The Diversity Of Technology Licensing Agreements And Their Causes[1]

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1. The Data and the Project

1.1 A survey on contractual practices among LESI members

This paper aims to synthesize the results of an investigation into technology licensing practices carried out by LESI members. We developed a questionnaire in collaboration with members of LES (USA & Canada) and LES France. It was sent in the Spring 2001 to 2685 firms, mainly in Europe (35.5 percent), Japan (13.0 percent) and North America (48.5 percent).

Information about licensing practices is still widely considered by companies as highly confidential and respondents were reluctant to provide detailed answers in the questionnaires. For that reason, despite the support of LESI, only 160 questionnaires (six percent) were completed and returned by the end of the year 2001. They describe 297 technology licensing agreements (TLAs) considered by the respondents as "reflecting their most current practices."

In our view, the relatively small response rate is compensated by the detail gathered on each agreement, which is described by 70 variables. Other empirical researches based upon surveys have also been confronted with a reluctance to disclose information on perceived sensitive issues (Bessy and Brousseau, 1998). Information is thus often scarce and the samples rather small in size. For instance, Macho-Stadler et al. (1996) studied 240 cases, Aulakh, Cavusgil and Sarkar (1997) gathered 110 cases, Chi and Roehl (1997) collected 93 cases and Bessy and Brousseau (1998, 2000) worked on 46 cases. Thus in comparison to previous studies, we managed to obtain a relatively large and diverse cross-country and cross-industry sample of licensing agreements.

The questionnaire was divided into two parts. The first part was devoted to a general description of the respondent firm, including its organization, licensing goals and its

1. This paper is based on a survey performed among LESI members. This survey benefited from the support of the LESI and from the LES (USA & Canada). LES France also actively supported the realization of this research. LESI members and executives—in particular Thierry Sueur, Elisabeth Thouret–Lemaitre and Kenneth Payne—are warmly thanks for their support.

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Table 1. Main Characteristics of the Surveyed Firms by Region (by percent)

Characteristics of firms	North America	Europe	Japan	Rest of the World	Total
Industries					
(1) Transformation of raw material	10	9.3	13.2	11.1	10.6
(2) Chemical	50	23.3	31.6	33.3	37.5
(3) Equipment Manufacturing and Selling	12.9	27.9	47.4	11.1	25
(4) Services	17.1	34.9	2.6	44.4	20
(5) Other	10	4.7	5.3	0	6.9
Total	100	100	100	100	100
Total number of responses	**70**	**43**	**38**	**9**	**160**
Subsidiary of a foreign firm	6.1	21.4	8.1	0	10.6
Total number of responses	**66**	**42**	**37**	**6**	**151**

industrial and institutional environments. In the second part, we asked the respondents to provide information about the characteristics of licensing agreements they considered as "the most representative of their activity." Added to this was information on licensing conditions, payment formulae, safeguards, governance structure that can be related to the nature of the transfers and characteristics of the partners and their environment.

Ninety-four percent of responses came from three economic zones: North America, Japan and Europe with the balance from other parts of the world (and inadequate for statistical analysis). North American firms accounted for 43 percent of our sample, European firms for 27 percent and Japanese firms for 24 percent. We divided firms into four principal sectors according to their main activity: transformation of raw material, chemical, equipment manufacturing and selling, and services. The other firms, whose activities are more disparate, belong to what we called the "other" sector. See Table 1.

The questionnaire contained questions on the patenting and licensing strategies of the firms. Firms were in particular asked to assess the average number of licensing agreements concluded each year. The majority of the respondents initiates less than five licensing-out agreements per year. Licensing-in agreements are even less common: more than 95 percent of the respondent firms of less than 500 employees implement less than five licensing-in agreements a year. Larger firms follow the same tendency, but in a lower proportion (69.4 percent). In the transformation of raw materials sector, firms seem to have more active licensing policies, since they tend to implement more licensing-in and more licensing-out agreements than in other sectors. Exchanges of technologies seem more frequent in the transformation of raw material industry, leading to consider that a "market of technology" exists there. Exchanges of technologies are also intensive in the chemical industry. In comparison to the raw material transformation industry, the chemical industry seems orientated to exporting its technologies to other industries. Firms in the "other" sector export their technology to other industries. It reflects the fact that this group includes several R&D firms (and universities).

Our sample cannot be considered as representative of the population of firms worldwide. It is also not representative of the LESI membership.[2] However, our aim is not to describe this population of firms, but to analyze the diversity of licensing practices the causes of this diversity. To that extent, although our sample could be wider, it contains a wide diversity of licensing situations.

Table 2. Principal Characteristics of the Surveyed Sample of Contracts (by percent)

General characteristics of contracts:	America	Europe	Japan	Rest of the World	Total
Licensing in	33.3	25	47.1	83.3	37.6
Licensing out	66.7	75	52.9	16.6	62.4
Total	100	100	100	100	100
Total number of responses	*126*	*68*	*85*	*11*	*290*
Partner's description:					
Same country	70.5	66.2	16.5	21.4	51.7
Total number of responses	*129*	*68*	*85*	*14*	*296*
Same industry	54.2	51.5	81.9	75	61.9
Total number of responses	*120*	*68*	*83*	*10*	*281*
Same size	35.4	52.3	73.5	70	51.9
Total number of responses	*113*	*65*	*83*	*7*	*268*
Prior licensing agreement	19.2	31.3	33.7	37.5	26.8
Total number of responses	*120*	*67*	*83*	*10*	*280*
Equity relationship	20.8	17.6	27.7	75	23.5
Total number of responses	*120*	*68*	*83*	*10*	*281*
Nature of the agreement:					
Sole license	59.3	64.2	56.6	60	60
R&D project	16.3	11.9	16.9	0	14.7
Partnership	10.6	11.9	9.6	20	10.5
Alliance	13	10.4	13.3	20	13
Other	0.8	1.5	3.6	0	1.8
Total	100	100	100	100	100
Total number of responses	*123*	*67*	*83*	*12*	*285*

The described relationships cover domestic and foreign exchanges in different countries, intra and inter-industry transfers in various industries, exchanges among firms of very different sizes, as well as a wide range of types of transfers (from transferring the simple right to exploit a patent to the management of cooperation in RD) as set out in Table 2.

There are clearly dominant practices in our sample. The most frequent agreement is a non-exclusive worldwide sole license that remains in force for an indeterminate duration and that includes a combination of lump sum payments and royalties. At the same time there are significant disparities among licensing agreements. For instance a third of contracts in the survey are settled for a wider purpose (i.e. cooperative R&D, alliance, partnership) than simply transferring technology.

Contrasts are also observable across countries and industries. In particular, there are wide differences between North American and Japanese agreements with European contracts often between these two extremes. Japanese contracts are mainly non-exclusive and limit the granted territory to the licensee's country. On the contrary, North American agreements mainly implement exclusive (or sometimes co-exclusive) and worldwide licenses for an indeterminate duration. North American contracts mostly deal with domestic exchanges and cross licensing is infrequent. Conversely, most Japanese agreements govern international exchanges and with a large number of cross licensing among the companies in place.

Disparities are also observed across industries. Licenses are predominantly exclusive in the chemical or services industries. In the equipment manufacturing or the raw material transformation industries, 73.3 percent and 50 percent of the agreements respectively implement non-exclusive licenses. Exclusive licenses are also more frequent in intra-industrial relations (44.2 percent against 31.8 percent in inter-industrial contracts).

The reasons for these differences be they the legal environment, the organization of the industry, local or sectoral customs, or other factors, is precisely the scope of this research. There are many reasons for the apparent contrasts between countries. For instance in our sample more than 83 percent of the Japanese contracts are international agreements, while 70.5 percent of North American contracts are implemented between North American companies. This is due to the bias in our sample between the large number of large Japanese international companies and the high proportion of small domestic firms in the U.S. sample. It is for this reason that we gathered as much data as we could to understand what influences TLAs beyond the nationality and the industry of the contractors. Indeed, many factors can influence interfirm relationships such as the "relational context." In our sample, firms had contractual relationships before signing the considered licensing agreement, in 26.8 percent of the cases. In one case out of five, they also had an equity relationship. This enabled us to test how long-term relationships and tying of mutual interests influence the ability to transfer technology.

1.2. The Project: Understanding TLAs and the condition of the emergence of markets for technologies

Technology licensing is a powerful tool for companies seeking to recover the benefits of their innovation strategies. It gives them the opportunity to leverage quickly and at a low cost their market size. For that reason, licensing can be considered as an efficient strategic tool for fast-changing and technology intensive businesses (Oxley and Sampson, 2004) and more generally, for innovators. Innovators, however, should manage licensing cautiously because it can expose valuable knowledge to the risk of appropriation by partners (Jorde and Teece, 1990; Oxley, 1999).

As pointed out by Caves et al (1983), and later by Bessy and Brousseau (1998), Anand and Khanna (2000), Arora and Fosfuri (2002), the transfer of knowledge among firms is complex to perform and subject to many hazards. The licensor has little or no ex-post control over how the intangible assets transferred to the licensee are used, while the latter can use what it learned to compete against its former partner. In this context, it is essential to understand how firms can build efficient contracts to deal with transactional hazards. It is also important to understand how institutions can be designed to decrease the cost of trading intangible goods to allow the emergence of "markets for technologies" enabling them to maximize use and diffusion of innovation (Arora et al, 2001).

In a set of earlier papers based on case studies and econometrics on a sample of TLAs, Bessy and Brousseau (1998) and Bessy, Brousseau and Saussier (2002, 2003) suggested that the shape of contracts (duration, complexity or payment schemes, safeguards, etc.) is strongly influenced by both the institutional environment and the features of the transactions. In the case of technology transfers, the institutional framework matters a great deal, since the "strength" and the "completeness" of Intellectual Property Rights (IPRs) vary widely across countries and industries (Anand and Khanna, 2000). In addition, transactions of knowledge can be quite diverse since knowledge may be embodied in very heterogeneous forms (e.g. tangible devices, soft-

2. The database is principally composed of American chemical firms (22 percent of the sample), Japanese equipment firms (11.3 percent) and European service firms (9.4 percent). In our survey the responding American firms have the smallest average size (measured by the number of employees), especially when compared to the Japanese firms, which often employ more than 10,000 persons. Being smaller and operating in a larger domestic market, the American firms are less internationalized than the Japanese and European ones (on the basis of their exportations). The firms that export the most are the European firms, which can be explained by the fragmentation of the European market.

ware, organizational design, the human brain, documents, etc.).

