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

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This article provides a theoretical framework and 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 show the choice of royalties vs. lump sum payments depends upon the quality of the protection provided to the licensor by the institutional environment. These results highlight the need to include the impact of the institutional environment in the analysis of contractual choices as a factor that greatly influences the level of ex post enforcement costs.

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0-INTRODUCTION

There is a wide and growing interest in the structuring of contracts. Over the last three decades, many theoretical developments have been made in this field. However, there have been few empirical analyses of existing contractual arrangements in the light of these theoretical developments, especially when it comes to econometric studies (Masten-Saussier [2002]; Saussier [2003]). Such analyses have been even scarcer, when it comes to the question of the way payment schemes are chosen in contracts. To our knowledge, that question has not yet been addressed in relation to technology-licensing agreements.

In this paper, we wish to somewhat bridge the gap between the theoretical and empirical literature by analyzing the way in which payment schemes are chosen in technology licensing agreements. Such agreements are particularly difficult to shape and this may explain the low willingness of firms to license their patented technologies. This propensity not to license is so strong that in many cases firms *de facto* do not claim for patents, or do not make these exclusive rights enforceable on many markets, whereas potential licensing would generate revenue, and whereas they have already borne most of the fixed costs of R&D and patent claim. Case studies and statistical analyses suggested that this is due to the low profitability and the high costs of licensing technology (Bessy-Brousseau [1998]).

Many contractual problems 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. 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. Apart from purely opportunistic behavior, but reinforcing such potential behavior, contractual problems may also arise because of the parties' risk aversion and because of uncertainty concerning the value of the technology that is licensed, and in addition because of the public good represented by technological knowledge (Caves et al. [1983]). Indeed, because licensees do not know ex-ante the value of the technology, they can be reluctant to pay in advance for it. When it is transferred, they can refuse to pay for the information that has been transferred to them.

In this perspective, payment schemes may be viewed as a way to realign the incentives of both parties in ways that minimize their ability and their motivation to behave opportunistically. That is the view of the agency theory, which gave rise to several empirical studies, especially concerning payment schemes in franchise contracts (see for example Lafontaine [1992]). The payment scheme is then analyzed in relation to both parties' incentives. On the one hand, the licensor would prefer a simple lump sum transfer, as it would permit him to recover the total value of his licensed intangibles at the outset of the agreement through a one shot transaction. On the other hand, royalties index the licensor's ability to generate revenue on the performance of his licensee, and incite the former to transfer to the latter the appropriate know-how to use the technology. It also allows the licensor to signal the value of his transfer of know-how to a potential licensee. Finally, it

protects the licensee against rapid obsolescence of the transferred know-how, since the licensor is motivated to transfer any improvement to the licensee[1].

In this paper, we choose another view in order to take into account the particular nature of technology-licensing agreements that oblige to focus on the way contractual provisions are enforced. Indeed, *ex post* contractual hazards appear to be particularly acute as soon as it is a question of licensing agreements. The choice of a payment scheme will strongly depend upon the *ex post* ability of licensor to secure the transfer. All things being equal, 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). 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 performance, or invent around it, or use the technology in domains for which he was not given authorization to do so, etc. 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. This ability strongly depends on both the nature of the technology (the way it is embodied and transferred and its impact upon the ease of measurement) and on the features of the institutional framework ("strength" of Intellectual Property Rights, efficiency of contract law and enforcement institutions). To analyze these factors, we use a unique exhaustive French database of all the international TLAs signed by French firms with foreign partners. A workable database has been built for the present paper by extracting a sub-sample of 224 contracts representative of licensing practices in seven industries.

In a first section, we develop our theoretical framework and we make assumptions concerning payment schemes in technology licensing contracts. In section 2, we describe our sample and the type of information we have found on 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. Conclusions follow.

1. PAYMENT SCHEMES IN TECHNOLOGY LICENSING AGREEMENTS: A THEORETICAL FRAMEWORK

11- Originality of our study

As pointed out in the introduction, there is very little research based on substantial applied studies trying to identify actual practices by firms. One of the major reasons for this is the difficulty in accessing information. Most firms consider their TLAs as highly confidential. Each individual

[1] However, the use of the royalty rate as an incentive tool is limited as soon as we consider the fact that the licensor has to give proper incentives to the licensee in several aspects of the transaction. In such multiple-task models it is commonly accepted that incentives must be weaker when the agent's performance on some of the activities is difficult to measure (Holmstrom-Milgrom [1991], [1994]). When there are multiple tasks, incentive pay serves not only to allocate risk and to motivate hard work. It also serves to direct the allocation of the agents' attention among their various duties. Thus, the desirability of providing incentives for any one activity decreases with the difficulty of measuring performance in any other activities that make competing demands on the agent's time and attention.

