Payment Schemes in Technology Licensing Agreements: A Transaction Cost Approach [+]

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This article provides an empirical assessment of payment schemes implemented in technology licensing agreements. Using a new source of data (a French governmental database designed to observe international technology transfers) we analyze the choice of royalties vs. lump sum payments as reflecting the ex post contractual hazards that may impede the use of royalties in such agreements. Such costs evolve with the quality of the protection provided to the licensor by the institutional environment and with the nature of what is exchanged. Our empirical investigations highlight the key role played by the tastiness of the licensed knowledge and support transaction cost propositions.

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0-INTRODUCTION

There is a wide and growing interest in the structure of contracts. Over the last three decades, many theoretical developments have been made in this field. However, there have been fewer empirical analyses of observed contractual arrangements, especially when it comes to econometric studies (Masten and Saussier [2002] and Chiappori and Salanié [2003] for a survey). Such analyses have been even scarcer when it comes to the question of the way payment schemes are chosen in contracts (franchise contracting is an exception: see Lafontaine [1992]; Lafontaine and Shaw [1999]; Scott [1996]; Lafontaine and Shaw [2005]).

In this paper, we wish to analyze the way payment schemes are implemented in technology licensing agreements. Such agreements are characterized by the many contractual problems that may arise when a patentee chooses to license his technology. Licensees may take actions that have an adverse impact on the licensor's ability to get return on his R&D investments (*e.g.* poor quality control, overstepping territorial restrictions, revelation of private information, etc.). Licensees may also "invent around" and develop innovations that will limit the licensor's ability to valorize his patents (Scotchmer, 1991). Alternatively, after the agreement is signed, the licensor may withhold technical and marketing support necessary for the licensee to effectively integrate the technology into his operations, both because it is costly and risky for him (Arora, 1995). Apart from purely opportunistic behaviors, but reinforcing such potential behaviors, contractual problems may also arise because of the nature of transactions over technology (Caves and al. [1983]). First, transaction over technology and knowledge are submitted to the Arrow paradox on trade on information. Ex ante, a licensee can be reluctant to pay in advance a fix fee for a technology, which he knows very imperfectly, especially if he is risk averse and if he does not know if he will be able to implement it in his own operations. Second, knowledge is a public good the exclusion of which is very difficult while released. Ex post, when it has been transferred to the licensee, this later can refuse to pay for its use, or use it for a different purpose than the one it was traded for.

Contract theories teach us that payment scheme implemented in technology licensing agreements is one available instrument to resolve those problems by giving adequate incentives to contractual parties. Theoretical developments point out the fact that agreements with lump sum payments (*i.e.* agreements with only fixed fees) would permit the licensor to limit double marginalization problem and to recoup his investments, thus giving no role to royalty rates in such agreements (*i.e.* payment schemes with a variable part).

The theoretical literature has mainly focused on the determination of payment schemes for the licensing of a cost reducing innovation on oligopolistic markets. It typically considers a market with perfect information, no risk, and where the licensor does not compete with its licensees. The results are well established and summarized in Kamien [1992], Reinganaum [1989] and Shapiro [1985]. In this framework, auctioning is found to be the best way to rent patent. Indeed, Katz and Shapiro [1986] and Kamien and al. [1986] show that an auction increases the opportunity cost of the licensee by comparison to a fixed fee.[1] Moreover, royalty

1 However, these results depend also of the magnitude of the innovation (see Kamien, Tauman et Zamir [1992] for instance).

is found to be the worst mechanism because it increases marginal costs, preventing the full extraction of the monopolistic rent from the licensees.

However, those theoretical results are not in line with actual licensing practices, where royalties are found to be predominant and often used *with* fixed fees (Contractor [1981], Rostoker [1984], Taylor and Sylberston [1973], Bessy and Brousseau [1998]). Three lines of arguments were developed to cope with this problem.

First, some scholars relaxed the non-competition hypothesis (See for instance Katz and Shapiro [1985], Muto [1993], Marjit [1994], Wang [1998], Kamien and Tauman [2002]). The basic idea is that technology licensing enables to manipulate the marginal cost of the licensor's competitors through the rate of royalty[2]. It thus may be optimal for a technology holder to use royalties when licensing its technology instead of lump-sum fees, because the indirect gains in market share may overcome the direct loss due to depressed payments for the technology. This line of argument refers mainly to collusive strategies (MacGee [1966], Shapiro [1985]). It might however ignore some important determinants of payment schemes. As Sattin [2002] notes, it fails to explain the persistence of royalty-based licenses in intersectoral or international technology transfers.

A second way to explain the prevalent use of royalties on market for technologies is to relax the risk neutrality assumption. According to Bousquet and al. [1998] if the licensee is risk averse, the implementation of an output-based payment may be used as an insurance mechanism to protect the buyer. This hypothesis is however difficult to test because of the lack of accurate data. The existing empirical investigations take the size of firms as a proxy for risk aversion. This is problematic since firm size reflects also other factors (Osborn and Baughn [1990]). In addition, these researches led to contrasted evidences in favor of this risk aversion argument (Yaganawa and Wada [2000], Sattin [2002], Mendi [2005]).

Lastly, some authors have turned to take into account the failures characterizing market for technologies. They relaxed the perfect information hypothesis to solve the paradox.[3] Information asymmetries concern, first, the value of the transferred technique. Gallini and Wright [1990] and Beggs [1992] for instance show how a royalty payment can be used to signal the actual value of the technology to potential users. Second, Choi [2002] and Macho-Stadler [1996] point out that royalties may also be used to overcome moral hazard by the licensor. It may motivate him to transfer the valuable know-how needed by the licensee to implement the technology; this knowledge transfer being non-contractible. A testable implication of this literature is that the use of royalty provisions should be positively correlated to the taciteness of the transferred knowledge, and negatively correlated to the

2 See Eurtku and Richelle [2007] for an exception, extending Kamien and Tauman's [1986] paper by allowing the inventor to design contracts specifying the payment of a fixed fee plus a royalty. See also Sen and Tauman [2007] for an exception, analyzing the optimal use of fees and royalties as a way to give right incentive to innovate in cost-reducing innovations.

3 For Saracho [2002], the main informational problem lies inside the licensee's firm. More precisely, he shows how complex remuneration schemes for licensee's managers may increase the profitability of royalty-based licenses for the patentee. As separation of ownership and control is strongly correlated to the size of the firm, the testing of this theory faces the same limitation than the risk-based explanations. Moreover, this explanation applies only to a small number of firms, and, to the best we know, has never been underlined in the licensing managerial literature as a major concern for royalty licensing.

equity links between partners. The contributions by Macho-Stadler [1996] and Mendi [2005] that test these propositions are discussed below.

A striking point in the theoretical explanations presented above is that there is no place for the ex-post contractual hazards. The choice of payment schemes, once decided, is implemented without any ex post costs, whereas the descriptive literature on technology licensing has extensively commented on the cost of securing those agreements, which are a major reason for relying on lump-sum fees instead of royalties. As Taylor and Silberston [1973, pp 120] note: "The lump sum (or series of lump sums) is favored when (…) there is doubt about the future level of security of license payments, and is the standard arrangement with licenses granted to organizations in Communist countries or in countries where royalty remittances are severely hampered by exchange controls". Moreover, Contractor [1981, pp 35] argues: "Royalties are subject to non-performance, default, exchange-conversion, and other risks in the future, whereas lump-sum fees are paid at the agreement inception".

In this paper we adopt a transaction cost economics perspective focusing on ex post costs of enforcement linked to chosen payment schemes. We argue that *ex post* contractual hazards are particularly acute in licensing agreements and that the choice of a payment scheme will strongly depend upon the *ex post* ability of licensor to secure the transfer. Such approach leads us to a trade-off explaining observed payment schemes in technology licensing agreements. On the one hand, licensees prefer to pay royalties instead of lump sum payments because the latter oblige them to make greater efforts in measurement and assessment *ex-ante*, and induce tremendous risks (because of the uncertainty concerning the actual value of the technology and the licensee's ability to efficiently implement it in his products or processes). On the other hand, however, with the implementation of royalties based payments, the licensor's vulnerability to the licensee's opportunism increases. The licensee can *ex post* refuse to pay for the transferred technology, or more subtly he can lie about his actual intensity of use. Licensors will therefore accept to implement royalties based payment if and only if they are able e*x post* to actually exclude the licensee from the ability to use the technology, should this be required. Such ability should strongly depend on both the nature of the technology (the way it is embodied and transferred and its impact upon the ease of measurement)[4] and on the features of the institutional framework ("strength" of Intellectual Property Rights, efficiency of contract law and enforcement institutions). This leads us to develop testable hypotheses concerning the way payment schemes should be implemented in technology licensing agreements.

