issues.

FOOTNOTES

1 Of course, these options are not mutually exclusive. A firm may well license its technology and also embed it into products for sale.

2 CFA models are not possible for the scales with three or fewer items because they are just identified.

3 The internal consistency reliability of the restriction index (RESINDEX) was estimated using Cohen's internal consistency index for a Rasch model. Cohen's (1979) index is similar to coefficient alpha in terms of computation and interpretation. The estimate for RESINDEX (.63) appears adequate.

4 We set the "Other Asian" category as the base case, so its dummy variable is omitted.

5 Note that end market uncertainty is specified as an endogenous variable although it is not causally influenced by other latent variables. This specification enables us to allow its residual to correlate with the residual of application uncertainty. These correlated residuals capture the common influences on these measures. For instance, if the technology can be applied to a variety of end products, then the uncertainty associated with the end product markets should increase because of widened market coverage. We did not postulate any causal relationship between the two variables because the plausible correlation is likely to stem from variables omitted from the model.

6

Φιναλλψ, ασ περ ουρ εξπεχτατιον, τηε ρεσιδυαλσ βετωεεν μαρκετ υνχερτ αιντψ ανδ απλιχατιον υνχερταιντψ αρε χορρελατεδ ποσιτιϖελψ (ψ_{32}=.39, t=4.21).

REFERENCES

Armstrong, J. Scott and Terry S. Overton (1977), "Estimating Nonresponse Bias in Mail Surveys," Journal of Marketing Research, 14 (August), 396-402.

Bajari, Patrick, Robert McMillan and Steve Tadelis (2003), "Auctions versus Negotiations in Procurement: An Empirical Analysis," Working paper, Stanford Institute for Economic Policy Research, Stanford University.

Balakrishnan, Srinivasan and Birger Wernerfelt (1986), "Technical Change, Competition and Vertical Integration," Strategic Management Journal, 7 (July-August), 347-359.

Capon, Noel and Rashi Glazer (1987) "Marketing and Technology: A Strategic Coalignment", Journal of Marketing, 51 (July) 1-14.

Caves, Richard, Harold Crookell and J. Peter Killing (1983), "The Imperfect Market for Technology Licenses," Oxford Bulletin of Economics and Statistics, 45 (August), 249-267.

Cohen, L. (1979), "Approximate Expressions for Parameter Estimates in the Rasch Model," British Journal of Mathematical and Statistical Psychology, 32 (May), 113-120.

Davidson, William H. and Donald G. McFetridge (1984), "International Technology Transactions and the Theory of the Firm," Journal of Industrial Economics, 32 (March), 253-264.

Grossman, Sanford J,. and Oliver D. Hart (1986), "The Cost and Benefits of Ownership: A Theory of Vertical Integration," Journal of Political Economy, 94, 691-719.

Hansmann, Henry and Reiner Kraakman (1992), "Hands-Tying Contracts: Book Publishing, Venture Capital Financing, and Secured Debt," Journal of Law, Economics and Organization, 8, (3) (October), 628-655.

Helper, Susan and David E. Levine (1992), "Long-Term Supplier Relations and Product Market Structure," Journal of Law, Economics and Organization, 8 (Fall), No. 3, 561-581.

Heide, Jan B. and George John (1990), "Alliances in Industrial Purchasing: The Determinants of Joint Action in Buyer-Supplier Relationships," Journal of Marketing Research, 27 (February), 24-36.

Henisz. Witold J. and Bennet A. Zelner (2004), "Explicating political hazards and safeguards: a transaction cost politics approach", Industrial and Corporate Change, 13 (6) :901-915

Hennart, Jean-Francois (1989), “Can the New Forms of Investment Substitute for the Old Forms?: A Transaction Costs Perspective,” Journal of International Business Studies, 20 (Summer), 211-234.

Hill, Charles W.L., Peter Hwang and W. Chan Kim (1990), “An Eclectic Theory of the Choice of International Entry Mode,” Strategic Management Journal, 11 (February), 117-128.

Joreskog, Karl G. and Dag Sorbom (1982), “Recent Developments in Structural Equation Modeling,” Journal of Marketing Research, 19 (November), 404-416.

_________________ and Dag Sorbom (1989), LISREL 7: A Guide to the Program and Applications, 2nd edition, Chicago: SPSS Inc.

Klein, Benjamin (1980), “Transaction Cost Determinants of Unfair Contractual Arrangements,” American Economic Review, 70 (May), 356-362.

Korea Industrial Research Institutes (1988), A Survey on Technology Licensing Contracts in Korea, Report 44. 88-6.