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 four studies based on statistical methodologies have been performed on payment schemes in technology licensing agreements (Aulakh et al. [1998], Degnan & Horton [1997]; Macho-Stadler et al. [1996], Yanagawa & Wada [2000]). Only two 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 because

i. We are not aware of any econometric study studying payment schemes in technology-licensing contracts with precise data concerning contract structures and the characteristics of exchanged technologies. In comparison to previous studies, we benefit from detailed data that enables us to identify the flow of resources that are actually exchanged between the parties. This enables us to discriminate more precisely between the environment of the transaction and the features of the transaction. 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]). However, since institutions exist at the industry level, they simultaneously cover the impact of the transaction features in the industry and the influence of the specific institutional environment at the industry level (private institutions). Such precise data are needed in order to compare contractual choices made in several kinds of contracts. For example, Lafontaine [1992] called for such a study in order to see whether the results she obtained on franchise contracts apply to license contracts

ii. We are not aware of any previous econometric study using a new institutional economics framework and trying to test hypotheses concerning the impact of the institutional framework on payment scheme choices. Such framework may give interesting propositions. For example, our conclusion is that previous results obtained by Lafontaine 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 that is often non-reversible. Accordingly, absent the

ability to effect deterrence, license contracts will take the form of a one-time, lump-sum fee rather than a royalty agreement: This point is well explained by Williamson ([1991], page 83) and our paper is somewhat a confirmation of his prediction.

Let us turn now to the trade-off at stake in such contracts.

12- Royalties versus lump sum contracts: the trade-off

Patents allow their owner to license innovations to other firms. A license contract is a document which names the parties included and gives the particulars of the technology transferred, duration of the license and the conditions, which implement a specific governance mechanism (supervision mechanism, renegotiations provision, etc) and design a payment scheme (Caves et al. [1983], Bessy & Brousseau [1998]). License contracts entail the payment of a license fee L, paid only once for the duration of the contract, and of royalties on sales r, where $0 \leq r \leq 1$. In some cases, license contracts involve no payments because a barter is organized among the parties. (Bessy & Brousseau [1998]). We do not consider these specific cases here.

In its most general form, the decision to choose a payment scheme (lump sum or royalty) represents a standard discrete choice problem[2]. Transactors will choose one form of contract if the expected gains (net of transaction costs) from doing so are greater than those of organizing the transaction in some other way, or formally,

$$(1) \qquad G^* = \begin{cases} G_c, & \text{if } V_c > V_a \\ G_a & \text{if } V_c \leq V_a \end{cases}$$

Where G^C represents contracting with a kind of payment structure (say lump sum payment), G^a an alternative to lump sum payment (say royalty payment), V^C and V^a the corresponding values of the transaction under a lump sum payment scheme and the alternative royalty payment scheme (V being the transactors' beliefs about the joint surplus), and G^* the governance form actually chosen.

Because the returns transactors expect from governing their transactions in different ways are difficult, if not impossible, to observe, a testable theory of payment schemes requires that the theory relate the benefits and costs of alternative governance arrangements to the observable features of the transaction. Thus, to the previous arguments we must be add relations of the form

$$(2) \qquad V^C = V^C(X, e_c)$$

And

$$(3) \qquad V^a = V^a(X, e_a)$$

where X represents a vector of observable attributes affecting the gains from trading under the relevant governance arrangements, and e_C and e_a are error terms that may reflect either variables omitted by the investigator or errors or misperceptions on the part of decision-makers about the true

[2] This way of formalizing the problem is general to contractual choices and not specific to payment schemes (See Masten-Meehan-Snyder [1991]).

values of V_c and V_a[3]. Let us assume for practical reasons that the preceding relations can be represented linearly as

(2') $V^C = \alpha X + e_c$

And

(3') $V^a = \beta X + e_a$

We can then represent the probability that a lump sum scheme will be chosen over the alternative governance form as $Pr(G^* = G^C) = Pr(V^C > V^a) = Pr(e_a - e_c < (\alpha - \beta)X)$. In other words, an element of X whose effect on the expected gains from trade under a lump sum agreement, α, is greater than its effect under the alternative arrangement (royalty scheme), β, will increase the likelihood that a lump sum scheme will be the observed form of governance. Theories of contracts inform the analysis by identifying which attributes empirical researchers should focus on and by predicting the differential effects (i.e., $\alpha - \beta$) of those attributes on the transaction value and, potentially, by providing guidance on the functional form of the V(X, e)'s.

13- Royalties versus lump sum contracts: attributes and hypotheses

Several attributes may affect this trade-off and explain the choice of using a lump sum contract instead of a royalty-based contract to govern technology-licensing agreements. Following the theoretical framework provided by the transaction cost theory, we defend the assumption 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.

Ex ante measurement costs can be socially valuable, as the more efficient producers are better rewarded. However, in the case of technology transfers, the characteristics of the technology are not affected by the licensee's efforts. Measurement by licensees simply redistributes wealth among licensors and from licensors to licensee and results in social waste. Licensors are therefore expected to develop selling practices that limit such measurement costs. Choosing between lump sum payments and royalty contracts is a way of influencing those costs (See for example Leffler and Rucker [1991]; Leffler and al. [2000] in the case of timber harvesting contracts). The question is now to analyze the net effect of the attributes of transactions to make clear hypotheses concerning payment schemes. Taking the view that royalty contracts economize on *ex ante* measurement costs, a special emphasis will be put on situations where enforcement costs (e.g. the strength of IPRs) are prohibitive compared to that saving[4]. Transaction cost economics turns its attention predominantly to (1) the attributes of the transactions, (2) public and formal institutions and (3) private institutions.

