ELSEVIER

Journal of Economic Behavior & Organization
Vol. 38 (1999) 283–309

JOURNAL OF
Economic Behavior
& Organization

Institutional environment and the mechanisms of governance: the impact of intellectual property protection on the structure of inter-firm alliances

Joanne E. Oxley*

University of Michigan Business School, 701 Tappan Street, Ann Arbor MI 48109-1234, USA

Received 22 January 1998; received in revised form 23 June 1998; accepted 22 July 1998

Abstract

This study builds on developments in transaction cost economics to examine how institutional environment and transaction (project) characteristics affect governance of inter-firm alliances. The focus is on the choice between equity and contractual alliance forms under differing regimes of intellectual property protection and other national institutional features. Empirical results identify transaction-level characteristics as primary drivers of governance choice in alliances, but intellectual property protection is also a significant factor: firms adopt more hierarchical governance modes when protection is weak. Complete understanding of the structure of inter-firm alliances thus requires a combined focus on the institutional environment and mechanisms of governance. © 1999 Elsevier Science B.V. All rights reserved.

JEL classification: F23; L22

Keywords: Alliances; Governance; Intellectual property

1. Introduction

Significant interlinking of firms from an expanding group of industrialized and industrializing countries has become an accepted feature of the global economy in the late 20th century. Driven by regional economic integration, geographic diffusion of

* Tel.: +1 734 763 0599; fax: +1 734 936 8715; e-mail: oxley@umich.edu

PII: S0167-2681(99)00011-6

technological capabilities and lingering barriers to high technology trade and investment, international alliances and joint ventures have proliferated. Many of these alliances are formed with the explicit aim of pooling technological resources and leveraging intellectual property. Firms wishing to establish such alliances face a difficult question: ''how can we promote technology transfer and learning, without losing control of valuable intellectual property?''

Application of transaction cost economics (TCE) has increased our understanding of the governance implications of such concerns about technology leakage, or so-called 'appropriability hazards' (Teece, 1986; Pisano, 1989). Recent work has highlighted a set of transaction or project characteristics associated with elevated hazards in technology transfer alliances, and hence with the adoption of more 'hierarchical' alliance structures (Oxley, 1997). These structures include the use of 'hostage–exchanges' in complex bilateral agreements and shared equity ownership in stand-alone joint ventures.

This previous research, in common with most of the other work in the transaction cost tradition, has focused exclusively on the mechanisms of governance, whereby economic agents align transactions with governance structures to affect economizing outcomes, taking the institutional environment as given (Williamson, 1996, p.5).[1] This has led to criticism that transaction cost economics has developed in relative isolation from the study of the institutional environment, itself an important strand of the new institutional economics research agenda. In response, Williamson (1991) introduced a comparative static framework to consider how equilibrium distributions of transactions (and governance structures) change in response to disturbances in the institutional environment. This is done by treating the institutional environment as a ''set of parameters, changes in which elicit shifts in the comparative costs of governance'' (Williamson, 1991, p.287).

Although this 'shift parameter framework' for analyzing the impact of changes in the institutional environment on governance is conceptually straightforward, empirical tests to date have been elusive. This reflects difficulties in obtaining adequate measures of relevant dimensions of the institutional environment, and in isolating the impact on governance structures. Furthermore, since institutional environments change only slowly and in complex ways, comparative static analysis in a single country setting is problematic. If, however, analysis is shifted to the international arena, some of these empirical problems can be mitigated: here we find sufficient heterogeneity in institutional environments to support cross-sectional analysis. In addition, while measurement problems do not disappear, data on several aspects of the institutional environment have been developed and applied in international business research focusing on the institutional determinants of foreign direct investment decisions. These institutional determinants include foreign investment regulations (Contractor, 1990), national cultural differences (Kogut and Singh, 1988; Shane, 1994) as well as aggregated concepts of

[1] The institutional environment is defined as ''the set of fundamental political, social and legal ground rules that establishes the basis for production, exchange and distribution. Rules governing elections, property rights, and the right of contract are examples...'' (Davis and North, 1971, pp.6–7).

'political risk' or 'investment risk' (e.g. Agarwal and Ramaswami, 1992; Kim and Hwang, 1992).

The current paper draws on this international business literature, along with a new data source on intellectual property regimes in 110 countries, and applies the shift parameter framework to examine how differences in intellectual property protection and other institutional features affect the governance of technology transfer alliances linking U.S. and non-U.S. firms. This study represents the first empirical application of the shift parameter framework.

The results of the analysis provide support for the central hypothesis that U.S. companies tend to choose more hierarchical alliances (i.e. equity joint ventures rather than contract-based alliances) when they partner with firms based in countries with weak intellectual property protection. Other national institutional features appear to have few systematic effects on alliance governance structure. Furthermore, the transaction-level variables featured in earlier work retain their significance here, with effects paralleling those found in US-only alliances. Thus, a complete understanding of the organization of inter-firm alliances requires that we consider both the institutional environment and the mechanisms of governance.

The remainder of the paper is organized as follows: the transaction cost theory of appropriability hazards and governance of international alliances is described in Section 2, focusing on the impact of national differences in intellectual property protection. The empirical analysis is described and discussed in Section 3. Section 4 concludes the discussion.

2. Appropriability hazards in international alliances

For a firm holding valuable intellectual property that can best be exploited in combination with assets (either technological or otherwise) held by a firm based overseas, a strategic alliance with the foreign firm is an attractive option. These alliances can take many forms, ranging from simple contractual arrangements such as a technology license or technology-sharing agreement, to the establishment of a separately incorporated equity joint venture. In choosing among these types of alliance, transaction cost theory suggests that, absent significant contracting hazards, the 'default' low-cost governance mechanism is a simple contract (Williamson, 1991, p.279). However, writing and executing a reliable contract for the use of technology (e.g. a simple technology licensing agreement) requires adequate specification of property rights, monitoring, and enforcement of contractual terms – any of which may be problematic, thereby increasing the potential for leakage of valuable intellectual property.

The ease with which property rights can be specified, and effective monitoring of partners' actions is achievable, is largely a function of the type and scope of activities involved in the transaction. Where creation or significant modification of technology is anticipated, delineation of property rights is particularly problematic, given the uncertainty surrounding the outcome of such activities and the complex, tacit nature of resultant technological know-how (Teece, 1986). As a result, it will be impossible to attach claims to much of the valuable intellectual property created within such projects

(Hennart, 1988; Pisano, 1988). Contractual arrangements in these circumstances are fraught with appropriability hazards.[2] Monitoring of partners' activities is further complicated where the complexity or 'scope' of the transaction is expanded: increases in the number of products or technologies in a contract, for example, will increase the difficulty and cost of monitoring all of the relevant activities involved in contract execution.

Where a contract for technology transfer can be adequately specified and monitored, the focus shifts to the problem of enforcement in the event that a violation is detected. Ease of enforcement depends on the legal regime governing the transaction, notably the efficacy of general contract enforcement. For technology contracts, intellectual property protection is of particular importance: enforcement of intellectual property rights in international alliances is by no means assured, as the strength of protection varies considerably among countries and specific provisions of intellectual property laws may actually limit protection for some technologies, as discussed below.

2.1. National differences in intellectual property protection

Firms seeking protection for technology transferred across national borders face a complex variety of legal rules and procedures. Many countries are signatories to the Paris Convention for the Protection of Industrial Property, which requires that foreign nationals are granted the same intellectual property protection as domestic citizens. However, the convention does not specify what standards of protection should be in place, and the actual level of intellectual property protection varies significantly across countries.

Take, for example, the patent – the most widely used instrument of intellectual property protection for industrial technology.[3] The effective duration[4] of patent protection ranges from 5 years in several Latin American countries to close to 20 years in most European countries (Kondo, 1994). Some technologies may be explicitly excluded from patent protection, such as in India, where product patents are not issued for chemicals, alloys, optical glass, semi-conductors or inter-metallic compounds (in contrast to most other countries). In addition, some countries require firms to license various patented technologies to local firms (e.g. for drug patents in India and the Philippines), sometimes at very low royalty rates.

Other significant differences occur in the general rules governing the scope of patent protection. These include whether a patent holder must work the invention within a

[2] Note that even for existing assets, specification is not necessarily straightforward. For example, the age of a technology may be an important factor: contracts are more difficult to specify for novel technologies (particularly those embodying a radical change from previous methods) because the buyer and seller will share even less of the tacit know-how associated with its application than is usual for more 'routine' technology transfers (Davidson and McFetridge, 1984a).

[3] Other legal instruments of relevance in certain industrial fields are trade secret laws (which offer only very limited protection), copyright (an important instrument for protection of computer software), and specialized protection such as provided for by the Semiconductor Chip Protection Act of 1984 in the US, combining elements of patent and copyright.