To assess the relevancy of our propositions, we use a unique exhaustive French database in which 61 244 international licensing contracts signed by French firms are registered. A workable database has been built for the present paper by extracting a sub-sample of 553 contracts representative of licensing practices in seven industries.

There is little research based on substantial applied studies trying to identify actual licensing practices by firms. One of the major reasons for this is the difficulty in accessing

4 According to Barzel [1989] and North [1990], setting property rights and contracts lead to measure — i. e. setting the boundaries — or the exclusive rights of use of a resource that are claimed for or transferred, and to make these right enforced by actually preventing the use

information. Most firms consider their TLAs as highly confidential. Each individual TLA provides any reader with a lot of details about the value of given technology, the complementary resources necessary to efficiently implement it, and the commitments that link industrial partners. TLA portfolios enable analysts to accurately assess the actual nature and value of the intellectual assets of a given firm. Consequently, firms are reluctant to display information about their TLAs.

To our knowledge only six studies based on statistical methodologies have been performed on payment schemes in technology licensing agreements (Aulakh et al. [1998], Degnan & Horton [1997]; Macho-Stadler and al. [1996], Yanagawa & Wada [2000], Mendi [2005], Vishwasrao [2007]). Only four provide econometric results. On the one hand, Aulakh et al. [1998] analyze the determinants of payment schemes, but on a fairly small sample (78 US contracts) and with relatively little information concerning exchanged technologies compare to our study. On the other hand, Yanagawa & Wada [2000] based their analysis on a large database. They interestingly link payment formulae to the value of the technology and to the possibility to invent around. But their paper focuses on one specific type of risk and opportunistic behavior linked to post-contractual innovation, while we give our attention to potential opportunistic behavior by the licensor and the licensee more generally. This difference may explain why Yanagawa and Wada do not consider the institutional environment as an explaining variable, and focus on the characteristic of the technological domain while we take into account both factors (even if we don't assess, as Yanagawa and Wada do, the potentiality to invent around).

Compared to those previous studies, we believe our paper to be a contribution on the subject for three main sets of reasons. First, in comparison to previous empirical studies (Anand and Khana [2000], Macho & Stadler [1996], Mendi [2005], Vishwasrao [2007]), we benefit from detailed data on the contracts characteristics, on the flow of resources that are actually exchanged between the parties, and on the context of the transaction, which allow us to disentangle between the influence of the environment and of the features of the transaction on contractual provisions. Previous papers were not able to do this and often considered the industry as a good proxy for the nature of the resources exchanged (Anand & Khanna [2000]). Since specific institutions might exist at the industry level, in the above quoted studies, sectoral dummies proxy simultaneously the features of transaction and the specificities of the institutional environment (i.e. private/self-governance institutions). Precise data as ours are needed in order to compare contractual choices made in several kinds of contracts[5]. Second, as far as we know, we provide the first empirical study using a transaction cost economics framework in order to analyze payment schemes in technology

5 Macho Stadler & al. [1996] highlighted a positive relationship between the implementation of royalties and the transmission of know-how. However, they did not base their paper on a precise description of what is transferred between the parties. According to us this may raise problems. Knowledge is indeed embodied in various formats (the human brain, documents, physical resources, etc.). Transferring knowledge requires the transmission of various resources that have very diverse properties in terms of rivalry, appropriability and ease of transmission. Taking into account the implementation of a know-how transfer provision only to assess the propensity of parties to shirk raise two problems because it could be an imperfect proxy of the transmission of tacit knowledge. According to us both the intensity of the transfer of tacit resource and the intensity of the transfer of codified resources have to be taken into account to analyze the impact of the nature of the transaction on the contract mechanism. In addition, the nature of this should be assessed through the description of the whole set of resources that are transferred between the licensor and the licensee, rather than by the implementation of a know-how provision only

licensing agreements (see Leffler and Rucker [1991]; Leffler and al. [2000] analyzing payment schemes in timber harvesting contracts). Because we are relying on the transaction cost perspective (and because we benefit from data of quality), we focus both on the management ex-pot contractual hazards and on the role of the institutional framework, which seems being particularly relevant, respectively issue and resource, impacting on the design of technology licensing agreements. We show that the tacit component of the transferred knowledge leads to the use of lump sum fees instead of royalties. These empirical results are not in line with several previous empirical studies and appear to support propositions derived from the transaction cost perspective (see the discussion below). Third, by adopting a transaction costs perspective on a class of contract on which few econometric studies related to this tradition have been performed, we provide not only another empirical test of the theory, but also a test enabling comparisons with comparable studies on other classes of transactions, contributing to a better understanding of the impact of transaction features and contexts on contractual design. For example, Lafontaine [1992] called for such a study in order to see whether the results obtained on franchise contracts apply to licensing agreements. Our conclusion is that previous results obtained by Lafontaine do not apply in the case of transfer of technology because e*x post* contractual hazards appear to be particularly acute. The licensee cannot be disciplined by imposing a termination at will clause, like it is often the case in franchise contracts (Brickley-Dark-Weisbach [1991]; Brickley [2002]). Termination is of no concern to the licensee, once he has absorbed the relevant knowledge since such transfer is non-reversible. Due to this inability to deter such opportunistic behavior, license contracts implement a once-for ever lump-sum payment rather than a royalty agreement. This point is well explained by Williamson ([1991a], page 83) and our paper is somewhat a confirmation of his prediction.

The paper is organized as follow. In a first section, we present our theoretical framework and we make hypotheses concerning payment schemes in technology licensing contracts. In section 2, we describe our sample and the type of information we have found concerning our contracts. Section 3 gives details on variables used in the empirical tests and the methodology of this study. Section 4 displays econometric tests aimed at explaining the payment formulae implemented in the contracts. Section 5 concludes.

1. PAYMENT SCHEMES IN TECHNOLOGY LICENSING AGREEMENTS : PROPOSITIONS

Following the theoretical framework provided by the transaction cost theory, we argue that the choice between lump sum and royalty payment schemes reflects efforts to economize on transaction costs. In this respect, lump sum payment gives purchasers an incentive to engage in extensive presale measurement of the exact value of the technology that is licensed, whereas royalties reduce incentives and require greater post-agreement monitoring and enforcement mechanisms, which costs are born by the seller.

11- Royalties versus lump sum contracts: the general trade-off

A transaction cost economics approach focuses on the fact that observed payment schemes in technology licensing agreements should reflect the willingness of the contracting parties to economize on ex ante and ex post transaction costs. *Ex ante* measurement costs can be socially valuable since uncertainty about the very nature and the value of the technology

could lead to ex post losses due to the costs of implementation and the risks of exploitation of the technology by the licensee. Licensors are therefore expected to develop selling practices that limit such measurement costs, since it will increase the likelihood of potential licensees to buy their technologies. Choosing between lump sum payments and royalty contracts is a way of influencing those costs.

A royalty payment avoids the deadweight loss of *ex ante* measurement but replace it by a cost of *ex post* opportunism. *Ex post* failure to pay by the licensee has no deadweight loss by itself. It is mere redistribution. However, it can cause a deadweight loss if the anticipation of the failure to pay changes the licensor's actions. *Ex ante,* the licensor is poorly incited to provide know-how to the licensee. *Ex post,* he has to dedicate resources to supervise the licensee and to retaliate in case of opportunistic behavior by the licensee. *Ex ante* and *ex post* risks of poor performance of the transaction and the costs of potential conflicts might even prevent trade to occur. This leads us to the two general following hypotheses:

Hypothesis 1. The higher the measurement costs, the more likely contracting parties will use royalty rates in technology licensing agreements.

Hypothesis 2. The higher the enforcement costs, the more probably contracting parties will use lump sum payments in technology licensing agreements.

In order to go a step further in our analysis, the transaction cost analysis helps us to identify the determinants of measurement and enforcement costs leading us to more precise and testable propositions.

12- Propositions

Transaction cost economics turns its attention predominantly to the attributes of the transactions and to the institutional framework ("shift parameter"; Williamson 1991b, Oxley 1999) as main determinants of transaction costs.