Transferring knowledge might be complex and risky. Indeed, the wording of a patent is insufficient to implement a technology. This is due to three main factors. First, knowledge is impossible to fully codify and codified knowledge requires many additional resources to be turned into actions (e.g. tacit knowledge mastered by individuals, organizational routines, equipments, etc.) Second, the information specified in a patent is complementary to other resources (e.g. know-how, technical tests, commercial methods, etc.) necessary to allow a firm to implement a technology in its own operations. Third, to control the leakage of their intangible capital, patent claimants are led to disclose as little knowledge as possible when filing for a patent. All these, result in the necessity for an innovator to teach its technology and to provide many services and resources to a potential licensee and which requires licensees to make significant efforts to absorb the technology. Transferring technology, even when it has theoretically been "codified" in a patent, is therefore costly.

At the same time, transfers of knowledge are sources of risk. The transfer of technology to a third part per se enhances the ability of competitors, either because direct competitors get access to the technology and the underlying knowledge, or because the transfer of technology increases the risk of knowledge leakage benefiting direct or potential competitors. This is true even if IPRs theoretically prevent third parties from using a patented technology. Indeed, IPRs do not protect against the use of all the dimensions of the useful knowledge (i.e. the complementary knowledge mentioned previously). More generally, the revelation of knowledge favors the ability of competitors to invent around the protected innovation.

In addition, pricing the transferred knowledge is complex. There are two reasons for this. First, it might be hard for both parties to agree on a price, as it is difficult for the licensee to determine the actual value of the technology before having implemented and experienced it. Before the deal the licensee has only incomplete information about the exact knowledge that will be transferred—a phenomenon known as the Arrow paradox—and is therefore unable to anticipate all the costs and benefits of its implementation. Second, the success of the transfer depends upon the efforts made by both parties.

The licensee is therefore prone to underestimate the value of the technology and to refuse to pay it through a lump sum payment. However, royalties are not the best solution from the licensor's point of view. First, it delays the recovering of the innovation and transfer investments made in the past. Second, it raises transactional risks, since the licensor's revenues will depend upon the efforts made by the licensee to implement and exploit the technology. The licensee also has an incentive to cheat on royalty payments as soon as it has learned what it wanted to learn from the licensor. The compromise about the pricing of knowledge therefore results in additional risks.

The transactional hazards resulting from the transfer of technology are not well controlled by the legal frameworks. This is partly due to imperfections in the legal environment and in the judiciary, which are not suited to highly specific and complex technological and relational problems. This is reinforced by many transactions being conducted internationally. Many discrepancies exist among legal and judicial frameworks and turn the contractual commitments into fuzzy commitments; not to mention the weak institutional frameworks in developing countries and countries in transition.

Therefore, in a context in which contracting parties can hardly fix potential problems just by implementing contractual safeguards, the transactional hazards require the implementation of "governance" mechanisms—based on self-supervision and alternative dispute resolution—to secure their transfer of knowledge and technology.

The need for governance of the exchange by the parties is also a consequence of the evolving nature of knowledge and of the competition based on innovation. Parties are often exchanging (or sharing the exploitation of) an evolving asset in a fast-changing competitive environment. They might need therefore to adapt to new circumstances and implement renegotiation and decision procedures.

All these elements lead to the idea that, generally speaking, TLAs are far from being simple agreements aimed at organizing a 'one-shot' deal between two parties. Because of the nature of knowledge and of the context in which it is generally exchanged, licensing agreements are complex and costly to settle and manage. They require from the parties, and in particular from the licensor, intensive efforts to monitor and manage the transaction. The costs and risks of transferring technology in many cases discourage innovators to really lever their IPRs portfolio through licensing, which has also a "social" cost, since it hinders the diffusion and the use of an existing innovation.

Economists seek therefore to understand more clearly what conditions are necessary to enable a market for technologies to emerge. They reason in the following way: because of the nature of knowledge, TLAs tend to be, what is identified by MacNeil (1974) as "relational" contracts; i.e. relatively complex contracts aimed at organizing the governance of a long-term cooperative process. However in some circumstances, agents are able to implement contracts, qualified as "transactional" by MacNeil, to manage the exchanges of technology. These are simple and "complete" contracts that, in this case, essentially describe the conditions to which the rights to use a patent are transferred between two economic units. Such contracts are implementable because the parties can rely on external resources to manage and secure the transfer of knowledge. When transactional contracts

are implementable, transactions over technology are less risky and less costly for the agents. They can therefore occur more frequently.

By analyzing various types of TLAs, our research aims to better understand the conditions which allow the settlement of more transactional TLAs since there is a continuum from pure transactional TLAs to pure relational TLAs. Several factors play a role:

- The nature of the transfer: parties can exchange more or less radical innovations for different purposes. Transactions over technologies range from the exchange of the right to use relatively mature and stabilized technology, to technologies that are still under development in a context where the licensee can contribute to the empowerment of the technology of the licensee.
- The relational situation between the parties. Entities that exchange technologies can be strongly opposed competitors, or potential partners (since they master complementary assets), or even members of the same company. Transactional risks and the means to fix them can therefore be very different.
- The (institutional) environment in which the transaction takes place. Various rules (like the law, but also "customs" and "practices") and organizations (the judiciary but also industry unions or professional organizations) can facilitate and secure the transfer of knowledge.

The main goal of our research is to understand how these factors make technology transfer easier and less costly, thereby facilitating the emergence of a market for technologies.

1.3. Methodology

To identify interdependencies among contractual characteristics, it is useful to build typologies of contracts on the basis of variables describing their main characteristics. As explained below, this allows both:

- to understand the logic of contractual architecture by considering contracts as consistent coordination devices based on complementarities among different provisions (licensing regimes, payment schemes, governance) and;
- to perform an analysis of the determinants of such or such type of contractual architecture.

Hierarchical Classification

To enable the analysis of a sample of individuals characterized by a wide number of variables, data analysis techniques have been developed to synthesize the information provided by large statistical tables. One of the core techniques in use is to compute the "distance" between two statistical individuals (or between two variables) by considering that each individual—in this case, the contracts—(respectively variable) is located in a space of n dimensions, 'n' being the number of variables used to characterize this individual (respectively, 'n' being the number of individuals). In measuring these "distances" it is possible to determine the proximity among individuals or variables and when two close individuals, characterized by a number of common features are observed to form clusters, characterized by features that are often associated.

In this paper we elaborate typologies of contracts by performing Ascending Hierarchical Classification (CAHQUAL procedure of the SAS Software), which measure proximity by using the Chi-square proximity on the variable that describes the main features of the contracts. Automated classification techniques allow the construction of several partitions of the sample, either in aggregated classes, or in very small classes; heterogeneity among individuals being larger in wide classes.

Econometrics

We try to go further by analyzing the causal factors that lead a contract to belong to one class or another. This is done via econometric methods that compute the likelihood of agents designing a contract that will pertain to one class or another given the type of coordination problems and the relational environment they face.

Multinomial logit econometric tests are made using the CATMOD procedure of the SAS software. The implicit ranking among classes could have led us to perform ordonated logit test, since the explained variables—the type of contracts—are implicitly ordered along an axis ranging from the more transactional to the more relational contracts. However, the imposed restrictions on the number and quality of data led us to reject the use of such a methodology here.

2. The Factors Influencing TLAs

2.1 The Complexity of Technology Transfers

As explained, technology and knowledge transfer require the exchange of many resources in addition to the right to use a license (Bessy & Brousseau, 1998). The nature of knowledge suggests that it can never be totally codified. Knowledge is indeed embodied in various formats. This diversity of formats implies that the wording of a patent does not contain all the knowledge it aims to protect and codify; and therefore does not contain all the information necessary to implement it. Licensing a technology thus requires additional transfers, in addition to the transfer of the right to use a patent. Documents such as books and manuals, confidential data such as technical test results or development data, prototypes, methods are also transferred from the licensor to the licensee. Consultant services and training can also be provided.

In our database, transferred resources are in most cases other intellectual property rights and technical services. This includes plans, drawings, technical tests, development data, technical assistance and consultant services (in 71 percent of the contracts). Marketing tests and commercial data, as well as accounting, marketing and management methods, are less often provided (in 19 percent of the respondents' contracts). Such transfers seem more frequent in services industries than in the others, even if it remains limited to 11.1 percent of the contracts. Finally, training and personnel delegations are implemented in less than one third of the agreements in the survey. Yet, they seem especially significant in the sector of raw mate-

rials transformation.

The survey shows that it is irrelevant whether the two partners belong to the same industry as far as the impact on the intensity of transfers is concerned. However personnel delegations and training are more frequent in intra-industry transactions than in inter-industry ones. The inclusion of the licensing agreement in a partnership or in a wider alliance is also linked to more intense transfers.

A way to secure technology transfers is to perform barter by mutually exchanging intangibles. The licensee has to provide the licensor with some resources such as the right to use intellectual property rights, or to transfer results from technical or commercial tests to the licensor. We first observe that these reciprocal transfers are more frequent in intra-industry agreements than in inter-industry exchanges. Second, the requirement to transfer results from technical and commercial tests to the licensor is the most frequent obligation of reciprocity, especially in the transformation of raw materials industry (nearly 40 percent of the contracts). After this comes cross licensing (27 percent), which seems to be a more prevalent practice in Japan (46.7 percent) than in North America (16.1 percent). In addition the majority of licensing in the transformation of raw materials industry are cross-licensing agreements (53.8 percent). See Table 3.