Kotabe, Masaaki, Arvind Sahay and Preet Aulakh (2004), “Emerging Role of Technology Licensing in the Development of Global Product Strategy: Conceptual Framework and Research Proposition”, Journal of Marketing, 60 (January) 73-88.

Long, Frank (1981), Restrictive Business Practices, Transnational Corporations, and Development, Boston, MA: Martinus Nijhoff Publishing.

Mansfield, Edwin and Anthony Romeo (1980), “Technology Transfer to Overseas Subsidiaries by US-based Firms,” Quarterly Journal of Economics, 95 (December), 737-750.

Polanyi, Michael (1967), The Tacit Dimension. Garden City, NY: Doubleday Anchor.

Pisano, Gary (1990), “The R&D Boundaries of the Firm,” Administrative Science Quarterly, 35 153-176.

Rindfleisch, Aric, and Jan B. Heide, (1997) "Transaction Cost Analysis: Past, Present, and Future Applications," Journal of Marketing, 61(October), 30-54

Stinchcombe, Arthur (1985), “Contracts as Hierarchical Documents,” in Organization Theory and Project Management, A.L. Stinchcombe and C.A. Heimer, (Eds.) Bergen, Norway: Norwegian University Press, 121-171.

Teece, David J. (1986), “Profiting From Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy,” Research Policy, 15, 285-305.

von Hippel, Eric (1988), The Sources of Innovation, New York: Oxford University Press.

Waldman, Michael (2003) "Durable Goods Theory for Real World Markets", The Journal of Economic Perspectives, Vol. 17, No.1, (March) 131-154.

Wilkinson, Leland (1986), SYSTAT: The System for Statistics, Evanston, IL: SYSTAT, Inc.

Williamson, Oliver E. (1985), The Economic Institutions of Capitalism, New York: Free Press.

TABLE 1

SAMPLE OF ITEMS FOR EACH SCALE

All items are measured on a 5 point response format ranginf from Strongly Disagree to Strongly Agree.

Perceived Restrictiveness Scale (RESPERC)

- Our firm has little discretion over the use of the licensed technology.
- We can make significant design and/or marketing changes to the end product without being constrained by the agreement. (Reverse)

Specificity of Complementary Assets Scale (COMPASSET)

- The technology has been customized by this licensor to meet our company's particular requirements (e.g., production capacity, technical skills).
- This licensor has made significant investments in tools and equipment dedicated to the licensing agreement with our company.

Behavioral Uncertainty Scale (BVHUNCT)

- It is difficult for this licensor to independently verify the figure on which the licensing payment is based.
- It is difficult for this licensor to evaluate the success of the licensing agreement from simply observing the sales of end product.

End Product Market Uncertainty Scale (ENDMKTUNCT)

- Market shares for the end product(s) are volatile.
- There are many new products in the end product market(s).

Application Uncertainty Scale (APPUNCT)

- The technology can be applied to a variety of end product markets.
- Our company feels that the potential of the technology has not been fully realized yet.

Tacitness Scale (TACIT)

- The licensed technology is difficult to document with blueprints and manuals.
- It is difficult to explain the technology to those who have not actually used it.

Technological Uncertainty Scale (TECHUNCT)

- Technological change in this area is so fast that it is difficult to predict what the new technology will look like.
- There are many factors and areas that influence the development of this technology.

TABLE 2

SAMPLE DESCRIPTION

		Mean or %
Licensee Characteristics (n=106)		
Number of Employees		2,569
Sales		USD425mm[a]
R&D/Sales Ratio		3.4%
Industry		
	Electrical/Electronics	21%
	Non-Electrical Machinery	34%
	Chemical/Petro	20%
	Other	27%
Licensor Characteristics		
Source of Technology	Japan	44%
	U.S.A.	29%
	Europe[b]	25%
	Other Asian	2%
Number of Available Suppliers	Current licensor only	7%
	2-5 firms	40%
	6-10 firms	31%
	11-15 firms	9%
	16-20 firms	5%
	More than 20 firms	8%
Technology Characteristics		
Commercial Age of Technology	1 year	3%
	1-3 years	8%
	3-5 years	18%
	5-10 years	31%
	11-20 years	24%
	Over 20 years	16%
Technology Type	Product Technology	44%
	Process Technology	12%
	Product/Process Technology	45%
Contract Characteristics (n = 288)		
Contract Length		5.6 years

a Dollar figures were calculated as midpoint (average of selling and buying rates) market rates for the year.

b European countries included Germany, England, France, Denmark, Netherlands, Sweden, Norway, Italy, Belgium, Swiss and Hungary.

