

INTELLECTUAL PROPERTY RIGHTS, TRANSACTION COSTS AND GOVERNANCE: ASSET COMPLEXITY AND LIMITS OF THE NEW LAW AND ECONOMICS APPROACH.

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Abstract

This paper intends to study the analytical relationship between the economic nature of Intellectual Property Rights (IPR) and the concrete modes of governance used to manage these IPR. I will demonstrate why, in regard to the IPR definition, private governance (i.e., the market) is not systematically, the most efficient one. I will show why Coase's hypotheses do not correspond to the economic nature of the IPR. Then I will explain why, in various concrete situations, the transaction costs are higher than they would be with other types of governance. Finally, from an institutional perspective, as held by Veblen and Common, I will propose other socially more efficient kinds of modes of governance.

In the Economic Literature, the economic nature of IPR is not analyzed with these conceptual instruments: on the contrary, the problematic I build incorporates, the existence of uncertainty, and the specificity (or complexity) of assets, and brings elements capable of constituting an alternative analysis in regard to various forms of intangible capital.

Key words: *Transaction Costs- Intellectual Property Rights- Governance - Institutions*

JEL Classification

B52 - Institutional; Evolutionary

D23 - Organizational Behavior; Transaction Costs; Property Rights

O 34- Intellectual Property Rights

Introduction

The aim of this paper is to study the analytical relationship between the economic nature of Intellectual Property Rights (IPR) and the concrete governance used to manage these IPR. This problematic may be extended to the economic analysis of Property Rights (PR) in general, and is related to various social fields: environmental components, cultural goods and services, knowledge production and digital economy, to name a few.

The definition of an IPR system is an important component of this immaterial economy: the degree of openness of this system and the possibility of implementing this system will partially determine the market dynamic, the modes of competition and the firms' strategies. In other words, *the internalization of externalities induced by the choice of an IPR system is a structuring element*. Obviously, this approach is incompatible with Coase's analysis, as shown by "Coase's theorem".

In this paper, I will demonstrate why, in regard to the IPR definition, private governance (i.e., the market) is not, systematically, the most efficient one. From a theoretical perspective, I will underline the oppositions between Pigou and Coase's approaches, regarding the economic nature of IPR, the conception of externalities and the criterion used to evaluate their social efficiency; I will show why Coase's hypotheses do not correspond to the economic nature of IPR. I will go on to explain why, in various situations, the transaction costs are higher than they would be with other types of governance. For that purpose, I will utilize Williamson's analysis, more specifically the relationship between the specificity assets, the nature of the contract and the transaction costs level. I will show why this methodological choice is pertinent when it comes to studying all the immaterial capital forms; finally, from an Institutional perspective, in the sense of Veblen and Commons, I will demonstrate what kind of modes of governance are more efficient.

In the Economic Literature, the economic nature of IPR is not analyzed with these conceptual instruments: the New Law and Economics School does not consider the assets specificities and the existence of uncertainty, nor does the literature on pollution rights. On the contrary, the problematic I constructed incorporates the existence of uncertainty, in the Post-Keynesian sense, and the specificity assets. Consequently, this paper underlines the importance of institutional components in the coordination mechanisms, the fact that the agent's rationality is bounded, and that the market is not, systematically, a self-regulatory instance and an efficient mode of governance.

In the first part, from stylized facts, I will show how the market's private logic translates high transaction costs. Then, from the opposition between Pigou and Coase, I will study the different conceptions of the economic nature of IPR and of the recommended market regulations. In the second part, I will point out, in regard to the *complexity* of the goods and services, the private negotiation limits, i.e. the Coasian approach limits; for that purpose, I will make full use of Williamson's theoretical framework to demonstrate that the market logic translates high level transaction costs, and I will formalize some of these economic relations: I will show why private negotiation may be inefficient, in regard to traditional maximization process, to technological cost and to free-rider behaviors.

