



The Governance of Contracts: Empirical Evidence on Technology Licensing Agreements

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Abstract:

This paper provides new evidence on the contractual governance of technology licensing agreements. Using an international sample of licensing contracts, we explore how contracts are designed to deal with specific contractual risks. In particular, we comparatively assess the influences of transaction attributes, institutional frameworks and strategic considerations on the creation of licenses. Empirical results reveal that contractual clauses for governance are crafted independently. This leads to a discussion of complementarities between contractual components, which are frequently assumed in theory. Furthermore, our results are certainly amongst the first to provide econometric evidence on the pervasive influence of private institutions on the trading of technology.

JEL: L14 - Transactional Relationships; Contracts And Reputation; Networks L24 - Contracting Out; Joint Ventures; Technology Licensing O34 - Intellectual Property Rights

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Key Words

Technology Licensing Agreements; Contractual Governance; Transaction Costs; Public And Private Institutions.

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1 Introduction

As pointed out by many authors (e.g. Caves et al. (1983), Bessy and Brousseau (1998), Anand and Khanna (2000), Arora and Fosfuri (2002, 2003), and others), knowledge transfer between firms is a complex procedure and subject to many hazards. The licensor (henceforth referred to as he) has little or no *ex post* control over how the intangible assets transferred to the licensee (she, hereafter) are used, while the latter can use what she has learnt to compete against her former partner. These hazards increase transaction costs and hinder the development of technology transfers, both major concerns for innovators and policy makers alike. The fact that patent owners miss opportunities to reap maximum revenue from their inventions, will ultimately produce a negative impact on collective welfare, i.e. poor distribution of inventions and poor-rewards for innovators will decrease incentives and capabilities for innovators to create. In this context, it is vital to understand how firms can establish efficient contracts to deal with transactional hazards. It is also important to analyze how more efficient institutional frameworks could be designed to decrease the cost of trading intangible goods to allow for the emergence of “markets for technologies” to maximize distribution (Arora et al. 2001).

A better understanding of contractual practices in the field of technology transfer will boost progress, both in the specifics of knowledge transfers (which is explored in literature on technology alliances, e.g. Oxley and Silverman, 2006; on technology licensing e.g. Bessy and Brousseau, 1998; Arora et al, 2001; and on optimal Intellectual Property Rights regimes, e.g. Scotchmer and Gallini, 2006; Jaffe and Lerner, 2004), and in the wider field of contractual design. Indeed, studies on the creation of contractual mechanisms and how to combine them in a contract are still emerging. Existing literature can be divided into two broad areas. The first focuses on an in-depth analysis of contractual components — especially incentive schemes and retaliation mechanisms — that are analyzed (either theoretically or empirically) independently of other features of the contracts. The second area — particularly Transaction Costs (e.g. Williamson, 1985) or Incomplete Contract perspectives (e.g. Grossman and Hart, 1986; Hart and Moore, 1988) contrasts contractual logics (e.g. market vs. hybrid vs. hierarchy, or transactional vs. relational contracting). Apart from the fact these two streams of literature ultimately relate to contrasting analytical traditions, because studies on potential interaction between contractual provisions are under-developed, it is difficult to reconcile the two streams. By considering the relationships between provisions organizing governance, this paper contributes to this field of study.

This paper is an applied contribution to both the study of contractual design and of technology transfer. The aforementioned literature on Technology Licensing Agreements (TLAs) reveals that such agreements are usually established in the long run in uncertain contexts. This is due to the fact that technological changes may occur and that complex strategic games may be played around the technology (e.g. Gallini and Winter, 1985, Shepard 1987, Jorde and Teece, 1990, Kamien, 1992) and around the alliances (e.g. Oxley and Silverman, 2007). This situation results in contracting parties implementing sophisticated “governance” mechanisms to adjust their mutual commitments during the lifetime of the contract. We focus on supervision, renegotiation, and dispute resolution mechanisms, both on an individual and combined basis. Findings are based on a database of 213 licensing contracts. Data has been collected from a survey of 160 American, Japanese and European firms, working mainly in chemical, equipment and service based

industries (see Brousseau, Chaserant and Bessy, 2005; Brousseau, Chaserant and Bessy, Coeurderoy, 2005).

We first develop our analytical framework (2), then present the data and research design (3), before finally discussing the results (4). We conclude that governance mechanisms implemented by contracts strongly depend on the features of transactions, the institutional framework — especially in the case of private institutions —, and the level of potential competition between parties. We refer to the issue of interdependence between contractual provisions, and recommend further research on nature of potential complementarities (5).

2 Theoretical Framework and Predicted Causal Relationships

Contributions point out that the content of technology licensing agreements is strongly influenced by both the resources actually transferred between parties and the institutional setting (Bessy and Brousseau, 1998; Anand and Khanna, 2000; Arora and Fosfuri, 2002 and 2003). This follows the two main lines of studies developed by New-Institutional Economics (NIE) to explain the design of governance mechanisms: the transaction features pointed out by Williamson (1975, 1985, 1996); and the Institutional Environment, especially as analyzed by Barzel (1989) and North (1990). However, these contributions fail to take into account the role of strategic behavior, which is particularly important in the case of TLAs. Indeed, as pointed out by Industrial Organization (Kamien, 1992), many TLAs are explained by other necessities than the need to govern the transaction *per se*. TLAs can be set-up within a framework of alliances aimed at controlling the development of technology, standards, or foreclosing a market (e.g. Gallini and Winter, 1985, Shepard 1987, Jorde and Teece, 1990). Such biases should impact on the structure of contracts. However, to our knowledge, there is little empirical evidence of the impact of these strategies on contractual features.

In this paper we point out how contractual provisions are influenced by these three types of determinants: the characteristics of transactions, the institutional environment and the strategic behavior of agents (2.1). We then develop the analysis of the design of governance mechanisms by highlighting the main trade-off which agents have to consider (2.2). This leads us to forming testable propositions (2.3)

2.1 The Economics of Contractual Design

The knowledge transfer is exposed to many contractual risks (Arora et al., 2001). Once transferred, it is hardly possible for the patentee/licensor to withdraw the knowledge from the licensee. The licensee can either use it without paying any compensation to the inventor, thereby depriving him of anticipated revenue, or worse still, can use it to actually harm the licensor. For instance, the inventor's insights may form the basis for innovations that surpass the licensor's own technical solutions. He will therefore try to control these transactional risks by implementing contractual commitments and governance mechanisms aimed at deterring opportunistic behavior. Three categories of solutions for preventing such risks can be created. Firstly, positive incentives can be included in contracts to encourage the licensee to take appropriate action. However, since the licensee expects nothing more from the inventor after the (sunk) transfer of knowledge is made, her *ex post* behavior is hardly likely to be controlled by incentives. Secondly, dissuasion

mechanisms can be implemented to deter the licensee from behaving opportunistically. Thirdly, as pointed out by Crocker and Masten (1991), allowing parties to readjust contractual obligations in an attempt to realign incentives for cooperation during the lifetime of the contract is also a way of ensuring the contract is complete.

These solutions are generally implemented via a governance mechanism that allows parties to manage their relationship *ex post*. The three main functions of this mechanism are as follows: supervision of *ex post* party behavior, plus the processes of *ex post* renegotiation and of solving potential conflict between parties. We study the choices made by parties with regard the design of supervision, renegotiation and conflict settlement provisions. In addition, we check whether these choices are independent.

We assume that agents balance the costs of the mechanism they implement with the benefits they obtain from adequate governance, i.e. less risks of *ex post*-misalignment of their behavior and of shirking by parties (and also less risk of associated losses due to both breaching and the costs of resulting conflicts). Three categories of factors influence this trade-off: (i) transactional attributes of technology transfers; (ii) the strategic behavior of contracting parties; and (iii) features of the institutional environment.