TABLE 3

CONTRACTUAL CLAUSES RESTRICTING LICENSEE DISCRETION

Contractual Element	δ_j
Prohibition of use after contract expiration	–1.564
Quality control of end product	–0.953
Production/sales volume restrictions	2.209.
Price of end product	2.716
Obligation to use licensor's trademarks	–0.277
Restrictions on advertising/promotion	0.668
Minimum royalty payment	–0.877
Management participation by licensor	2.716
Cross-licensing	–0.479
Confidentiality of licensed technology	–4.290
Grant-back provisions	–1.362
Field of use restrictions	–0.007
Sub-license restrictions	–2.603
R&D restrictions	1.443
Package licensing	2.015
Tie-out provision	0.170
Distribution of end products	0.035
Licensor’s personnel at licensee site	3.576
Export restrictions	–1.755
Tie-in provisions	–1.382

* Mean number of restrictions: 3.74

TABLE 4

PROPERTIES OF MULTI-ITEM SCALES

Scale	N of Items	No. of Factors $EV^a > 1.0$	Fit Indices	α
Perceived Restrictiveness (RESPERC)	4	1 (EV=2.03)	$\chi^2(2)=9.69$, P=.088 GFI=.98, AGFI=.92, RMSR=.04 Δ=.94, ρ=.86	.678
Asset Specificity (COMPASSET)	4	1 (EV=2.59)	$\chi^2(2)=3.87$, P=.145 GFI=.99, AGFI=.96 RMSR=.02 Δ=.99, ρ=.98	.818
Behavioral Uncertainty (BVHUNCT)	3	1 (EV=2.04)	___[b]	.760
Market Uncertainty (ENDMKTUNCT)	4	1 (EV=2.22)	$\chi^2(2)=16.30$, P=.001 GFI=.97, AGFI=.85 RMSR=.05 Δ=.93, ρ.81	.732
Application Uncertainty (APPUNCT)	3	1 (EV=1.74)	___[b]	.634
Tacitness (TACIT)	3	1 (EV=1.86)	___[b]	.691
Technological Uncertainty (TECHUNCT)	3	1 (EV=1.71)	___[b]	.617
Restriction Index (RESINDEX)	20	___[c]	C=.03[d]	.631 (Cohen's index)

[a] EV=eigenvalue
[b] Trivial fit for 3-item scale
[c] Factor analysis not suitable
[d] Fit index from Rasch latent trait model.

TABLE 5

STRUCTURAL EQUATION MODEL

Hypothesis	Path From	To	Parameter	Standardized Estimate	t-value
8	Tacitness	Restrictiveness	$\gamma 41$	.30	2.94
6	Technological Uncertainty	Restrictiveness	$\gamma 42$	–.51	–3.76
1	Asset Specificity	Restrictiveness	$\gamma 43$	.01	.08
9	Market Power	Restrictiveness	$\gamma 44$	.11	1.32
10	Age	Restrictiveness	$\gamma 45$	.12	1.56
	U.S.A.	Restrictiveness	$\gamma 46$	.29	.71
	Japan	Restrictiveness	$\gamma 47$	.33	.76
	Europe	Restrictiveness	$\gamma 48$	.45	1.17
2	Behavioral Uncertainty	Restrictiveness	$\beta 41$	.41	4.48
4	Application Uncertainty	Restrictiveness	$\beta 42$	.44	3.07
3	Market Uncertainty	Restrictiveness	$\beta 43$	.10	.91
7	Tacitness	Behavioral Uncertainty	$\gamma 11$	.31	3.69
5	Technological Uncertainty	Application Uncertainty	$\gamma 22$	.44	4.68

Residual Covariance between
Market Uncertainty & Application Uncertainty $\psi 32$ .39 4.21

Squared Multiple Correlations for Structural Equations

Behavioral Uncertainty	.10
Application Uncertainty	.20
Market Uncertainty	.00
Restrictiveness	.62

Total Coefficient of Determination=.61

$\chi^2(34)=100.17$, p=.00, GFI=.95, AGFI=.86, RMSR=.30, $\Delta=.92$, $\rho=.88$