[3] Potential differences in the set of attributes that affect efficiency under alternative governance arrangements are taken into accountin the model by the possibility that the estimated marginal effects of particular attributes equal zero.

[4] A royalty payment avoids the deadweight loss of *ex ante* measurement but at 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

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 assessing the nature of the knowledge 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. In transactional terms this means that transactions of intangibles 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)[5].

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). 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 hypothesis:

Hypothesis 1: **Payment formulae implemented in TLAs should vary according to the kind of knowledge that is transferred through the contract. When transferred knowledge is codified, it will be more frequent to see royalties compared to the case where the knowledge transferred is essentially tacit**[7].

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deadweight loss if the anticipation of the failure to pay changes the licensor's actions (e.g., providing know-how) in any way or requires expansive governance structures.

[5] That is probably the reason why technology-licensing agreements have not really been studied within the framework of Transaction Cost Economics (TCE). Klein & Shelanski [1995] and Masten & Saussier [2002], who surveyed empirical studies based on TCE, do not refer to empirical studies about technology licensing agreements.

[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] It should be noted that this proposition is going against the main Principal Agent propositions, viewing royalty contracts useful to infuse incentive when tacit knowledge is concerned by TLAs (Cf. Macho Stadler & al. 1996). Our point is that this view is correct as long as the institutional framework is supposed perfect enough to enforce contracts based on royalty payments.

The attributes of public and formal institutions

North [1990], inspired by Barzel [1989], pointed out the impact of the institutional framework on governance mechanisms. Indeed, the institutional framework contributes to the delineation (measure) and enforcement of rights of use over all kinds of economic resources. When it comes to the exchange of intangibles (and related level of transaction costs) this is essential to take into account the impact of the institutional framework on the completeness and the strength of these exclusive rights or use. Due to the high costs of measuring and enforcing property rights over these *a priori* non-excludable resources, and the indivisibility of these resources, it is not socially optimal to design a complete and perfect system of IPRs[8]. 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 host country. 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 in that market, or can minimize uncertainty regarding intellectual property protection by opting for a lump sum compensation to be paid upfront, typically when *ex post* transaction costs are prohibitive compared to *ex ante* measurement costs. This leads us to our second hypothesis:

***Hypothesis 2*: When TLAs are signed with partners in countries where IPRs are weak, we should more frequently observe contracts with payment formulae based on lump sum payments as compared to the cases in which TLAs are signed with partners in countries where IPRs are strong.**

The same hypothesis can be made with regard to the strength of contractual law and the efficiency of its enforcement by courts.

The attributes of private institutions

Since economies of scale, scope and learning arise in governing transactions as in many other economic activities, economic agents may seek to socialize the governance of their transactions in specific fields by creating private and specific institutions that complete the incompleteness of public and generic ones (Fares-Brousseau [2000]). Compared to the public and general institutions of the society that are mandatory for individual agents, and which the latter have no control over, private and specific institutions are based on voluntary adherence and are designed by economic agents themselves.

[8] This is a direct consequence of the protection vs. diffusion dilemma that characterizes the optimal design of an IPR system. Incomplete IPRs allow protection but favor diffusion at the same time, since property rights holders do not systematically effectively exclude third parties from using their information or knowledge because it would be too costly (Cf. Bessy & Brousseau [1998]).

In matter of transfers over intangibles, it is essential to take into account the impact of these private institutions on inter-individual governance structures. Previous case studies suggest indeed that in many industries standardization committees, scientific and engineering associations, industry unions, business communities, (etc.) complete the incompleteness of the public intellectual property rights systems by providing resources that facilitate the delineation and the enforcement of intellectual property rights (Bessy & Brousseau [1997, 1998]).

In those industries where such private institutions exist, technology transfers are easier to manage, both because industry members already share knowledge, and because contractual commitments are more easily enforced (IPRs are stronger, collective enforcement mechanisms reduce enforcement costs, etc.). Consequently, TLAs can implement light governance structures, and remuneration schemes based on royalties.

Hypothesis 3: **Payment formulae implemented in TLAs should vary according to the industry concerned with the contract, to the extent that each industry is characterized by different private institutions that influence the enforcement of IPRs. When TLAs concern industries with strong private institutions, we should be able to observe contracts implementing royalty payments more frequently.**

To sum up, the probability of TLAs implementing (only) royalties should (1) increase when property rights are efficiently enforced in the country of the non-French partner and increase given the efficiency of the contractual law and its enforcement; (2) increase when private institutions exist in the industry; (3) decrease when the transmitted knowledge tends to be tacit[9]. These are the main propositions of the paper[10].

2- DATA

21-The Sample

The database we are relying on is a governmental database designed to observe international technology and other IPR based transfers. It contains 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

[9] This does not contradict Arrora [1995] who argues that lump sum payments may be preferred if the transaction requires substantial know-how transfer. However, the fundamental explanation is slightly different.