The attributes of the transaction

What are the principal dimensions with respect to which transactions differ and which potentially affect contractual hazards? The analysis of technology transfers requires considering how knowledge is embodied in various formats (the human brain, documents, physical resources, etc.). Transferring knowledge requires indeed the transmission of various resources that have very diverse properties in terms of rivalry, appropriability and ease of transmission. Transactions have to be considered in terms of the complexity of the transfer (whether the actual transfer of knowledge requires emission and absorption efforts by the parties, or is easy to perform), the reversibility of the transfer (whether the licensor can *ex post* actually exclude the licensee from the use of knowledge, if he no longer wishes to allow him to use it), and the degree of possible opportunism (whether the licensor can actually confine the licensee to the ex-ante forecasted uses of the transferred knowledge).

The level of codification of knowledge appears to be a central element and strongly varies from one technological domain to another (technological domains being often proxied by

industries, *e.g.* Anand & Khanna [2000])[6]. In those domains where knowledge is highly codified (as opposed to being tacit), IPRs are strong and technology transfers through royalty contracts are easy to secure (since courts can easily supervise the transfer of knowledge and how it is used).[7] This results in low *ex post* transaction costs. On the other hand, in those domains where knowledge is only tacit, royalty contracts are not easy to secure *ex post*, and the economy they provided on measurement costs *ex ante* may not be justified in comparison with the enforcement costs they entail. This leads us to our first proposition:

Proposition 1: The implementation of royalties in technology licensing agreements is positively linked to the codification of transferred resources.

The public and private institutions

The institutional framework contributes to the delineation (measure) and enforcement of rights of use over all kinds of economic resources (North [1990]). When it comes to the exchange of intangibles (and related level of transaction costs) it is crucial to take into account the impact of the institutional framework on the completeness and the strength of these exclusive rights or use. Despite international treaties and conventions, the actual completeness of IPRs systems differs significantly from one country to another, as does its impact upon the ability of parties to secure transfer of knowledge.

In countries where the legal system protects strongly and efficiently against IP infringement, e*x post* transaction costs are reduced. Since royalty-based licensing agreements imply rents for the licensors over the course of the agreement, it is important to these firms that their knowledge is adequately protected in the country where its licensee operates. Royalty-based compensation structures are likely to be implemented in countries with strong legal protection. In the absence of adequate legal protection, a licensor can either refuse to license his technology, or can minimize uncertainty regarding intellectual property protection by opting for a lump sum compensation to be paid upfront.

As pointed out in particular by Caves and al. (1983) and by Bessy and Brousseau (1993), in the case of technology licensing agreements, but also more generally by Arora and al. (2001), the imperfections of the Intellectual Property Rights system might lead the participant in an industry to implement private institutions and self-governance mechanisms to secure property rights and increase the likelihood to comply with commitments by providing means to share information on the behaviors of participants to an industry, by contributing to build reputation mechanism, by providing alternative dispute resolutions capabilities, etc. Thus, contractual design should also depend upon the specificities of the institutional environment at the industry level.

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6 It has to be pointed out that our data set enables us to precisely assess the intensity of the transfer of both codified and tacit knowledge for each transaction. We can therefore really observe each technological domain, while most studies relies on strong assumptions about the nature of knowledge at the industry level (in which most of the time contrasted - in terms of codifiability, commonness, etc. — technological domains co-exist).

7 Tacitness of knowledge has often been presented as a key factor explaining the internalization of technological exchanges within firms. The main rationale for integration is to cope with the opportunism of the contractual partner (Teece [1986], Osborn et Baughn [1990]).

Proposition 2*: *The use of royalties in technology licensing agreements is positively linked to the strength of institutions that secure transactions (IPRs, contractual laws, …).

To sum up, the probability of TLAs implementing royalties should (1) increase when property rights are efficiently enforced in the country of the non-French partner, and when the contract law is well designed and efficiently enforced, and when private institutions/self-regulation contribute to secure transactions at the industry level. It should (2) decrease when the transmitted knowledge tends to be tacit. These are the main propositions of the paper.

It should be noted that our propositions contrast with the predictions of the principal-agent and adverse selection models, viewing royalty rates as a useful tool in order to infuse proper incentive when tacit knowledge is concerned by TLAs (Cf. Macho Stadler & al. [1996], Choi [2001]), or in order to signal good technologies (Gallini et Wright [1990], Beggs [1992]). We argue here that theses views are correct as long as the institutional framework is supposed perfect enough to enforce the contracts based on royalty payments.

2- OHE DATABASE

21-The Sample

Firms incorporated in France, even if they are subsidiaries[8] of foreign firms are requested to fill all their international TLA at the French Patent Office. The database we are relying on is draws from this obligation transfers. It gathers 61,244 contracts (TLAs, but also copyright licensing agreements, technical assistance commitments, patent sales, etc.) signed between 1904 and 1998 (but, because of World War II, it is incomplete for the pre-war period). As a first approach we decided to focus on the contracts that were still in force over the 1994-1998 period in the sense that they generated financial transfers over that period (2,798 TLAs). Our aim is to perform extended data and econometric analyses on a representative sample of these 2,798 contracts. This is however a labor-intensive task, since the contracts have to be read and codified before any analytical processing. Indeed, while we have access to the complete and actual wording of the contracts, only a part of the information on them is computerized.

The present paper is therefore based on a sample of 553 contracts[9] that come from 7 different industries (see table 1). The 7 industries were selected because they are associated to contrasted licensing practices (both in terms of willingness to license and in terms of contractual practices).

[Table 1 ABOUT HERE]

Thanks to the contract and the administrative registration form that a French firm must fill in when registering a contract, we have extensive information on the contract, which encompass

[8] French firm means that the firm is incorporated in France. However, the firm can be a subsidiary of a foreign firm. This is the case in 27% of the French firms in our sample

9 This sample is representative of the diversity of licensing practices, since we are interested in explaining the diversity of Technology Licensing Agreements. Its structure does not reflect, therefore, the structure of the mother population of contracts since some types of contracts are more frequent than other and since TLAs are more frequent in some industries than in others.

information on the French firm, contractual provisions, and details on the exchanged resources[10].

22-Major Features of the Analyzed Sample of TLAs

In the following lines, we present some descriptive statistics about the sample. They point out that this sample is not too biased even if it relies on a relatively small set of contracts[11]. Moreover, it will enable us to remind some general characteristics of TLAs (which were previously highlighted, especially by Caves et al. [1983] and Bessy & Brousseau [1998]).

Of the 553 processed contracts, 50% are contracts in which the French partner is the licensor. The French firm is therefore the licensee in 50% of the cases. 21,5% of the contracts are agreements between firms that belong to the same group (that have at least a minority shareholding relationship). In 24,4% of the cases, the two companies had contractual relationships before the signature of the studied contracts.

As pointed out in Arora [1995] and in Bessy & Brousseau [1998], technology and knowledge transfers often require the exchange of many resources in addition to the right to use a license. Table 2 illustrates this. It has to be pointed out that the Domestic Appliances industry and Agriculture (mostly seeds) are industries in which the intensity of transfers is far below the mean. χ^2 tests confirm that the type of resources exchanged vary across industries. This is obviously linked with various degrees of knowledge codification, and more generally to the fact that knowledge is embodied in various formats in the various technical fields.

This is also because the difficulty of performing and securing the transfer of knowledge varies across industries. The bundling of knowledge to other resources (such as the right to use a trademark, or basic products or services) is a way of securing these transfers. 17,5% of the contracts implement an obligation for the licensee to buy products or services from the licensor. Bundling is frequent in the chemicals and pharmaceutical industries, but scarce in the domestic appliance industry.[12]

[Table 2 ABOUT HERE]

Another way of securing technology transfers is to perform barters by mutually exchanging intangibles (and sometimes tangibles). The licensee is in that case liable to provide the licensor with some types of resources. Reciprocity requirement exists in some of our contracts (22,8%), however, except for technical test results, they are in a minority. This is because we selected a sample of contacts implementing payment mechanisms, while by definition barter tends to exclude payment.

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[10] The size of the partner has been checked using the Kompass database.