(i) Features of the transaction (as described by Williamson, 1975, 1985) impact on the likelihood of opportunistic behavior, and on the level of potential losses for the contracting parties.

One of the main characteristics of transactions pointed out by TCE is asset specificity. This refers to sunk investments borne by parties in certain transactions, locking them into a bilateral relationship. In the case of TLAs, sunk costs relate to the difficulty of transferring and absorbing knowledge. As pointed out in Bessy and Brousseau (1998), the wording of a patent often fails to include all the information required to implement the protected technological solution. In addition to the right to use the license, complementary resources (such as secrets, red-books, prototypes, training and consultancy services, etc.) are transmitted by the licensor to the licensee. These transfers require efforts by both parties that are sunk in the case of a contractual breach. They then correspond to investments specific to this relationship.

(ii) The parties are also potentially involved in a strategic game over the use of technology. Knowledge transactions are specific in that knowledge can be used by the beneficiary of the sunk transfer in a way that will directly harm the competitive position of the inventor, or the inventor's ability to gain revenue on his investments. More precisely, the licensee may adopt two opportunistic strategies:

- (a) She may "invent around" the transferred knowledge, or learn things that are not licensed, to compete against the licensor;
- (b) In the case of competition between alternative technological solutions, a technological competitor may ask for a license and under-use it to hinder diffusion of the licensed technology. Indeed, if there are strong and increasing returns of adoption (David, 1985), limiting the distribution of a particular technology can increase the probability of competing technologies succeeding.

The probability and the nature of potential losses inflicted on the inventor depend on the specific

nature of the technological competition, and on the relative competitive position of the licensee.

(iii) The relationship between licensors and licensees is also affected by the nature of the institutional environment (as described by Barzel, 1989 and North, 1990). Indeed, these institutions provide tools — rights, rules, dispute resolutions mechanisms, etc. — that can be used by agents to facilitate any dealings, while discrepancies between generic coordination resources and specific coordination needs call for bilateral governance mechanisms (Brousseau and Fares, 2000, Brousseau and Raynaud, 2006).

The institutional framework is made up of public institutions (i.e. the legal system) and private institutions (e.g. industry unions and trade associations, among others). Public institutions establish property rights that can be traded between agents to transfer usage rights and obtain benefits from their exploitation (Barzel, 1989, North, 1990). Nevertheless, public institutions always create an incomplete property rights system. It would be prohibitively costly to implement a complete system, recognizing in advance the owner of exclusive rights to any potential uses of a property, and developing means of supervision and punishment to prevent any infringement. So agents perform a wide range of operations needed to actually implement transferable and exclusive usage rights (North, 1990). This is particularly the case for IPRs (Brousseau, 2004, Brousseau and Bessy, 2006). Public institutions fail to properly define IPRs, and all things equal, economic agents must devote substantial resources on claiming and transferring exclusive rights for use of knowledge. To reduce these costs, they may depend on private institutions (Brousseau and Raynaud, 2006); i.e. on collective governance resources aimed at facilitating the establishment and transfer of property rights. The governance of licensing contracts is then influenced by the natures of both public institutions (which are generally defined on a national level) and private institutions (more often created on an industry level).

2.2 The Three Components of Governance

The diversity of risks tends to prevent contractual parties to design *ex ante* a complete contract. They introduce a contractual governance mechanism to readjust misalignments when necessary. Below, we highlight the trade-offs of each component of a governance mechanism. In the case of TLAs, we focus mainly on contractual risks arising from licensee's behavior. The licensor may be opportunistic, but levels of relational risks for each party greatly differ. The licensee acquires access to the licensor's strategic assets — namely his knowledge, but also his reputation — while the reverse is generally not the case. The licensee can therefore harm the licensor to a far greater extent than vice versa. At the same time, the licensor can be opportunistic in two ways. Firstly, since the licensee does not know everything about the technology prior to the transfer, there is a classic adverse selection issue. The technology could be overpriced due to the inability of the licensee to properly assess its value and quality. Secondly, the licensor might actually renege on providing the licensee with the know-how needed to implement the transferred technology (Arora, 1995). Responses to both risks are traditionally delivered *ex ante*, due to the adequate design of the payment formulae. Implementation of royalty payments, in particular, aims at controlling these risks. While they may protect the licensee, they increase her *ex post* ability to harm the licensor (by stopping or underpaying royalties), an ability controlled by governance mechanisms (which also control other potential misbehavior). This is the reason why governance clauses tend to address the licensee's potential for opportunism, rather than the licensor's. This

statement is shared by most researchers working on knowledge and technology transfers (e.g., see Oxley and Silverman, 2007).

2.2.1 Supervision and the Ability to Retaliate against Opportunism

A contractual agreement grants audit rights to one of the parties (or to a third party) in order to check contractual commitments are being enforced. While supervision does imply a certain amount of effort, it should reduce shirking. All things equal (particularly the costs of retaliation borne by guilty infringers), increasing supervision increases the anticipated costs of opportunism.

Today, it is widely recognized that supervision is needed when the licensor runs the risk of opportunistic behavior by the licensee, i.e., when sunk investments in the relationship, and hold-up risks occur (Williamson, 1985; Gatignon and Anderson, 1988). It makes sense, however, to implement supervision provisions only if the supervisor can provide a court with proof of infringement. Indeed, if mutual obligations are hazy, or if no external efficient enforcement mechanism is available, there is no point contractually implementing the right to audit in the contracts. Indeed, in the latter case, parties will either refuse the contract, or rely on their own ability to informally supervise and retaliate.

2.2.2 Renegotiation and the Ability to Reduce Adjustment Costs

A renegotiation provision states the extent to which contractual obligations can, *ex post*, be redesigned to adjust contractors' behavior either to new environmental conditions, or to changing mutual preferences, or indeed to the accumulation of knowledge. When a renegotiation provision is implemented, parties agree to renegotiate only part of the mutual commitment; meaning that its other components remain in place. This is a means of gaining flexibility while avoiding excessively high renegotiation costs. As pointed out by Croker and Masten (1991), a renegotiation clause provides agents with incentives not to shirk (since they can adapt to new situations) and reduces the level of misalignments, since it reduces the costs of adaptation. The "cost" of such a provision, however, is that parties benefit from weaker contractual protection. In addition, all else being equal, such a provision increases the likelihood of renegotiation.

So parties only implement such a clause when *ex post* mutual adjustment is really needed. When uncertainty is high, it is too costly to *ex ante* write down a complete contingent contract (Williamson, 1985, Crocker and Masten, 1991). The anticipated length of the relationship matters as well, since of the longer it lasts, the greater the uncertainty — and since opportunity costs of non-adaptation increase with time.

However, a renegotiation provision tends to reduce the credibility of *ex ante* commitments. This may then encourage opportunistic behavior, ruining positive incentives provided by flexibility (in particular, incentives to invest specifically in the relationship). A renegotiation provision will therefore be implemented in a contractual agreement in the case of two enabling conditions:

- Firstly, parties must not have interests that are too divergent. Indeed, if they play a zero-sum game (e.g. when they are direct competitors), they will fail to reach any agreement *ex post*.
- Secondly, as pointed out in MacNeil's seminal paper (1974) on relational contracting, the institutional framework can facilitate renegotiations. Indeed, by channeling the behavior of

agents and by influencing their beliefs, institutions — especially informal ones — impact on their willingness to behave fairly, and hence on the likelihood of reaching agreements.