TABLE 6

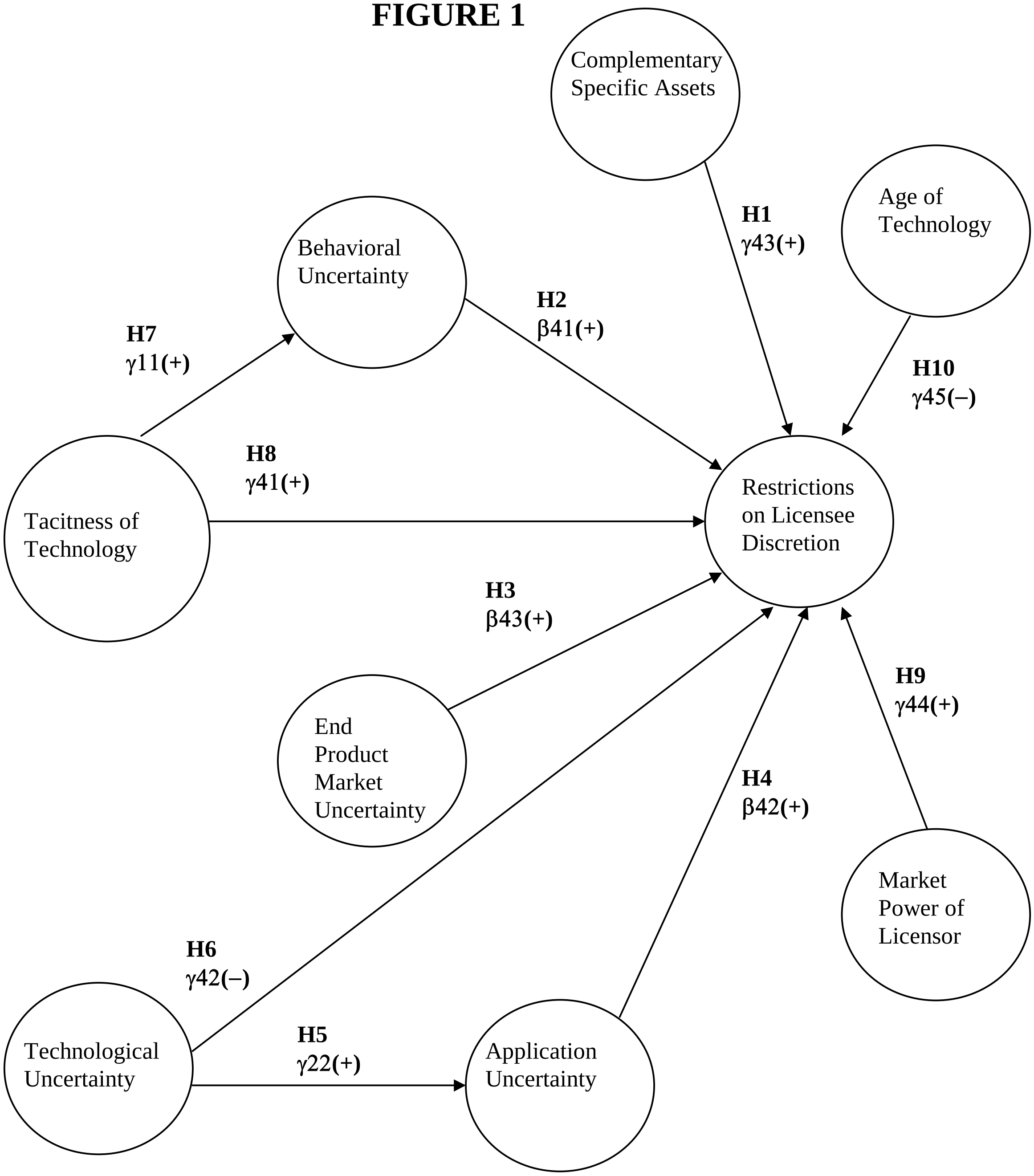
CORRELATIONS MATRIX OF MEASURES OF LATENT VARIABLES

	BVUN (y1)	APPUN (y2)	MKTUN (y3)	RESIND (y4)	RESPER (y5)	TACIT (x1)	TECHUN (x2)	CMPAS (x3)	MKPWR (x4)	AGE (X5)	USA (X6)	JPN (X7)	EUR (X8)
BVUN (y1)	2.14[a]												
APPUN (y2)	.07[b]	1.56											
MKTUN (y3)	.21	.30	2.66										
RESIND (y4)	.34	.23	.22	2.22									
RESPER (y5)	.33	.03	.17	.40	2.50								
TACIT (x1)	.24	.17	.27	.18	.27	2.22							
TECHUN (x2)	–.16	.29	.12	–.14	–.21	.13	1.78						
CMPAS (x3)	–.08	.10	.01	.03	.01	.12	–.01	2.76					
MKPWR (x4)	.05	–.01	–.17	.01	.06	–.03	–.00	.12	1.30				
AGE (x5)	–.07	–.01	–.13	.10	–.06	–.09	–.12	.16	–.20	1.26			
USA (x6)	.03	.11	.01	–.12	.03	.09	.19	–.12	.11	–.12	.46		
JAPAN (x7)	–.04	–.01	–.01	–.02	–.01	.07	–.09	.13	–.17	.04	–.58	.50	
EUROPE (x8)	.02	–.11	.01	.15	–.02	–.17	–.08	–.03	.01	.08	–.38	–.52	.44

[a] Entries in main diagonal are standard deviations.