[4] The effective duration of patent protection is the length of protection granted from the time of the grant date. In countries where the 'official' length of protection granted is counted from the date of application, this must be reduced by the average delay from filing to grant assess to the effective duration of patent protection.

specified time limit for it to remain valid, whether the patent application is kept secret until a patent is granted, and whether the patent is awarded to the party who can show that they were the 'first to invent' (as in the U.S.) or if it is simply awarded to the 'first to file' (i.e. apply) for the patent, as in most other countries. These differences in the patent laws, while often arcane, can have a significant impact on the ease of obtaining a patent, and may have the effect of discriminating against foreign firms. For example, according to the U.S. General Accounting Office (1993), p.34), the cost of patent-filing in Japan for foreign applicants is the highest in the world, due to "translation costs and fees charged by 'benrishi' (Japanese patent attorneys)."

There is currently a process of international convergence occurring in legal rules governing intellectual property protection. The agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs), part of the Uruguay Round of GATT negotiations completed in December 1993, calls for the elimination of some of the national differences in patent laws mentioned above. However, the period of phase-in of the relevant changes lasts up to 11 years for the least developed countries, and even then, important exclusions will remain (Chaudhry and Walsh, 1995). Furthermore, enforcement of intellectual property rights relies on the general enforcement powers of the courts – where the judicial system is corrupt, or where property rights and contracts are not respected, firms' ability to contract for the use of valuable intellectual property will be compromised.

Ranking countries by the 'strength' of their intellectual property rules is hampered by the multi-dimensionality of protection, as noted in the discussion of operationalization issues in Section 3. However, from the point of view of the intellectual property holder, strong protection is achieved when property rights are easy to establish, are interpreted broadly and are strictly enforced, with substantial penalties for non-compliance.

2.2. *Implications for governance*

Preliminary support for the notion that intellectual property regimes can influence the organization of international technology transfers is provided by Mansfield (1994). Results from this survey of U.S. operations in a limited number of countries suggest that the strength of national intellectual property regimes is positively correlated with aggregate levels of direct foreign investment by U.S. firms. In addition, there is a reported reluctance to transfer advanced technology to unrelated third parties (e.g. a licensee) in countries with weak intellectual property regimes.[5]

But what are the implications of appropriability hazards for governance of technology-related inter-firm alliances, where exposure of intellectual property to the alliance partner is an inherent feature of the arrangement? The logic of transaction cost economics suggests that difficulties encountered at any of the three stages of contracting for technology (specification of property rights, monitoring, or enforcement) will lead to an increase in appropriability hazards, and a move towards more hierarchical governance

[5] According to the vice president for R&D at one chemical company, for example, "We have no situation where we decided not to transfer advanced technology to a country having weak intellectual property laws... [but] we have transferred our advanced technology only to overseas affiliates or joint ventures where we have a substantial equity position and therefore a strong voice in management" (Mansfield, 1994, p.26).

forms. For inter-firm alliances, this implies a move from contract-based alliances such as licensing or technology-sharing agreements, to equity joint ventures.[6]

The sharing of equity in a joint venture works to mitigate appropriability hazards in several ways: joint ownership reduces the incentives of either party to cheat on the letter or spirit of the agreement and encourages jointly optimal behavior. In addition, joint managerial control and shared board membership enhance partners' abilities to monitor alliance activity (Pisano, 1989). Thus, there will be greater confidence that a joint venture partner will limit use of a partner's technology to those purposes prescribed in the agreement. Furthermore, the on-going relationship embodied in the joint venture (through equity-sharing) reduces the incentives of the technology recipient to sell information regarding the technology to unrelated third parties for a one-shot pay-off. Of course, the incentives and ability to 'cheat' are not removed entirely through adoption of the joint venture structure, but they are nonetheless reduced, relative to contractual alternatives, and it is this relative efficacy in mitigating appropriability hazards that is relevant to the governance decision. The benefits of equity-sharing, or hierarchy, do not, however, come without cost. Attenuated incentives of joint venture partners relative to licensees mean that the technology may not be exploited in its best use, or to its fullest extent – a particularly significant issue where success relies on the licensee's (or joint venture partner's) knowledge of a local market. Consequently, equity joint ventures will be reserved for situations where appropriability hazards are more severe.

The strength of intellectual property protection is one important factor in the institutional environment for border-crossing inter-firm alliances involving technology transfer. For U.S. firms partnering with firms in other countries, weak protection of intellectual property in the 'foreign' country will tend to raise the cost of relying on contract-based alliances relative to equity joint ventures, thereby encouraging the use of joint ventures for a wider range of transactions (relative to contracts). This leads to the first hypothesis:

H1: The degree of hierarchical control in alliances between U.S. and non-U.S. firms is inversely related to the strength of intellectual property protection (i.e. the 'appropriability regime') in the 'foreign' (non-U.S.) country, ceteris paribus.

The ceteris paribus condition is of critical importance here. As the theoretical discussion suggests, the level of appropriability hazards (and hence governance choice) does not depend solely on the environment in which an alliance takes place. In addition to

[6] Of course there may be significant variety in the governance properties of contract-based alliances. In particular, bilateral contracts such as technology-sharing agreements may have inherent hostage–exchange or monitoring features that are unavailable within a unilateral technology transfer or licensing agreement. Nonetheless, sharing of equity within the joint venture form represents a discrete, observable, 'step function' in governance attributes, effectively separating it from contractual forms. As such this is a useful 'break point' in the underlying market–hierarchy continuum of alliance forms. (See Oxley (1997) for further discussion of obstacles to more fine-grained operationalization of the market–hierarchy continuum). Empirical results pertaining to the choice between different contractual modes in international alliances are discussed briefly in Footnote 22.

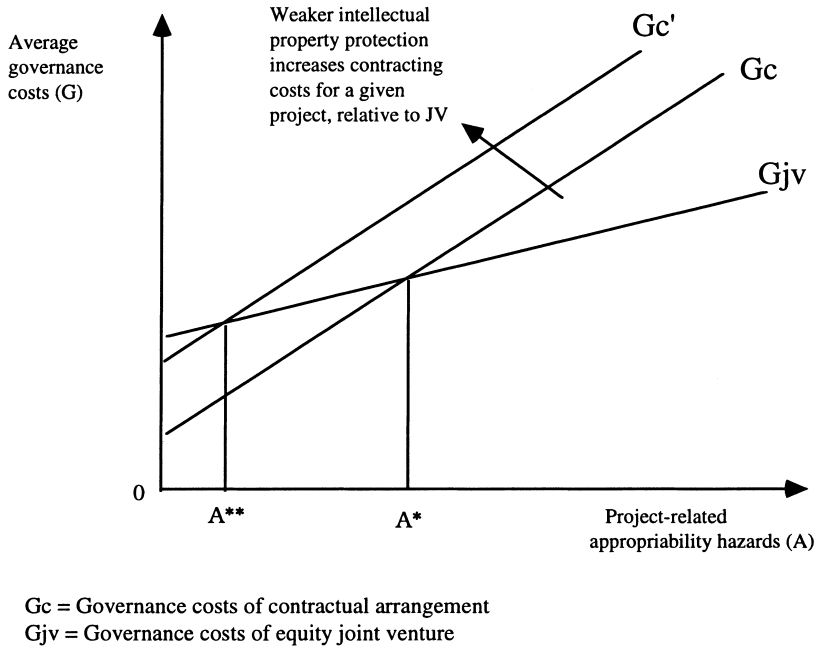

Fig. 1. The shift parameter framework – choosing between contract-based and equity alliances.

concerns about enforcement, the ease of specification and monitoring inherent to the transaction must also be taken into account. Furthermore, if a firm is considering an alliance in an environment of weak protection, it must make two simultaneous decisions: what technology will be shared or transferred and how will that transfer be governed. If a firm responds to weak protection by limiting transactions undertaken to those that are easy to specify and monitor (and hence also somewhat easier to enforce) then this may skew the observed cross-national pattern of alliances. Thus, in empirical analysis, we must simultaneously consider characteristics of the transaction which affect contract specification and monitoring difficulties, along with enforcement issues related to the institutional environment.

The relationship between the strength of intellectual property protection and the transaction-level variables implicated in specification and monitoring difficulties, and the resulting simultaneity in the content/governance decision within inter-firm alliances can be more clearly illustrated using the 'shift parameter' framework (Williamson, 1991), an extension of the transaction cost model.