[10] Industrial Organization reasoning points out, however, that there are additional elements to be taken into account since royalties on sales damage the licensee's ability to compete (e.g. Katz and Shapiro, 1986). Thus, there is a presumption in favor of the lump sum payment. On the other hand, when licensing to rivals, a royalty is a way of creating de facto collusion. Moreover, royalties can serve as "warranties" signaling the quality of the industry.

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 224 contracts randomly chosen in 7 of the 30 industries available in our database (see table 1). The 7 industries were selected according to their economic importance for French industry, and also according to the fact that they can be considered to feature contrasting 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[11] must fill in when registering a contract, we have extensive information on the contract, quite detailed information on the French, and some information about the foreign firm.

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. Moreover, it will enable us to recall some general characteristics of TLAs (these have been previously highlighted, especially by Caves et al. [1983] and Bessy & Brousseau [1998]).

Of the 224 processed contracts, 62% are contracts in which the French is the licensor. The French firm is therefore the licensee in 38% of the cases. 20.5% of the contracts are agreements between firms that belong to the same group (that have at least a minority shareholding link). In 23% of the cases, the two companies had contractual relationships before the signature of the studied contracts.

Those contracts concern international exchanges with five types of economic zones. The bulk of the exchanges is concentrated within OECD and EU countries. This is consistent with most of the information we have on international technology flow that is concentrated within the most developed countries.

[Table 2 ABOUT HERE]

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 3 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

[11] 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 FFs in our sample.

trademark, or basic products or services) is a way of securing these transfers. 19.4% 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 3 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, however, except for technical test results, they are in a small minority. This is because we selected a sample of contacts implementing payment mechanisms, while by definition barter tends to exclude payment.

3- VARIABLES USED FOR THE ECONOMETRIC STUDY

31- Explained variables

In our database, 63% of our 224 license 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. Several variables have been created in order to evaluate payment schemes in license contracts.

We first created variables in order to 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/LS**, 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 only, in order to analyze the choice between these two extreme payment schemes. To go further in the analysis of payment schemes, analyzed as discrete choices, 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. Finally, we 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.

Secondly, we created a **Royalty Rate** variable equal to the rate of royalties specified in contracts entailing such payment schemes in order to be able to analyze the choice of using a payment scheme based on royalties as a continuous choice.

32-Explaining variables.

Following our analysis, the types of transfers, the strength of IPRs and the quality of the legal environment, as well as the industry features should be the primary influences on the design of TLAs. Other relational (contextual) variables should also play a role.

[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.

321- Types of resources exchanged between the two companies[13]

As justified above, we begin by contrasting the resources exchanged depending on whether knowledge is tacit or codified. Variable **CODKn** (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.

Variable **TACITKn** (for tacit knowledge) is an indicator taking into account whether the contract covers consultancy services and technical assistance; training; personnel delegation; accounting, management and marketing methods.[14] [15]

322- Strength of IPRs

The nationality of the non-French partner is a proxy of the strength of IPRs in the non-French countries[16]. In fact, we used three methodologies to assess that strength.

Firstly, we used a division of the world into five types of economic areas (OECD except EU, EU, OPEC, Eastern Europe, and Rest of the World) by assuming that these various zones reflect different levels of IPR strength (**ZONE** variables).

Secondly, we used a variable specifying the nationality of the licensee in the contract (**LAW** variables), because we believe the law of the recipient contracting party to be the more important in the licensor's ability to enforce the contract *ex post.*

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[13] Even if we have no model at hand, we make the plausible explicit assumption that the technology is given (e.g., the types of resources exchanged between the parties are decided before the contract structure).

[14] 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 (the one rated in our study). We do not have any intensity indicator for each item of our definition of tacitness, reversibility, etc. 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 one another. One might have expected different weighting for each resource in the definition of tacitness or reversibility, 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 resistant to minor changes in those definitions.

[15] 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.

[16] To assess the impact of the legal environment, two features could have been taken into account: the law of reference of the agreement or the nationality of the non-French partners. Spontaneously, the law of reference should be the one taken into account. This is however open to discussion. Indeed, the law of reference in question is the contractual law, not the IP law. Moreover, in many cases, the court of last appeal for the arrangement is a private body of enforcement (such as the arbitration courts of the international chambers of commerce), not the habitual judicial institutions. Last but not least, the nationality of the partner matters because it is the law of the country where the company is incorporated that will be the reference if the French partner has to sue as a last resort, because this is the only mandatory legal regime for the foreign partner. This reasoning is also followed by Aulakh & al [1998].

Thirdly, we use several indexes to measure IPR strength, to complete and improve our area variables. 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[17]. 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 following more relevant indexes:

1. Computed by World Bank specialists estimating the level of the legal security on a country basis (Knack and Keefer [1995]). These indices were drawn from assessments made by country risk evaluators to potential foreign investors. They include evaluations of contract enforceability, the rule of law and risk of expropriation (that estimate the strength of property rights). While they do not reflect only the IPR domain, these indicators can be considered as proxies of the legal environment. However, they do not include a temporal dimension.