2.2.3 Dispute Resolution Mechanisms and the Ability to Reduce Conflict Costs

Contracts are enforceable by courts as a final recourse. However, according to Williamson (1985), courts may resolve disputes inefficiently, especially when contractual breaches are costly and when transactions tend to be unique (because the judge must learn everything about the case). An Alternative Dispute Resolution (ADR) provides the benefit of specialized arbitrators, which in itself reduces verifiability constraints. In addition, arbitration may be subject to constraints such as delays or confidentiality. Altogether, it will enhance the efficiency of the dispute resolution process. The law and economic literature on ADR (Cooter and Rubinfeld, 1989; Benson, 2000) confirms these benefits and points out the ability to maintain long-term mutually beneficial relationships due to a lower level of conflict in solving the disputes, to the freedom in choosing the reference legal system, and to shortened delays and reduced procedure costs (due to the lack of appeal and specialist arbitrators).

The same literature points out, however, that the benefits of ADR are countered by significant costs, mainly due to weaker security for the parties (and therefore reduced incentives to “invest” in the transaction). The lower security of ADR is due to the ability of the defendant to escape the procedure or the sentence (even if the arbitrator’s sentence is legally binding), to the informality of the procedure and to the absence of appeal that may result in the arbitrator failing to make full use of essential arguments made by one of the parties, and from the lack of accumulation of knowledge on the basis of precedents by arbitrators due to the privacy of cases and sentences. Thus, while dispute settlements *per se* are less costly with ADR, transactional hazards are only poorly controlled (especially if stakes are high). In Transaction Cost Economics literature, it is considered the internalization by the parties of all the costs of dispute resolution (Bernstein, 2001; Hadfield, 2005), which eventually leads to ineffective resolution in case of conflicts (and therefore ex-post losses or ex-ante lack of investment/commitment).

Referring to this literature is important, since the comparative costs/benefits of public vs. private justice by Milgrom and al. (1990), Charny (1990) and Bernstein (1992) reveal that an appropriate institutional setting, based on relational networks and specialized private institutions, pushes away many of the ADR boundaries. These settings control the behavior of parties due to adequate retaliation mechanisms (based on ostracization) and manage information and knowledge more efficiently.

2.3 Testable Proposals

The previous developments allow us to draw testable propositions about the design of governance mechanisms. However, in the specific case of TLAs, the general analytical categories usually used in transaction costs should be adapted to the particularities of the transferred resource, i.e. knowledge.

Transfers of knowledge are high risk for the licensor, since they are irreversible. It is impossible to force the licensee to “unlearn”. Judicial means allow the licensor to prevent the licensee from directly competing with him, but it is obvious the latter is still able to use the transferred

knowledge to invent and compete “around”; i.e. to use the knowledge to either bypass the licensor’s patent or to invent rival patents. Such transactional hazards are increased by another feature of knowledge. Since knowledge is not fully codifiable, the wording of a patent does not encompass all the knowledge required to turn a “mother idea” into a “technical realization”, and *a fortiori* into a marketed product or service. A patentee therefore needs to transfer unpatented knowledge to the licensee. In concrete terms, the licensor often provides prototypes, red-books, data-files, counsel, and trains or delegates personnel. These make the transaction more complex to manage, and also increase contractual hazards. Tacit knowledge, in particular, makes the delineation of property rights problematic and increases appropriability hazards (Teece, 1986; Oxley, 1999).

2.3.1 Supervision Provision

In the case of transfers of knowledge, the level of contractual hazards is strongly dependent on two factors: the scope of the transfer and the degree of potential competition between the parties. As pointed out above, when a lot of additional cognitive resources have to be transferred by the licensor to the licensee, both the costs and the value of what has been transferred to the licensee (which is therefore appropriable by him) are higher.

Moreover, when the two parties are direct competitors, the knowledge that is useful for one of them can directly be exploited by the other. This is not the case for firms operating in different markets.

Of course, it is also risky for a licensee to be supervised by a licensor who might learn from her. Relational hazards on the matter are especially high when the two parties are direct competitors. This should hinder the likelihood of licensees accepting such a contractual provision. On the other hand, if a direct competitor agrees to implement the technology, this is probably because she has no alternative. Either the licensor’s technology is a technological (*de facto* or *de jure*) standard, or it is a technology without any alternative on the technology market. The licensee is therefore in a weak bargaining position vis-à-vis the licensor, and must accept his preferred conditions. This is why when there are technology transfers between two competitors, a supervisory provision is likely to be included by the licensor.

H1a The higher the “intensity” and “sunkedness” of the transfer, the more likely the implementation of a supervision clause;

H1b The higher the degree of potential competitive conflict between the parties, the more likely the implementation of a supervision clause.

However, a supervision provision is a safeguard if, and only if, the institutional environment guarantee enforcement. If the rights granted to an IPR holder are ambiguous, or if the court is inexperienced in dealing with conflicts over technology transfers, the parties will *ex ante* prefer to rely on their own ability to informally retaliate. Thus, H1a and H1b are subject to the condition:

H1c The higher the “quality” of the formal institutional environment, the more likely the implementation of a supervision clause

2.3.2 Renegotiation Provision

As pointed out in section 22, the implementation of a renegotiation provision should be positively related to the need for flexibility. Generally speaking, it is related to both the level of uncertainty — which, ex ante, makes it harder to implement an efficient set of mutual commitments — and to the expected length of the relationship — which, given a level of environmental uncertainty, means the longer the horizon, the greater the need to adapt the contract.

In the specific case of TLA, uncertainties about technological evolutions are particularly important. When technological uncertainty increases, the traded technology is more likely to become obsolete before the end of the contract, either because the parties will invent new solutions, or because competitors will develop new technologies. The value of the transfer, and even its justification, can therefore be “questioned” ex post. Thus

H2a The higher the technological uncertainty of the transfer, the more likely the implementation of a renegotiation clause;

H2b The longer the expected length of the relationship, the more likely the implementation of a renegotiation clause.

However, an institutional condition is also needed. To avoid non credible commitments, renegotiation provisions should be implemented if the institutional environment guarantees that future renegotiations will be framed, especially by informal institutions (MacNeil, 1974). Therefore:

H2c The higher the “quality” of the institutional environment – especially of private institutions –, the more likely the implementation of a renegotiation clause

2.3.3 Alternative Dispute Resolution Mechanisms

Since transfers of technology can request the transfer of many resources, in particular tacit knowledge, which is barely protected by the IPRs system, and more generally by the formal public institutions, public and generic conflict resolution mechanisms tend to be poorly adapted. Judges are unable to check these complex relationships and can hardly rely on legal categories to make decisions. The patentee will prefer to keep secret the details of the conflict he might have with his licensee. This is because the weak protection provided by the IPRs system allows any third party assessing the evidence provided during the hearings access to part of the licensor’s knowledge and use of it. Consequently, all else being equal, the incentive to rely on an ADR increases with the level of the resources transferred to the licensee. This is because such an increase corresponds both to lower verifiability and to lower protection of property rights by the public IPRs system. Therefore,

H3a The higher the “intensity” of the transfer, the more likely the implementation of an ADR mechanism.

As pointed out above, the recourse to an ADR should be hindered by the intensity of conflicts among parties. Thus,

H3b The higher the strategic stakes between partners, the less likely the implementation of an ADR mechanism.

Any decision to settle conflicts outside the public judicial system is made only when ex-post, one party considers the other likely to enforce the sentence made by the arbitration tribunal. Moreover, the chances of agreement on a common procedure should increase when parties have shared beliefs. The implementation of an ADR should be facilitated by the parties' inclusion in common relational networks and informal institutional frameworks.