Quite simply, the shift parameter framework posits that while the underlying logic informing firms' governance decisions does not vary across nations, differences in the institutional environment change the relative costs of alternative governance structures, so that the overall pattern of observed organizational forms may differ across countries. Williamson (1991) describes security of property rights (including intellectual property) as one of a range of such 'shift parameters,' and Fig. 1 summarizes the shift parameter

logic for the choice between contract-based and equity alliances in the case of a relative weakening in intellectual property protection.[7]

Note that as intellectual property protection becomes weaker, a narrowing range of transactions are most efficiently governed within a contractual arrangement (from 0–A^* with strong protection to 0–A^{**} with weaker protection). Take the example of a U.S. firm with two similar technology transfer projects involving firms based in countries having differing intellectual property protection. If transaction-related appropriability hazards in each case are, say, a little below A^*, then we might expect to observe one project governed through a contractual arrangement (in the country with stronger protection), and one organized within an equity joint venture (where protection is weaker). Alternatively, the U.S. firm may choose to use a contractual arrangement in each case, but modify the scope of the project (e.g. only transferring older or simpler technology) where protection is weak, to bring the transaction-related appropriability hazards below A^{**}.

The implication of this simultaneity in the choice of content and governance of transactions is that we cannot reliably observe the relationship between features of the institutional environment (such as intellectual property protection) and governance choices in inter-firm alliances without also including transaction level variables in the empirical model. Two further hypotheses are therefore advanced, describing the predicted impact on governance mode of the specification and monitoring difficulties rooted in transaction-level characteristics:

H2: The degree of hierarchical control in alliances between U.S. and non-U.S. firms will be greater for transactions where specification of property rights is difficult (e.g. where asset creation or substantial modification is involved, or where the know-how is highly tacit).

H3: The degree of hierarchical control in alliances between U.S. and non-U.S. firms will be greater for transactions where monitoring is difficult (e.g. where the technological or geographic scope of the agreement is large).

The importance of including such transaction-level variables in empirical analysis is illustrated by some inconsistencies in the results from previous studies. Failures in the market for know-how and the resultant dangers of intellectual property leakage in international transactions have long been recognized in theoretical work in international business (e.g. Buckley and Casson, 1976; Hennart, 1991b). However, most empirical tests in this tradition rely on industry-level or, at best, firm-level proxies (e.g. R&D intensity, advertising intensity and firm size) to capture the severity of appropriability hazards for a firm organizing its international technology transfers (e.g. Gomes-Casseres, 1990; Hennart, 1991a; Agarwal and Ramaswami, 1992; Kim and Hwang, 1992). Perhaps as a result, there is a lack of consistency in the observed effects of these variables on the

[7] While the governance costs associated with equity joint ventures are also likely to rise in these circumstances, they will do so at a lower rate than is expected for contractual arrangements (because of the incentive properties discussed earlier). It is the change in relative governance costs of the two modes that will determine the optimal governance arrangement for a particular transaction.

choice between autonomous foreign direct investment and joint ventures for particular technology transfers.[8]

In the shift parameter framework, the relevant institutional environment impacting optimal governance choice for a given transaction is broadly defined as ''the set of fundamental political, social and legal ground rules that establishes the basis for production, exchange and distribution'' (Davis and North, 1971, pp.6–7). Thus, in addition to intellectual property protection, relevant features of the institutional environment may include, for example, cultural differences, government regulation of foreign investment and the general political climate. The empirical model described below therefore includes a series of control variables capturing features of the institutional environment that previous research in international business suggests may have an impact on the governance of foreign investments.

3. Empirical analysis

3.1. Data source

The population of interest in this study is horizontal technology transfer alliances linking U.S. and non-U.S. based firms. The sample is drawn from the Cooperative Agreements and Technology Indicators (CATI) information system, a relational database covering approximately 10,000 cooperative agreements involving some 3500 parent companies in many different industries and countries. Cooperative agreements in the CATI database are defined as ''common interests between independent industrial partners which are not connected through majority ownership,'' (Hagedoorn and Duysters, 1993) and all involve some arrangement for technology transfer or joint research, thereby making intellectual property protection a significant concern. The empirical sample is limited to bilateral agreements involving a U.S.-based firm and a non-U.S. firm, to focus attention on the appropriability regime (and other institutional features) of the 'foreign' country.

The CATI data are based on a systematic examination of secondary reports of alliance formation, primarily during the 1980s. In addition to the organizational form of the alliance, the database includes information on the identity and nationality of the partners, the date of establishment, the type and scope of the transaction involved, and the industry or technology sector in which the cooperative agreement takes place. Although the database aims at complete coverage of alliances established worldwide, significant omissions and biases in the data are inevitable, particularly with respect to geographic and industrial sectors covered.[9] Such biases arguably render the data

[8] See Oxley (1997) for a discussion of this issue, and for empirical evidence that firm-level characteristics are uniformly insignificant in a model of alliance governance form which incorporates appropriate transaction-level variables. Further discussion of inconsistencies in previous firm-level results, particularly with reference to R&D intensity, can also be found in Gomes-Casseres (1989).

[9] Hagedoorn and Duysters (1993, p.1) describe the shortcomings of the data as follows: ''...skewness in the distribution of modes of cooperation (i.e. an underestimation of the number of customer–supplier relations and licensing agreements, due to under-reporting in published media),...some geographic – i.e., Anglo-Saxon – bias... an underestimation of certain technological fields not belonging to modern core technologies and... some over representation of large firms.''

unsuitable for analysis of overall alliance activity or of particular firms' propensity to form strategic alliances. However, conversations with the originators of the data and independent verification of data on a random sample of alliances did not reveal systematic bias in the description and coding of alliance form and activities. The data limitations are therefore not expected to introduce significant systematic bias in the current study, where we focus on individual decisions regarding alliance structure. Nonetheless, where data limitations may affect interpretation of results, this is noted in the discussion.

3.2. Operationalization and methods

3.2.1. Dependent variable

The hypotheses link transaction characteristics and elements of the institutional environment (specifically the host country appropriability regime) to the governance structure of the alliance – that is, the choice between a contractual form and an equity joint venture. Thus the dependent variable represents partner firms' choice of governance structure for alliance *i*. This variable is coded as follows:

$\text{EQUITY}_i = 1$ if alliance *i* is organized as an equity joint venture; or
$\text{EQUITY}_i = 0$ if alliance *i* is organized as a contractual (i.e. non-equity) alliance.

Contractual alliances in the sample include unilateral technology licenses and cross-licensing agreements, plus technology-sharing and second-sourcing agreements.

3.2.2. Independent variables

The country-level variable of central interest is the 'national appropriability regime' (Hypothesis H1). While there are several previous studies that measure the strength of intellectual property protection in various countries and industries, most suffer from significant shortcomings, particularly in terms of coverage. Some studies, such as Mogee (1989) focus on only one or two industries, while others, like Mansfield (1994) cover many industries but include only a few countries. A 1988 study by the U.S. International Trade Commission surveyed a somewhat broader spectrum of countries, but did not rank countries' intellectual property protection per se; instead U.S. firms were asked to list countries "...in approximate order of importance to you, which you would most like to see adopt fully adequate and effective intellectual property protection." (U.S. International Trade Commission, 1988 quoted in Mansfield, 1994, p.9). This ranking may differ significantly from actual or perceived levels of intellectual property protection.

An alternative measure of intellectual property protection is proposed by Rapp and Rozek (1990). Their index of patent protection ranks the level of patent protection in each nation on a scale of zero to five, based on conformity of the patent laws to the minimum standards proposed by the U.S. Department of Commerce. Unfortunately, although the index is available for 87 countries, there are several notable exceptions, including Japan, Hong Kong, South Korea and Austria. Since these countries (particularly Japan) account

for a significant number of alliances with U.S. firms, their omission severely hampers the utility of Rapp and Rozek's (1990) index for this study.[10]

The measure of intellectual property used in the analysis below is the one developed by Park and Ginarte (1997). This measure, *IPINDEX*, is based on an examination of five categories of patent law: extent of coverage, membership in international patent agreements, provisions for loss of protection,[11] enforcement mechanisms and duration of protection.[12] This index shares some of the limitations of previous intellectual property measures, particularly with respect to the narrow focus on patents rather than on alternative forms of protection (such as copyright or trade secret law). However, the inclusion of enforcement issues in the index – that is, the availability of preliminary injunctions, contributory infringement pleadings and burden-of-proof reversals – mitigates an important shortcoming of alternative measures. In addition, IPINDEX is available for a broader range of countries (110 in all) yielding a larger sample of alliances for which complete data are available.[13]

For Hypotheses H2 and H3, intended to capture simultaneity effects in the choice of content and governance of technology transfers undertaken within an alliance, transaction-level variables are included in the analysis. These variables mirror those used in an earlier study of appropriability hazards in U.S.-only alliances (Oxley, 1997) so that direct comparisons can be made of the logic informing U.S. firms' governance decisions in a cross-national setting with those in the domestic arena.