[11] Other empirical Due to the difficulty to access contractual information and to the cost of building a data set out of written contracts in contractual samples tend to be rather small in size. For instance, Davies [1977] investigated 26 cases; Davies [1992] 204 cases; Macho-Stadler, Martinez-Giralt, and Perez-Castrillo [1996] 240 cases; Aulakh, Cavusgil, and Sarkar [1998] 110 cases; Chi and Roehl [1997] 93 cases; Bessy and Brousseau [1998] 46 cases; Brousseau, Couerderoy and Chasserant [2007] 213 cases.

12 While bounded sales in the case of TLAs are tolerated under the US antitrust regulations implemented in 1989 (Intellectual Property Antitrust Protection Act), the EU antitrust regulation has strictly forbidden it since 1995.

3- TCONOMETRIC TEST

3.1. Explained variables

In our database, 63% of our 553 licensing contracts are based on royalties only. Only 8% are based on lump sum payments only. The remaining part is characterized by a combination of lump sum and royalty payments. As pointed out in the introduction, royalties is more the rule than the exception. Several variables have been created in order to test our propositions concerning payment schemes in license contracts.

We analyze the choice of a payment scheme as a discrete choice between pure royalty payments, lump sum payments and a combination of the two. We created the variable **PR/RLS** that is a dichotomic variable equal to 1 if the contract is based on royalties only, equal to 0 if the contract is based on lump sum payments or a combination of lump sum and royalty payments. We also created variable **LS/RLS/PR** that is a variable equal to 0 if the contract implements a single lump sum payment, 1 if a two-part tariff is implemented, and 2 if only royalties are paid. This will enable us to perform ordered logit tests to take into account the fact that payment schemes are not a dichotomic choices but more likely a continuous choice in which pure royalty contracts and pure lump sum contracts are only two polar forms of a more continuous choice.

3.2. Explaining variables

3.2.1. Exchanged Resources.

As justified above, we begin by contrasting the resources exchanged depending on whether they entail the transfer of tacit or codified knowledge. In order to distinguish the tacit component of the transfer from the codified one, two separate variables are implemented.

Variable **COD** (for codified knowledge) is an indicator taking into account whether the contract covers model transfers; plans and red book transfers; development and test data; commercial and marketing data. All these resources enable an outsider to check the reality of the transfer. Transfers are verifiable, and the circulation and the use of the related knowledge can be (to a certain extent) controlled ex-post.

Variable **TACIT** (for tacit knowledge) is an indicator taking into accounts whether the contract covers consultancy services and technical assistance; training; personnel delegation; accounting, management and marketing methods.[13] [14]

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13 Such classification might appear subjective and is not immune to criticism. Several problems should be discussed here about the way to evaluate the kind of knowledge that is transferred through contracts. Firstly, we do not consider a level for each resource. For example, a contract with few know-how transfers is rated the same as a contract with a lot of know-how transfer. We do not have any intensity indicator for each item of what is considered as tacit or codified. A second problem with our measure is that the theory does not clearly state whether all resources should be regarded as equally important (*i.e.* , with a unit rating) or as independent of each other. One might have expected different weighting for each resource in the definition of tacitness, but the theory tells us nothing on this point. That is why we chose a simple operational definition of our variable (each kind of resource rated), but refinements are possible. Nevertheless, we tried several specifications for these variables, and results obtained in the next section of the paper appear to be robust to minor changes in those definitions. To

We expect the variable COD impacting positively on the likelihood to implement royalties, while increasing taciteness should lead to lump sum payments. The Pearson correlation coefficient between TACIT and COD is important and positive (51,8%). It is also significant (1/1000 level). As noted above, this result supports the necessity to include both variables TACIT and COD in our estimations.

3.2.2. Public Institutions

To assess the impact of the institutional environment, three features can be taken into account: the law of reference of the agreement, the nationality of the licensee (since the IP law that matters is the one of the country of the licensee), or the nationality of the non-French partners.

Spontaneously, the law of reference used in the contract should be the one taken into account. This is however open to discussion, since the law of reference in question is the contractual law, not the IP law. Thus, in order to grasp the extent to which the intellectual property regime impacts on the contractual arrangement, we have to deal with the nationality of the licensee. It is the patent law of this country that will apply in last resort. However, in many cases, the court of last appeal for the arrangement is a private body (such as the arbitration courts of an international chambers of commerce). In these cases, the nationality of the partner matters because the judiciary authorities of the country where the company is incorporated will be in charge in last resort of guaranteeing the enforcement of the arbitration sentence. This reasoning is also followed by Aulakh & al [1998].

We use here a composite index to measure IPR strength. Many indexes exist but they are all confronted with serious limitations. In our opinion, there are two main limitations concerning existing indexes. Firstly, scores are usually based on the laws in force at one point in time. Changes and amendments to the laws or in the performance of judicial institutions or patent offices that may have occurred during the period over which our contracts are signed are not taken into account.[15] Secondly, many indexes, although they try to evaluate the strength of IPRs, do not take into account the way they are enforced *ex post.* With those indexes we expect, however, to evaluate the presence of public institutions that should affect contract structure.

We focus our attention on the indexes that were computed by Ginarte & Park [1997]. Using five categories of the patent laws (extent of coverage; membership in international agreements; provisions for loss of protection; enforcement mechanisms; duration of

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test for reliability, we applied the Cronbach alphas for the scales with the recommended 0. 7 used roughly as a cut-off. Reliability for the TACIT construct was 0.76, and 0.50 for the COD one. The low score of the COD variable is not as challenging as it appears at first glance. Indeed, we have to keep in mind that the codified resources are often substitutable means to transfer information, whereas the tacit components are more often used in a complementary way in order to transfer knowledge.

14 Since degrees of freedom are not a problem in our data, we could have incorporated each of the factors that make up these variables in estimates in order to see whether the results are being driven by a specific component of the measures. Nevertheless, because of multicolinearity problems, such estimates did not give us any clarification about the main driving components.

15 Contracts in our sample were signed from 1969 to 1998, with more than 85% of contracts signed between 1986 and 1998. We then have to find a temporal index.

protection), they propose an index of patent rights for 110 countries for the period 1960-1990. The way IPRs are effectively enforced is not taken into account; but at a first glance, this index can be considered as a good proxy of the quality or strength institutional protection. Therefore, we built two variables with this indicator. The first one reflects the level of IPR protection in the country of the non-French partner (**GINARTREF**). The second one assesses the IPR protection in the country of the licensee, and thus the legal protection of the patent (**GINARTREP**).[16]

3.2.3. Private Institutions

As Arora [1995] points out, inter-sectoral technology transfers often lead to greater asymmetrical information with licensee less familiar with the traded technology. Moreover, some researches highlighted the role of sectoral institutions (as engineers networks) as a way to share knowledge between companies, thus reducing the information problem (*e.g.* Von Hippel [1988]). Bessy and Brousseau [1998] and Kim and Vonortas [2006] point out that in addition to facilitated transfers, the repetition of exchanges within an industry can lead to the emergence of private institutions that secure these transfers. Arora and Fosfuri [2002] illustrate such emergence of formal organizations and informal norms framing the exchanges of knowledge (and resulting in a market for technologies) in the case of the chemical industry.

We are not aware of any index computed in order to grasp private institutions at stake in technology licensing agreements. In order anyway to capture their impact we created the variable **SECT-ID** to take into account the community of knowledge between the licensee and the licensor and also to the potential existence of such private institutions facilitating and securing transfers. We also add **sector dummies.** Of course, such indicators are not precise enough and might reflect also sector differences not linked to private institutions/self-governance. For example, Anand and Khanna [2000] used sector dummies to grasp what kinds of resources are exchanged from one sector to another. Because we benefit of a precise measure of what is exchanged, we are confident that in our own econometric analysis sector dummies will reflect other differences across industries, and possibly the specificities of the institutions at stake in each sector.

3.2.4. Other control variables

Other factors might also affect payment formulae. Among subsidiaries belonging to the same company, or between a subsidiary and its mother company, the securization of exchanged property rights should play a weaker role in the design of contractual agreements.[17] Consequently, we created the variable **CAP-LINK** to take into account the existence of equity links between the licensor and the licensee. The impact of such control variable is however difficult to predict. According to our framework, the more secured environment existing among firms belonging to the same group should facilitate the implementation of

16 The test performed with the proxy of the patent nationality uses only 551 contracts, because the Ginarte and Park indexes for Comoro and for Yugoslavia are not available.