In order to synthesize the information about the transfer of resources among contracting parties, we built a typology on the basis of the resources exchanged, as described in Brousseau, Chasserant, Bessy (2005). This allowed us to map out a continuum ranging from transactions in which only the right to use a patent is transferred (54 percent), to transactions in which additional intellectual property and tangibles are transmitted to the licensee (seven percent), to transactions in which methods are transferred (10 percent), and finally to transactions in which "tacit" knowledge is provided by the licensor in addition to the other resources transferred (30 percent).

Tacit knowledge is complementary to codified knowledge. It leads us to qualify the transactions in function of the *intensity* with which resources

Table 3. Nature, Intensity and Reciprocallity of Transfers, by Industry (percent)

General characteristics of contracts	Raw Mat. Transformation	Chemicals	Equipment	Services	Other	Total
Transferred resources:						
Other IPR	67.7	70.1	61.3	55.6	68.4	64.4
Trademark	32.3	30.8	25.3	34.9	15.8	29.5
Plans	48.4	24.3	42.7	47.6	47.4	38
Prototypes	22.6	36.4	25.3	42.9	47.4	34.2
Technical tests data	41.9	53.3	42.7	42.9	31.6	45.8
Marketing tests data	22.6	17.8	14.7	17.5	15.8	17.3
Technical assistance	71	49.5	53.3	52.4	52.6	53.6
Accounting methods	9.7	4.7	5.3	11.1	5.3	6.8
Training	58.1	24.3	34.7	28.6	21.1	31.2
Personnel delegation	12.9	12.1	16	19	10.5	14.6
Other inputs	12.9	14	12	14.3	5.3	12.9
Total number of responses	***31***	***107***	***75***	***63***	***19***	***295***
Purchase of goods & services	9.7	37.9	15.3	9.5	15.8	21.5
Total number of responses	***31***	***103***	***72***	***63***	***19***	***288***
Reciprocal transfers:						
Cross-licensing	53.6	18	32.9	23.8	22.2	27
Other IPR	10.7	5	13.7	22.2	22.2	12.8
Tests results	39.3	30	23.3	27	11.1	27.3
Goods & services	3.6	18	12.3	19	0	14.2
Other	0	9.1	6.8	4.8	0	6
Total number of responses	***28***	***100***	***73***	***63***	***18***	***282***

are transferred between the parties. Intensity is low when only a right of use is transferred; it is medium when some tangibles resources and codified knowledge are transferred in addition to these rights. Transfers are qualified as intensive when tacit knowledge is transferred in addition to the other resources above.

2.2 The Complexity of the Institutional Environment

Transferring technology and managing licensing agreements is costly. Firms might sometimes rely on collective coordination resources to help them to manage coordination and therefore reduce transaction costs. These resources are of two types:

- The "public" institutional framework mostly made of the IPRs system, the contract law and the courts, which is however "incomplete" in the sense that it does not avoid parties having to employ resources to manage and secure their transactions since they do not fit their needs exactly. For instance, the IPRs system does not protect the intangible capital of the firm either fully or without cost, making it necessary for firms to use resources to protect its knowledge.
- Private institutions, often organized at the industry or technological domain levels, complete the "incompleteness" of the institutional framework by providing agents with collective resources that help them to perform and secure their transfer of technology. Private institutions[3] can be formal or informal, purpose-built or the result of decentralized interactions. In any case, they implement common rules—ranging from the definition of what fair practices mean to the de facto standardization of contractual agreements—and common enforcement mechanisms—including management of reputation and alternative dispute resolution mechanisms. Since they are enabling conditions for the development of market of technologies, we tried to improve the documentation on the role of these private institutions in licensing.

The Central role of "Private Institutions"

Our questionnaire included questions on these collective organizations. We asked respondents if a collective organization exists in their technological field and if so, to be specific about their role. In the second part of the questionnaire, devoted to the precise description of the representative licensing arrangements, questions were aimed at assessing more accurately the role played by these private institutions in the design and in the performance of the agreement.

Respondents usually answered that private institutions facilitated technology transfers by facilitating contacts and stimulating networking, especially in North America (74.2 percent). To a lesser extent, collective organizations seem to produce and to make available information about the various competitors' behaviors (30.6 percent), and to publish licensing guidelines (26.5 percent). Their role in the resolution of disputes is spontaneously considered as marginal, while the second part of the questionnaire points out that many contracts rely on alternative mechanisms provided by these private institutions to resolve disputes.

The perception of the role of the collective organizations differs across countries. More precisely, if the ranking among the provided "services" (facilitating contacts, producing information, publishing guidelines and providing dispute resolution mechanisms) remains the same, the proportion of answers varies greatly across countries. North American respondents reported the role of private institutions more often than European and Japanese firms.

The survey showed that there are also strong variations amongst industries. Noticeably, collective organizations seem to have a much weaker role in the equipment industry than in the other sectors. On the other hand, chemical firms seems

3. The economics of private institutions is developed in other papers (Brousseau & Fares (2000), Brousseau & Raynaud (2005)), and the notion has already been applied to the analysis of licensing agreements in previous papers especially in Bessy & Brousseau (1998) and Brousseau & Bessy [2005].

Table 4. The Role of Private Institutions on Licensing Practices, by Industry

Collective organizations facilitate TLA by:	Raw Material Transformation	Chemicals	Equipment	Services	Other	Total
Facilitating contacts	66.7	81.5	25	58.1	63.6	59.9
Producing information	20	46.3	22.2	19.4	27.3	26.5
Publishing guidelines	20	31.5	8.3	41.9	27.3	30.6
Providing disputes resolution mechanisms	33.3	25.9	5.6	3.2	9.1	30.6
Total number of responses	***15***	***54***	***36***	***31***	***11***	***147***

Table 5. The Role of Private Intermediaries and Institutions

Services provided by private entities	Number	%
Reference		
In matter of TLA conditions	33	11.8
Regarding financial conditions	57	20.4
Total number of responses	*279*	
Supervision	32	11.6
Total number of responses	*277*	
Dispute resolution	117	41.8
Total number of responses	*280*	

to benefit from a lot of collective resources to facilitate technology transfers [which is consistent with the historical analysis proposed by Arora, Fosfurri, Gambardella (2001)] See Table 4.

When firms were requested to state if their representative TLAs referred to "private institution" such as industry organization, the frequency with which these facilitators was quoted was higher. Indeed, in 41.8 percent of the contracts, firms relied on private entities to settle disputes, whereas only 15.6 percent of the respondents thought primarily that its field's collective organizations provide mechanisms to resolve disputes. Collective institutions also provide benchmarks, standards and more generally information facilitating contract settlement. In 20.4 percent of the cases, this concerns in particular, the financial conditions (price index, tariffs or payments formulae). In 11.8 percent of the contracts it covered technology transfer conditions (as "fair practice" guidelines). In 11.6 percent it concerned supervision since the external entity provided information concerning the parties' behaviors (assessment of actual sales or produced volumes for example). These frequencies were relatively homogeneous among countries and sectors. See Table 5.

The complex assessment of the role of public institutions

The law of reference for a licensing agreement is generally the law in the licensor's country. This is the case for 73.1 percent of the contracts from the survey. In the chemical industry, however, more agreements refer to the licensee's country than in other industries (20.4 percent). Moreover, in 11.1 percent of the contracts, the law of reference was neither the licensor's nor the licensee's countries but the law of another country, generally a neutral country like Switzerland or Sweden, or the American Law for some Japanese contracts.

The influence of the legal environment is however difficult to measure and predict. Indeed it depends, at least, both on the influence of the IPRs regime and of the influence of the contract law, that may contradict. Moreover, in each case, various components of the law can also have contrasting impacts on contracting practices. Lastly, the impact of a legal framework depends both on the wording of the law and on the quality of the implementing institutions. These elements mean that it is not easy to predict or test the impact of the legal environment "in general" on TLAs practices "in general."

An example shows that usual common wisdom is often misleading in the matter of quality of the institutional framework. In the questionnaire, respondents were asked to estimate the frequency of the occurrence of various types of conflict likely to occur in relation to IPRs according to a Lickert scale from one to five. Tables 6 and 7 present the average and the standard deviation of the answers for each type of conflict.

The most frequent type of conflicts relates to patent infringements (2.9 on the Lickert scale) in all the countries and all the industries. Patent infringements seem particularly frequent in North America (3.1) and in the chemical industry (3.1 in which there is a majority of the Canadian and the American firms). The second most frequently occurring type of conflict concerns the violation of payment obligations by the licensee. This type of conflict seems however less frequent in Japan (1.8). The violation of obligation of secrecy by the licensee seems slightly less frequent in the whole sample (2.1) and especially in Japan (1.6). It remains however, significant in the chemical industry (2.1) and in services (2.6).

It is interesting to note that the two industries in which "markets for technologies" seem to exist have a different pattern in the matter of conflictuality. Transformation of raw materials is the activity with less frequent and intensive IPRs conflicts, leading to the idea that IPRs should be well established and strong in this industry. Conversely, IPRs title deeds seem to be actually weaker in the chemical industry since firms have to face frequent conflicts. This might also be due to additional factors like the intensity of competition in the industry. In any case, it reflects the insufficiencies of the public institutional framework and the need of private institutions to secure exchanges of technology. See Table 6.