I) Some stylized facts: the different interpretations

1) *The economic nature of IPR*

1.1 *Some tendencies*

Since the 1980s, we have seen that there is no positive correlation between the deposited quantity patents and R&D expenditure (Lebas, 2002, p. 252). Consequently, it can be said that the extension of IPR does not correspond to an incitement to develop technological innovation; so, there are, in contemporary capitalism, important modifications related to the economic nature of the IPR.

A number of firms have a patents portfolio strategy, which may be characterized by the following elements:

i) The patent is no longer conceived as a way of appropriating temporary rents related to technological innovation (Idem, p. 254), and secrecy is preferable to going public. Secrecy is related to the most important firms.

ii) The patent function consists of preventing the entrance of potential outsiders: it does not mean constituting a means of divulging innovation in the cheapest way, but rather a means to increase the market power of firms of a critical size. The raising of entry barriers results in a drop in competition, to the extent that IPRs are related to *process and not to products*.

The outsiders are the object of a hold-up strategy, from the insiders: these insiders constitute a closed network in which they exchange their respective IPR. Moreover, such market structures imply in *increased uncertainty regarding the valorization of patents*: firm A's patent depends on the patents of B and C, and of the possibilities that B and C have of preventing A's patent registration. This situation is characterized by an oligopoly or games theory mechanism.

1.2 *Implications concerning markets structures*

The patent value depends on the anticipated product that the innovation may produce for the rights holder. Until the 80s, when patents were related to specific products, it was quite easy to anticipate patents' revenues. The patent's utility depended on its industrial and commercial applications, which were identifiable.

Today, patents are related to discoveries, not only inventions¹. In fact, they are related to processes and not only with identifiable inventions: property rights are conceded to the virtual applications of *generic processes*. By nature, it is impossible to anticipate these future applications. This must be interpreted as an important market power extension: the new systems of property rights permit a more important monopoly power, in as much as this power is related to scientific and/or technological generic principles whose concrete applications are not identifiable.

In these markets, the externalities produced by technical progress are internalized within closed or semi-closed networks: these entry barriers limit the social appropriation of these externalities and the cumulative technical progress. This kind of strategy and the Property

¹ Contrary to Posner's affirmation (2005), today the IPR are not applied only to processes, but also to "ideas".

Right fragmentation may be interpreted as market failures (see the formalization of this mechanism in the last section).

The anti-commons (Heller & Eisenberger, 1998) appear when knowledge is fragmented between various Property Rights holders. We can consider a technological process constituted by two complementary segments a and b . If, for example, there are two PR holders, A and B, and if A decreases its price, A and B's demand will increase, even though B does not decrease its price. So, the IPR price necessary to use the technological process will be higher in this case, in relation to the situation where there is only one PR holder. This *externality of demand*² will produce coordination failures and will result in a decrease in welfare corresponding to the higher price, in regard to the competitive price. This situation is characterized by *sub-additive costs* and may be compared with the monopoly traditional analysis, in that, under certain conditions, the monopoly price is the lowest one.

Finally, when there is an indivisible public good, a common good in a determined community (common knowledge, ecological components, etc.), private appropriation modes may prejudice the whole collectivity: the result may be a decrease of the stock available for the other agents and, in regard to the cumulative character of production, a decrease in total production growth. Applied to scientific and technological production, such predatory behavior may lead to decrease in production innovation growth; in that the privatization of the Scientific and Technological knowledge may produce such a result³.

1.3 IPR and new property forms

Digital economy development is characterized by a double movement: the transformation of the nature of goods and services and the transformation of the IPR forms.

On one hand, most of these goods and services are public goods, whose principal characteristics are their non-exclusion and indivisibility. The economic dynamic consists of internalizing the network externalities that appear on these markets. In regard to such specificities, it is not possible to maximize microeconomic profit function equaling marginal cost and marginal product (Herscovici, 2008): these markets are not Walrasian, and their dynamic does not consist of selling private goods, but rather of negotiating the access to the networks in order, to "capture" the consumers/users, and to differentiate the public in regard to the different groups' propensity to pay (Idem).