17 Moreover, within a group, bringing back profits into the country where the mother firm is based is a crucial question, and licensing royalties are a good way to perform that type of transfer.

royalties (that are also efficient means to repatriate profits from a taxation point of view). On the other hand, the IO literature and in particular Katz and Shapiro [1985], Muto [1993], Marjit [1994], Wang [1998], Kamien and Tauman [2002] already quoted in the introduction would predict that it should impact negatively on the likelihood to implement royalties since the letter payment schemes are useful to control competitors behavior but inefficient in extracting innovation rents.

When companies sign various contracts together, one can expect that they are committed in a cooperative relationship. Securization might therefore be less important and based on reputation (Banerjee-Duflo [2000] ; Corts and Singh [2004]). Consequently, we created the variable **PREVIOUS-CONTRACT** taking into account the existence of previous contracts between the parties. We expect that previous contracting will increase the willingness to implement payments based on royalties.

Reciprocity requirements (*i.e.* transfers from the licensee to the licensor) are usually used to secure exchanges according to the logic of the exchange of hostages. The transfer from the licensee to the licensor is expected to secure the transfer made by the licensor to the licensee (especially of know-how), thus reducing the need for implementing royalties that could aim at guaranteeing these transfers. Consequently, we created the variable **RECIPROCITY** to take into account the transfers from the licensee to the licensor, and we expect it having a positive impact on the implementation of lump-sum payment (and negative impact on the implementation of royalties).

We have seen before that the size of the licensee is an important matter for choosing the proper payment formulae. Many scholars explain that large companies have less capital constraints and are less risk averse (Montalvo et Yafeh [1994], Yaganawa et Wada [2000]). Large licensees could be less reluctant than small firms to pay lump sum at the beginning of a deal. On the other hand, large firms facing smaller one might benefit from stronger bargaining power. Large licensees are therefore everything equal more able than smaller one to impose to the licensor its first best solutions in terms of payment scheme which is a royalty scheme (as compared to a lump sum) because the licensees shares then the implementation and exploitation risks of the licensee. To check for these possible impacts, we created the **SIZEE** variable that grasps the size of the licensee.

The impact of the implementation of geographical restriction is also potentially complex. On the one hand, such contractual safeguards reduce the risks born by the licensor, because it confines the negative impact of the potential opportunistic behavior by a licensee. The licensor is therefore less reluctant to implement royalties. On the other hand, geographical restrictions might be implemented in specific TLAs covering the transfer of processes. In such case, the exclusive right to use a technology on a specific market can be granted to a licensee. The licensor being reluctant to share this licensee exploitation risks, he will opt for a lump sump payment, which is for instance typically the case the building of turnkey plants. To control for these potential effects, we created the variable **RESGEO** that takes into account the provision of geographical restrictions in the contract.

All variables are summarized in Table 3.

[TABLE 3 ABOUT HERE]

4- THE ECONOMETRIC RESULTS

Results are presented in tables 4 and 5. We first consider the choice to include or not royalty payments in technology licensing agreement by estimating a logit model looking at the pure lump sum payments vs. other kinds of payment including royalty rates. Results are given in table 4. Nevertheless, it is natural to consider payment schemes as more complex discrete organizational choices. That is why we also performed ordered logit estimates to analyze the pure lump sum payments choice vs. the pure royalty payments and the mix payments choices. Results are given in table 5. The two kinds of estimates lead us to the same results. We can therefore consider the ordered logit test as being relatively robust.[18]

[Tables 4 and 5 ABOUT HERE]

Our main result is that, as expected, 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. This result is robust, whatever the kind of estimates (Logit or ordered logit). It is also robust to different specifications, including or not institutional indicators (our GANARTEF and GINARTEP variables), including or not sectoral dummies, focusing or not on the sub sample of French licensors. This result goes against the more habitual explanations that focus on incentives and confirms the relevancy of a theoretical framework taking into consideration ex post transaction costs to predict payment scheme in TLAs. By the way, it raises a lot of questions concerning previous empirical tests in this area. Indeed, previous empirical literature that tests the agency propositions usually relies on unreliable proxies of the transferred resources (see the discussion of the Macho-Stadler et al. [1996] in the note 5 o, the introduction); sometimes measuring such resources by using sector dummies (Anand & Khanna [2000]) and concluding that royalty payments is a way to give incentives to the licensor to transfer tacit resources. Our results suggest that this can be misleading. Disentangling resources exchanged and differences in the environment across sectors leads to different results.

The institutional indexes provided only limited results. The Ginarte and Park indicators are never significant when it is applied to the nationality of the non-French partner. It has sometimes a weak significance when it grasps the nationality of the patent, but this impact is very sensitive to the type of estimation performed (logit or ordered logit). Therefore, our results suggest that the impact of the institutional environment is difficult to grasp because it is difficult to benefit from relevant proxies to assess the quality of the environment. It is difficult to identify relevant methods to "measure" the features of the legal frameworks, and to draw objective assessment of the institutional environment. This is obviously due to the fact that many dimensions have to be taken into account (various features of various laws, diverse characteristics of the enforcement institutions, etc.). Single-dimension indexes are

18 To the extent that the explained variable is effectively ordered. If it were not the case, one would expect a multinomial logit to be more satisfying. We checked that results do not dramatically change when using a multinomial logit instead of an ordered logit.

therefore strongly biased and probably only adapted to very specific type of studies. Brousseau and Sattin [2007] extensively discuss these problems and suggest an alternative methodology — based on databases of licensing agreements like the one relied on here — to compute relevant indexes of the "quality" or "strength" of intellectual property rights protection.

Our sectoral dummies used as crude variables to grasp private institutions (and other relevant 'environmental' characteristics) at the sectoral level appear to explain significantly the way contract are designed. This is not a surprise. Such indicators already appeared significant in previous studies. What is interesting is that the introduction of such indicators does not change the results and does not appear as crucial in the explanation of contractual choices, even if they are jointly significant.

Other results are interesting to highlight. Control variables play a role. In the case of the equity links, the transaction cost arguments seems to be confirmed. The securization of transaction favors the implementation of royalties. The same explanation seems valid for the impact of previous contracting. As expected reciprocity reduces the willingness to implement royalties, which is also consistent with our transaction cost economic reasoning. The size of the licensee matters and the risk neutrality effect seems to dominate the bargaining power one; larger licensing tending to accept more easily lump sum payments formulae. In our sample, the implementation of geographical restrictions is a proxy of deals by which a licensor is not willing to share the risk of a licensee to which exclusive rights to exploit a process are granted for a limited territory.

5- DISCUSSION

Those results are clearly in sharp contrast with the few previous existing empirical studies on the topic (Anand and Kahnna [2001]; Macho-Stadler [1986] and Mendi [2005]) and thus rise questions about their robustness. As compared to Anand and Kahnna [2001] and to Macho-Stadler [1986], we believe that our results differ essentially because our data are more precise as compared to the one they rely on, especially in the way resources exchanged are measured. We already discussed this point.

Mendi [2005] found an interesting result suggesting an alternative explanation that would be consistent with our results. He argued that contracting parties might choose payments schemes in technology licensing agreements to avoid early termination of the relationship. Following this argument, there should be a positive relationship between contract duration and the probability of the parties including variable payments. Our results, as presented in table 4 and 5 cannot corroborate or refute such story, since we did not try to test the influence of all other contractual provisions to avoid endogeneity problems. To test Mendi's insight, we however run the same tests, focusing on the whole sample and on recent contracts as he did, but using our explaining variables, once again measuring more precisely what is actually transferred in the agreements. Results are showed in table 6 and do not change our main results. Duration does not appear as one main driving factor of contractual choices. This reinforces the confidence in the robustness of our results. In the same time, it has to be pointed out that estimating the contract duration is very difficult in the case of technology licensing. Indeed most often licenses are granted for the whole duration of the patent, which

is an extremely imprecise information because licenses can be granted at different stage of the life of a patent, and since in many industries, the pace of innovation lead patented technologies to become obsolete long before the expiration of the patent, leading the TLA to become obsolete as well.

[Table 6 ABOUT HERE]

6- CONCLUSION

In this paper we use a transaction cost framework for analyzing payment schemes in TLAs. Our results suggest that payment schemes in technology-licensing agreements may be explained by the willingness of the parties to economize on contract enforcement costs, and highlight the complex impact of the tacitness of the transferred resources on the payment formulae.