When one compares the extent of conflicts by regions, conflictuality seems to be higher in the Canada and the United States than in Europe or Japan. This tends to question the accepted idea about the strength of IPRs in North America. The principle of IPRs is well established in business and judicial practices, and the law grants patentees extended rights. However, due to the evolution of legislation and practices of the US Patent Office, many title deeds are actually weak since they can be contested (see also the more general

Table 6. IPRs related Conflicts, by Industry

More frequent type of conflict *(scale from 1 to 5)*	Raw Materials Transformation		Chemicals		Equipment		Services		Other	
Infringement	2.8	*(0.7)*	3.1	*(1)*	2.9	*(1.1)*	2.7	*(1)*	2.6	*(1.1)*
Violation of payment obligations	1.8	*(0.7)*	2.4	*(1)*	1.8	*(0.8)*	2.8	*(1.2)*	2.5	*(0.8)*
Violation of other obligations	2.0	*(0.4)*	2.2	*(0.8)*	2.0	*(0.7)*	2.3	*(1)*	2.2	*(0.7)*
Violation of secrecy	1.7	*(0.5)*	2.1	*(0.9)*	1.9	*(0.8)*	2.2	*(0.9)*	1.9	*(0.5)*
Total number of responses		***16***		***57***		***35***		***32***		***11***

Table 7. IPRs related Conflicts, by Region

More frequent type of conflict *(scale from 1 to 5)*	North America		Europe		Japan		Rest of the World		Total	
Infringement	3.1	*(1)*	2.7	*(1)*	2.8	*(1)*	2	*(1.1)*	2.9	*(1)*
Violation of payment obligations	2.6	*(1)*	2.1	*(1.1)*	1.8	*(0.8)*	2.4	*(1)*	2.3	*(1)*
Violation of other obligations	2.3	*(0.8)*	2.1	*(0.8)*	1.7	*(0.6)*	2.6	*(1.6)*	2.1	*(0.8)*
Violation of secrecy	2.3	*(0.9)*	2	*(0.8)*	1.6	*(0.6)*	2.2	*(1.2)*	2	*(0.9)*
Total number of responses		***68***		***41***		***37***		***5***		***151***

analysis of the US IPR system by Jaffe and Lerner, 2004). See Table 7.

3. Some General Characteristics of Licensing Agreements

We have already stated in section 1.1 that contrasted contractual practices occur across industries and national environments. However, differences among the contracts on the basis of their nationality or of their industry are partly due to the structure of our databases. This is why purely descriptive statistics can be misleading. Observed differences among national or industrial practices could in fact be due to many factors including the nature of the relationship, the degree of internationalization of firms, their size, etc. In the following, we will briefly describe the sample, but interpretation will be developed later in the paper when more sophisticated data analysis and econometric techniques allow us to control for the bias due to the structure of the sample.

That said, it is possible to describe briefly the structure of the surveyed licensing agreements. We established a distinction between three main components. First, the payment formula establishes how the benefits and the implementation risks of a transferred technology are spread between the licensor and the licensee. Second, the safeguards point out how ex-ante both parties attempt to protect themselves against the possible opportunistic behavior of the other party. Indeed payment schemes are imperfect and incomplete tools to monitor the exchange and provide the required incentives to both parties. On the one hand the licensee seeks guarantees in relation to the value of the technology (both ex-ante by making sure that the exclusive rights of use are strong, and ex-post by knowing whether their main competitors will or will not be granted rights of use). Moreover, they want to make sure that the licensor will actually transfer the knowledge needed to implement it. On the other hand, the licensor wants to secure retaliation means in case of opportunistic behavior by the licensee. Third, governance mechanisms need to be built to monitor the transaction ex-post. Indeed, in most cases it is impossible to write a "complete" contract able to ex-ante set rules that will solve ex-post all the possible coordination problems among the parties, and which will rely on external mechanisms—in particular the judicial system—to make them been enforced. Parties implement therefore renegotiation, supervision and conflict resolution means.

3.1 Payment Mechanisms: the trade-off between lump sum payments and royalties

The value of a transferred technology is always uncertain, in particular

because it depends on the licensee's ability to successfully implement it either in its processes or in its products. It also depends on the specificity of the licensee's market, which is hardly known by the licensor. In addition, to prevent infringement, the patentee often keeps private part of the information, necessary to implement a technology. This hidden information which is transmitted to the licensee ex-post when a deal occurs, is not known ex-ante, which makes it hard for the licensee to accurately assess the costs and the benefits he will draw from the technology. As a result, many uncertainties and information asymmetries prevent parties from easily agreeing on the value of a technological transfer. This explains why, everything being equal, licensees have a strong preference for payments based on royalties, since it allows them to limit the consequences of this uncertainty. On their side, the licensors have a strong preference for lump sum payments. Indeed, they get a quicker return on their past R&D investments, and they do not share implementation risks with the licensee. Moreover, licensees can more easily cheat on the assessment and payment of royalties than on the payment of a lump sum.

Table 8. The Payment Formula

Characteristics of contracts	Number	Percent
Financial conditions		
No financial transfers	15	5.1
Lump sum payments	34	11.6
Royalties	62	21.2
Lump sum payments + royalties	182	62.1
Total number of responses	***293***	
LUMP SUM PAYMENTS		
Date		
At the beginning	103	48.4
After attaining a milestone	35	16.4
Spread over the duration	51	23.9
Composite	24	11.3
Total number of responses	***213***	***100***
Determinant		
Expected sales of the licensee	58	27.5
Licensor development costs	42	19.9
Market value of the technology	119	56.4
Other	10	4.7
Total number of responses	***211***	
ROYALTIES		
Basis of payments		
Sold volumes	37	15.2
Sales incorporating the licensed technology	178	73.3
Total sales	26	10.7
Costs incurred by the licensor	1	0.4
Total number of responses	***243***	
Factor determining the rate		
Market value of the technology	142	58.4
Standard rate	78	32.1
Licensee's ability to pay	21	8.6
Other	12	4.9
Total number of responses	***243***	

Descriptive Statistics

In our survey, 62.1 percent of the contracts specify both lump sum and royalty payments, especially in Europe. If only one of the two payment modes is applied, royalties are more frequent (21.2 percent of the contracts) than lump-sum payments alone (11.6 percent). These figures point out that economic agents have a strong preference for the mixed formula that allows them to balance the disadvantages of both royalties and lump sum. Mixed payments schemes have also the advantage of being a compromise between the first rank preferences of the two parties. The implementation of payment schemes based either on pure royalties or on pure lump sums is therefore a residual choice, when it is impossible to implement mixed payments. Pure royalties can be implemented in three cases: when the value of the technology is too uncertain; or when the licensee is in weak financial health, or when the institutional environment is secure enough to guarantee the licensor that the licensee will not easily cheat ex-post. Pure lump sum should be utilized particularly when there is no uncertainty over the value of the technology and when the institutional environment is very insecure. In only 5.1 percent of the cases, there is no financial transfer between partners. This is often linked to cross-licensing. See Table 8.

A typology based on payment schemes

We performed a typology based on all our variables describing the contracts; i.e. the payment mechanism, the licensing regime, the guarantee and governance provisions, and the recourse to "private bodies." As a result, we got a typology that depends upon the payment formulae. This points out that payment formulae are a strong characteristic contrasting licensing agreements, and therefore characterizing them.

- A first class is made up of the 15 contracts that do not implement payments;
- A second class is made up of 31 contracts that implement only lump-sum payments (while they are 12 percent in the whole sample);
- The third class is made up of contracts that implement a two-part tariff (lump sum plus royalties) in 67 percent of the cases and;
- A fourth class is made up of contracts, 75 percent of which implement only royalties.

Many variables influence the choice of payment formulae, and this study did not focus on the explanation of this choice. We thus did not run in depth analysis of the choice of payment mechanism.

Bessy, Brousseau, Saussier (2002) performed such an analysis on a different sample. They showed that the remuneration regime is sensitive to the nature of the transferred resources: transferring codified knowledge increases the recourse to royalties, while logically transmitting tacit knowledge raises the probability of implementing lump sump payments. In addition, the size of the licensee—a proxy of its bargaining power—matters as well. The larger the licensee, the higher the probability to implement variable payments. The payment scheme is also sensitive to the relational situations between the parties. When they belong to the same group or when they have several contractual relationships, the propensity to implement royalties increases. It decreases when reciprocity or geographical restrictions are implemented. Generally speaking, the use of royalties is acceptable for the licensor when it can control transactional hazards because the transfer is not potentially harmful, the relational context is secure, or because the institutional environment protects his transfer.

3.2 Safeguards

As compared to many alternative contracting practices, licensing is inherently risky. Indeed, it is always complex to control, once a transfer of technology, know-how and knowledge was made. How the licensee will behave ex-post, either within the frame of the contractual relationship (cheating about payments, insufficient protection of secret, etc.) or out of it (e.g. when the licensee uses what they learned to harm the licensor's competitive position either by inventing around or by bypassing its technology). To manage ex-post uncertainty and possible opportunistic behaviors, safeguards and governance mechanisms aim at generating the security and the adaptability necessary to the success of the licensing relationships.

To secure the agreement, the licensor and the licensee can implement safeguards, which rigidify the relationship by specifying precisely what is authorized or what is not, without any possible renegotiation. These safeguards can take the form of a restriction bounding the possible uses of the transferred knowledge, grant back provisions, confidentiality or minimal performances provisions.

We built a simple indicator of the presence of safeguards in contracts (using a cumulative scale). It allowed us to point out that safeguards are correlated with the industry of the licensor (especially in chemical and in the equipment industries) and its country (especially North America and Japan). The intensity of safeguards is not, however, linked to the intensity of the resources exchanged. This suggests that the implementation of safeguards is linked to the ability to implement them, which depends upon the institutional environment, rather than to their necessity (contractual risks being correlated to the nature of the relationships between the partners). See Table 9.