Absent detailed information on the particular technology involved in the alliance, and the degree of 'tacitness' of the relevant know-how, the proxy for specification difficulties (H2) is activity-type: while technology transfer alliances are primarily concerned with the exploitation rather than creation of new technology, there is still significant variation in the types of activities undertaken within these alliances. Activities include product or process design and development, production and marketing, or some mixture thereof. Among these different activity-types, design and 'mixed' activities are most likely to involve the creation or modification of technology, thereby complicating the specification of contractual terms. Dummy variables proxy for these specification difficulties: for each alliance i, $DESIGN_i = 1$ if the alliance involves only product or process design or development activities; $MIXED_i = 1$ if the alliance involves design or development *and*

[10] Other criticisms and shortcomings of Rapp and Rozek's (1990) index include the ommitance of enforcement or implementation issues, and the 'snapshot' nature of the index, which was compiled for a single year (1988). Business International Corporation also provides evaluations of protection of industrial property rights for selected countries (primarily developing countries). However, these data can support, at best, broad categorical coding of intellectual property protection (see e.g. Chi and Roehl, 1997) and the country coverage is inadequate for the purposes of the current study.

[11] This refers to protection against losses arising from compulsory licensing, 'working' requirements or revocation of patents.

[12] Each of these categories is given a score in the range of 0–1 and the *IPINDEX* is the unweighted sum of the five values. See Park and Ginarte (1997) for a more complete discussion of the measurement of patent provisions and determination of the index, including sensitivity of the index to changes in specification.

[13] Another limitation of *IPINDEX* is that the measure is available only quinquennially. Intellectual property protection was actually quite stable over the sample period (1980–1989) in most countries, with either no major change or just one or two discrete changes in patent laws and enforcement in some countries. The discrete nature of the changes suggests that interpolation is not an appropriate way to assess the strength of protection for the interim years. Instead, the 1980 value of $IPINDEX_j$ is used for alliances established in 1980–1982, the 1985 value for alliances with establishment dates 1983–1987 and the 1990 value for those established in 1988–1989.

production or marketing activities; 'pure' production and marketing agreements are the excluded category.

Monitoring difficulties are hypothesized to increase with the technological scope of alliance activities (H3). The technological scope variable used here is a categorical variable, where for each alliance i, $SCOPE_i = 1$ if multiple technologies or products are included in the alliance charter, and $SCOPE_i = 0$ if the alliance covers only a single technology or product.

3.2.3. Control variables

In addition to the measures of the appropriability regime, several other country-level variables are included in the empirical model to address alternative explanations proposed in previous research. These control variables are as follows:

Cultural distance: Following Kogut and Singh (1988), a composite index of 'cultural distance' (between the U.S. and the home country of the 'foreign' partner firm) is included in the model. Based on Hofstede's 'dimensions of culture,' (Hofstede, 1980) cultural distance ($CULDIST_j$) is measured as the deviation across each of the four dimensions (power distance, uncertainty avoidance, individualism and masculinity), corrected for variance differences among the dimensions.[14]

Kogut and Singh (1988) argue that cultural distance increases the cost of acquisitions relative to greenfield investment or joint ventures for foreign investors, because of difficulties in integrating existing foreign management. This argument would also suggest higher costs for joint ventures relative to more arms-length contracts as cultural distance increases management integration costs. However, cultural distance is also likely to increase contracting costs related to monitoring and enforcement (e.g. due to a lack of familiarity with relevant aspects of the legal system). Thus, as illustrated in Fig. 2, the net effect on the threshold level delimiting the least-cost governance mode is ambiguous, and the impact of cultural distance on the choice between an equity joint venture and contract-based alliance is indeterminate.

Societal trust: Shane (1994) suggests that 'societal trust' may have an impact on the organization of U.S. firms' overseas operations: In 'high trust' cultures, less monitoring is necessary to deter opportunistic behavior, and therefore contracting is feasible for a wider range of transactions, relative to more hierarchical modes. Shane's analysis is based only on aggregate licensing and foreign direct investment flows from the U.S. to the countries in the study. The argument is nonetheless applicable here, where we would expect an increase in societal trust to be related to an increased use of contractual arrangements in alliances, relative to equity joint ventures.

Absent a definitive measure for societal trust, the proxy most commonly used in previous work is also adopted here – one based on Hofstede's (1980) 'power distance' scale. This scale actually represents the extent to which members of a society expect power to be distributed equally within organizations and institutions, but power-distant societies also tend to exhibit less inter-personal trust and a greater need for external controls on the behavior of individuals. Therefore we use $TRUST_j$, the negative of

[14] For country j, $CULDIST_j = \sum_{k=1-4}\{(I_{k,j} - i_{k,\mathrm{us}})^2/V_k\}/4$, where $I_{k=1-4}$ are the indices of the four cultural dimensions, V_k is the respective variance, and $_{\mathrm{us}}$ indicates the United States.

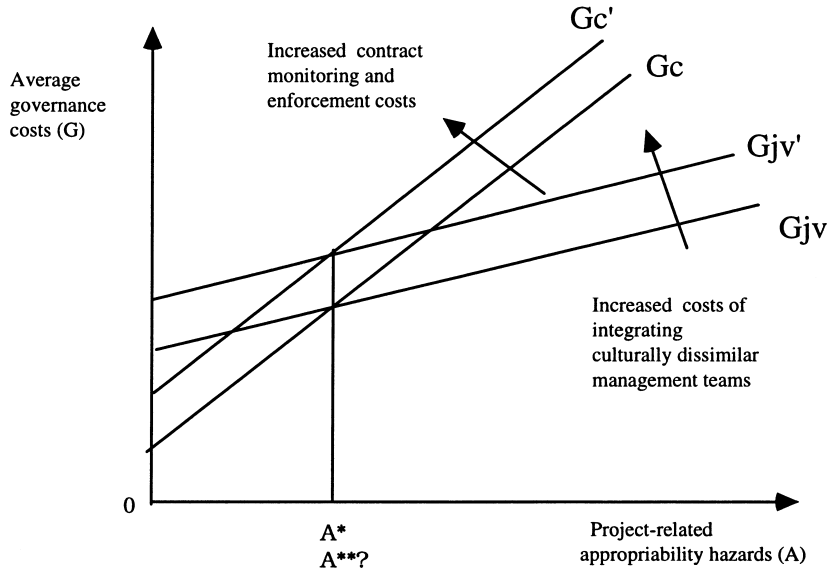

Fig. 2. The impact of cultural distance on alliance form.

power distance, as the proxy for the level of societal trust in the non-U.S. partner's home country j.[15]

Education: Education levels in the 'host' country are frequently adopted as control variables in cross-national studies of foreign entry governance mode (e.g. Davidson and McFetridge, 1984b). The rationale is that higher competencies on the part of the recipient facilitates arms-length technology transfer, relative to in-house transfer to an affiliated subsidiary (Teece, 1977). For the choice between contractual forms and equity joint ventures, the implication of this argument is that a greater level of demonstration, training, etc., will be necessary when partner capabilities diverge, and since these activities pose contracting hazards, the relative costs of contractual arrangements will increase.

Two measures of education level are adopted in the study to control for the potential impact of non-U.S. firms' capabilities on alliance form. The first measure, $EDUCPER_{jt}$, is the secondary school enrollment rate, as a percentage of population in the appropriate age group. The limitation of this measure is that contemporaneous levels of secondary school enrollment may not accurately reflect the education level of the adult labor force available to alliance participants. An additional measure is therefore considered: $EDUCYRS_{jt}$, the average years of higher schooling (i.e. beyond secondary school) in the total population over age 25 (Barro and Lee, 1993). Since these latter data are available only quinquennially, values for interim years are estimated using linear interpolation.

[15] See Shane (1994), pp.629–630) for a more complete discussion of the use of this measure as a proxy for societal trust.

Investment regulations: Governments may directly intervene in foreign firms' investment decisions. Therefore, following Contractor (1990), a composite measure of performance requirements ($INVESTREG_j$), derived from the 1982 Benchmark Survey of the U.S. Department of Commerce (U.S. Department of Commerce, 1985), is included as a proxy for investment regulations imposed on U.S.-owned joint ventures in country j.[16] This measure is based on the sum of the proportion of all U.S. affiliates in a nation that are subject to an export minimum, an import limit and/or a local content minimum.[17]

Political risk: 'Political risk,' broadly defined, may be a significant concern for foreign investors, and there is some evidence that political instability deters foreign direct investment (Kobrin, 1976; Root and Ahmed, 1978). Alliance governance costs may also be affected: for example, political upheaval has historically been associated with increased risk of government expropriation of foreign-held assets in many countries, potentially raising the cost of equity joint ventures relative to contractual alliances with local firms. However, the security of contracts with local firms is also likely to be negatively affected by increased political risk (due to lack of confidence in the enforcement powers of the courts). Thus, the impact of political risk on the organization of inter-firm alliances is unclear.[18] Measures of political risk are nonetheless included as control variables.