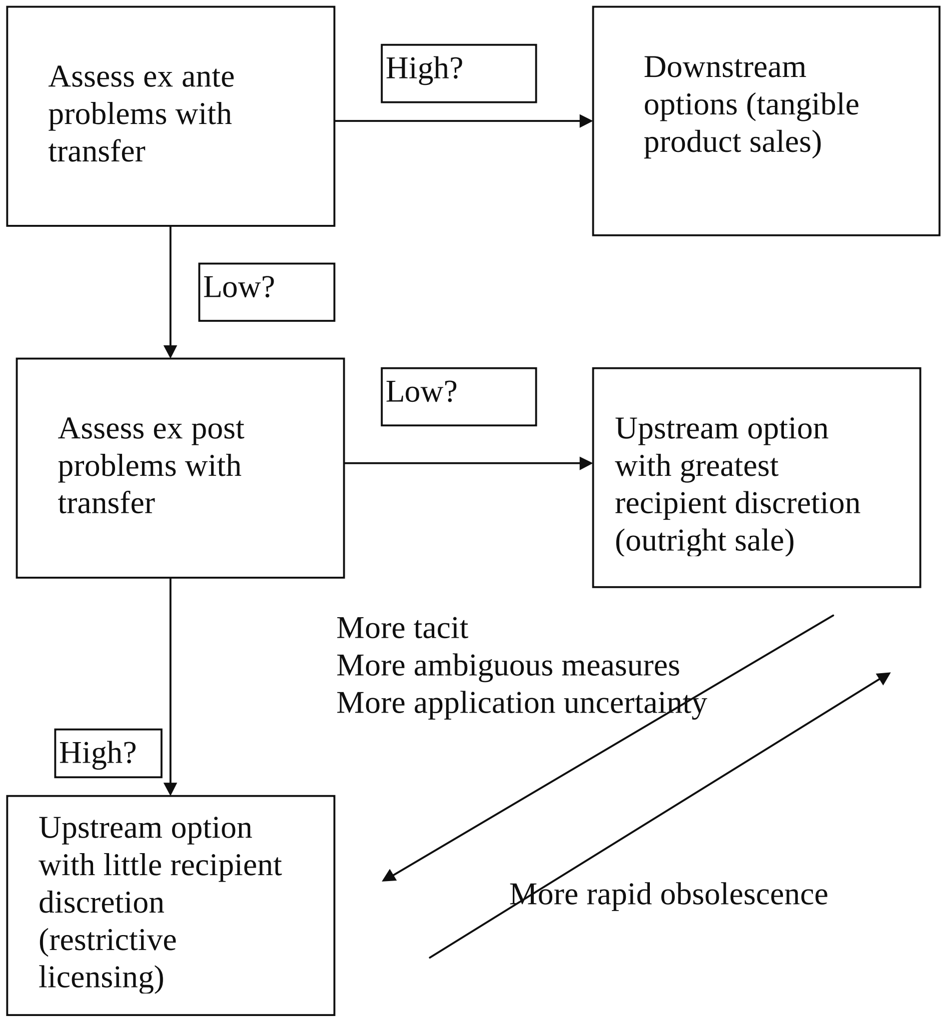
[b] 1>.10 are significant at p≤.05 for n=260.

FIGURE 1



Complementary Specific Assets
Age of Technology
Behavioral Uncertainty
H1
γ43(+)
H2
β41(+)
H7
γ11(+)
H10
γ45(–)
H8
γ41(+)
Tacitness of Technology
Restrictions on Licensee Discretion
H3
β43(+)
H9
γ44(+)
End Product Market Uncertainty
H4
β42(+)
Market Power of Licensor
H6
γ42(–)
H5
γ22(+)
Technological Uncertainty
Application Uncertainty

FIGURE 2


Assess ex ante problems with transfer
High?
Downstream options (tangible product sales)
Low?
Assess ex post problems with transfer
Low?
Upstream option with greatest recipient discretion (outright sale)
More tacit
More ambiguous measures
More application uncertainty
High?
Upstream option with little recipient discretion (restrictive licensing)
More rapid obsolescence