In order to limit competition among and with licensees, and to a lesser extent to reduce the risks of knowledge leakages, the licensor may prohibit the use of the transferred technology in certain domains and circumstances. In our survey, more than 60 percent of the licensing agreements are subject to such restrictions on uses. In the majority of situations, the agreement placed restrictions on the commercial scope of the license (35.2 percent of the contracts), especially in the chemical industry (40.9 percent), services (40 percent) and in the R&D activities (the "other" sector, 47.4 percent). Restrictions of use are less frequent

Table 9. Safeguards, by Industry (by percent of the various sub-populations)

Characteristics of the contracts	Raw Material Transformation	Chemicals	Equipment	Services	Other	Total
Specific uses restrictions						
No restriction	48.3	34.3	49.3	38.1	26.3	39.8
In some application uses	20.7	46.1	23.9	33.3	47.4	35.2
For specific marketing channels	24.1	5.9	4.2	7.9	10.5	8.1
Both	3.4	11.8	11.3	20.6	0	12
Other	3.4	2	11.3	0	15.8	4.9
Total	100	100	100	100	100	100
Total number of responses	***29***	***102***	***71***	***63***	***19***	***284***
Sub-licensing						
Right to assign the license	12.5	29.5	6.8	14.8	0	16.8
The licensor gets a right of veto	28.1	16.2	32.4	24.6	31.6	24.4
Right to sell the license	3.1	14.3	6.8	9.8	0	9.3
The licensor gets a right of veto	15.6	5.7	6.8	14.8	0	8.6
Right to sub-license	21.9	44.8	21.6	42.6	42.1	35.7
The licensor gets a right of veto	43.8	18.1	16.2	19.7	31.6	21.6
Right to sub-contract the production	54.8	48.6	50	55.7	47.4	50.9
The licensor gets a right of veto	25.8	8.6	17.6	18	21.1	15.5
Total number of responses	***32***	***105***	***74***	***61***	***19***	***291***
Grantback provision	62.5	51	61.6	43.9	31.6	52.3
Free rights	53.1	43.3	42.5	24.6	21.1	38.9
Subject to additional payments	9.4	7.7	19.2	19.3	10.5	13.3
Total number of responses	***32***	***104***	***73***	***57***	***19***	***285***
License on future improvements	71.9	59.2	64.8	65.5	29.4	61.6
Free rights	34.4	33	47.9	19	17.6	33.1
Optional rights	37.5	26.2	16.9	46.6	11.8	28.5
Total number of responses	***32***	***103***	***71***	***58***	***17***	***281***
Liability						
No provision	87.5	61.8	81.4	83.9	100	76.8
Shared liability	12.5	38.2	18.6	16.1	0	23.2
Total	100	100	100	100	100	100
Total number of responses	***32***	***102***	***70***	***62***	***19***	***285***
Most favored licensee provision						
Provision	28.1	17.5	27.4	16.9	0	19.9
With regard to royalty rate	21.9	8.7	17.8	11.9	0	12.6
To geographical extension of the license	0	3.9	5.5	3.4	0	3.5
Both	0	1	4.1	0	0	1.4
Other	6.3	3.9	0	1.7	0	2.4
Total number of responses	***32***	***103***	***73***	***59***	***19***	***286***
Minimal performances						
No provision	54.8	46.7	64.8	31.7	33.3	48.1
Provision of a minimum level of effort	12.9	18.1	14.1	15	11.1	15.4
Minimum of royalties	19.4	21	18.3	35	27.8	23.5
Minimum level of sales	9.7	13.3	2.8	13.3	16.7	10.5
Both	3.2	1	0	5	11.1	2.5
Total	100	100	100	100	100	100
Total number of responses	***31***	***105***	***71***	***60***	***18***	***285***

Table 9. con't. Safeguards, by Industry (by percent of the various sub-populations)

Characteristics of the contracts	Raw Material Transformation	Chemicals	Equipment	Services	Other	Total
Licensor commitments						
Warranty of ownership	53.1	57.7	55.4	50.8	31.6	53.4
Partial	6.3	12.5	12.2	15.9	5.3	12
Warranty of non infringement	18.8	27.9	0	25.4	10.5	22.6
Partial	15.6	24	20.3	19	10.5	20.2
Maintain the licensed patents	25	53.8	39.2	44.4	36.8	43.8
Partial	21.9	13.5	4.1	22.2	21.1	14.4
Immunity from suit	15.6	28.8	18.9	15.9	5.3	20.5
Partial	28.1	32.7	21.6	25.4	10.5	26.4
Total number of responses	***32***	***104***	***74***	***63***	***19***	***292***
Licensee commitments						
To report any patent infringement	56.3	71.6	61.4	75.8	63.2	67.7
Partial	6.3	13.7	2.9	6.5	5.3	8.1
Not to contest the licensor's patents	34.4	29.4	37.1	38.7	31.6	34
Partial	3.1	9.8	7.1	4.8	5.3	7
To maintain the licensed patents	6.3	24.5	17.1	16.1	31.6	19.3
Partial	6.3	13.7	5.7	24.2	10.5	13
To sue for patent infringement	9.4	16.7	5.7	9.7	10.5	11.2
Partial	12.5	26.5	14.3	35.5	35.5	23.5
Total number of responses	***32***	***102***	***70***	***62***	***19***	***285***
Right to sue for patent infringement	20	51	30.9	49.1	47.1	41.7
Total number of responses	***30***	***96***	***68***	***55***	***17***	***266***

in intra-industrial relationships (58.4 percent compared with 65 percent in inter-industrials relationships) and in more complex forms of agreement than a sole license (alliances or partnerships).

In 51 percent of the surveyed contracts, the licensor granted the right to sub-contract the production. The licensee also had the right to sub-license in 35.7 percent of the contracts and to assign the license in 16.8 percent. It was possible to sell the license in only 9.3 percent of the cases. Such provisions have a double impact: they restrain the licensor's control upon the transferred technology and at the same time widen the scope of possible leakages. The licensor in these circumstances should be reluctant to grant licensees with such provisions, except if the institutional environment is very secure, or the technology is mature

The majority of contracts in the survey specify a grant-back provision. Such a provision gives the licensor a right over any technological development by the licensee. In most cases, the licensee grants free rights of use to the licensor. Such a grant-back provision enables the licensor to benefit from the unanticipated developments of their initial innovation. It aims at dissuading the licensee to innovate around the licensed technology. We observe that its implementation is significantly correlated to the fact that the licensor and the licensee belong to the same industry (threshold of 1 percent). This confirms that these provisions are aimed at controlling competitors' behaviors. Grant-back provisions are also more frequent in partnerships and alliances (75 percent) as compared to sole licenses (46 percent). In these cases, the objective of the clause is to favor revelation between the partners so as to ensure the success of the cooperation process.

The rights of exploitation granted by the license can also apply to the future improvements made by the licensor. This is the case in 61.6 percent of the contracts. The extension of the license to future improvements made by the licensee is significantly correlated to the exchange of tacit knowledge such as training, personnel delegation and so on. Such provision is very useful and likely to be implemented when the technology is still uncertain and developing. In mature technological domains, agents have a clear vision to contract only for the technology they need.

The liability provision relates to the damages that can yield the licensed technology. Consequently, a shared responsibility can be interpreted as insurance provided by the licensor that the use of its technology would not result in losses, and therefore act as a signal of quality and implementability. In 77 percent of the contracts, the licensor is not contractually liable for the damages caused by the products manufactured or by the processes managed

by the licensee. Sharing liability is also a signal of industrial and commercial cooperation. In alliances, liability is shared between the licensor and the licensee in 54.3 percent of cases. On the contrary, 82.4 percent of the sole licenses and 87.8 percent of the contracts included in cooperative R&D projects do not implement any liability provision.

Only 19.9 percent of the contracts implement a "most favored licensee" provision. In most of the cases it concerns the royalty rate (12.6 percent). This provision ensures the licensee that it will benefit without any renegotiation from the best conditions granted by the licensor to any other licensee. For both parties, it is a way to reduce negotiation costs since it encourages them to report the burden of these costs on other contract settlement processes. We observed little disparity between countries. The transformation of raw materials industry is the one where contracts implement more often such a provision, even if it concerns less than a third of the contracts (28.1 percent).

In 52 percent of the contracts, the licensee is submitted to minimal performances. These guarantee the licensor that the licensee will effectively use the technology. In most cases, a minimum amount of royalty payment is contractually specified (23.5 percent). Disparities are strong across countries. Only 32.2 percent of the Japanese contracts submit the licensee to minimal performances, compared with 76.9 percent of the North American agreements. This is due to the intensity of technological competition, and to the fact that American licensors granted exclusive licenses most often. Differences across sectors are also significant: in the services sector, more than 70 percent of the contracts impose minimal performances on the licensee, and more than 20 percent implement a provision imposing a minimum level of effort. We also observed that when the license is included in a wider arrangement, it submits the licensee to minimal performance more often. Lastly, minimal performances are more often specified in inter-industrial contracts (65.1 percent compared with 42.7 percent of the intra-industrial contracts).

The licensor and the licensee can commit themselves to guaranteeing intellectual property rights. In our survey, the licensee generally benefits from a warranty of ownership. In 53.4 percent of the contracts, the licensor guarantees that its title deeds are not subject to conflicts and do not infringe other property rights. The licensor also often guarantees that it will continue to maintain the licensed patents in 43.8 percent of the contracts. Warranty in case of infringement and immunity in case of suits are less frequent (respectively, in 23 and 20.5 percent of the contracts). We also note that licensors need to guarantee the quality of their IPRs more often in North America than in other regions. Disparities across industries are significant. For instance, the licensor commits itself in guaranteeing that it will defend the licensee against any suit related to the license in 28.8 percent of the contracts in the chemical industry, while such provision is implemented in only 15.6 percent of the contracts in the raw materials transformation industry. These contrasts among industries and countries reflect, the uncertainty of intellectual property rights and are highly correlated to the level of conflictuality over intellectual assets (which depend upon both the actual weaknesses of the public institutional environment and upon the intensity of technological competition).

Commitments of the licensee may also be strong. Indeed, in 67.7 percent of the contracts, the licensee commits itself to guaranteeing that it will report to the licensor any patent infringement it detects, and in 34 percent of the cases, commits itself to refrain from contesting the licensor's patents. Commitments to maintain the licensed patents and to sue for patent infringement are scarce (respectively 19.3 percent and 11.2 percent of the contracts).

These various elements highlight two contrasting licensing logics. When licensing is made to simply sell a technology, parties are clearly in a transactional logic and try to settle a "complete" contract aimed at controlling ex-ante for most transactional hazards. When the licensing agreement is embedded in a "co-operative" relationship, through which parties share risks and manage joint business or research operations, contracts are inherently incomplete and parties do not seek to control ex-ante for any possible bilateral cheating.

Another factor plays a strong role in the safeguards regime: the licensing regime. Exclusive licensing—especially when it is associated with royalties payment—makes the licensor strongly dependent upon the licensee's behavior. It leads the former to impose restrictions to control as extensively as possible the resulting transactional hazards. On the other hand, in the case of exclusive licensing, the licensee's rent depends upon the strength of the licensor's intellectual title deeds. The licensor can delegate the management of these rights to the licensee.