On the other hand, these goods are *experience goods* (Varian, 2003): therefore, the price system cannot transmit all the necessary qualitative information to the consumer. Other social mechanisms must do this in order to compensate the system price failure: institutions, online communities concerning the digital economy, etc.

These new strategies consist of developing, at first, free, or almost free services for consumers: this mechanism permits the creation of the network and the corresponding externalities and the divulging of the necessary information that the prices system hides. There are various examples which illustrate this kind of strategy:

- i) Various software producers make a certain software available for a limited period.
- ii) Some economic studies determine the piracy level, in order to maximize the producer's profit.

² They are close to the externalities of demand defined by the New Keynesians.

³ In this sense, Nelson (2003) underlines the danger of such a system, in regard to the Bayle Dole Act, in the United States.

- iii) All free softwares (such as Linux, but also Google) are other examples.
- iv) When it comes to the immateriality of the diffusion support, in the case of peer to peer networks, more particularly in the music sector, it is no longer possible to control and limit piracy (Herscovici, 2007).
- v) Finally, new collective IPR forms appear: the various kinds of copy-left may be interpreted as *collective property forms*. The same phenomenon is observed with the creative commons.

However, on the other hand, there is a considerable extension of the private IPR system: (a) the IPR system is applied to new social fields: biotechnologies, scientific knowledge, software algorithms and pollution rights (b) with the Bayle Dole Act, public institutions may negotiate the product of scientific research (c) these rights are negotiated within a private logic, on the base of market mechanisms (Coriat, 2002). In fact, we can observe a privatization of part of the immaterial and scientific production, in that they are no longer directly administered by public institutions.

2) *Externalities and Intellectual Property Rights: Pigou versus Coase*

2.1 *IPR economic specificities and the Pigouvian approach*

IPRs are a mechanism that makes the externalities produced by some types of commodities like Knowledge and Information endogenous. In the case of industrial commodities, because of their economic characteristics, it is relatively easy to implement a property right mechanism, to implement price exclusion mechanisms and divisibility. For instance, regarding Knowledge and Information, the problem is quite different: these commodities are characterized by no rivalry, by non exclusion and by their cumulative character.

- i) The non rivalry may be explained by the consumption *indivisibility*: the good does not “disappear” in the consumption process. It may be consumed, in its entirety, in a simultaneous manner, by other consumers.
- ii) The non exclusion means that it is impossible to control the various appropriation of the service provided by the commodity. In other words, the commodity intrinsically produces *externalities* which benefit the agents who do not contribute to its production.
- iii) Finally, the production is cumulative in the way the actual production depends of the initial stock of knowledge available today. This dimension outlines the interdependency between the different producers, and the dangers of a “closed” IPR system (Nelson, 2003).

The IPR mechanism applied to these kinds of goods will be specific, because of these economic specificities; in this regard, Arrow (2000) outlines the retro-engineering process which characterizes this kind of commodity. The private efficiency of the IPR system depends on the possibilities it offers to make these externalities endogenous.

In fact, it is possible to distinguish two concepts of externalities: the first one may be called Pigouvian, and comes from Pigou’s analyses. In this perspective, the externalities are not transferable from one agent to another; the endogeneization is implemented out of the market, based on an “administrative” and/or institutional mechanism.

This institutional mechanism consists of taxing the agent who produced the negative externality to compensate for the disutility of the agent’s victims of this externality. It is

possible to establish rules to end the cause of externality. In this perspective, externalities are conceived as *market failures*, which result from the divergence between private and social interest. The optimal pollution level is that which equalizes the marginal profit of the polluter with its marginal cost plus the Pigouvian tax.

This approach is based upon the collective interest primacy: the existence of pure public goods translates the fact that a private appropriation of these public goods produces negative externalities. These public goods are patrimonial goods (Herscovici, 1997), and the social interest consists of limiting their private modes of appropriation: the urban laws, the environmental regulations or the arts laws on exportation regulation are based on such principles. The internalization modes lead to institutional interventions to neutralize the effects of the private appropriation.