The multidimensionality of political risk and the scarcity of adequate time-series measures pose challenges in variable construction. One available measure, the Euromoney measure of country risk, is based on the rating of a nation's debt in the international financial markets. This measure thus combines elements of political and economic risk.[19] While the measure is available for each sample year, the methodology used in constructing the index changed significantly several times during the period, making year-to-year comparisons problematic. Two alternative measures based on this index are therefore adopted: $POLITIC_j$ is the Euromoney index for 1985 for each of the countries in the sample. This index, on a scale of 0–100, ranges in our sample from 11.6 (for Chile) to 100 (for Japan, Australia, Canada and several European countries), with higher levels indicating greater political stability and lower country risk. $POLRANK_{jt}$ is the ordinal ranking of each country based on the index, in each of the sample years.

[16] Note that there are significant changes occurring in investment regulations as a result of the TRIMs (Trade-Related Investment Measures) agreement, part of the most recent GATT settlement. However, these changes post-date the sample period, and many of the same conditions apply here as in the TRIPs agreement (discussed earlier, in Section 2.1).

[17] Contractor's (1990) second index, measuring restrictions on equity holdings, is not adopted, as the Benchmark Survey documents equity restrictions affecting the choice between minority- and majority-owned affiliates only – and not the choice between equity-based joint ventures and contract-based alliances. Furthermore, there are no countries in the sample with an outright ban on foreign equity holdings which would be expected to have a more direct effect on the choice under investigation. On the other hand, in countries where performance requirements are imposed on majority-owned affiliates these may be extended to all equity joint ventures, potentially increasing the cost of this governance mode relative to a contractual arrangement with a local firm. Thus the performance requirement measure is relevant to this study.

[18] Even for the choice between joint ventures and wholly owned subsidiaries, the impact of political risk is multifaceted and complex (see Henisz, 1998).

[19] The validity of this measure of political and economic risk is supported by a study demonstrating that the index is replicable using objective host country economic and political data (Cosset and Roy, 1991).

Market size: Measures of market size and growth are frequently included in empirical studies of foreign market entry mode. For example, Contractor (1990) finds support for the argument that host government bargaining power is greater in large and fast growing markets and that this allows them to enforce their preference for joint ventures with local producers (thereby increasing the observed incidence of joint ventures relative to wholly owned subsidiaries).[20] Although the impact on the choice between contractual and equity alliance forms is more ambiguous, both market size and growth are included as control variables. The measure of market size is the natural log of real GDP (in 1985 US dollars) for the year of establishment of the alliance, and market growth rate is proxied by average annual growth in GNP/capita. Data for each of these measures, $LGDP_{jt}$ and $GROWTH_{jt}$, come from the Penn World Tables (Summers and Heston, 1991).

Overlapping or previous alliances: The structure of a particular alliance may also be conditioned on the previous alliance activities of the partner firms involved; for example, where an existing relationship between the alliance partners reduces the risk of opportunistic behavior and so decreases the need for equity ties in an alliance (Gulati, 1995).[21] The variable $OVERLAP_i$, capturing the effect of pre-existing relationships between alliance partners, is therefore included. This is a count of alliances in the entire CATI database which include both of the partners to alliance i, and which were established prior to the establishment date of alliance i.

Previous alliance structure choice: Evolutionary economists argue that 'history matters' since firms develop routines that shape their strategic and organizational choices (Nelson and Winter, 1982). If this is the case, then the likelihood of a particular alliance being organized as an equity joint venture will depend, in part, on the partners' experience, and their overall propensity to use this type of alliance structure. For each partner firm in alliance i, the percentage of all previous alliances that were organized as an equity joint venture is therefore calculated and the variable $JVPERCENT_i$ is the average of these measures for the two alliance partners. To ensure that this variable does not simply capture general alliance experience (since $JVPERCENT_i$ is by definition zero for all firms with no previous alliances) $EXPERIENCE_i$, the average of a simple count of previous alliances for the two partners in alliance i, is also included.

Finally, control variables are added to distinguish among the three industrial sectors in the study: $BIOTECH_i = 1$ if alliance i is in the biotechnology sector; $MATERIALS_i = 1$ if the alliance is in the new materials sector; the default sector is information technology. Dummy variables for geographic regions (i.e. Japan, Europe and Asia/NICs with 'other' as the default category), plus year of alliance establishment are also included in some specifications, as detailed below.

[20] Davidson and McFetridge (1984b) argue for the reverse effect, but find no relationship between market size and observed patterns of foreign entry governance mode.

[21] This result may be attributed to the development of trust in the relationship, or alternatively to the 'exchange of hostages' embodied in overlapping alliances, where opportunistic behavior in the course of one alliance, if detected, puts the gains from all current and potential alliances with the relevant partner at risk (Williamson, 1983).

3.2.4. Statistical method

A logit model used to assess the effects of the independent variables on the choice of alliance form, with the general specification as follows:

$$\log\{P(Y_i = 1)/(1 - P(Y_i = 1)\} = B(X_i, X_{jt})$$

where $P(Y_i = 1)$ is the probability that alliance i is an equity joint venture and $\boldsymbol{X_i}$ and $\boldsymbol{X_{jt}}$ are vectors of independent and control variables for the alliance i and the non-U.S. country j in the year of alliance formation, t.

3.3. Sample and descriptive statistics

The initial sample drawn from the CATI data comprised all bilateral technology transfer alliances established between 1980–1989, involving one U.S.-based firm allied with a firm based in another country and whose activities were centered in one of the technologies designated by the CATI compilers as a 'core' technology, that is, biotechnology, information technology or new materials. This yielded a sample of 773 alliances from 34 countries. All of the alliances involved product or process design, manufacturing and marketing, or some mixture of these activities. Focusing on the 'core technologies' (which together comprise approximately 65 percent of the total alliances documented in the CATI database) mitigates some of the under-reporting and biases mentioned earlier, since the secondary sources used in compilation of the CATI data are concentrated in these three sectors. In addition, since industry-level data are unavailable for the large number of countries in the sample, reducing the number of industries has the advantage of removing some potential variation in industry-level effects while still maintaining an adequate sample size.

Elimination of alliances for which some of the country data were unavailable further reduced the sample to 727 alliances in 27 countries. Of these, 513 are contract-based alliances, that is, technology licensing and cross-license agreements, second sourcing agreements and technology-sharing agreements. The remaining 214 alliances are organized as equity joint ventures. The country distribution of the resulting alliance sample is as shown in Table 1.

A noteworthy characteristic of this country distribution is the dominance of Japanese and European companies in the sample, and the small number of alliances involving firms from countries outside of Japan, Europe and the Asian NICs. This concentration of alliances within the 'triad' of North America, Europe and Japan has also been documented elsewhere (Hergert and Morris, 1988), and the observed pattern of alliances roughly tracks that of global economic activity (based on 1985 GNP), albeit that alliances are moderately more concentrated in the triad countries.

Table 2 presents descriptive statistics and Table 3 shows the correlation matrix for the independent variables. Many of the country-level variables are correlated, as one would expect. For example the measure of intellectual property protection (*IPINDEX*) is positively correlated with a measure of educational attainment (*EDUCPER*) and market size (*LGDP*), negatively related to government-imposed performance requirements (*INVESTREG*) and country risk (*POLRANK*). These associations are to be expected, and are consistent with the general observation that economic development provides

Table 1
Distribution of sample alliances across countries

Country	No. of alliances
Australia	7
Austria	2
Belgium	7
Brazil	1
Canada	19
Chile	1
Denmark	4
Finland	3
France	47
Germany	57
HongKong	1
India	4
Ireland	1
Israel	6
Italy	52
Japan	325
Mexico	1
Netherlands	54
New Zealand	1
Norway	4
Singapore	1
Spain	5
Sweden	23
Switzerland	20
Thailand	1
United Kingdom	82
Venezuela	2

motivation for the development of institutions to provide effective intellectual property protection (Park and Ginarte, 1997; Rapp and Rozek, 1990).

4. Results and discussion

4.1. Simple appropriability model

Estimation results for a 'simple' appropriability model of alliance governance are shown in Table 4, and provide support for the transaction cost hypotheses: In Model 1, the coefficient on *IPINDEX* (−0.826), the indicator of patent strength, or appropriability regime, is negative, as hypothesized, and significant at the 1 percent level. This suggests that U.S. firms are more likely to organize an alliance as an equity joint venture when the partner is from a country where intellectual property protection is weak (all else being equal).