3.3 The Governance Structure of Licensing Agreements

To ensure ex-post adaptation and enforcement of licensing agreements, the licensor and the licensee may use governance mechanisms. They are based on contractual provisions implementing supervision, renegotiation, dispute resolution mechanisms (which refer sometimes to external professional entities and norms) aimed at enabling ex-post adaptations and enforcement of mutual promises.

Here again, we built an indicator of the degree of governance—which is related to the costs of ex-post governance—by cumulating contractual governance provisions. We observed that the more intensive exchange of tacit knowledge, the more complex the governance structure. Moreover, when the licensor and the licensee belong to the same industry, licensing agreements contain more governance provisions.

43.5 percent of the contracts involve a renegotiation provision. The renegotiation provision seems to be linked to the technological uncertainty of the market. The dominant provision is the renegotiation

of the rate of royalty (in 21.8 percent of the cases), but in 18.9 percent of the cases the entire contract may also be renegotiated. Renegotiation also often concerns the geographical scope of the license or the licensed technology (in 16.8 percent of the contracts). Renegotiation is current when the license is included in a wider arrangement, especially in alliances—in which 62.9 percent of the contracts involve a renegotiation provision, mainly concerning the geographical extension of the license (31.4 percent)—as contrasted with the other types of agreement (sole license, partnership and so on). This is consistent with the idea that a cooperative agreement is long-term and requires flexibility to allow parties to optimally adapt and to play a win-win game. To that extent, alliances behave a specific way since in 28.6 percent of the cases (compared with 20 percent for all the other agreements) the renegotiation provision concerns the whole contract. The implementation of a committee to manage the relationship is highly correlated to the renegotiability of the agreement and to its cooperative character.

Only 17.9 percent of the agreements implement a formal supervision mechanism, which in most of the cases relies on a committee. A supervision mechanism is more likely to be implemented when the payment is based on royalties and the licensee is subject to specific restrictions of uses, which is consistent with the logic of such a provision. Formal supervision is more frequent when the frequency and intensity of conflicts is high. This explains why it is more frequent in U.S. contracts and in contracts between firms belonging to the same industry, and less frequent when the licensor is a R&D firm or a university.

Many agreements grant to the licensor or a third party the right to inspect the licensee's uses of the licensed technology. The implementation of such inspection rights is linked to the law of reference for the agreements. At first sight, inspection rights seem less necessary when property rights are well protected and when the judiciary is efficient in enforcing contracts. However, deeper analyses show that formal supervision is contractually implemented if and only if the institutional environment is secure enough to make such a threat credible. If it were not the case, it would be useless to supervise the partner. Inspection rights can also be allocated to the licensor, to a committee or to a third party, according to the type and the intensity of the exchanged resources. In our survey, allocation is correlated to the fact that the licensor transfers a great deal of intangibles—i.e. the right to use other intellectual property rights (such as know how, designs and so on) and marketing tests or commercial data—in addition to the right to use a patent.

The most frequently cited audit right is the licensee's books (78.9 percent of the contracts). The licensee's products and its industrial installations are submitted to inspection rights in respectively 36.8 percent and 26.3 percent of the contracts. The licensee's R&D projects are less frequently submitted to inspection rights (10.2 percent). If the ranking in implementation frequency of these various mechanisms remains the same across countries, more contracts implement inspection rights in North America than in the other countries. At the sectoral level, inspection rights on the licensee's products are noticeably less frequent in the chemical industry. Rights of inspection on industrial installations are more frequent in services and in the transformation of raw materials industry than in the other sectors (respectively 36.2 percent and 34.4 percent of the contracts).

Most contracts (65.9 percent) in our sample specify a formal mechanism of dispute resolution. In most cases, an independent arbitrator is contractually nominated (33.1 percent) or the two parties agreed to settle their conflict before a private nominee such as a Chamber of Commerce or an Industry Union (23.3 percent). Resort to a committee is scarce; it affects only 4.9 percent of the agreements.

Dispute resolution mechanisms are more often specified in North American contracts (72.7 percent) than in Japanese (63.5 percent) or European (61.8 percent) contracts. This reflects the higher frequency of conflicts cited by North American respondents at the beginning of the questionnaire. Moreover, in North America, dispute resolution relies more often on a private instance, in contrast with other countries. Dispute resolution mechanisms are more frequent in intra-industrial than in inter-industrial relationships (71.2 percent instead of 60.8 percent of the contracts). Parties mainly rely on an independent arbitrator in the first case (38.8 percent), whereas the inter-industrial contracts more often resort to a private instance (28.4 percent).

When the license is included in a wider alliance or in a cooperative R&D project, a dispute resolution mechanism is implemented in more than 80 percent of the cases; whereas this rate falls to 59.8 percent for the sole licenses. Generally it is an independent arbitrator (in more than 44 percent of the cooperative R&D contracts, while this proportion falls to 24.3 percent for the sole licenses).

In summary, we observe a strong relationship between the transfer of technology linked to cooperation among the parties and the fact that specific mechanisms to govern the transaction are implemented. To go further, we need to carry out more sophisticated analyses.

In Brousseau, Coeurderoy and Chasserant (2005), we investigated in greater detail the determinants of governance mechanisms. We showed that:

- formal supervision mechanisms are likely to be implemented only when possible—because the formal institutional environment implements well-defined IPRs that are efficiently enforced by the judicial system. This becomes a necessity when the licensor is submitted to contractual hazards, both because it has to invest significantly to transmit its knowledge and its know-how, and because it makes contracts with partners that could become competitors.

Table 10. Governance Mechanisms, by Industry (in percent of the sub-populations)

Characteristics of the contracts	Raw Mat. Transformation	Chemicals	Equipment	Services	Other	Total
Renegotiation						
Provision of renegotiation	56.3	36.6	50	40.7	42.1	43.5
For royalty rate	15.6	15.8	27	30.5	15.8	21.8
For geographical extension	21.9	11.9	14.9	22	26.3	16.8
For provided technology	18.8	13.9	17.6	22	10.5	16.8
For the entire contract	37.5	10.9	20.3	22	15.8	18.9
Total number of responses	***32***	***101***	***74***	***59***	***19***	***285***
Formal negotiation mechanism	18.8	44.6	23.6	22.8	29.4	30.8
Total number of responses	***32***	***101***	***72***	***57***	***17***	***279***
Supervision						
Formal supervision mechanism	15.6	28	9.6	11.9	18.8	17.9
Committee	15.6	28	5.5	6.8	0	14.6
Independent third party	0	0	4.1	5.1	18.8	3.2
Total number of responses	***32***	***100***	***73***	***59***	***16***	***280***
Inspection Rights						
On books	78.1	79.4	79.7	82.8	63.2	78.9
Licensor	25	33.3	44.6	43.1	31.6	37.2
Third party	37.5	39.2	27	39.7	26.3	35.1
Both	15.6	6.9	8.1	0	5.3	6.7
On products	62.5	19.6	43.2	43.1	42.1	36.8
Licensor	50	9.8	33.8	3.1	2.9	27.4
Third party	87.3	60.8	0	0	0	6.7
Both	12.7	39.2	0	0	0	2.8
On industrial installations	34.4	25.5	21.6	36.2	5.3	26.3
Licensor	31.3	18.6	16.2	25.9	5.3	20
Third party	0	2.9	1.4	10.3	0	3.5
Both	3.1	3.9	4.1	0	0	2.8
On R&D projects	6.3	11.8	6.8	13.8	10.5	10.2
Licensor	6.3	8.8	5.4	10.3	10.5	8.1
Third party	0	2	1.4	3.4	0	1.8
Both	0	1	0	0	0	0.4
Total number of responses	***32***	***102***	***74***	***58***	***19***	***285***
Dispute resolution						
Formal mechanism	77.4	78.4	59.5	42.6	78.9	65.9
A committee	6.5	8.8	0	1.6	10.5	4.9
An independent arbitrator	29	42.2	29.7	16.4	57.9	33.1
A private authority	41.9	19.6	25.7	23	5.3	23.3
A combination of these mechanisms	0	2	1	0.4	1.3	3.1
Total number of responses	***31***	***102***	***74***	***61***	***19***	***287***
Suspending mechanism	40	53	28.8	30.5	29.4	39.1
Total number of responses	***30***	***100***	***73***	***59***	***17***	***279***

• renegotiation mechanisms are likely to be implemented when uncertainty and a long-term horizon prevent the party from writing *ex-ante* a complete contract that would be efficient *ex-post*. However given the 'one-shot' aspect of the transfer from the licensor to the licensee, there are strong conditions necessary for the implementation of flexibility in the agreement. The licensee cannot be a potential direct competitor of the licensor. Private institutions have to frame the renegotiation process.

• Alternative Dispute Resolution (ADR) mechanisms are subject to strong conditions because of the irreversible and large consequences of behavioral hazards when there is a transfer of knowledge. Parties are reluctant to design an ADR mechanism if the level of conflict among them is potentially high. The existence of private institutions favors the implementation of ADR mechanisms since these private institutions are potential providers of this service and since they provide the framework for the behavior of agents. See Table 10.

4. A Typology of Licensing Practices and its Explanation

4.1 From Transactional to Relational Contracts

Our aim is to explain the governance of technological transfers among firms. We chose to establish typologies on the information that characterize the logic and the governance of the contractual arrangements we have in hand. While we agree that payments schemes are essential components of the contractual design, it is relevant to exclude this dimension from the making of the typology because we would like to focus on the governance mechanism drawn by the parties, since we consider that these mechanisms directly impact on the costs of licensing. To do so, we performed three typologies based on the data describing the guarantees and governance provisions. The first one considers the licensing regime and the recourse to "private bodies" in addition to these provisions. The second one excludes the licensing regime. The third one considers the safeguards and governance provisions only. Each is consistent and result in highlighting that there is a continuum of contractual modes from pure transactional to pure relational contracts. In this synthesis of our findings, we will focus on the second typology, which is the most enlightening. Detailed results are, however, available in Brousseau, Chasserant, Bessy (2005).