2. Computed by Rapp & Rozek [1990] proposing an evaluation of the degree of patent protection based primarily on the laws in force against infringement. Nevertheless, the temporal dimension is still absent and these authors do not take into consideration enforcement or implementation of IPRs (see fn. 11, page 79).

3. 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 protection), the authors 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.

4. Computed by Ostergard [2000], proposing an alternative method for measuring IPR protection that incorporates the strength of national intellectual property laws and a nation's enforcement practices of those laws. The idea developed by the author is that the measurement of IPRs must incorporate both a statute component and an enforcement component. The second is not present in many proposed indicators. The author proposes such an indicator for 73 countries over the period 1988-1994[18]. It is thus the most relevant index for our study[19].

323- Industry Features

The industry in which the transfer is performed (**SECTOR** variables) is a good proxy of the presence of informal institutions that favor and secure knowledge transfer and make TLAs more

[17] Contracts in our sample are signed from 1969 to 1998, with more than 85% of contracts signed between 1986 and 1998.
[18] Data is available at the following website: http://www.binghamton.edu/polsci/.
[19] The choice of the proper index for studying the impact of IPRs on TLA design is a difficult one. Indicators are generally not constructed the same way, and it is not a simple matter to choose the most relevant indicator. In our case, indexes provided by Ginarte & Park [1996] and Rapp & Rozek [1990] seem to be highly correlated (r=0.9 over 90 common observations). This is not the case, however, for the other indexes.

easily enforceable. Contrary to the strength of IPRs and more generally to the quality of public institutions, there is no indicator available for private institutions. In the near future, we expect to compute more precise proxies qualifying the level to which knowledge is common in various industries and identifying the presence of private enforcement institutions, as they appear important in the explanation of contractual choices. We can note however that, because we measure quiet well the kind of knowledge that is exchanged through contracts we can be confident in the fact that sector variables reflect the presence/absence of private institutions. Without measures of exchanged knowledge, it would be difficult using sector variables to disentangle if they reflect the presence of private institutions or the differences of exchanged knowledge between sectors. We expect to observe differences between sectors, depending on whether private institutions exist in the industry.

324- Other control variables

Other factors should 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 is not crucial[20]. This lowers *ex post* transaction costs in order to enforce contractual agreement. Consequently, we created the variable **CAP-LINK** to take into account the existence of capital links between the licensor and the licensee. We expect that the probability of implementing payments based on royalties will increase with the existence of capital links between the licensor and the licensee.

When companies sign various contracts together, one can expect that they are committed in a cooperative relationship. Securization is therefore less important. Moreover, each contract is a guarantor of the other contracts. On the other hand, contractors are more likely to share risks. 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. They should therefore reduce the willingness to implement payments. When payments are nevertheless implemented (which is the case in our sample), they should increase the willingness to have recourse to single royalty based payment schemes, since the transfer from the licensee to the licensor is expected to secure the transfer made by the licensor to the licensee (instead of a lump sum payment). Consequently, we created the variable **RECIPROCITY** to take into account the transfers from the licensee to the licensor.

All variables are summarized in Table 4-1 and 4-2.

[TABLE 4-1 & 4-2 ABOUT HERE]

[20] 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.

4- THE PAYMENT FORMULAE

41- The Influences of Transfer, Environment, and Relationship

In a first test, we computed the data without using the indexes rating the foreign country's legal environment. The model we wish to estimate in order to test our propositions is the following one. For estimation purposes, we retained a linear specification of the model, with a constant term. We have then by extension of equation (1):

$$(5) \qquad G^* = \begin{cases} G_c \ \ if \ \ TC_c < TC_a \quad with \quad TC_c = C + \alpha T + \beta S + \gamma P + u \\ G_a \ \ if \ \ TC_a \leq TC_c \quad with \quad TC_a = \alpha' T + \beta' S + \gamma' P + v \end{cases}$$

With TC_a (respectively TC_c) the transaction costs associated with royalty payments (respectively with lump sum payments), C the constant term, T the tacitness of knowledge that is transferred through the contract, S the weakness of intellectual property rights in the recipient country, P the weakness of private institutions in each sector. We expect the differential effect of each variable to be to the advantage of the royalty payment governance structure, that is to say: $\alpha - \alpha' > 0$; $\beta - \beta' > 0$; $\gamma - \gamma' > 0$; $\alpha - \alpha' > 0$; $\beta - \beta' > 0$; $\gamma - \gamma' > 0$.

Results are as follows (see table 5). Only the most significant results are reported.

[Table 5 ABOUT HERE]

Considering payment schemes as discrete organizational choices (estimations 3 to 6), the ordered logit test — more satisfying from an analytical point of view (because two part tariff contracts are not mixed with lump sum payment contracts) — is confirmed by the simple logit test. We can therefore consider the ordered logit test as being relatively robust[21].

As expected, the remuneration regime is sensitive to the legal environment: When a French firm signs a contract with a company belonging to the EU (ZONE1) or when the licensee pertains to the EU (LAWEU), it can consider that the legal environment is secure because the IP and contractual laws are both of good quality and harmonized. This is why firms are more likely to implement payments based on royalties.