H3c The higher the inclusion in relational networks and involvement in "private" institutions, the more likely the implementation of an ADR mechanism.

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Given that the three governance provisions we study here address different transactional difficulties, we do not expect strong dependencies between the three.

H4 The settling of supervision, renegotiation and dispute resolution provisions is likely to be independent from each other

3. Data and Research Design

Below we first present our database (3.1) and then explain how we made our data operational by detailing the design of the explained variables (3.2) and the selection of the explaining and control variables (3.3).

3.1 The Database

Our analysis is based on a database developed together with the Licensing Executive Society International (LESI), a business-oriented, international organization of professionals involved in licensing and other aspects of intellectual property rights transfers.

We carried out a survey among LESI members to study their technology licensing practices. A questionnaire was drawn up with members of LES USA-Canada and LES France. It was sent to 2,185 firms, mainly in Europe (35.5%), Japan (13.0%) and North America — USA and Canada — (48.5%). Information on licensing practices, however, is still widely considered highly confidential by companies and they are reluctant to answer. For this reason, despite the support of LESI, only 160 questionnaires were completed and sent back. They describe 297 licensing technology agreements respondents believe "reflect their most current practices".

In our view, the relatively low response rate is compensated by the details gathered on each agreement, which is described by 70 variables. Other empirical research based on surveys is also limited by the reluctance of firms to disclose information on these issues. Information is thus often scarce and samples rather small in size. For instance, Davies (1977) investigates 26 cases; Davies (1992) 204 cases; Macho-Stadler et al. (1996) 240 cases; Aulakh, Cavusgil and Sarkar (1997) 110 cases; Chi and Roehl (1997) 93 cases; and Bessy and Brousseau (1998) 46 cases.

Compared to previous studies, we managed to obtain a relatively large and diverse, cross-country and cross-industry sample of licensing agreements. After discarding incomplete responses, we retained 213 questionnaires.

The questionnaire was divided into two parts. The first focused on a general presentation of the respondent firm, its organization, licensing goals and industrial and institutional environment. The second part, we asked respondents to provide information on the characteristics of licensing agreements they consider “best represent their activity”. Afterwards, information on licensing conditions, payment formulas, safeguards and governance structure was collected.

Responses came from three economic zones: North America, Japan and Europe. We collected a few questionnaires from the rest of the world, but not enough for statistical analysis. North American firms account for 60% of our sample, European firms 30% and Japanese firms 10%. Because of the size of the US market, and also because the American firms in our sample are on average smaller than the European and Japanese respondents, there is a greater share of US initiated TLAs that are purely domestic. The contracts initiated by European and Japanese firms tend to be more oriented toward international exchanges. This is particularly true for Japanese contracts, since the Japanese firms in our sample are huge and highly internationalized.

We divided these firms into four main sectors depending on their main activities, i.e., firms whose activities are related to the transformation of raw materials (11.7%), to chemicals (41.3%), to equipment manufacturing and sales (23%) and services (17.8%). The remaining firms, whose activities are more varied, belong to what we called the “other” sector (6.1%; cf. Table 1).

< insert table 1 >

Our database is mainly composed of licensing-out agreements (the respondent is the licensor). As License-in and license-out contracts are not significantly different, we do not distinguish between the two in our analysis. Almost 60% of our database agreements are sole licenses. The others are included either in a cooperative R&D project or in a wider alliance or partnership. All these characteristics are summarized in the following Table 2.

< insert table 2>

3.2 The contractual governance design

In the following section, we describe the three explained variables — supervision, renegotiation and dispute resolution provisions — which are our proxies for the design of the contractual governance mechanism. We also provide some descriptive statistics (table 3).

3.2.1- Supervision

In our sample, many agreements grant inspection rights aimed at controlling the licensee’s usage of the licensed technology to the licensor or to a third party. The most common inspection right relates to the licensee’s books (85% of the contracts). The contract grants inspection rights on the licensee’s products and its industrial installations in 34% and 22% of the cases respectively. The licensee’s R&D projects are less frequently submitted to inspection rights (10%).

Supervision of books is by itself a virtually cost-free activity. On the other hand, inspecting products, facilities and R&D programs is costly. This is why we differentiate between the contracts that do not implement a supervision mechanism or that implement the supervision of books alone, and those that implement supervision on other items. Moreover, the supervision of books is linked to the potential hazards of payments, rather than to contractual hazards related to the specifics of the knowledge (Brousseau and Coeurderoy, 2005).

We created a “supervision” variable, which takes a value of 0 when the contract either implements the supervision of books by itself, or, when the contract does not implement any inspection rights. A value of 1 is assigned if audit rights are granted on at least one of the following aspects of the licensee’s concerns: its products, industrial installations or R&D capacities.

3.2.2 Renegotiation

40% of the contracts in our database involve a renegotiation provision. The royalty rate is subject to renegotiation in 18.3% of cases, while the whole contract may be renegotiated in 15.5% of cases. Renegotiation also concerns the geographical extension of the license in 13% of cases, and the licensed technology itself in 12% of agreements. In about one third of the contracts, a committee is created to manage the relationship between parties. Such a formal renegotiation mechanism seems to be more frequent in North America than in Japan or Europe.

We therefore created the “Renegotiation”, variable - a dummy variable equal to 1 if the contract implements a renegotiation provision (which can range from the royalty rate or the geographical extension of the license, to the whole contract), otherwise equal to 0.

3.2.3 Dispute Resolution

Many contracts - (62%) in our sample - implement a specific mechanism for dispute resolution. In most cases, either an independent arbitrator is contractually nominated (37% of cases) or the two parties agree to bring their conflict before a private instance such as a Chamber of Commerce or an industry union (27%). Relying on a committee to solve disputes concerns only 10% of the agreements. The implementation of a specific dispute resolution mechanism is more common in North America (68%) than in either Japan (52%) or Europe (57%).

We created the variable “conflict resolution device” that assumes a value of 0 if the contract does not implement a formal mechanism for dispute resolution, and a value of 1 if an ADR is settled.

< insert table 3>

3.3 Explanatory variables

As mentioned in section 1, the shape of contractual mechanisms is strongly influenced by the features of the transactions, the institutional framework and strategic considerations. Before detailing the proxies, we must first clarify methodological issues concerning the econometrics of contracts.

3.3.1 Methodological Choices

We introduced contractual clauses to the set of explanatory variables that we consider good proxies for the characteristics of the relationship between the two parties. In our opinion, these contractual variables relate to the judgments made by contracting parties regarding the state of the technological and business features of their transaction. From this point of view, they are much better measures than generic data such as second hand industry indices of technology or competition.

However, we are aware that such a choice is potentially exposed to severe endogeneity biases in the right hand side variables (Masten and Saussier, 2000; Chiappori and Salanie, 2003). This is why we systematically checked that the estimates were not affected by such possible disturbances: estimates were made with only contractual variables and results were similar to those obtained with the complete model. We also tested a two-step procedure by running regressions of each contractual variable on other variables. This method helped check whether estimates would have been improved by introducing instrumental variables. Our results remained unchanged. We therefore conclude that in our sample, our right hand contractual variables are not seriously affected by endogeneity. Contracting parties appear to negotiate each strategic commitment rather autonomously from other commitments.

In addition, we ensured these contractual variables, which aim to proxy some characteristics of the transaction and of the (competitive) relationship between the parties, are not conceptually linked with the explained variables. We recognize, however, that we are testing consistency among contractual commitments rather than testing per se the reason for including contractual clauses. The test we perform and its consistency with the theory enables us, however, to interpret the results in terms of causal relationships.