This second typology excludes the licensing regimen from the active variables, which participate in the construction of the typology. We comment on the results by ranking the contracts from those that are the more transactional and cover low intensive transfers, to those that are more relational and govern the performance of intensive transfers. Four classes are contrasted.

Transactional Transfers of Rights of Use

This class groups 91 contracts, which are characterized by a very light contractual structure. Few guarantees on the quality of IPRs are given. Further technological developments are not considered. Supervision, renegotiation and dispute settlement are not organized, meaning that the legal system is the only mechanism involved in the enforcement of these contracts which do not cover the transfer of resources in addition to the right to use a patent. In more cases than in the whole sample (while it is still minoritary), these contracts do not implement payments. These contracts govern "one-shot transfers of rights of use" which are considered here as resembling to other rights of use on intellectual property—like copyright or a trademark—in the sense that no additional transfer (of knowledge in particular) is needed; and also in the sense that the object of the transaction is considered as not evolving.

Transactional Transfers of Technology

This class groups about a third of our sample (123 contracts). As compared to the previous class, contractual commitments are more precise in the sense that they are characterized by more precise guarantees (in particular on future technological developments) and an organization of the right to sub-contract or sub-license the technology. As far as governance is concerned, renegotiation provisions (in particular on royalties) are implemented, as well as rights of audit on books of account. This is linked to the fact that most of these contracts utilize royalties as payment (either alone or combined with lump sum payments).

These contracts clearly differ from the previous category in the sense that they take into account the fact that the purpose of the exchange is technology. In that case technology is not considered as a fixed set of knowledge, but as an empowering tool (able to solve technical and commercial problems) whose content evolves with the passing of time. This is clearly why the licensee seeks to obtain guarantee on future developments and why they need flexibility (in particular in being able to sub-contract and sub-license). The goal of the licensor is to valorize its IPRs portfolio. It therefore focuses on the supervision of streams of revenues. From a strategic point of view, it should avoid being too tough with the licensee so as not to incite them to bypass its technology. This explains why it accepts to implement royalties and "most favored licensee" provisions. Both clauses make access to the technology relatively low risk for the licensee.

Such types of contracts can be implemented because they concern technologies that are well established and recognized. IPRs are therefore strong and parties can easily rely on public institutions to have their contracts enforced in the last resort. Transactions costs are low.

Relational Transfer to Favor Technological Development

These 37 contracts are characterized by a massive recourse to provisions dealing with future developments, restricting the uses and the transfer of the license, bundling the transfer of knowledge (which

Table 11. A characterization of TLAs in function of their governance mechanisms and recourse to "external" coordination devices (in percent)

Variables	Typological class (No. of contracts)	Total (297)	Clas1 (91)	Clas2 (123)	Clas3 (37)	Clas4 (46)
VARIABLES SUP						
Intellectual property						
	Right to use the brand	29.3	24.2	28.5	18.9	50.0
	Right to use other IPRs.	64.0	58.2	65.9	70.3	65.2
Transfer of resources						
	"Tacit knowledge" (at least one element)	36.7	23.1	40.7	40.5	50.0
	Codified data (at least one element)	73.1	64.8	72.4	89.2	78.3
	Inputs	12.8	7.7	12.2	18.9	19.6
Modes of payment						
	No payment	5.1	7.8	2.4	8.1	4.4
	Royalties	20.9	13.2	25.2	13.5	30.4
	Mixed	61.3	61.5	65.0	59.5	52.2
	Lump sums	11.5	16.5	4.9	18.9	13.0
Sole or exclusive license						
		54.2	49.5	53.7	64.9	56.5
Industries						
	Raw material transformation	10.8	6.5	13.0	13.5	10.9
	Chemical industry	36.0	34.1	28.5	48.7	50.0
	Machine tools and equipment	25.3	28.6	27.6	16.2	19.6
	Services	21.5	18.7	26.8	16.2	17.4
	Other	6.4	12.1	4.1	5.4	2.2
Partner's description						
	Equity relationships	22.2	18.7	26.1	35.1	8.7
	Prior licensing agreement	25.3	23.1	27.6	27.0	21.7
	Wider agreement (R&D project, partnership,…)	39.0	25.6	42.3	59.5	39.1
ACTIVE VARIABLES						
Safeguards						
	Restrictions	62.0	52.8	67.5	73.0	56.5
	Reselling of rights forbidden	57.5	60.4	46.3	67.6	73.9
	Sub-licensing forbidden	41.8	58.2	20.3	40.5	67.4
	Grant-back	54.2	16.5	75.6	75.7	54.4
	Perpetuation of the license in the case of improvement	63.6	18.7	91.1	83.8	63.0
	Most favored licensee provision	22.9	6.6	39.8	16.2	15.2
	Minimal performances	39.1	34.1	44.7	40.5	32.6
	Bundling	20.9	17.6	11.4	27.1	47.8
	Guarantee of an absence of infringement problems	22.2	4.4	17.9	12.2	73.9
	"Patent immunity"	20.2	8.8	4.1	21.6	84.8
Governance provisions						
	Renegotiation	45.8	24.2	62.6	40.5	47.8
	Supervision mechanism	16.9	5.5	3.3	91.9	15.2
	Audit of facilities and products	39.4	33.0	41.5	40.5	45.7
	Audit of books	79.8	67.0	87.8	83.8	80.4
	Professional standards	19.2	13.2	26.8	10.8	17.4
	Professional instances of litigation settlement	39.4	29.7	40.7	56.8	41.3

is intensive and includes a lot of codified knowledge, in particular technical data and tests) with other transfers. They also rely on specialized professional mechanisms to ensure supervision and conflict settlement. These are consistent with the overall logic of the agreement, which is part of a cooperative relationship in 60 percent of the cases also characterized by exclusivity (65 percent) and which concern companies with strong relational ties (equity links in 35 percent of the cases, but those links are also past agreements or present contractual relationships). We are in the case in which a key technology—often still in a phase of development—is transferred to a company able to exploit it on its own market. The latter company takes the risk of acquiring the technology and adapting it. This is why lump sump payments are more important in these contracts than in other cases. Ex-post, the companies are no longer "partners." This is a sort of one-shot transfer. However the risks of unveiling a technology which is still being developed to another company are high for the licensor. This explains why so many provisions aim at controlling ex-post the licensee's behavior and at avoiding knowledge leakages.

Relational Transfer for Market Joint-Exploitation

As compared to the previous category, this class is characterized by the richness of the contractual structure, but for different reasons. These contracts cover the transfer of key and still immature technology. The licensor wants to jointly exploit it with its licensee, which explains the reason why payments are based on royalties, but also the fact that the contract organizes the transfer of the rights to use a trademark. Clearly, the licensor wants to sign its technology. This is probably a way to secure the massive transfer of tacit knowledge, since the licensee remains dependent on the licensor's reputation (as Intel does in the PC industry). Bundling is also a way to secure these transfers, and frequently is employed in this class. In any case, the contract is clearly a long-term contract of commercial co-operation and joint exploitation of the technology. It creates mutual interdependencies. Since joint exploitation is essential, private institutions are mobilized to facilitate the management of the flow of revenues.

Since parties are engaged in a long-term de facto partnership, they are encouraged to maintain a win-win type of cooperation. Governance mechanisms are therefore less sophisticated than in the previous case, since there are fewer incentives to cheat ex-post. See Table 11.

The various classifications show robustness. We can therefore conclude that it is reasonable to point out the existence of four types of TLAs that range from highly transactional contracts to relational ones.

Transactional contracts covering technological transfers can easily be guaranteed in last resort by legal institutions because they relate to a technological domain in which knowledge is as well established as the IPRs. Licensors want to value their IPRs portfolios, but do not really need to transfer knowledge since all the participants in the market know the technology which is public and whose implementation relies on common knowledge. Two types of situations are then contrasted:

- In the first case the technology does not evolve and a spot market exchange is performed. TLAs are close to very simple sales contracts used to transact over tangible goods.
- In the second case, the licensee wants access in the long term to the solutions developed by the licensor. Contracts implement more safeguards due to the long-term relationship which is established.

Relational contracts are useful when the technology transferred is in an early stage of development. Property rights are insecure and the required knowledge to implement the technology is not widely dispersed. A lot of resources therefore have to be transferred and shared between the parties that rely on a combination of public institutions, private institutions and self-governance mechanisms to manage and secure the transfer. Again, two types of situations can be contrasted:

- When the partners operate contrasting activities in disconnected markets, the transfer is 'one-shot' and does not generate long-term relationships. The transfer generates however ex-post dependence of the licensor from the licensee's behavior. The contract therefore should focus on the implementation of safeguards and supervision mechanisms.
- When the partners are competitors or participate in complementary markets, they can settle cooperative agreements to jointly exploit a technology in their common market. On the one hand mutual interdependences and long-term relationships call for the implementation of heavy governance mechanisms. On the other hand, repeated relationships, mutual interests of cooperation, and the embeddedness of the contract in long term cooperative relationships rely on mutual adjustment rather than on formal governance mechanisms.

4.2 Explaining the Determinants of Contractual Structures

We rely here on econometrics to test the factors explaining why agents design contracts pertaining to one of the above quoted categories. In another way we try to explain why the contracts are more transactional or more relational.

We believe several factors should play a role:

- First, the nature of the transfer should have a strong influence on the contract aimed at governing it. The more intensive the transfer, the more relational the contract since it is more complex to govern the transfer and since competitive stakes are wider, requiring ad-hoc mechanisms to secure the exchange. We rely on our indicator of the intensity of exchange.
- Second, the relational environment is important since mutual knowledge and repeated relationship allow transactions to be secured and adjusted more easily, and therefore enable parties to rely on more informal governance mechanisms.

To assess the degree of importance of the relationship between the parties we rely on the two items that measured it in our questionnaire by pointing out whether an equity relationship exists between the contracting parties and whether they were previously involved in contractual relationships. Some times we aggregate these two measures by using an indicator of the "relational environment" that assess whether there is (1) or is not (0) a link among the parties.