As expected, the remuneration regime is also sensitive to the fact that the parties operate in specific industries. According to many specialists, IPRs are quite strong in the mechanical construction industries (Sector 2), because the patent system is well adapted to those types of technologies[22]. We also observed that in the seed industry (Sector 8) the presence of private institutions allows to

[21] 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 verified that results do not dramatically change when using a multinomial logit instead of an ordered logit.

[22] The patent system was designed at a time in which the bulk of invention originated from mechanics. The codification technique in force at the patent office is therefore well tailored to mechanics. It suits techniques that are more abstract like chemical processes (see Arora & Fosfurri [2001]) or software.

complete the incompleteness of the IPRs system. That is why in those two industries partners are more likely to implement remuneration based on royalties.

Finally, as expected, the remuneration regime is also 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.

We can note furthermore that the remuneration regime is sensitive to the specific 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 is implemented.

We forecasted that reciprocity provisions would replace lump sum payments, and therefore call for the implementation of royalties. We observe the opposite impact. This can be due to a desire to simplify payment schemes. Indeed, royalties are more subject to opportunistic behavior by the licensee than lump sum payments. In order to avoid implementing and running costly supervision and conflict resolution mechanisms, the licensor may prefer to transform the transaction into a reciprocal one shot transfer. He will therefore simultaneously require a transfer of money (lump sum payment) and a transfer of other resources (reciprocity requirements), probably to solve licensee's potential liquidity difficulties.

Considering now the royalty rates implemented in contracts (estimations 1 and 2), we must note that royalty rates are very sensitive to the nature of the transferred resources. The more tacit knowledge is exchanged, the lower the royalty rates are, independently of the existence of a lump sum payment. This result goes against propositions that can be drawn from agency theory. Especially in two-sided moral-hazard models, the royalty rate is supposed to motivate the licensee to effectively transfer tacit knowledge to the licensee, and lump sum payments should be negatively correlated with royalty rates (See Lafontaine [1992]; Lafontaine & Slade [2000]). This is consistent, however, with our TCE analysis pointing out that the payment scheme will be sensitive to the e*x post* costs of enforcing contracts that are higher when knowledge is tacit (and therefore hard to describe and protect)[23].

42- The Effect of the Legal Environment

In order to benefit from more precise control variables — because one can expect that differences among contracts strongly depend upon the strength of IPRs, and more generally upon the quality of the legal environment, factors that are poorly proxied by the nationality of the non-French contractor — we now include in our regression the measures of the quality of the legal environment.

We might expect that geographical zones would no longer be significant explaining variables. IPR indicators based on a country by country in depth analysis are obviously better proxies than the rough rating provided by knowing whether or not a country belongs to an international organization

[23] As they are defined, it appears that codify and tacit knowledge variables (CODKn, TACITKn) need not be inversely related and could be positively correlated in the data. This leaves open the possibility for the pricing arrangements to be related to the relative share of codified knowledge over tacit knowledge. We made estimates using the ratio (CODKn+1)/(TACITKn+1). All results hold.

(OECD, UE, OPEC, etc.). Such result would lead us to assume that IPRs indicators efficiently capture the impact of the legal environment on contracts. On the other hand, previous analysis and case studies (Bessy & Brousseau [1998], Anand & Khanna [2000], Merges [1996]) really suggest that there are strong industry effects due to the existing "private institutions" that sustain contract enforcement or the circulation of knowledge within industries. Case studies reveal, however, that these institutions often play a role at the level of the "technological field". This means that such national indicators may well not be sufficient to assess the effect of IPRs on licensing contract structures. Results are shown in table 6.

[Table 6 ABOUT HERE]

We can conclude that IPR indicators did not permit us to improve our regressions, as all coefficient indicators are not significant.

43- Discussion

As compared to the tested hypotheses, 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. 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.). Simple and single-dimension indexes are therefore strongly biased and probably only adapted to a very specific type of study.

Consequently, we cannot be sure that our sector variables efficiently grasp the nature of this private environment. However, the fact that we obtain significant correlation while the effect of the nature of the transmitted resources is eliminated — because we take it into account directly though our variables describing the features of the transferred knowledge — confirms our insights that the sector variable does not reflect the nature of knowledge (as assumed in Anand & Khanna [2000]), but other discriminating characteristics (according to us, the nature of the private institutional environment). This certainly calls for the development of better indicators aimed at measuring the very nature of these private and specific institutional environments. It also points out the relevancy of precisely "measuring" the nature of the transfer for each transaction when studying TLAs.

CONCLUSION

In this paper we provide a framework aimed at pointing out that TLA features depend upon three major factors: the legal environment, the private institutions organized at the industry level and the characteristics of the knowledge. Our results suggest that payment schemes in technology-licensing agreements may well be explained by the willingness of the parties to economize on transaction costs. This result goes against more habitual explanations focusing on incentives and confirms the relevancy of a new-institutional framework.