The transaction level variables in these models are also highly significant and are consistent with results found in previous analysis of alliances involving only U.S.-based

Table 2
Descriptive statistics for independent variables

	Variable	Description	Mean (SD)	Range	Expected sign
Hypothesis variables	SCOPE	Multiple technologies involved in project	0.429 (0.50)	0 or1	+
	DESIGN	Design or development only	0.054 (0.23)	0 or1	+
	MIXED	Mixed activities (design/dev and production)	0.209 (0.41)	0 or1	+
	IPINDEX	Patent strength indicator	3.84 (0.42)	0.75 to 4.33	–
Control variables					
Insitutional environment	CULDIST	Cultural distance, based on Hofstede	1.662 (0.99)	0.02 to 4.01	?
	TRUST	Negative of Hofstede 'Power Distance' scale	48.24 (11.29)	−11.0 to −81.0	–
	EDUCPER	Secondary school enrollment rate	0.909 (0.10)	0.30 to1.09	–
	EDUCYRS	Ave. years of higher schooling in adult population	0.405 (0.11)	0.09–0.67	–
	INVESTREG	FDI performance requirements (1982)	0.011 (0.02)	0.00 to 0.31	–
	POLRISK	Euromoney's country risk measures (1985)	96.70 (9.01)	11.6 to 100	?
	POLRANK	Rank in Euromoney's country risk rating	4.923 (7.00)	1 to 59	?
	LGDP	Natural Log of Real GDP (in 1985 US dollars)	20.37 (0.92)	16.74–21.25	?
	GROWTH	Growth in GNP/Capita	2.759 (0.87)	−1.3 to 5.9	?
Firm history and relational controls	OVERLAP	No. of previous alliances linking current partners	0.607 (1.24)	0 to 9	–
	EXPERIENCE	Average of prev. alliance experience for 2 partners	26.23 (30.64)	0 to 187	?
	JVPERCENT	Proportion of previous alliances organized as JVs	0.185 (0.16)	0 to 1	+
Sector controls	BIOTECH	Alliance activities in biotech sector	0.208 (0.41)	0 or 1	?
	MATERIALS	Alliance activities in new materials sector	0.249 (0.39)	0 or 1	?

Table 3
Correlation matrix for independent variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. SCOPE	1.00														
2. DESIGN	0.003	1.00													
3. MIXED	0.242	−0.124	1.00												
4. IPINDEX	0.088	0.059	−0.027	1.00											
5. CULDIST	−0.014	0.013	−0.031	0.046	1.00										
6. TRUST	−0.011	0.025	0.025	0.128	−0.605	1.00									
7. EDUCPER	0.019	0.043	−0.088	0.720	0.344	0.123	1.00								
8. EDUCYRS	−0.048	0.039	−0.075	0.153	0.613	−0.056	0.542	1.00							
9. INVESTREG	−0.041	−0.048	0.002	−0.661	0.110	−0.359	−0.382	−0.154	1.00						
10. POLRISK	0.021	0.044	−0.114	0.622	0.058	0.392	0.724	0.549	−0.535	1.00					
11. POLRANK	−0.028	−0.056	0.098	−0.466	−0.166	−0.171	−0.580	−0.520	0.385	−0.868	1.00				
12. LGDP	0.017	0.022	−0.007	0.617	−0.125	0.333	0.110	0.271	0.005	0.211	−0.425	1.00			
13. GROWTH	0.020	0.026	−0.047	0.174	0.594	−0.340	0.211	0.282	−0.101	0.365	−0.473	0.734	1.00		
14. OVERLAP	0.125	0.047	−0.034	0.098	0.113	−0.066	0.056	0.059	−0.057	0.040	−0.078	0.109	0.109	1.00	
15. EXPERIENCE	0.104	0.038	0.006	0.157	0.059	−0.056	0.054	0.047	−0.077	−0.001	0.009	0.113	0.065	0.443	1.00
16. JVPERCENT	0.103	0.030	0.134	0.011	0.086	−0.127	0.036	0.007	0.049	−0.016	−0.049	0.065	0.035	0.052	0.070

Table 4
Estimation results: Simple appropriability model

	1	2	3	4
Intercept	−0.155 (0.965)	0.154 (1.19)	−0.565 (1.05)	−0.077 (1.27)
SCOPE	1.305 [b] (0.286)	1.322 [b] (0.288)	1.367 [b] (0.292)	1.404 [b] (0.296)
DESIGN	3.259 [b] (0.409)	3.268 [b] (0.410)	3.261 [b] (0.409)	3.275 [b] (0.410)
MIXED	4.973 [b] (0.371)	4.991 [b] (0.372)	5.008 [b] (0.377)	5.046 [b] (0.380)
IPINDEX	−0.826 [b] (0.254)	−1.048 [a] (0.459)	−0.782 [b] (0.260)	−1.122 [a] (0.259)
BIOTECH	−0.144 (0.409)	−0.127 (0.412)	−0.191 (0.408)	−0.153 (0.411)
MATERIALS	1.121 [b] (0.315)	1.091 [b] (0.317)	1.120 [b] (0.318)	1.095 [b] (0.321)
JAPAN	n/a	0.588 (0.879)	n/a	0.898 (0.887)
EUROPE	n/a	0.552 (0.854)	n/a	0.750 (0.856)
ASIANIC	n/a	1.554 (1.508)	n/a	1.715 (1.52)
YR82–83	n/a	n/a	0.197 (0.441)	0.193 (0.446)
YR84–85	n/a	n/a	−0.287 (0.468)	−0.297 (0.471)
YR86–87	n/a	n/a	0.313 (0.424)	0.331 (0.436)
YR88–89	n/a	n/a	0.671 (0.428)	0.744 (0.440)
Log Likelihood	−204.01	−203.40	−201.30	−200.34
χ^2	473.12 [b]	473.34 [b]	478.53 [b]	480.46 [b]
'Hit rate' (%)	90.9	90.9	90.6	90.8
Sample size (n)	727	727	727	727

[a] $p < 0.05$.
[b] $p < 0.01$.
Standard errors in parentheses.

firms (Oxley, 1997).[22] Design and mixed activities are more likely to be organized within equity joint ventures than are pure production or marketing activities, suggesting that specification difficulties lead to the adoption of the joint venture structure, as hypothesized.[23]. The hypothesized impact of monitoring difficulties on alliance structure is also observed, as wider technology scope is associated with equity arrangements, with a positive and significant coefficient. These results provide an important link to earlier empirical research in the transaction cost tradition, and confirm the similarities in the essential organizational problems facing firms in domestic and international settings.

[22] One potentially revealing difference in these empirical results compared with those from the U.S.-based analysis is the inability of the model to predict governance choice *within* the general class of contract-based alliances. Oxley (1997) found that for alliances between U.S.-based firms, it is useful to distinguish between unilateral and bilateral contractual forms: the hostage–exchange features of bilateral agreements place them between unilateral contracts and joint venture agreements on the market–hierarachy continuum of alliance forms. This ordering was confirmed in an ordered probit model of governance choice. Running a similar model on the international alliances here proved ineffective, as the model was unable to differentiate among the three governance forms. Instead, the predicted value of the dependent variable was always 0 (unilateral contract) or 2 (equity joint venture). Bilateral contracts were thrown in with unilateral contracts 80 percent of the time. This suggests that firms effectively choose between just two discrete structural alternatives for agreements with firms from other nations – contracts or equity joint ventures – perhaps because hostage exchanges within a contract are less effective in this setting.

[23] The coefficient on mixed transactions (4.973 in Model 1) is also significantly larger than that for design (3.259), paralleling Pisano's observations in the biotech industry, where collaborations involving both R&D and other functions were more likely to use equity links than were 'pure' R&D agreements (Pisano, 1989).

Adding dummy variables for the major geographic areas (Model 2) does not materially change these results (except that the significance of the *IPINDEX* is lowered slightly, to 2%) and none of the area dummies are significant.[24] Furthermore, estimating the model on a sample with all Japanese alliances removed produced essentially identical results. Nor does adding dummy variables for the establishment year of the alliance change the results (Models 3 and 4).[25] A χ^2-test reveals that area and year controls do not collectively add to the explanatory power of the model. The industry dummy for alliances involved in the new materials sector is, however, significant and positive in each case suggesting that both biotechnology and information technology alliances are more likely to be organized as contract-based alliances than are alliances in the new materials sector.

The overall predictive power of the appropriability model is excellent: the 'correct' prediction regarding governance mode is made for over 90 percent of the agreements in the sample in each case, significantly better than a random assignment (58% correct) or the simple assignment of all predicted outcomes to the contractual category (70% correct).

Coefficients from a logit estimation cannot be directly interpreted in terms of the effect on the dependent variable, since the logit is not a linear form. The effect of a change in an independent variable on the probability of an alliance having an equity joint venture structure can nonetheless be calculated, for a given starting level of that variable and values of other variables in the model. For a change in a given country-level variable, from x_{jt} to x'_{jt}, this is calculated as

$$\frac{\exp\{\beta(\boldsymbol{X_i}, \boldsymbol{X_{jt}})\}}{[1+\exp\{\beta(\boldsymbol{X_i}, \boldsymbol{X_{jt}})\}]} - \frac{\exp\{\beta(\boldsymbol{X_i}, \boldsymbol{X'_{jt}})\}}{[1+\exp\{\beta(\boldsymbol{X_i}, \boldsymbol{X'_{jt}})\}]}$$

where $\boldsymbol{X_i}$ is the vector of alliance specific independent variables, $\boldsymbol{X_{jt}}$ and $\boldsymbol{X'_{jt}}$ are vectors of country-level independent variables, and $\boldsymbol{X_{jt}}$ and $\boldsymbol{X'_{jt}}$ differ only with respect to change in the variable under investigation from x_{jt} to x'_{jt}.