• Third, the institutional environment matters since it states the quality of the property rights regime on which the exchanges are based. The collective coordination resources that are available through public and private institutions also influence contracts. When standard rules of coordination exist, when institutions can organize supervision or conflict settlement, agents do not need to implement complex governance structure. We establish a distinction between public and private institutions:

– Quality public institutions should favor the implementation of transactional contracts. It is however very difficult to "measure" the quality of institutions. We combined different methodologies to try to grasp the impact of public institutional frames on TLAs. In particular we contrasted contracts according to the nationality of the licensor, since the legal framework in which the licensor operates should influence their practices and since it is the legal framework of reference in many TLAs. We also used the legal typology built by La Porta et al. (1999) that contrasts five legal families: Common Law, Socialist law, French law, Scandinavian law and German law.

– Private institutions are even more difficult to "measure." However, since we asked respondents whether their contract referred to coordination resources (standards, governance devices) that are available in their technological domain, we calculated an indicator of the "strength" of private institution contract by contract, considering that the more references to these institutions, the more developed they are. This measure ranged from 0 to 4.

Detailed results are available in Brousseau, Chasserant, Bessy (2005). We present here the main conclusions from the econometric analyses.

Our results confirm:

• the positive impact of the intensity of transfers on the relationality of contracts;

• the securing influence of the relational environment, while it does not translate the same way into actual effects:

– equity relationships favor the implementation of less relational contracts when highly relational contracts should be implemented because transfers are intensive;

– previous contracting favors the implementation of Relational Transfer to favor Technological Development, which would not be implemented without this de facto securization and facilitation linked to mutual confidence and trust;

• transactional transfers of rights of use tend to be favored by the industrial environments characterizing the chemical industry and the transformation of raw material industry;

• Europe and Japan favor the implementation of highly relational contracts, which is disfavored in the U.S. and in the rest of the world. This can be interpreted as caused by the strong competitive pressure in the U.S. and the unreliablility of institutions in developing countries and transition countries which do not favor the implementation of cooperative relationships;

• we conducted additional tests to improve our assessment of the role of the institutions. To better understand the role of the public institutional environment, we separate the role of the contract law from the role of the IPRs regime. It allowed us to point out that the contract law and the IPR regime in force in civil code country plays a contrasting role (as compared with common law). Civil code applied to contract law favors transactional contracting. However, IPRs seem weaker in civil code country, which favors the setting of more relational contracts.

• private institutions have mixed influences that converge in encouraging the parties to implement contracts of the third class. i.e. relational transfer to favor technological development. When transfers are not intensive, private institutions favor, everything being equal, more cooperative relationships. While when exchanges are highly intensive, private institutions allow parties to simplify their governance structure.

We also checked how the payment scheme and the licensing regime impacts on the design of the contract. The idea here is that these contractual clauses impact on contractual hazards—especially on ex-post mutual interdependencies—and that it could affect our results. Econometrics point out that there is an impact, but it is difficult to interpret; the category of reference being the mixed payment schemes in our regressions. Everything being equal, the implementation of a pure payment scheme (based either on pure lump sum or on pure royalties) impacts positively on the relationality of the contract (except for pure royalties between class 2 and 4). It suggests that mixed payment schemes allow parties to balance contractual hazards, enabling them to simplify their governance structure.

5. Concluding Remarks

Our data highlight that transferring knowledge is never a simple operation. Due to the transactional characteristics of knowledge—an asset which is embodied in many complementary resources, whose value is difficult to assess, which is at the core of the competitive advantage of firms; while it is appropriable by competitors—Technology Licensing Agreements require, the deployment of a lot of resources to safeguard and govern transactions.

This is reinforced by the fact many transfers of technology and knowledge are not aimed at simply trading an intangible good to benefit from

revenues from the exploitation by a partner. They are aimed at jointly exploiting knowledge, which results in ex-post interdependencies among the parties, and associated hazards.

These elements explain why markets for technologies do not spontaneously emerge. First, many innovators prefer to exploit their innovation by themselves or through a limited number of cooperative relationships. Second, transfers of knowledge are difficult to make secure due to existing institutional and legal tools.

As such firms favor the sharing of their innovation within relational networks in which a dense web of long-standing relationships among members favor trust and deter opportunistic behavior. This could lead however to an under-development of the potential of many innovations. Markets for technologies can develop if, and only if, the institutional frameworks are strengthened in the following ways:

• Public institutions: both the formal institutional framework—the law and the judiciary as well as the Patent Offices practices—and the informal one—the business practices that are in force in a country—strongly impact on the ability of economic agents to settle deals at a low cost because they can rely on their IPRs title deeds and on their formal contracts to secure their transactions.

• Private institutions—both formal and informal—which are organized at the industry level are important also. They ensure collective coordination tasks that are not performed by public institutions. By doing so, they facilitate the implementation of more transactional contracts. Moreover, when transactions are inherently complex and risky (because they have strong cooperative and joint-venture features), private institutions are an enabling condition for the performance of such R&D or industrial cooperation by channeling the relationship between the parties.

The relationality of the contract seems independent of the other contractual provisions. Indeed, the licensing regime does not seem to impact significantly on the contractual design. Mixed payment schemes allow parties to balance contractual hazards, enabling them therefore to simplify their governance structure. It is therefore confirmed that the reduction of transactions costs lies primarily in the organization of a well designed institutional framework and where public and private institutions both play a role.

References

Anand, B.N., Khanna, T. (2000), "Intellectual Property Rights and Contract Structure," *Journal of Industrial Economics*, XLVIII, 103-135.

Arora, A., Fosfuri, A. (2002) "Licensing in the Chemical Industry," in: E. Brousseau and J-M. Glachant (eds.), *The Economics of Contracts: Theories and Applications*, Cambridge University Press.

Arora, A., Fosfuri, A., Gambardella, A. (2001), Markets for Technology: The Economics of Innovation and Corporate Strategy, *MIT Press*, Cambridge, MA.

Aulakh, P.S., Cavusgil, S.T. and Sarkar, M.B. (1998), "Compensation in International Licensing Agreements," *Journal of International Business Studies*, 29(2), 409-419.

Bessy, C., Brousseau, E. (1998), "Technology Licensing Contract: Features and Diversity," *International Review of Law and Economics*, 18, 451-489.

Bessy, C., Brousseau, E. (2000), "Technology Licensing Practices in France," *les Nouvelles*, 25:2, pp. 66-75, June.

Bessy C., Brousseau E. (2003), "Contrats de Licence et Innovation," in P. Mustar & H. Pénan, *Encyclopédie de l'Innovation, Paris, Economica, 2003*, p. 341-366.

Bessy C., Brousseau E., Saussier S., (2002), "Payment Schemes in Technology Licensing Agreements: a Transaction Cost Approach," Working Paper, *FORUM, University of Paris X & ATOM,* University of Paris I.

Bessy C., Brousseau E., Saussier S. (2003), Safeguards and Governance Mechanisms in Contractual Relationships: The Case of Technology Licensing Agreements, Working Paper, FORUM, University of Paris X & ATOM, University Paris Sorbonne.

Brousseau, E., Bessy, C., (2005), "Public and Private Institutions in The Governance of Intellectual Property Rights," in: B. Andersen (ed.), *Intellectual Property Rights: Innovation, Governance and the Institutional Environment*, Edward Elgar Publishers, Forthcoming.

Brousseau E., Chaserant C., Bessy C. (2005), "The Diversity of Technology Licensing Agreements and their Causes: An International Survey on Technology Licensing Practices," Report for the *LES International, Miméo,* University of Paris X, Paris, July.

Brousseau E., Coeurderoy R., (2005), "Combining Institutional and Contractual Mechanisms to Control Transactional Hazards Related to Transfers of Technology: an Empirical Analysis of Supervision Provisions in Technology Licensing Agreements," *International Journal of the Economics of Business*, 11 (3), November, pp. 425–446.

Brousseau E., Coeurderoy R., Chaserant C., (2005), "Supervision, Renegotiation, and Dispute resolution: the complementarities of contractual clauses against 'governance misalignment,' Working Paper, EconomiX, U. of Paris X, March.

Brousseau E., Fares, M. (2000), "The Incomplete Contract Theory and the New-Institutional Economics Approaches to Contracts: Substitutes or Complements?" in: C. Ménard (ed.), *Institutions, Contracts, Organizations, Perspectives from New-Institutional Economics*, Edward Elgar Pub.

Brousseau E., Raynaud E., (2005), "The Economics of Private Institutions," 8th Annual Conference of the New Institutional Economics, "*Institutions and Economic and Political Behavior*," September 30 – October 4, 2004, Tucson Arizona, U.S.A. /Revised draft 2005.

Caves, E., Crookel, H., Killing, P.J. (1983), "The Imperfect Market for Technology Licenses," *Oxford Bulletin of Economics and Statistics*, 45, 249-267.

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.

Degnan S.A., Horton C. (1997), A Survey of Licensed Royalties, *les Nouvelles*, June, pp. 91-96.

Jaffe A., Lerner J., (2004), Innovation and Its Discontents: How Our Broken Patent System is Endangering Innovation and Progress, and What To Do About It (with). Princeton: Princeton University Press.

Jorde, T.M., Teece, D.J. (1990), "Innovation and Cooperation: Implications for Competition and Antitrust," *Journal of Economic Perspectives*, 4(3), 75-96.

La Porta, R., Lopez-de-Silanes, F., Schleifer, A., Vishny, R. (1999), "The Quality of Government," *Journal of Law, Economics, and Organization*, 15(1), 222-282.

Macho-Stadler I, Martinez-Giralt X, Perez-Castrillo D. J. (1996), "The Role of Information in Licensing Contract Design," Research Policy, 25, 43-57.

Macneil, I.R. (1974), "The many futures of contracts," *Southern California Law Review*, 47, 691-816.

Oxley, J.E., (1999), "Institutional Environment and the Mechanisms of Governance: the Impact of Intellectual Property Protection on the Structure of Inter-Firm Alliances," *Journal of Economic Behavior and Organization*, 38, 283-309.

Oxley, J.E., Sampson R.C., (2004), "The Scope and Governance of International R&D Alliances," *Strategic Management Journal,* 25(8-9).

Teece, D. (1986), "Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy," *Research Policy,* 15, 285-305.