The consequence is that previous results obtained in other kind of exchanges less concerned by tacit resources (for example Lafontaine [1992] in the case of franchising) do not apply because e*x post* contractual hazards appear to be particularly acute as soon as licensing agreements are concerned. More precisely, the licensee cannot be disciplined by imposing a termination at will clause, like it is often the case in franchise contracts (Brickley-Dark-Weisbach [1991]; Brickley [2002]). Termination is of no concern to the licensee, once he has acquired the relevant knowledge which transfer is often non-reversible. Accordingly, absent the ability to affect deterrence, license contracts will take the form of a one-time, lump-sum fee rather than a royalty agreement. This point is in line with transaction economics predictions (Williamson ([1991a], page 83).

While innovative, our results are to a certain extent frail. They call for further study in order to be confirmed. Firstly, we ignored potentially important interactions with and qualifications by other contract provisions that can alter their nominal meaning. It may be that a given contractual provision is likely to be implemented because another particular one is also introduced in the contracts. For instance, a licensor might be inclined to grant a payment scheme based on royalties if he could implement a complex governance structure to secure the transfer of his knowledge. Alternatively, the contract duration may impact on the willingness of the contracting parties to implement variable payments (Mendi [2005]), even if we were not able to find such evidences in our data. Such dependency between contractual provisions is rarely studied (for an exception see Brousseau and al. [2007]). However, as far as we can see, there seems to be no correlation between payment schemes and other contractual provisions. But such issues merit further studies. Secondly, we cannot be sure that our national institutional variables alone capture correctly the impact of the institutional framework. A better assessment of the impact of these public institutions is dependent upon the development of new types of indicators able to "measure" the quality and the various features of the institutional environment *at a micro level*. As pointed out above, the design of such indexes has to take into account the many features of diverse sets of rules and enforcement mechanisms. The computing of such indexes requires an extended access to a wide range of information. The complexity of these operations is reinforced when one considers private and informal institutions. Relevant indexes to "measure" the features of the institutional environment will have to be both pluri-dimensional and computed at several

"levels" (national legal systems and industry private frameworks). The task is wide-ranging and difficult (Brousseau and Sattin [2007]). However, this should lead to a better understanding of the impact of various institutional features on contractual provisions. This better understanding will be useful for the design of technological strategies and industrial policies.

7- REFERENCES

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

Arora A. [1995], Licensing Tacit Knowledge: Intellectual Property Rights and the Market of Know-How, *Economics of Innovation and New Technology*, 4, 41-59.

Arora A., Fosfuri, A. & A. Gambardella [2001] Markets for Technology and their Implication for Corporate Strategy, *Industrial and Corporate Change*, 10, 2, 419-451.

Arrow, K. [1962] Economic Welfare and the Allocations of resources for inventions, in: Nelson, R. (ed), The Rate and Direction of Incentive Activity (Princeton: Princeton University Press).

Aulakh P.S., Cavusgil S.T. & Sarkar M.B. [1998] Compensation in International Licensing Agreements, *Journal of International Business Studies*, 29, 2, 409-419.

Banerjee A. V., Duflo E. [2000], "Reputation Effects and The Limits of Contracting: A Study of The Indian Software Industry", *Quarterly Journal of Economics,* 115 (3), 989-1017.

Beggs, A.W. [1992] Licensing under Asymmetric Information, *International Journal of Industrial Organization* 10, 170-191.

Bessy C. & Brousseau E. [1998], Technology Licensing Contracts: Features and Diversity, *International Review of Law and Economics*, 18, 451-489.

Bousquet, A., Cremer, H., Ivaldi, M., Wolkowicz, M. [1998] Risk Sharing in Licensing, *International Journal of Industrial Organization* 16, 535-54.

Brousseau E., Coeurderoy R. and Chaserand C. [2007], "The Governance of Contracts: Empirical Evidences on Technology Licensing Agreements", *Journal of Institutional and Theoretical Economics*, 163, 205-235.

Brousseau, E., Sattin, J.-F., [2007], "Les Contrats pour Evaluer le Droit : Quelques Propositions Méthodologiques Fondées sur l'Analyse du Droit des Brevets et des Contrats de Licences de Technologie", *Revue Economique*, 58 :6, p.1363-1386.

Caves E., Crookel H., Killing P.J. [1983], The Imperfect Market for Technology Licenses, *Oxford Bulletin of Economics and Statistics*, 45, 249-67.

Chiappori P.A., Salanié B. [2003], "Testing Contract Theory: A Survey of Some Recent Work", in Advances in Economics and Econometrics, vol 1, M. Dewatripont, L. Hansen and S. Turnovsky eds, Cambridge University Press.

Choi, J.P., [2001] Technology Transfer with Moral Hazard, *International Journal of Industrial Organization* 19, 249-266.

Contractor, F. [1981], International Technology Licensing: Compensation Costs and Negotiation, Lexington Books: Lexington.

Corts, K. Singh, J. [2004], "The Effect of Repeated Interaction on Contract Choice: Evidence from Offshore Drilling." *Journal of Law, Economics and Organization*, 20 (1), 230-60.

Degnan S.A., Horton C. [1997], A Survey of Licensed Royalties, *Les Nouvelles*, June, 91-96

Erutku C. and Richelle Y. [2007], "Optimal Licensing Contracts and the Value of Patent", *Journal of Economics and Management Strategy*, 16, 407-436.

Gallini, N., Wright, B., [1990] Technology Transfer under Asymmetric Information, *Rand Journal of Economics* 21, 147-160.

Gibbons R. [2005], "Four Formalizable Theories of the Firm", *Journal of Economic Behavior and Organization*, 58 (2), 200-245.

Ginarte J. C. & Park W.G. [1997], Determinants of Patent Rights: A Cross-National Study, *Research Policy*, 26, 283-301.

Kamien, M.I., [1992] Patent Licensing, in: R.J. Auman and S. Hart (editors), Handbook of Game Theory (North Holland: Elsevier Science Pubishers), 331-344

Kamien, M.I., Tauman, Y., [1986] Fees Versus Roylties and the Private Value of a Patent, *Quarterly Journal of Economics*, 101, 471-491.

Kamien, M.I., Tauman, Y., Zamir, S. [1990] The value of Information in a Strategic conflict, *Games and Economic Behavior*, 2, 129-153

Kamien, M.I., Tauman, Y.[2002] Patent Licensing : the Inside Story, *The Manchester School*, 70, 7-15.

Katz M.L. & Shapiro C., [1986], How to License Intangible Property, *Quarterly Journal of Economics*, 101, 567-590.

Kim Y. and Vonortas N. S. [2006], "Technology Licensing Partners", *Journal of Economics and Business*, 58, 273-289.

Klein, P. and H. Shelanski, [1995]. Empirical Research in Transaction Cost Economics: A Survey and Assessment, *Journal of Law, Economics and Organisation* 11, 335-362.

Lafontaine, F. [1992], "Agency Theory and Franchising: Some empirical results", *Rand Journal of Economics*, 23, 81-103.

Lafontaine, F., Shaw K. [2005], "Targeting Managerial Control: Evidence from Franchising", *Rand Journal of Economics,* 36, 131-150.

Lafontaine, F., Shaw K. [1999], "The dynamics of Franchise Contracting: Evidence from Panel Data", *Journal of Political Economy,* 107, 1041-1080.

Leffler K.B., Rucker R.R. [1991], Transaction Costs and The Efficient Organization of Production: A Study of Timber Harvesting Contracts, *Journal of Political Economy*, 99, 1060-1087.

Leffler K.B., Rucker R.R., Munn I.A. [2000], Transaction Costs and The Collection of Information: Presale Measurement on Private Timber Sales, *Journal of Law, Economics and Organization*, 16, 166-188.

Levin, R., Klevorick, A. and Nelson R.R. [1987], "Appropriating the Returns from Industrial R&D," *Brookings Papers on Economic Activity*, 783-820.

MacGee, J.S., [1966] Patent exploitation: Some Economic and Legal Problems, *Journal of Law and Economics*, 9, 135-162

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

Marjit, S., [1990] On a Non-Cooperative Theory of Technology Transfer, *Economics Letters*, 33, 293-298.

Masten S.E. & Saussier S. [2002], Econometrics of Contracts: An Assessment of Developments in the Empirical Literature of Contracting, in E. Brousseau and J-M. Glachant (eds.), The Economics of Contracts: Theories and Applications, Cambridge University Press.