The results of such calculations based on the estimations in Model 1 provide some interesting insights into alliance partners' choice of organizational form. Changes in the scope and type of activities in an alliance have a large impact on the probability that an alliance will be organized as an equity joint venture. For example, with all other variables evaluated at their means, moving from an alliance covering only a single technology to one involving multiple technologies increases the probability of an equity joint venture structure from 6.2 to 19.6 percent. Comparing an alliance engaging in design activities to one involving only production and marketing activities, we see an increase in the probability of equity sharing from 3.3 to 47 percent; with a mixture of production and design activities, this probability increases to 83 percent.

What about the impact of intellectual property protection? For small increases in the patent strength indicator (e.g. from the mean to one standard deviation higher), the reduction in probability of a joint venture structure is quite modest – under 4 percent in

[24] Similar results were obtained in a model of appropriability hazards, featuring the variables in Hypotheses 1–3 along with country fixed effects.

[25] The results in the rest of the models reported below are without these dummies added, but all of the results were replicated without significant changes with area and year dummies added as well as with a single time trend variable with values from 1 for alliances established in 1980 to 10 for alliances established in 1989.

Table 5
Estimation results for models with additional control variables

	5	6	7	8
Intercept	2.109 (4.09)	2.633 (4.10)	0.619 (4.70)	1.474 (4.34)
SCOPE	1.258 [b] (0.298)	1.262 [b] (0.298)	1.262 [b] (0.299)	1.267 [b] (0.298)
DESIGN	3.366 [b] (0.422)	3.357 [b] (0.422)	3.380 [b] (0.423)	3.366 [b] (0.422)
MIXED	5.003 [b] (0.380)	4.995 [b] (0.379)	5.004 [b] (0.380)	4.993 [b] (0.379)
IPINDEX	−0.955 [a] (0.441)	−0.875 (0.483)	−0.948 [a] (0.436)	−0.899 [a] (0.412)
CULDIST	0.127 (0.215)	0.177 (0.221)	0.145 (0.211)	−0.184 (0.220)
TRUST	−0.007 (0.018)	−0.006 (0.018)	−0.008 (0.018)	−0.006 (0.019)
EDUCPER	0.306 (2.24)	n/a	0.843 (1.89)	n/a
EDUCYRS	n/a	−0.053 (1.19)	n/a	−0.108 (1.096)
INVESTREG	−2.608 (8.06)	−1.915 (7.95)	−1.645 (7.40)	−2.025 (7.71)
POLRISK	−0.017 (0.027)	−0.007 (0.025)	n/a	n/a
POLRANK	n/a	n/a	0.016 (0.028)	0.011 (0.026)
LGDP	−0.127 (0.237)	−0.139 (0.240)	−0.108 (0.246)	−0.113 (0.250)
GROWTH	0.003 (0.257)	−0.032 (0.257)	−0.015 (0.249)	−0.028 (0.251)
OVERLAP	−0.105 (0.125)	−0.107 (0.124)	−0.103 (0.125)	−0.105 (0.125)
EXPERIENCE	0.005 (0.005)	0.005 (0.005)	0.005 (0.005)	0.005 (0.005)
JVPERCENT	2.557 [b] (0.837)	2.547 [b] (0.838)	2.567 [b] (0.837)	2.556 [b] (0.838)
Log Likelihood	−196.68	−196.85	−196.70	−196.79
χ^2	487.77	487.44	487.74	487.55
'Hit Rate' (%)	91.2	91.2	91.2	91.2
Sample size (n)	727	727	727	727

[a] $p < 0.10$; [b] $p < 0.05$; [c] $p < 0.01$.
Standard errors in parentheses.

each of the models. However, if we look at the effect of moving an alliance, for example, from the United Kingdom (with an *IPINDEX* value of 3.67) to India (with a value of 1.33), the probability of a joint venture structure goes from 22 to 62 percent. Together, these results suggest that the activities involved in an alliance are the primary drivers of alliance structure choice, but that the strength of intellectual property protection is also a significant factor.

4.2. Appropriability model with other institutional environment controls

Table 5 reports results for models that include control variables designed to capture the effects of other national differences in institutional environment. Since there are two alternative measures for each of 'foreign' country education level and political risk, Models 5–8 were estimated with different combinations of these variables along with the other hypothesis and control variables. The coefficients on the transaction level variables and IPINDEX are comparable in magnitude (with the latter at slightly lower levels of significance) to those in the 'simple' appropriability models reported in Table 4.

None of the control variables capturing other aspects of the institutional environment are significant in these models. For example, the estimated coefficient on *CULDIST* (cultural distance) is positive, but insignificant at the 10 percent level. This is consistent with the prediction that the impact of cultural distance on the choice between contract-based alliances and equity joint ventures is ambiguous.

The sign of the coefficient on *TRUST* is negative (consistent with Shane's (1994) findings on the choice between foreign direct investment and licensing) but, again, the effect is not statistically significant. A possible explanation is related to the focus here on inter-firm alliances. As noted by Shane (1994), it is not clear that business people in high trust cultures will transfer this trust to people from *other* cultures; an implicit assumption made when applying these concepts to cross-national alliance activity. Indeed, if we take Japan as the archetype of a high trust culture, it can be argued that entrepreneurs there ''...see natives as in-group members and foreigners as out-group members. Entrepreneurs in these societies stress the differences between foreigners and natives and may not trust foreigners'' (Shane, 1994, p.630). This effect could make contractual relationships particularly problematic and so confound any effect of higher societal trust on the choice between equity joint ventures and contract-based alliances.

The presence of government-imposed performance requirements also does not apparently discourage the use of equity joint ventures relative to contract-based forms. *INVESTREG* has a negative coefficient as expected, but is statistically insignificant. Thus, while government-imposed requirements on U.S. affiliates have a significant impact on the choice between majority- and minority-owned ventures (Contractor, 1990), this effect does not appear to extend to the choice between equity joint ventures and contractual alliances. Nor do the measures of education, political and country risk or market size and growth appear to capture anything of significance to U.S. firms choosing between contract-based alliances and equity joint ventures.

4.3. Firm history and previous alliance activity

The relational variables included in the model yield some interesting results. First, contrary to Gulati's (1995) findings, the number of previous alliances between partner firms (*OVERLAP*) does not have a significant effect on alliance structure in this sample. This result should be interpreted with caution, however, as the *OVERLAP* variable is an imprecise proxy for on-going links between alliance partners. Some agreements between the relevant firms may not be included in the CATI data and there are no data available on alliance dissolution or total project value, both of which are relevant to a hostage–exchange model of overlapping alliances.

Firm history does appear to matter, however, in the choice of alliance structure: while general alliance experience does not have a significant effect, a joint venture structure is more likely to be chosen by firms which have previously favored this form of alliance. The probability that an alliance is organized as a joint venture is positively and significantly related (at the 1% level) to the proportion of each partner firm's previous alliances that were also joint ventures. This observation suggests a role for firm history in governance choice, and highlights the potential importance of organizational routines in shaping and limiting firms' organizational choices (Nelson and Winter, 1982), thereby creating organizational inertia or 'strategic momentum' (Amburgey and Miner, 1992; Miller and Friesen, 1980). Alternatively, the result may simply reflect unobserved heterogeneity in the types of projects undertaken by firms in the sample. In any case, firm history does not override transaction cost considerations, suggesting that a useful approach to governance questions is to maintain the transaction as the unit of analysis, but

also to consider the potential impact of firm history and inter-dependencies across transactions.

5. Conclusion

The results of this first empirical test of Williamson's (1991) 'shift parameter framework' provide strong support for the central transaction cost hypotheses. Appropriability hazards are an important factor in U.S. firms' choice of governance mode when they enter into cooperative agreements with foreign firms, and these effects operate at two levels – at the transaction level and at the institutional environment level. The results thus support the contention that "the institutional environment (laws, polity, etc.) and the institutions of governance (markets, hierarchies, etc.) matter a lot and in ways that are pertinent to industrial organization and much else, such as... business strategy [and] multinational business..." (Williamson, 1996, p.4).

The most important factors contributing to appropriability hazards in the inter-firm alliances studied are related to transaction characteristics: the type and scope of the transaction explain a large fraction of the variation in alliance form. However, significant effects are also found at the institutional environment level, where appropriability hazards depend on the foreign country's intellectual property protection or 'appropriability regime.' When allying with firms from countries where intellectual property protection is weaker, U.S. companies more frequently opt for an equity joint venture structure rather than relying on a contractual arrangement. The joint venture structure serves to mitigate appropriability hazards by more closely aligning the incentives of the partners, and providing enhanced monitoring and control capabilities.