While innovative, our results are to a certain extent frail. They call for further study in order to be confirmed.

Firstly, in our study, we ignored potentially important interactions with and qualifications by other contract provisions that can alter their nominal meaning. It may be that a given feature 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 payments scheme based on royalties if he could implement a complex governance structure to secure the transfer of his knowledge. Such dependency between contractual provisions is rarely studied (See Saussier [2000] for one exception). 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 and industry variables alone capture the impact of the institutional framework only. A better assessment of the impact of these public and private institutions is dependent upon the development of new types of indicators able to "measure" the quality and the various features of the institutional environment. As demonstrated by our results based on the use of such indicators developed in previous studies, this kind of index is very hard to design and compute. 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. 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.

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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	31	13,7
Automobiles and Terrestrial Transportation Material (07)	93	4,09	9,03	30	13,3
Electrical Appliances and Machines (08)	72	1,62	1,37	25	11,1
Basic Chemicals (10)	119	6,94	4,25	32	13,7
Pharmaceutical Products (12)	474	39,55	37,16	32	14,2
Domestic Appliances and Dom. Equipment. (20)	54	0,22	12,54	28	12,4
Agriculture, Fishing, Forestry (30)	298	3,03	0,94	35	16,4
Other (22 industries)	1315	38,03	33,23	11	5,3
TOTAL	2798	100,00	100,00	224	100.0

Table 2: The Distribution of Contracts in 5 Groups of Countries

(in % of 224 contracts)

European Union	43.1
OECD except EU	41.3
OPEC	1.8
Eastern European Countries	1.8
Rest of the World	10.2

Table 3: Transfers to the Licensee performed through TLAs
(in % of 224 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	**22.2**	*12.9*	*16.7*	*8.0*	*16.7*	*50.0*	*25.0*	*24.3*	19.8**
Model	**9.3**	*0.0*	*30.0*	*20.0*	*6.7*	*0.0*	*7.1*	*2.7*	28.4***
Know-how	**57.8**	*54.8*	*80.0*	*68.0*	*90.0*	*11.6*	*14.3*	*21.7*	68.7***
Codified and Embodied Knowledge									
Plans, red books	**54.9**	*64.5*	*70.0*	*68.0*	*83.9*	*9.3*	*21.4*	*5.4*	66.1***
Development and Test Data	**42.9**	*29.0*	*33.3*	*36.0*	*77.4*	*71.9*	*10.7*	*27.0*	46.0***
Commercial and Marketing Data	**14.6**	*12.9*	*26.7*	*20.0*	*9.7*	*25.0*	*7.1*	*2.7*	13.1*
Tacit Knowledge									
Consultancy Services, Technical Assistance	**45.6**	*58.1*	*56.7*	*64.0*	*64.5*	*40.6*	*21.4*	*8.1*	39.2***
Training	**30.1**	*29.0*	*46.7*	*60.0*	*51.6*	*9.4*	*7.1*	*5.4*	46.9***
Personnel Delegation	**28.8**	*25.8*	*33.3*	*52.0*	*51.6*	*12.5*	*10.7*	*5.4*	34.6***
Accounting, Management and Marketing Methods	**4.9**	*12.9*	*3.3*	*0.0*	*0.0*	*0.0*	*3.6*	*0.0*	15.3*
Other									
Prototypes, biological material	**50.4**	*29.0*	*43.3*	*40.0*	*51.6*	*56.3*	*14.3*	*94.6*	51.2***
Products and Services (Regular Input)	**34.1**	*3.2*	*16.7*	*36.0*	*32.3*	*59.4*	*17.7*	*67.6*	47.8***

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

Table 4-1: The Explaining Variables

Variables	Definition
SECTOR1	Dichotomic var. equal to 1 if the contract concerns a sector other than the ones listed below
SECTOR2	Dichotomic var. equal to 1 if the contract concerns mechanical machines and tools
SECTOR3	Dichotomic var. equal to 1 if the contract concerns the automobile industry
SECTOR4	Dichotomic var. equal to 1 if the contract concerns electrical appliances
SECTOR5	Dichotomic variable equal to unity if the contract concerns basic chemicals
SECTOR6	Dichotomic variable equal to unity if the contract concerns pharmaceutical products
SECTOR7	Dichotomic variable equal to unity if the contract concerns domestic appliances
SECTOR8	Dichotomic variable equal to unity if the contract concerns agriculture and biotechs
ZONE1	Dichotomic variable equal to unity if the contract concerns EU countries
ZONE2	Dichotomic variable equal to unity if the contract concerns OECD (with the exception of Economic Union)
ZONE3	Dichotomic variable equal to unity if the contract concerns OPEC countries or Eastern European countries
ZONE4	Dichotomic variable equal to unity if the contract concerns other countries
CODKn	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
TACITKn	Variable ranked betwenn 1-4 depending on whether the contract covers consultancy services and technical assistance; training; personnel delegation; accounting, management and marketing methods
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
CAP-LINK	Dichotomic variable equal to unity if the contract concerns two parties with capital links
PREV-CONTRACT	Dichotomic variable equal to unity if previous contracts between the parties exist
ID-SECTOR	Dichotomic variable equal to unity if the licensee and the licensor operate in the same sector
LAWUE	Dichotomic variable equal to unity if the law of the recipient contracting party pertains to the EU