3.3.2 Transactional Characteristics of Technology Transfers

Transaction cost economics focuses on three key transactional attributes: asset specificity, uncertainty and frequency. The latter is meaningless for technology and knowledge transfers, since most of these transactions are one shot. When it has been transmitted (and absorbed) by the recipient, it is pointless to transmit it again. As previously noted in the case of TLAs, the relational lock-in does not refer to investments in specific assets, but rather to the “investment” in a costly and sunk transfer of knowledge. Uncertainty refers mainly to technology.

Intensity of the transfer Through factor analysis, we extracted one vector summarizing eleven dummies for the transfer of technology. The respondent explained whether the contract covers the transfer of one or more of the following: (i) the right to use other intellectual property rights (e.g. a trade secret) other than Trademark, (ii) the right to use the Licensor’s Trademark, (iii) plans, (iv) prototypes or material, (v) technical tests and development data, (vi) marketing tests and other commercial data, (vii) technical assistance and consulting services, (viii) accounting, marketing and management methods, (ix) training, (x) personnel delegation and (xi) other inputs such as products, equipment or services. We thereby established a continuum of contracts starting with those that do not organize any transfer of resources (but rather the right to use the patent) and ending in contracts characterized by multiple transfers. The construction is labeled by the variable “transfer intensity”

Technological uncertainty In TLAs, the main source of uncertainty that may affect governance mechanisms concerns technological developments. Indeed, they may render the principles and conditions of the exchange obsolete, thereby generating the need for *ex post* adaptation.

Uncertainty is a complex concept to operationalize in empirical analysis (Chiapoorri and Salanie, 2003). In many studies, technological uncertainty is measured by an industry dummy (e.g., Anand and Khanna, 2000). But such methodology is rudimentary because many different technologies matter in an industry. In addition, many technologies are used across industries, while some are actually general-purpose technologies. It is therefore more appropriate to measure uncertainty at the level of transactions. Questionnaires and measures by items of unobservable dimensions are the most common techniques, given that they capture the perceptions of decision makers in the technological and business landscape (Shelanski and Klein, 1996; Coeurderoy and Quélin, 1997). In our research, we decided to rely on the assessment made by contracting parties themselves. Two items in our questionnaire proxy the level of uncertainty: the implementation of grant-back provisions and the implementation of rights for the licensee to benefit from future improvements. A grant back provision enables the licensor to benefit from the right to appropriate the developments made by the licensee on the basis of its initial innovation (Caves et al., 1983, Bessy & Brousseau, 1998). In a role reversal, the licensee may request to profit from future improvements made by the licensor. Contracting parties are likely to implement such provisions if they expect technological change during the life of the contract, with potential consequences on the contractual circumstances of the two parties and on technological competition in general (Choi, 2002). We therefore created the "technological uncertainty" variable, which takes a value of 0 if neither grant-back nor future improvement provisions are included, and a value of 1 if the contract specifies either one of the two, and a value of 2 if it includes both.

3.3.3 The Influence of Institutional Environment

Public institutions To assess the impact of public institutional frameworks on contractual structures, we introduced a set of nine dummies describing the flow of technology transfer across geographical areas (e.g., "us_us" for domestic licensing in the USA, or "eur_jap" for licensing from Europe to Japan). As the licensing contracts of the sample are drawn up within three large economic zones (North America, Europe and Japan), we assume these zones reflect different levels of intellectual property rights protection and qualities of contractual law.

It is generally accepted that the strength of IPRs varies across countries, both because of the design of the law and the organization of institutions in charge of managing the IPRs system (Ostergard, 2000). However, these differences are difficult to measure because they depend on many factors (including a lot of informal ones, such as the way courts document cases or make decisions). Most existing indicators are unsatisfactory (e.g. La Porta et al., 1998). This is because they are highly biased by the goal of each of the particular studies (Sattin, 2005). In this paper, we use the nationality of parties to qualify the IPRs regime. Even if differences between European countries still exist, the IPRs regime are converging in Europe due to the existence of the European Patent Office and to the European Union's active policy in this area to create a single market. According to literature, IPRs are stronger in the US than in Europe, and stronger in Europe than in Japan.

However, the structure of licensing agreements is not only influenced by the IPRs regime. Other dimensions of the legal framework, particularly contract law, also play a role. It is therefore difficult to accurately forecast how the complex web of legal regulations impacts the design of contracts, since various components of the law may have contrasting impacts. A more detailed study should therefore be carried out in the future, on a provision by provision basis. However, a larger sample would be needed to check the respective roles of the many (legal and non legal) explanatory factors of contractual structures.

Private institutions The role of informal institutions was directly measured by asking if the agreements make any reference to information, regulations or services provided by private entities in an effort to simplify technology transfers. In our database, recourse to private institutions for establishing financial conditions is reported in 20% of the contracts (e.g. references to price index, tariffs or payment formulas). In 10% of cases, the settlement of technology transfer conditions refers to private institutions (e.g. “fair practice” guidelines). Private institutions also play a role in supervising the behavior of parties in 12% of contracts (e.g. by assessing actual sales or production volume). This data is relatively homogeneous across countries and sectors.

In order to measure the influence of private institutions on the implementation of governance provisions, we then created the “private institutions” variable, equal to 0 if the contract does not make reference to private institutions, and ranked from 1 to 4 according to the number of “services” provided by these entities: provision of “fair practice” or of financial guidelines, provision of information on parties’ behavior (e.g. assessment of actual sales or produced volumes), dispute resolution procedures.

3.3.4 Strategic Hazards Arising from Technological Competition

We identified several proxies for the level of technological competition and potential conflict among contractors.

Licensor’s Commitments Regarding Property Rights The licensor can commit to the quality of the transferred intellectual property rights by granting the licensee three guarantees: (a) a warranty of ownership in which the licensor certifies that he is the actual and sole owner of the transferred knowledge, (b) a warranty of non-infringement, which guarantees that title deeds are not subject to oppositions by other potential IPRs owners, and (c) immunity from suit by which the licensor commits himself to defending the licensee against any suit related to the licensed technology. These guarantees are credible signals that firstly, the transferred IPRs are valuable in the sense that they are likely to generate income, and secondly, that the IPRs holder will invest in means to maintain its (and its licensees’) exclusive access to the patented knowledge. By promising the licensee an actual exclusion to a source of rent in the case of contractual breach, these clauses make the termination of the arrangement a real threat. Such provisions are therefore proxies of both the value of the technology (the stakes of the transaction) and of the anticipation of possible conflicts over access to it. In order to take into account these commitments, we created the “IPRs commitment” variable, which is ranked from 0 to 2 according to the number of warranties the contract implements.

Minimal performances To prevent the licensee from inhibiting the use and distribution of

the technology (see section 21), the licensor can implement a provision for a minimum level of performance (assessed either by royalties, sales or production volumes). In our sample, 32% of the contracts implement this minimal performance provision. In our opinion, this is a relevant proxy for potential technological competition between parties, given that only a competitor would have the incentive to become a licensee and hinder use of a technology. We created the “minimal performance” variable, a dichotomic variable equal to 1 if the contract implements minimal performances, otherwise equal to 0.