Mendi, P., [2005] The Structure of Payments in Technology Transfer Contracts: Evidence from Spain", *Journal of Economics and Management Strategy*, 14, 403-429.

Montalvo, J.G. and Y. Yafeh [1994] A Microeconometric Analysis of Technology Transfer, *International Journal of Industrial Organization*, 12, 227-244.

Muto, S., [1993] On Licensing Policies in Bertrand Competition, *Games and Economic Behavior*, 5, 257-267.

North D. [1990], Institutions, Institutional Change and Economic Performance, Cambridge University Press.

Osborn, R.N., Baughn, C.C., [1990] Forms of Interorganizational Governance for Multinational Alliances, *Academy of Management Journal* 33, 503-519.

Oxley, J. E. 1999. ''Institutional Environment and the Mechanisms of Governance: The Impact of Intellectual Property Protection on the Structure of Inter-firm Alliances,'' J. Econ. Behav. Organ., 38, 3, pp 283–309.

Reinganaum, J.F., [1989] The Timing of Innovation: Research, Development and Diffusion, in: R.Willig and R. Schmalansee(editors), Handbook of Industrial Organization (North Holland: Elsevier Science Pubishers), 849-908.

Rostoker, M. [1983], "A Survey on Corporate Licensing", *The Journal of Law and Technology*, 24, 59-92.

Saracho, A.I., [2002], "Patent licensing under strategic delegation", *Journal of Economics and Management Strategy*, 11, 225-251.

Scotchmer S. [1991], Standing on the Shoulders of Giants : Cumulative Research and the Patent law, *Journal of Economic Perspectives*, 5:1.

Sen D. and Tauman Y., [2007], "General Licensing Schemes for a Cost-Reducing Innovation", *Games and Economic Behaviors*, 163-186.

Saussier S [2000] Transaction Costs and Contractual Completeness», *Journal of Economic Behavior and Organization*, 42 (2), 189-206

Shapiro, K., [1985] Patent Licensing and R&D Rivalry, *American Economic Review*, 75, 25-30.

Taylor, C., Silberston, Z.A., [1973] The Economic Impact of the Patent System: A Study of the British Experience, University of Cambridge, D.A.E. monograph 23, (Cambridge: Cambridge University Press).

Teece, D.J. [1986] Profiting from Technological Innovation: Implication for Integration, Collaboration, Licensing and Public Policy, *Research Policy*, 15, 286-305.

Vishwasrao S. [2007], Royalties vs. Fees: How do Firms Pay for Foreign Technology", *International Journal of Industrial Organization*, 25, 741-759.

Von Hippel, E. [1988] The Sources of Innovation, Oxford University Press: New-York.

Wang, X.H., [1998] Fee Versus Royalty Licensing in a Cournot Duopoly Model, *Economics Letters*, 60, 55-62.

Williamson O.E. [1985], The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting, New York, Macmillan, The Free Press.

Williamson O.E. [1991a], Strategizing, Economizing, and Economic Organization, *Strategic Management Journal*, 12, 75-94

Williamson, Oliver E. [1991b]. "Comparative Economic Organization: The Analysis of Discrete Structural Alternatives," *Admin. Sci. Quart.,* 36, pp. 269-96.

Yanagawa N. & Wada T., [2000], Post-Contracting Innovations and Contingent Payment Scheme in Patent Licensing Contracts, Mimeo, University of Tokyo & Gakushuin University.

Tables

Table 1: The Sample

Industry Name	Total Number of Contracts in the Data base	%of Payments made by French Firms in 1997	% of Payments received by French Firms in 1997	Number of Contracts in the Sample	% of the sample
Mechanical Machines and Tools (05)	150	6.46	1.41	101	18.26
Automobiles and Terrestrial Transportation Material (07)	93	4.09	9.03	40	7.23
Electrical Appliances and Machines (08)	72	1.62	1.37	34	6.15
Basic Chemicals (10)	119	6.94	4.25	58	10.49
Pharmaceutical Products (12)	474	39.55	37.16	117	21.16
Domestic Appliances and Dom.Equipment.(20)	54	0.22	12.54	31	5.61
Agriculture, Fishing, Forestry (30)	298	3.03	0.94	35	16.4
Other (22 industries)	1315	38.03	33.23	77	13.92
TOTAL	2798	100.00	100.00	553	100.00

Table 2: Transfers to the Licensee performed through TLAs

(in % of 553 contracts)

Transfer to the licensee in addition to the right to use a patent	**Whole Sample.**	*05*	*07*	*08*	*10*	*12*	*20*	*30*	χ^2
User rights over other IPRs									
Trademark	**26.2**	*25.7*	*12.5*	*14.7*	*19.0*	*47.0*	*22.6*	*23.3*	37.1***
Model	**11.0**	*12.9*	*30.0*	*20.6*	*5.2*	*5.2*	*6.4*	*1.3*	36.9***
Know-how	**60.4**	*63.3*	*82.5*	*67.6*	*75.9*	*73.5*	*16.1*	*16.8*	113.1***
Codified and Embodied Knowledge									
Plans, red books	**50.5**	*61.3*	*70.0*	*58.8*	*74.1*	*52.1*	*19.3*	*5.2*	101.2***
Development and Test Data	**28.7**	*21.7*	*30.0*	*26.5*	*50.0*	*39.3*	*9.7*	*24.7*	31.3***
Commercial and Marketing Data	**11.6**	*9.9*	*20.0*	*20.5*	*10.4*	*14.3*	*6.4*	*3.9*	12.1*
Tacit Knowledge									
Consultancy Services, Technical Assistance	**40.5**	*56.4*	*55.0*	*61.8*	*56.9*	*29.9*	*22.6*	*7.8*	71.6***
Training	**28.7**	*36.6*	*50.0*	*52.9*	*53.4*	*8.5*	*6.4*	*2.6*	102.4***
Personnel Delegation	**28.2**	*36.6*	*37.5*	*47.1*	*48.2*	*8.5*	*9.7*	*3.9*	88.1***
Accounting, Management and Marketing Methods	**9.4**	*14.8*	*15.0*	*2.9*	*3.4*	*11.1*	*3.2*	*0.0*	22.0**
Other									
Prototypes, biological material	**34.4**	*23.8*	*32.5*	*29.1*	*32.6*	*35.9*	*12.9*	*80.5*	97.1***
Products and Services (Regular Input)	**28.9**	*10.9*	*15.0*	*32.3*	*20.7*	*60.0*	*16.1*	*48.0*	77.7***

***: Dependency hypothesis is accepted at the threshold of 1 P.1000; **: OF 1 P.100*; OF 5 P.100

Table 3: The Explaining Variables

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max
COD	Variable ranked between 1-4 depending on whether the contract covers model transfers; plans and red book transfers; development and test data; commercial and marketing data	553	1.02	1.02	0	4
TACIT	Variable ranked betwenn 1-4 depending on whether the contract covers consultancy services and technical assistance; training; personnel delegation; accounting, management and marketing methods	553	1.07	1.28	0	4
RECIPROCITY	Variable ranked between 1-4, depending on whether the contract covers licence transfers, data transfers, brand-name or model transfers and input transfers from the licensee to the licensor	553	.25	.52	0	4
CAP-LINK	Dichotomic variable equal to unity if the contract concerns two parties with capital links	553	.22	.41	0	1
PREV-CONTRACT	Dichotomic variable equal to unity if previous contracts between the parties exist	553	.24	.43	0	1
ID-SECTOR	Dichotomic variable equal to unity if the licensee and the licensor operate in the same sector	553	.52	.50	0	1
RESGEO	Dichotomic variable equal to unity if there is some geographical restriction in the contract	553	.13	.33	0	1
SIZEE	Dichotomic variable equal to unity if the licensee employs more than 500 workers	553	.48	.50	0	1
GINARTEF	Ginarte and Park index for the country of the non-French partner	551	3.81	.61	.33	4.86
GINARTEP	Ginarte and Park index for the country of the patent	551	3.77	.51	.33	4.86

Table 4: The Payment Formulae Explanation:

Pure Royalties vs. Payments with Lump-sum
(Royalties=1 , else = 0)