Table 4-2 Payment Schemes and characteristics of the relationships

PAYMENT	Lump-sum	Lump-sum and royalties	Royalties.	Val □2	Number of obs.
Geographical zones					221
EU	4,1	19,6	76,3		
OECD	9,7	36,6	53,8		
Rest of the world	12,9	38,7	48,4	13,9**	
Sectors					214
Mechanical Machines and Tools	0	22,6	77,4		
Automobiles and Terrestrial Transportation Material	3,3	30,0	66,7		
Electrical Appliances and Machines	16,0	44,0	40,0		
Basic Chemicals	22,6	19,4	58,1		
Pharmaceutical Products	0,0	31,3	68,8		
Domestic Appliances and Dom. Equipment.	7,1	57,1	35,7		
Agriculture, Fishing, Forestry	2,7	10,8	86,5	44,6***	
Sectors					226
Identical	5,1	27,4	67,4		
Non identical	15,7	33,3	51,0	7,9*	
Previous contracts					216
NO	7,8	31,3	60,8		
YES	6,0	20,0	74,0	2,9	
Total	7,5	28,8	63,7		

Table 5: The Payment Formulae Explanation (1)

Explaining Variables	OLS (1)	Tobit (2)	Logit (3)	Logit (4)	Ordered Logit (5)	Ordered Logit (6)
	Royalty Rate	Royalty Rate	PR/LS	PR/RLS	LS/RLS/PR	LS/RLS/PR
ZONE1	0,96 (0,88)	1,34 (1,27)	1,21 (1,75)*	1,14 (3,33)***	1,17 (3,51)***	-
SECTOR2	-1,66 (-1,27)	0,42 (0,32)	-	1,57 (3,04)***	1,67 (3,29)***	1,56 (3,07)***
SECTOR8	18,14 (7,73)***	15,64 (7,06)***	1,51 (1,31)	1,91 (3,43)***	1,85 (3,34)***	1,72 (3,12)***
TACITKn	-0,93 (-1,81)*	-1,49 (-3,01)***	-0,76 (-2,59)***	-0,41 (-2,47)**	-0,43 (-2,88)***	-0,40 (-2,70)***
CODKn	1,92 (2,92)***	1,71 (2,63)***	0,41 (1,09)	0,54 (2,70)***	0,50 (2,66)***	0,40 (2,19)**
RECIPROCITY	-0,06 (-0,05)	-0,65 (-0,53)	-0,56 (-0,77)	-0,58 (-2,05)**	-0,55 (-2,06)**	-0,53 (-2,04)**
CAP-LINK	-1,23 (-0,91)	0,23 (0,17)	-	1,75 (3,39)***	1,85 (3,65)***	1,81 (3,55)***
PREV-CONTRACTS	1,02 (0,77)	1,78 (1,35)	0,4 -0,44	0,55 (1,32)	0,49 (1,23)	0,44 (1,09)
SECT-ID	-0,74 (-0,54)	1,55 (1,24)	1,38 (2,07)**	0,55 (1,43)	0,69 (1,91)*	0,63 (1,77)*
LUMP-SUM	0,06 (0,05)	2,14 (1,80)				
LAWUE	-	-	-	-	-	1,01 (3,20)***
INTERCEPT	1,36 (0,77)	-2,02 (-1,27)	0,29 (0,43)	-1,20 (-2,83)***	-1,09 (-2,63)***	-1,09 (-2,63)***
Log Likelihood		-264,01	-34,03	-118,49	-157,7	-159,07
Pseudo R_	0,47	0,11	0,27	0,19	0,17	0,16
Observations	84◆	101♦	104●	224	224	224

*t-stats and z-stats in parentheses.*** denotes significance at 1% level; **denotes significance at 5 % level; * denotes significance at 10% level;*

◆ We regress only on 84 observations because we restricted the sample to contracts with a royalty scheme concerning sales on a specific product. We did not mix those contracts with others, less numerous, specifying royalties over other contractual terms (like for example total business revenues or product volume).

♦ The full tobit sample has 17 observations censored at zero, and 84 uncensored.

● We regress on 104 observations because of empty cell problems.

Table 6: The Payment Formulae Explanation[24] (2)

	Used Index	Coeff.	Level of Significance	Number of observations	Expected sign
Knack & Keefer 1985	Risk of Nationalization	0,02	40%	215	-
	Ability to Enforce Contracts	0,01	20%	215	+
Ostergard 2000	Law Measurement	-0,08	43%	197	+
	Enforcement Measurement	0,06	29%	197	+
	Law * Enforcement	0,007	20%	197	+
Rapp & Rozek 1990	Patent Laws	-0,07	39%	214	+
Ginarte & Park 1996	Patent rights	-0,04	83%	198	+

[24] Results presented here are derived from the inclusion of the measures of the quality of the legal environment in the ordered logit regression that gave the better results in table 5.