Renewal provisions Lastly, long-term involvement can also be expected to influence governance costs. Indeed, the licensee is more motivated to invest when the licensor commits himself in the long run. But, in the long run, uncertainty increases. The longer the length, the higher the risk of maladaptation. However, it is difficult to measure contract duration because many respondents did not provide us with the number of years for which the contract is valid, and often pointed out that the license was granted for the whole duration of the patent. This information would have been, in any case, extremely imprecise, since we neither know how old the patent is, nor whether technical changes will allow exploitation of the patent until its validity ends. We thus decided to assess the horizon of the commitment between parties through the presence of a renewal provision. Such a provision means that the parties anticipate the patent will be maintained in the long run (or at least as long as the technology remains competitive), and that the licensee would like to maintain an option for accessing the technology. This commitment by the licensor will, however, increase hazards, given that optimal licensing conditions may evolve. The licensor can therefore ask for a clause to adapt contractual conditions to the changing business context. We introduced the “renewal” variable, which is a dichotomic variable equal to 1 when the contract includes a renewal provision of (52% of cases), and equal to 0 otherwise.

3.3.5 Other Control Variables

Finally, other factors may also affect the governance structure of contracts. We took into account industry features, equity relationships, and licensor size.

Sectoral dummies As previously mentioned, we divided our sample into five industries (chemical related activities being used as the reference industry). The industry where the technology transfer occurs has been used in many studies as a proxy of both the presence of informal institutions and technological uncertainty (e.g. Anand and Khanna, 2000, Bessy, Brousseau and Saussier, 2002). Since we have the opportunity to use more precise proxies for these two elements, we use a sectoral dummy to check for other sectoral effects, such as the industry structure or level of technological interdependence.

Equity links Among subsidiaries of the same firm or between a subsidiary and its parent company, additional governance mechanisms exist that will decrease enforcement costs. Consequently, we created the “equity links” variable to take into account the existence of an equity relationship between licensor and licensee. We expect equity links to decrease the probability of contractual governance clauses.

Company size A larger firm is more likely to possess sufficient resources and also able to devote the effort and expertise needed to manage its licensing activities. Moreover, it is more likely to benefit from learning effects. Size can therefore affect the management of licensing contracts. We

discriminate our sample depending on the size of the licensor, distinguishing between firms employing less than 500 staff and those employing over 500 (“licensor’s size” variable).

4. Analyzing Results

In this specific study, we focus on the creation of contractual governance, resulting from three simultaneous decisions made by the licensor:

- the decision to closely supervise how the licensee uses the licensed technology;
- the decision to explicitly anticipate the need for ex post adaptation and to therefore implement a renegotiation mechanism;
- the decision to implement an alternative dispute resolution mechanism.

However, we must assess the potential joint incidence of the three contractual clauses. Since we use one dummy variable for each contractual clause, we use a multivariate probit model estimated by simulated maximum likelihood, available in STATA software (Cappelari and Jenkins, 2003). The multivariate probit model uses the Geweke-Hajivassiliou-Keane (GHK) simulator to evaluate the M-dimensional Normal integrals in the likelihood function. For each observation, a likelihood contribution is calculated for each replication, and the simulated likelihood contribution is the average of the values obtained from all the replications. The simulated likelihood function for the sample as a whole is then maximized using standard methods. Furthermore, we use the Huber/White/Sandwich variance estimator instead of traditional calculations. This alternative variance estimator consistently produces standard errors when observations are not fully independent.

So our regression model for contractual governance is the following M equation, multivariate probit model:

$$Y_{im}^* = \beta_m' X_{im} + \varepsilon_{im}, m = 1, \dots, M$$

$$y_{im} = 1 \text{ if } y_{im}^* > 0 \text{ and } 0 \text{ otherwise}$$

ε_{im} , $m = 1, \dots, M$, are error terms distributed as a multivariate normal, each with a zero average and variance-covariance matrix V , where V has values of 1 on the leading diagonal and correlations $\rho_{jk} = \rho_{kj}$ as off-diagonal elements (Cappelari and Jenkins, 2003).

Results are provided in table 4 and discussed below:

< insert table 4 >

Below, we present the results following the order of our testable propositions in section 2.3. We therefore discuss determinants for the supervision arrangement (4.1.), the renegotiation scheme (4.2), and the dispute resolution mechanism (4.3). In addition, we discuss the independence of

choices made regarding these three components of the governance mechanism (4.4). Concluding remarks follow.

4.1 Supervision

Our results confirm the close link between the intensity of the transfer — and therefore the lock-in between parties due to switching costs — and the preference for supervision. We provide one more piece of evidence supporting the TCE conjecture that a transaction exposed to appropriability hazards requires a more protective mode of governance (Williamson, 1985; Oxley, 1999). In general, such an argument is tested through the trade-off of “licensing versus direct investment”. Here we provide proof of the impact of *ex post* issues on contract design.

The second salient feature is the licensor’s commitment to guaranteeing the quality and the strength of his intellectual title deeds. Protected technologies are more likely to be valuable and therefore lie at greater risk of opportunistic appropriation. The licensor implements a supervision provision to control this risk. This confirms the limits of *ex ante* safeguards and the need to monitor opportunism *ex post*. Since we consider a provision for minimal performance as a proxy for the intensity of the technological competition among the parties, as expected, it is positively linked to supervision. Other transaction features and strategic variables do not significantly impact on supervision.

Our results also show the influence of the institutional framework. Firstly, private institutions clearly matter. They positively influence the recourse to supervision. The implementation of bilateral supervision is therefore complementary to the provision of other coordination services provided by private institutions, which, in line with MacNeil (1974), contribute to secure bilateral relationships.

Secondly, our results also reveal the importance of the public institutional framework. The most stringent finding is that the presence of a US partner significantly increases the probability of implementing a supervision mechanism. It confirms the idea raised in research by scholars such as La Porta, Lopez-de-Silanes and Visnhy (1999) that there is more internal conflict in the US legal system than in the European institutional system, due to the influence of Common Law in the US (whereas the European model is based more on Roman law or Civil Code). Our results also confirm that inter-zone agreements are influenced by institutional complexities and uncertainties faced by agents when they trade IPRs across national boundaries. Except for licensing from the USA to Japan, where the coefficient is lower than for domestic licensing, cross-border licensing contracts systematically reveal higher coefficients than the domestic benchmark. International transfers of technologies induce more intensive use of supervision. However, this positive relationship is not systematic and bilateral. For example, European firms are more likely to implement a supervision mechanism when they export technology to Japan, than vice versa. Such results, however, are difficult to interpret since our sample is too small to make any generalisations.

Furthermore, there is noticeable diversity in supervision across industries (the reference being the chemical industry). In particular, attention should be paid to greater supervision in the raw materials and service industries. This is probably linked to the fact that most patented technologies in these industries are process technologies. IPRs infringement on technologies

implemented in processes is more difficult to detect than infringement of a product technology.

Firm-specific variables (size and equity partnership) have no influence on supervision decisions. Since recourse to supervision is linked to judicial enforcement in the last resort, this suggests that access to such public enforcement resources is not discriminatory among firms.

4.2 Renegotiation Provision

By granting a renewal provision, the licensor explicitly provides, *ex ante*, a long-term commitment. As expected, a renegotiation clause is included as a safety net. On the one hand, the licensee will improve her prospects for expected profits; while on the other, the licensor maintains the opportunity to adjust the contractual terms in the case of misalignment. Renegotiation as a means of readjusting transactions can also be seen through the impact of technological uncertainty (albeit only significant at a 10% threshold). Since most industry dummies are not significant, despite wide fluctuations in technological settings, it confirms the idea that technological uncertainty is a significant variable at a micro-level of transactions and in the technological field only.

We also note that the renegotiation clause is more likely to be included when private institutions support licensing activities. We therefore confirm that when such private bodies provide a framework underlying party behavior, renegotiations are more easily viewed as a way of realigning mutual behavior. Again MacNeil's study (1974) of relational contracting seems to be validated.

It is surprising to discover that there is no major link between supervision provisions and the level of specific "investment" in the transaction. But, as explained earlier, transferred knowledge is a sunk cost and so negotiation is pointless.