Clearly the choice between equity and non-equity modes is only one relevant consideration in the design of alliances, although apparently an important one. There is additional anecdotal evidence of this pattern: In China, the U.S. firm Xerox refuses to discuss terms for technology transfer until a joint venture is formed (Van Oldenborgh, 1995). Nonetheless, many alliances involve more subtle safeguards. For example, at Fuji–Xerox, a long-running and reputedly successful joint venture between Xerox and Fuji Photo Film in Japan, a variety of evolving mechanisms have been employed to control technology leakage. These include specific restrictions on the location of alliance activities, controlled personnel transfers and the like.[26] Further study is warranted on the role of such organizational features in safeguarding technology and promoting inter-firm learning in alliances, as these issues will continue to grow in importance as cross-border alliances and technology transfers become a common feature of the growth strategies of firms in the U.S. and overseas.

The study of course has limitations. Most obviously, some of the country-level measures adopted, while the best available, are nonetheless rough proxies for the underlying phenomena, prompting cautious interpretation. Furthermore, the countries represented in the sample are mainly from within the 'triad' of the U.S., Europe and

[26] For detailed description of this joint venture, see *Xerox and Fuji Xerox*, Harvard Business School Case No. 9-391-156.

Japan. However, as noted earlier, this is quite representative of the global pattern of alliances and economic activity. Indeed, the infrequency of alliances between firms from the triad countries and firms in developing countries almost certainly reflects concerns regarding leakage of intellectual property, along with the obvious scarcity of valuable resources and capabilities offered by these developing country firms. Only where appropriability risks are offset by huge anticipated gains from rapid market development (such as in China in recent years) are we likely to see significant alliance activity. An interesting, albeit challenging, question in such situations is, how do economic actors strategically interact with the institutional environment to promote changes that will support efficient governance mechanisms? There is clearly still a long way to go before we can describe the precise interactions between the institutional environment and the mechanisms of governance.

Acknowledgements

Many thanks for guidance and suggestions go to Oliver Williamson, David Mowery, Bronwyn Hall, Chris Ahmadjian, Nick Argyres, Scott Masten and Bernard Yeung. I would also like to acknowledge the helpful comments of participants at conferences and seminars where earlier versions of this paper were presented, and those of Richard H. Day (the Editor) and two anonymous referees.

References

Agarwal, S., Ramaswami, S., 1992. Choice of foreign market entry mode: Impact of ownership, location and internalization factors, Journal of International Business Studies (First Quarter), 1–27.

Amburgey, T.L., Miner, A.S., 1992. Strategic momentum: The effects of repetitive, positional and contextual momentum on merger activity. Strategic Management Journal 13, 335–348.

Barro, R.J., Lee, J.-W., 1993. International comparisons of educational attainment, National Bureau of Economic Research.

Buckley, P., Casson, M., 1976, The Future of the Multinational Enterprise, Holms and Meier, London.

Chaudhry, P.E., Walsh, M.G., 1995. Intellectual property rights: Changing levels of protection under GATT, NAFTA and the EU, Columbia Journal of World Business (Summer), 80–91.

Chi, T., Roehl, T.W., 1997. The structuring of interfirm exchanges in business know-how: Evidence from international collaborative ventures. Managerial and Decision Economics 18, 279–294.

Contractor, F., 1990. Ownership patterns of U.S. joint ventures abroad and the liberalization of foreign government regulations in the 1980s: Evidence from the benchmark surveys, Journal of International Business Studies (First Quarter), 55–73.

Cosset, J.C., Roy, J., 1991. The determinants of country risk ratings. Journal of International Business Studies 22(1), 135–142.

Davidson, W.H., McFetridge, D.G., 1984a. International technology transactions and the theory of the firm. Journal of Industrial Economics 32(3), 253–264.

Davidson, W.H., McFetridge, D.G., 1984b. Key characteristics in the choice of international technology transfer mode. Journal of International Business Studies, 5–21.

Davis, L.E., North, D.C., 1971. Institutional Change and American Economic Growth, Cambridge University Press, Cambridge, UK.

Gomes-Casseres, B., 1989. Ownership structures of foreign subsidiaries: Theory and evidence. Journal of Economic Behavior and Organization 11, 1–25.

Gomes-Casseres, B., 1990. Firm ownership preferences and host government restrictions: An integrated approach, Journal of International Business Studies (First Quarter), 1–22.

Gulati, R., 1995. Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances. The Academy of Management Journal 38(1), 85–112.

Hagedoorn, J., Duysters, G., 1993. The cooperative agreements and technology indicators (CATI) information system, unpublished manuscript, MERIT.

Henisz, W.J., 1998. The institutional environment for multinational investment, unpublished manuscript, Haas School of Business, University of California at Berkeley, Berkeley, CA.

Hennart, J.-F., 1988. A transaction costs theory of equity joint ventures. Strategic Management Journal 9, 361–374.

Hennart, J.-F., 1991a. The transaction costs theory of joint ventures: An empirical study of Japanese subsidiaries in the US, Management Science (April), 483–497.

Hennart, J.-F., 1991b. The transaction costs theory of the multinational enterprise, in: Pitelis, C., Sugden, R. (Eds.), The Nature of the Transnational Firm, Routledge, London.

Hergert, M., Morris, D., 1988. Trends in international collaborative agreements, in: Contractor F., Lorange, P. (Eds.), Cooperative Strategies in International Business, Lexington Books, Lexington, MA, pp. 99–110.

Hofstede, G.H., 1980, Culture's Consequences: International Differences in Work-related Values, Sage, Beverly Hills, CA.

Kim, W.C., Hwang, P., 1992. Global strategy and multinationals' entry mode choice, Journal of International Business Studies (First Quarter), 29–53.

Kobrin, S.J., 1976. The environmental determinants of foreign direct investment: An ex post empirical analysis. Journal of International Business Studies 7, 29–42.

Kogut, B., Singh, H., 1988. The effect of national culture on the choice of entry mode, Journal of International Business Studies (Fall), 411–432.

Kondo, E.K., 1994, Patent laws and foreign direct investment: An empirical investigation, unpublished Ph.D. dissertation, Harvard University.

Mansfield, E., 1994, Intellectual property protection, foreign direct investment and technology transfer, International Finance Corporation discussion paper, 19, The World Bank.

Miller, D., Friesen, P.H., 1980. Momentum and revolution in organizational adaptation. Academy of Management Journal 23(4), 591–614.

Mogee, M.E., 1989. International trade in chemicals: Intellectual property problems and issues, Organization for Economic Cooperation and Development, May 18.

Nelson, R.R., Winter, S.G., 1982. An Evolutionary Theory of Economic Change, Harvard University Press, Cambridge, MA.

Oxley, J.E., 1997. Appropriability hazards and governance in strategic alliances: A transaction cost approach. Journal of Law, Economics and Organization 13(2), 387–409.

Park, W.G., Ginarte, J.C., 1997. Determinants of patent rights: A cross-national study. Research Policy 26(3), 283–301.

Pisano, G., 1988, Innovation through markets, hierarchies and joint ventures: Technology strategy and collaborative arrangements in the biotechnology industry, unpublished Ph.D. dissertation, University of California, Berkeley, CA.

Pisano, G., 1989. Using equity participation to support exchange: Evidence from the biotechnology industry. Journal of Law, Economics and Organization 5(1), 109–126.

Rapp, R., Rozek, R., 1990. Benefits and costs of intellectual property protection in developing countries. Journal of World Trade 24(2), 75–102.

Root, F.R., Ahmed, A.A., 1978. The influence of policy instruments on manufacturing direct foreign investment in developing countries. Journal of International Business Studies 9(3), 81–93.

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

Summers, R., Heston, A., 1991. The Penn World Table (Mark 5): An expanded set of international comparisons, 1950–1988, Quarterly Journal Of Economics, 106(9).

Teece, D., 1977. Technology transfer by multinational firms: The resource costs of transferring technological know-how, The Economic Journal (June).

Teece, D., 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. Research Policy 15, 285–305.
U.S. Department of Commerce, 1985. U.S. Direct Investment Abroad, 1982: The Benchmark Survey, Washington, DC.
U.S. International Trade Commission, 1988. Foreign Protection of Intellectual Property Rights and the Effect On U.S. Industry and Trade, USITC Publication, no. 2065.
U.S. General Accounting Office, 1993. Intellectual property rights: U.S. companies' patent experiences in Japan, Report no. GAO/GGD-93-126, July.
Van Oldenborgh, M., 1995. Court with care, International Business (April), 20–22.
Williamson, O.E., 1983. Credible commitments: Using hostages to support exchange. American Economic Review 73, 519–540.
Williamson, O.E., 1991. Comparative economic organization – The analysis of discrete structural alternatives. Administrative Science Quarterly 36(4), 269–296.
Williamson, O.E., 1996. The Mechanisms of Governance, Oxford University Press, New York, NY.