The Pareto criterion is used to guide these interventions; one state may be called Pareto superior (S_1) when no agent prefers the previous state S , and at least one agent prefers S_1 . This criterion corresponds to distributive goals, in regard to utility and to income distribution. Finally, the transaction costs related to the public or institutional administration are ignored; the Coasian approach will focus this point to elaborate its critique.

2.2 *The Coasian Social Cost Theory: the main results*

The New Institutional School, inspired by Coase's analysis, uses another hypothesis and another axiomatization. The externality is no longer viewed as a market failure but, on the contrary, as the result of the absence of a market mechanism, i.e. the absence of private negotiation. Unlike Pigou's analysis, the externality is the result of PR failure. The solution lies in extending the market logic to social activities which can be negotiated in a private way, and which can be patented (Berg 2003, Brousseau 2003, Guerrien 1999).

I do not agree with Liebowitz and Margolis (1994) when they define technological externalities as situations in which "the benefits or the costs are imposed outside of market mechanisms. Resolution of such problems may occur through property rights, private negotiation or government interventions that allow the externalities to be internalized". My argument is that (a) the dynamic of the markets changed: the benefits and costs are indirect (Herscovici, 2008), and the competition does not occur within the direct prices system (b) we can see the development of markets to administer property rights (for example, pollution rights) and (c) private negotiation is a mechanism which can be assimilated to a market. In fact, the internalization is implemented within an indirect mechanism and not within the direct prices.

The Coasian analysis implies that (a) the PR are transferable (b) the PR system can be clearly defined and that (c) the agents may implement a substantive rationality. The first criterion implies that the PR are negotiable on a market, and that it is possible to quantify them; the second that the object of PR may be defined without any ambiguity. The third criterion means that there is no uncertainty about the asset value and about the other agents' behavior; in regard to agents' behavior, all types of information asymmetries constitute a limit to the concrete realization of a substantive rationality (Saussier Yvrandre Brillon, 2007, Williamson, 2002); in other words, *in Coase's approach, the contracts are complete, in relation to the hypothesis of substantive rationality.*

The PR are conceived as the possibility to use one specific production factor, and to produce the negative externalities which result from this use (Coase, 1960, p. 22). The PR are defined in terms of availability, and no longer in terms of property (Kirat, 1999, p. 65), in the traditional sense.

The efficiency criterion is different from that used by the Pigouvian economy: it incorporates the production or utility maximization, and ignores the income distribution implications.

In this regard, Coase affirms that “« Pigou is, of course, quite right to describe such actions as « uncharged disservices ». But he is wrong when he describes these actions as « anti-social » » (1960, p. 18).”. This means that Welfare is conceived only in function of total production and/or utility. The criterion used is that of Kaldor-Hicks.

If A makes a profit equal to 100, but this activity produces a disutility equal to 30, and if A pays 30 to B, this situation is a Pareto optimal one. On the one hand, neither agent prefers the previous state; on the other hand, the total utility net growth is equal to 70. However, in this situation, there are no transaction costs.

The problem is different when we introduce transaction costs: if, for instance, in the last example, the transaction costs are equal to 80, there are two solutions:

- i) If the compensation is achieved, the total utility (or production) reduction is equal to 10.
- ii) If the compensation is not achieved, the utility increase is equal to 70. However, the inequalities are more important between the polluters and the polluted. And the situation is no longer a Pareto's optimum. The inequalities become more and more important; the Kaldor-Hicks criterion *only considers the PR allocation efficiency and its impact on production level*.

This kind of allocation of PR is possible only if the different opportunistic behaviors are controlled and do not result in high transaction costs. The market solution is, naturally, considered to be the most efficient one: this means that the transaction costs are less high than they would be in an “institutional” situation, and that the situation is efficient, in regard to the criterion chosen.

2.3 Stigler's interpretation

Despite its limits, the Coase Theorem, in the way it was formulated by Stigler (1966), may be considered as a first presentation of Coase's problematic in the way it was developed in his paper “The problem of Social Cost” (1960). It underlines the fact that the private negotiation between private actors is the most efficient governance mechanism.