4.3 Dispute Resolution Mechanisms in Licensing Contracts

The confirmed strong link between ADR provisions and the existence of private institutions confirms the notion that an ADR is required when the governed transactions are so specific that conflicts cannot be easily settled in court. Again, MacNeil's vision prevails. Despite large differences in the organization of industry settings, because industry dummies are not significant, it confirms that relevant private institutional frameworks, are, as pointed out by Bessy and Brousseau (1998), organized at "technological field" rather than "industry", level.

We find no evidence on how technological transfers impact the mode of conflict resolution (H3a). One possible explanation is that arbiters are more mobilized as business experts rather than technological experts. In this way, note that both IPR and performance commitments positively influence the settlement of conflicts by arbitration. Licensing parties agree on the efficiency of ADR when arbitrators can rely on written contractual commitments and secure formal institutions. In such a case, they can use their expertise to check the (potential) gap between promises and actions carried out.

Furthermore, equity links play a role when selecting an ADR. They decrease the need to formally

resort to an ADR since parties can rely on “hierarchical” means to solve conflicts.

We also note that neither the geographical origins of the licensor, nor the international nature of the transfer, impact on the design of dispute resolution mechanisms. There is no impact on formal institutions. In fact, only transfers from Europe to Japan result in the implementation of an ADR mechanism, which, out of ten case studies, is difficult to understand. So this confirms that the implementation of an ADR is strongly linked to final enforcement by private and informal institutions.

4.4 Dependence Between Contractual Provisions

We checked whether the three governance provisions are chosen independently or not. As table 4 reveals, the overall hypothesis of independence for the three regression models is not rejected. So we confirm that generally speaking, supervision, renegotiation and dispute resolution provisions carry out different roles.

These results call for more detailed analyses in the design of contractual mechanisms. Indeed, contracts include a set of provisions addressing different issues (e.g. supervision, renegotiation, dispute resolution). In the theory of contracts, it is important to state whether these different provisions are designed independently from each other. There are two possible approaches:

- The first one suggests that the performances of contractual components are linked; an idea which corresponds to the mathematical property of super-modularity (Holmström and Milgrom, 1994; Athey and Stern, 1998 ; Brickley, 1999). This leads to the idea that polar forms of governance and therefore of contract, exist. This fits with the idea proposed by Williamson (1991) that economic agents choose between reduced set of possible governance/contractual modes, which may, for example, correspond to “markets”, “hybrids” or “hierarchies”.
- The second approach is linked to the idea that contractual components address independent coordination problems. This leads to a modular conception of contracts in which provisions are chosen independently of each other. The large number of possible combinations of contractual clauses result in a vision of a continuum of contracts from the market to the hierarchy.

Of course, the two visions may be combined by highlighting the strong complementarities between certain types of contractual mechanisms, and independence among others that might explain variations around polar forms (Brousseau, 1995).

Gaining a better understanding of the complementarities between contractual mechanisms represents a complex challenge, particularly for applied studies, due to the fact it is highly data demanding (see Arora, 1996). Our results however, appear to support the idea that the design of contractual governance addresses each issue independently. Nevertheless, we do not provide any test rejecting the idea that complementarities exist. Several elements suggest that complementarities also exist. For instance, on several occasions, we pointed out the fact that there are obvious links between some decisions made about the design of the ex ante mechanisms — e.g. the payment formulae — and the ex post governance mechanisms — e.g. supervision of

books when royalties are implemented. So it seems contracts are marked by the co-existence of independence and complementarities among their mechanisms.

5. Concluding Remarks

Table 5 sums up the most important econometric outcomes.

< insert table 5 >

Generally speaking, most of our hypotheses are confirmed. Table 5 confirms that the contractual provisions studied cannot be explained by the same variables, hence suggesting that they address different contractual hazards. Moreover, many contractual solutions appear to be linked to different vital conditions. This justifies our approach of dealing simultaneously with the transactional, institutional and strategic determinants of contractual features (and therefore of transaction costs). In addition, the identified complementarities correspond to the idea that contracts are partially made up of independent mechanisms.

In a nutshell, a formal supervision mechanism for controlling potential contractual risks is likely to be included only when possible — because the formal institutional context implements well-defined IPRs that are efficiently/effectively enforced by the judicial system — and necessary — when the licensor is subject to contractual risks both because he must invest significantly to transmit knowledge (resulting in lock-in), and because he can contract with partners that could become competitors.

A renegotiation mechanism to enable mutual adjustment *ex post*, is likely to be introduced when uncertainty and a long-term horizon prevent the party from drawing up a complete contract *ex ante*. Private institutions are particularly useful for creating frameworks for the renegotiation process.

Implementing an ADR mechanism is subject to stringent conditions because of the irreversible nature and huge consequences of behavioral hazards if transfer of knowledge occurs. Private institutions, in particular, seem to prefer implementing ADRs since they frame the behavior of agents.

More generally, our results provide evidence of the influence of private institutions on technology markets. By facilitating the exchange of information among firms and through agreements on behavioral norms, these entities simplify technology transfers and clarify the rules of the game in the business. Public authorities should favor their development, rather than seeing them as organizations that promote collusion and anti-competitive practices.

Despite a number of checks and controls, we know that our estimates can still be partially impacted by biases and misspecifications. An important limit is that we only focus on choices made by contracting parties, without being in a position to properly assess how these choices perform. On the one hand, we can expect that the contracts considered as the “most representative” of their practices by IPR executives in the surveyed companies were selected because these executives considered them successful. Also, they were supposed to describe their current practices, which are constantly exposed to a survival test. On the other hand, we cannot

exclude that some of the contracts in our database have transaction costs that are outweighed by the expected value.

At the same time, we are confident our key findings are sound enough to provide new findings on the main transactional, institutional and strategic determinants influencing the shape of technology licensing agreements. We hope these results will encourage economists to carry out further empirical research on the structure of contractual governance mechanisms. In particular, accurate proxies for the quality of the legal and institutional environment in the case of IPRs should better explain how public institutions shape the environment of knowledge-based transactions. It would be a key contribution to improve the design of institutional frameworks supporting the development of a market for technologies.

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Table 1: Characteristics of Questionnaire Respondents (in %)

Country	North America	Europe	Japan	Total
Characteristics of firms				
Industries				
(1) Transformation of raw materials	10.48	11.67	17.24	11.74
(2) Chemicals	50.00	23.33	41.38	41.31
(3) Equipment manufacturing	20.16	21.67	37.93	23.00
(4) Services	12.10	38.33	0.00	17.84
(5) Other	7.26	5.00	3.45	6.10
Total				
<i>Total number of responses</i>	124	60	29	213

Table 2a The Geographic Distribution of Contracts sampled (in %)

Licensee's region	Licensor's region			
	USA	Japan	Europe	Total
USA	79 63.71	9 31.03	18 30.00	106 49.77
Japan	28 22.58	13 44.83	10 16.67	51 23.94
Europe	17 13.71	7 24.14	32 53.33	56 26.29
Total	124	29	60	213

Table 2b: Characteristics of Contracts Sampled (in %)

Country	North America	Europe	Japan	Total
Partner's description				
Same country	63.71	53.33	44.83	58.22
Same industry	55.65	60.00	82.76	60.56
Same size	41.94	53.33	79.31	50.70
Prior licensing agreement	20.16	27.12	48.28	25.94
Equity relationship	20.97	18.33	20.69	20.19
Nature of the agreement				
•1 Sole license	57.50	63.79	62.07	59.90
•2 R&D project	20.00	10.34	24.14	17.87
•3 Partnership	9.17	8.62	10.34	9.18
•4 Alliance	12.50	15.52	3.45	12.08
•5 Other	0.83	1.72	0.00	0.97
<i>Total number of responses</i>	124	60	29	213