Explaining Variables	Logit (1)	Logit (2)	Logit (3)	Logit (4)	Logit (5)	Logit (6)	Logit (7)
	PR/RLS	PR/RLS	PR/RLS	PR/RLS	PR/RLS	PR/RLS	PR/RLS
TACIT	-0.316** (0.096)	-0.322*** (0.098)	-0.302** (0.097)	-0.298** (0.106)	-0.278** (0.105)	-0.336* (0.147)	-0.322* (0.147)
COD	0.327** (0.126)	0.322* (0.126)	0.335** (0.127)	0.391** (0.133)	0.398** (0.134)	0.461** (0.179)	0.480** (0.180)
RECIPROCITY	-0.391+ (0.203)	-0.366+ (0.208)	-0.420* (0.207)	-0.425* (0.217)	-0.472* (0.216)	-0.472 (0.324)	-0.520 (0.326)
CAP-LINK	2.099*** (0.336)	2.130*** (0.339)	2.108*** (0.339)	2.334*** (0.356)	2.302*** (0.355)	2.310*** (0.531)	2.301*** (0.531)
PREV-CONTRACTS	0.796** (0.255)	0.825** (0.258)	0.814** (0.257)	0.851** (0.270)	0.834** (0.268)	0.407 (0.368)	0.409 (0.371)
SECT-ID	0.660** (0.207)	0.687** (0.210)	0.729*** (0.210)	0.683** (0.227)	0.724** (0.228)	0.524+ (0.288)	0.573* (0.291)
RESGEO	-1.908*** (0.349)	-2.014*** (0.359)	-2.020*** (0.359)	-1.975*** (0.383)	-1.978*** (0.382)	-1.728*** (0.465)	-1.770*** (0.468)
SIZEE	-0.715*** (0.200)	-0.689*** (0.201)	-0.700*** (0.201)	-0.355 (0.225)	-0.365 (0.225)	-0.455 (0.280)	-0.448 (0.281)
GINARTEF		-0.053 (0.170)		-0.068 (0.177)		0.178 (0.205)	
GINARTEP			0.287 (0.202)		0.269 (0.209)		0.389+ (0.219)
SECTORAL DUMMIES	*No*	*No*	*No*	*Yes****	*Yes****	*No*	*No*
COUNTRY DUMMIES	*No*	*No*	*No*	*No*	*No*	*No*	*No*
CONSTANT	0.111 (0.187)	0.276 (0.674)	-1.032 (0.803)	-0.326 (0.743)	-1.631+ (0.872)	-0.712 (0.825)	-1.533+ (0.887)
SAMPLE	*Whole*	*Whole*	*Whole*	*Whole*	*Whole*	*French Licensors*	*French Licensors*
Log Likelihood	-302.319	-299.460	-298.479	-286.489	-285.719	-157.297	-156,65
Pseudo R^2	0.20	0.21	0.21	0.24	0.24	0.17	0.18
Observations	553	551	551	551	551	275	275

*Robust standard errors are given in brackets. *** denotes significance at 1‰ level; **denotes significance at 1 % level; * denotes significance at 5% level; + denotes significance at 10 % level*

Table 5: The Payment Formulae Explanation:

Pure Lump Sum Payment vs. Payments with Royalties vs. Pure Royalties (LS = 0, Mix = 1, Royalties = 2)

Explaining Variables	Ordered Logit (1)	Ordered Logit (2)	Ordered Logit (3)	Ordered Logit (4)	Ordered Logit (5)	Ordered Logit (6)	Ordered Logit (7)
	PR/RLS	PR/RLS	PR/RLS	PR/RLS	PR/RLS	PR/RLS	PR/RLS
TACIT	-0.293*	-0.288*	-0.306*	-0.380**	-0.392**	-0.402*	-0.419*
	(0.118)	(0.119)	(0.120)	(0.131)	(0.132)	(0.173)	(0.174)
COD	0.303***	0.300***	0.282***	0.240*	0.222*	0.344*	0.328*
	(0.080)	(0.082)	(0.081)	(0.101)	(0.100)	(0.134)	(0.132)
RECIPROCITY	-0.413*	-0.410*	-0.465*	-0.734**	-0.787**	-0.339	-0.394
	(0.195)	(0.200)	(0.198)	(0.253)	(0.252)	(0.331)	(0.332)
CAP-LINK	2.147***	2.156***	2.143***	2.354***	2.328***	2.471***	2.455***
	(0.356)	(0.360)	(0.356)	(0.399)	(0.396)	(0.583)	(0.577)
PREV-CONTRACTS	0.776**	0.792***	0.798**	0.977***	0.972***	0.461	0.475
	(0.239)	(0.239)	(0.243)	(0.278)	(0.281)	(0.351)	(0.358)
SECT-ID	0.617**	0.653***	0.711***	0.656**	0.705**	0.499+	0.562*
	(0.192)	(0.198)	(0.198)	(0.227)	(0.227)	(0.283)	(0.285)
RESGEO	-1.956***	-2.017***	-2.038***	-1.630***	-1.654***	-2.011***	-2.047***
	(0.282)	(0.280)	(0.279)	(0.340)	(0.337)	(0.381)	(0.380)
SIZEE	-0.671***	-0.651***	-0.654***	-0.254	-0.253	-0.460+	-0.447+
	(0.187)	(0.188)	(0.188)	(0.219)	(0.219)	(0.262)	(0.265)
GINARTEF		0.032		0.004		0.213	
		(0.193)		(0.203)		(0.233)	
GINARTEP			0.380*		0.337+		0.410+
			(0.186)		(0.189)		(0.215)
SECTORAL DUMMIES	*No*	*No*	*No*	*Yes***	*Yes***	*No*	*No*
COUNTRY DUMMIES	*No*	*No*	*No*	*No*	*No*	*No*	*No*
CONSTANT	2.65***	2.52***	1.17+	2.25*	1.03	1.91+	0.85
	(0.23)	(-0.82)	(0.75)	(1.29)	(1.23)	(0.97)	(0.90)
SAMPLE	*Whole*	*Whole*	*Whole*	*Whole*	*Whole*	*French Licensors*	*French Licensors*
Log Likelihood	-416.774	-413.941	-411.800	-377.802	-376.275	-221.589	-220.060
Pseudo R^2	0.17	0.17	0.18	0.25	0.25	0.16	0.17
Observations	553	551	551	551	551	275	275

*Robust standard errors are given in brackets. *** denotes significance at 1‰ level; **denotes significance at 1 % level; * denotes significance at 5% level; + denotes significance at 10 % level*

Table 6: The Payment Formulae Explanation:

The role of contract duration

Explaining Variables	Logit (8)	Logit (9)	Logit (10)	Logit (11)
	Fixed Payment	Fixed Payment	Fixed Payment	Fixed Payment
TACIT	0.247+ (0.142)	1.074* (0.528)	0.412** (0.150)	1.299+ (0.664)
COD	-0.603*** (0.172)	-1.893** (0.640)	-0.607** (0.200)	-2.241*** (0.603)
RECIPROCITY	0.333 (0.322)	2.131+ (1.105)	-0.008 (0.377)	4.455* (2.127)
CAP-LINK	-2.492*** (0.517)	-2.095+ (1.175)	-2.980*** (0.614)	1.109 (1.934)
PREV-CONTRACTS	-0.593+ (0.343)	-1.124 (1.128)	-0.557 (0.389)	-2.913 (2.093)
SECT-ID	-0.432 (0.325)	0.772 (0.791)	-0.542 (0.353)	1.092 (0.918)
RESGEO	2.388*** (0.549)		2.209*** (0.539)	
SIZEE	-0.041 (0.294)	1.196 (1.048)	0.009 (0.330)	-0.211 (1.383)
DURATION	0.015 (0.036)	0.114 (0.107)	0.027 (0.044)	-0.157 (0.187)
SECTORAL DUMMIES	*Yes****	*No*	*Yes****	*Yes****
COUNTRY DUMMIES	*Yes****	*No*	*Yes****	*No*
CONSTANT	2.874 (1.887)	-0.662 (1.364)	2.588 (2.112)	0.748 (2.135)
SAMPLE	*Whole*	Signed after 1994	Contract duration more than 4 years	Signed after 1994 and Contract duration more than 4 years
Log Likelihood	-169.564	-23.338	-135.269	-14.683
Pseudo R^2	0.31	0.29	0.35	0.39
Observations	361	48	303	35

*Robust standard errors are given in brackets. *** denotes significance at 1‰ level; **denotes significance at 1 % level; * denotes significance at 5% level; + denotes significance at 10 % level*