We can illustrate this theorem with the following example (Pejovich, 1995): two agents, X and Y, have a house, and Y's activity consists of testing alarm sirens. This activity implies an increasing utility evaluated at 500, for Y, and a decrease of X's utility of 200.

	X Utility	Y utility	Total utility
With alarm sirens	1000	1500	2500
Without alarm sirens	1200	1000	2200

Case 1 Y wins the case and is allowed to test the alarm sirens; this means a disutility of 200 for X, and a utility increase of 500 for Y. The value that X can buy Y's "silence" cannot be higher than 200; there is no possibility of negotiation, and the total utility is 2500.

Case 2 X wins and Y can buy the right to silence up to 500. If this right is evaluated at 300, the final situation is the following one : X's utility is equal to 1300, Y's utility to 1200, and total utility is 2500.

Proposition 1 Social Efficiency does not depend on the attribution of initial rights.

Proposition 2 The economic activity is implemented, independent of attribution of rights, and the social product is maximized.

New Law and Economics economists conclude that the private negotiation is the most efficient mode of internalization of externalities and that the social utility, evaluated from the total product, is maximized (Kirat, 1999, p. 61).

We can formulate the following observations:

- i) this mechanism does not include a social justice criterion; in the first situation, the deviation between polluted and polluter increased.
- ii) This mechanism is valid only when there are no transaction costs; this implies that there are no opportunistic behaviors. On the contrary, the control of these opportunistic behaviors means that the transaction costs are positive, and high (Lévêque, 2005, p. 38).
- iii) When the transaction costs are positive, we have to compare the transaction costs relative to the private negotiation and those relative to other modes of governance. In other words, the private solution does not systematically constitute the solution which minimizes transaction costs.

We can observe that this approach implies an *instrumental* conception of institutions, quite different from the Old Institutional one: the institution is conceived of as a tool which allows agents to choose the mode of governance which corresponds to the lowest transaction costs. The reality and the recent controversial debates about IPR do not correspond to these results: this debate shows explicitly that the definition of an IPR system is important in terms of the

economic interests of the different agents. The economic activity, the dominant positions and the funding mechanisms depends on the IPR system ⁴ .

This means that the IPR system must be conceived of as an *institutional form*, as the product of divergent economic interests: therefore, the economic activity is not independent from the initial IPR attribution.

II) The limits of the Coasian approach: another institutional alternative

1) Williamson's alternative

The question is, for Williamson, to establish, within the market rules, a positive relation between the asset's specificities and the amount of transaction costs (Williamson, 2002). Contrary to the standard neo-classical analysis⁵, Williamson asserts that the market rules defined by Walras do not produce, *systematically a first best*, in so far as they do not result in a Pareto efficiency. Williamson establishes that each type of asset, according to its own level of specificity, is related to a specific type of regulation which minimizes transaction costs: "*Transaction costs economizing is the unifying concept* (Williamson, 2000, p.180).

Specific assets present an irreversible feature: these costs are irreversible in that they cannot be the object of multiple uses (Saussier, Yvrande-Billon, 2007, p. 18). Unlike the neo-classical market, whose main feature is dealing with anonymous supply and demand, when it comes to this type of transaction, the agents' relationships are strongly individualized (Williamson, 2002, p.176). A *bilateral dependence* arises between buyers and sellers, in so far as their relationships are defined in a contract compatible with the IPR system in force.

We must also consider the existing relationship between the nature of contracts, the asset's specificities and uncertainty. The more specific the asset, the more important the uncertainty related to its economic valorization; a way to reduce uncertainty may consist of rising transaction costs. However, we must consider, more deeply, in what way transaction costs would enable the reduction of this uncertainty.