Table 3: Characteristics of governance clauses sampled (in %)

Frequency of clause implementation	America	Europe	Japan	Total
Supervision	45.16	35.00	44.83	42.25
Renegotiation	36.29	40.00	51.72	39.44
Alternative Dispute Resolution	67.74	56.67	51.72	62.44
<i>Total number of responses</i>	<i>124</i>	<i>60</i>	<i>29</i>	<i>213</i>

Table 4 Joint Analysis of Mechanism for Contractual Clauses by a multivariate probit model

	Governance of Technology Licensing		
	Supervision	Renegotiation	Conflict resolution
transfer intensity	0.614** (0.231)	-0.024 (0.206)	0.021 (0.200)
renewal	-0.130 (0.216)	0.686*** (0.202)	0.105 (0.207)
Techno. uncertainty	-0.111 (0.124)	0.192 (0.123)	0.044 (0.120)
IPRs commitment	0.114* (0.060)	0.054 (0.058)	0.112* (0.061)
minimal performance	0.465* (0.232)	0.303 (0.228)	0.634** (0.253)
Private institutions	0.242* (0.107)	0.234* (0.104)	0.335** (0.135)
raw material	1.451*** (0.398)	0.216 (0.343)	-0.435 (0.353)
equipment	0.685** (0.277)	0.514 (0.291)	-0.585* (0.271)
Other	1.313** (0.492)	0.084 (0.428)	-0.111 (0.488)
services	0.860** (0.325)	0.088 (0.312)	-0.484 (0.298)
equity links	0.372 (0.246)	0.204 (0.253)	-0.561* (0.258)
large enterprise	-0.190 (0.272)	0.322 (0.258)	0.136 (0.248)
us_us	1.193*** (0.355)	-0.081 (0.300)	0.624* (0.304)
us_jap	1.054** (0.415)	0.036 (0.385)	0.464 (0.380)
us_eur	1.906*** (0.464)	-0.085 (0.378)	0.372 (0.423)
jp_us	2.443*** (0.639)	0.493 (0.562)	-0.527 (0.623)
jp_jap	0.889 (0.611)	0.006 (0.504)	0.001 (0.442)
jp_eur	1.035 (0.590)	-0.290 (0.569)	1.207 (0.694)
eur_us	1.351** (0.455)	-0.237 (0.400)	0.487 (0.408)
eur_jap	1.345** (0.501)	0.216 (0.528)	1.118* (0.551)
_intercept	-2.274*** (0.499)	-1.639*** (0.419)	-0.530 (0.392)
Rho 21		-0.012 (0.129)	
Rho 31		-0.020 (0.132)	
Rho 32		0.077 (0.126)	
N		213	

Log pseudo likelihood	-342.25
Wald chi square	172.23***

Likelihood ratio test of $\rho_{21} = \rho_{31} = \rho_{32} = 0$; $\chi^2(3) = 0.370$ Prob > $\chi^2 = 0.946$.
Coefficients significant at 1% (**); 1% (**); 5% (*); 10% ().

Table 5. Synthesis of the Results

	Supervision Mechanism	Renegotiation	Alternative Dispute Resolution (Ext)
Transaction Features			
Transfer Intensity	+		
Technological Uncertainty		+	
Strategic Bias			
Commitment to Maintaining Strong IPRs	+		+
Minimal Performance	+		+
Contract Renewal		+	
Institutional environment			
North America	+		
Japan			
Europe			
Internationalization of the exchange	+		
Recourse to Private Institutions	+	+	+
Control Variables			
Equipment	+	+	-
Service	+		
Raw Materials	+		
Other	+		
Equity Links			-
Licensor's size			

Appendix
Descriptive data and matrix correlation

Variable	Std.																							
	Mean	Dev.	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1) asset specificity	-0.03	0.52	-0.68	1.73	1.00																			
(2) renewal	0.52	0.50	0.00	1.00	0.25	1.00																		
(3) technological uncertainty	1.13	0.85	0.00	2.00	0.32	0.08	1.00																	
(4)IPR commitment	2.20	1.71	0.00	6.00	0.21	-0.02	0.16	1.00																
(5) minimal performance	0.32	0.47	0.00	1.00	0.13	0.11	0.11	0.07	1.00															
(6) private institutions	0.81	1.04	0.00	4.00	0.21	0.07	0.09	0.11	0.20	1.00														
(7) raw materials	0.12	0.32	0.00	1.00	0.12	0.09	0.13	-0.03	-0.03	0.04	1.00													
(8) equipment	0.23	0.42	0.00	1.00	-0.13	0.06	0.01	-0.11	-0.18	-0.16	-0.20	1.00												
(9) other	0.06	0.24	0.00	1.00	-0.02	0.05	-0.20	-0.14	0.12	-0.01	-0.09	-0.14	1.00											
(10) services	0.18	0.38	0.00	1.00	0.13	-0.04	-0.04	-0.06	-0.03	-0.16	-0.17	-0.25	-0.12	1.00										
(11) equity links	0.20	0.40	0.00	1.00	0.06	0.11	0.10	-0.02	0.18	0.13	-0.04	-0.11	0.02	-0.08	1.00									
(12) large enterprise	0.54	0.50	0.00	1.00	-0.05	0.07	-0.09	-0.16	-0.29	-0.04	0.22	0.24	0.16	-0.35	0.05	1.00								
(13) us_us	0.37	0.48	0.00	1.00	-0.02	-0.02	0.00	0.03	0.22	-0.09	0.02	-0.23	0.13	-0.10	0.05	-0.22	1.00							
(14) us_jap	0.13	0.34	0.00	1.00	-0.12	-0.10	0.04	-0.13	-0.12	-0.01	-0.06	0.25	-0.04	-0.11	0.01	0.20	-0.30	1.00						
(15) us_eur	0.08	0.27	0.00	1.00	0.08	-0.06	0.08	0.17	-0.09	0.04	-0.05	-0.04	-0.08	0.00	-0.06	-0.07	-0.23	-0.11	1.00					
(16) jp_us	0.04	0.20	0.00	1.00	0.09	0.06	-0.01	0.21	-0.04	0.04	0.00	-0.06	0.04	-0.10	0.07	0.20	-0.16	-0.08	-0.06	1.00				
(17) jp_jap	0.06	0.24	0.00	1.00	-0.12	0.01	-0.11	-0.13	-0.17	0.07	-0.03	0.23	-0.07	-0.12	0.02	0.24	-0.20	-0.10	-0.08	-0.05	1.00			
(19) jp_eur	0.03	0.18	0.00	1.00	0.04	0.07	0.06	0.03	-0.07	0.03	0.18	0.02	-0.05	-0.09	-0.09	0.17	-0.14	-0.07	-0.05	-0.04	-0.05	1.00		
(20) eur_us	0.08	0.28	0.00	1.00	0.13	0.12	0.01	0.03	0.01	0.02	-0.06	-0.13	-0.08	0.30	-0.07	-0.16	-0.23	-0.12	-0.09	-0.06	-0.08	-0.06	1.00	
(21) eur_jap	0.05	0.21	0.00	1.00	0.01	0.17	0.10	0.03	-0.06	0.06	0.06	0.14	-0.06	-0.10	0.11	0.16	-0.17	-0.09	-0.07	-0.05	-0.06	-0.04	-0.07	1.00

All correlations over 0.15 (in absolute terms) are significant at a 0.05% threshold.