In the framework of a neo-classical analysis, assets are not specific, transaction costs are nil and, thus, the market is efficient. On the contrary, when an asset is specific, transaction costs are increasing and the best way to minimize these costs is to develop an intra-firm integration, a public management or a hybrid form (Williamson, 2000, p.604). It is interesting to observe that, in the case of a competitive market, the more important the uncertainty, the higher the asset price: thus, the asset offer-price incorporates a risk premium (idem). *Transaction costs include safeguard clauses, penalties, asymmetries of information, control systems and costs related to conflict resolution by an external authority* (Williamson, 2002, p183). Therefore, choosing a mode of governance depends on the relation between the price rising due to strong uncertainty and the transaction costs necessary to reduce this uncertainty. While transactions costs are less important than the price rising, i.e, the loss of collective welfare, the competitive market is not the best governance solution.

⁴ The debate about IPR and peer to peer networks is particularly representative. Concerning this subject, see Herscovici (2007).

⁵ By standard neoclassical analysis, I mean the approaches which use substantive rationality hypothesis and optimal adjustment realized by markets. This conception is similar to that of Favereau. (1990) and of Hodgson (1998).

In regard to the specificity of the assets, regulations specific to digital economy are not those defined by the Walrasian framework ; they require other modes of production and distribution for goods and services: networks, clubs or other types of *community governance* (Herscovici, 2008).

2) *Private mechanisms: limits and complexity*

2.1 *Complexity versus substantive rationality?*

We can point out various limits to the Coasian analysis regarding the hypotheses related to the commodities' economic nature and the agents' behavior:

i) The goods cannot be specific, in Williamson's sense: if the goods are specific, the transaction costs level necessary to contain the uncertainty may be high (Williamson, 2000). When the assets are specific, the market does not constitute, systematically, the most efficient mechanism to internalize the externalities. For the same level of asset specificities, it is necessary to compare the transaction costs level which characterizes each kind of governance: the private one, the intra-firm integration, the public (or institutional) one, the hybrid ones, and all forms of community governance.

The specificity may be defined from the following characteristics: (a) the irreversibility asset, in that it cannot be the object of multiple uses; the investment represents irreversible costs and cannot be used to produce other types of goods (b) the relationships between supply and demand are highly individualized; there is a bilateral dependency between buyers and sellers. In regard to IPR, owing to the cumulative production aspect, it is possible to speak of *multilateral dependency*. These specificities explain the *behavioral uncertainty* which characterizes these markets.

ii) Part of the goods are *experience goods*; the price system does not transmit their qualitative characteristics. The uncertainty related to these qualitative characteristics must be compensated by other mechanisms: a brand name strategy, shared information communities, and so on. This kind of mechanism, necessary to the market coordination, translates some type of transaction costs related to the differentiation strategies, to the formation and coordination of shared information communities, or to monitoring activities⁶. These markets are not Walrasian ones, in that the transaction costs are positive, in that the prices system does not transmit, freely, all the information necessary to implement the transactions.

The agents' behavior is characterized by various types of information asymmetries: on the one hand, the relationships between producers and consumers do not allow the evaluation of the good's utility or the asset's marginal product. The price system is *noisy* and can spread false information concerning quality (Akerlof, 1970). Consequently, it is not possible to maximize microeconomic utility or profit functions, nor is it possible to determine the precise extent of PR. On the other hand, these goods are, at least partially, non exclusive and non rival. Possibilities for opportunistic behavior appear. The club operating may be harmed by free rider behaviors⁷; it is a form of moral hazard.

⁶ The communities' online development, for example.

⁷ See Herscovici 2007.

Unlike the Walrasian approach (the central auctioneer), or the Rational Expectations Theory (continued market clearing hypothesis), for the New Institutional economy, the central problem is market coordination mechanisms, in the way the Walrasian natural adjustment does not work any more.

We can observe two positions: Coase maintains the substantive rationality and the non specificities goods hypothesis, and advocates the market mechanism to negotiate the PR. This means, in the last instance, that the contracts are complete and that, in this universe, there is no uncertainty; in this way, *he maintains a relationship with the neoclassical framework*. On the contrary, Williamson's analyze constitutes a *rupture* in regard to the neoclassical/Walrasian construction, in the way he does not adopt the substantive rationality and the ergodic hypothesis: the agents' rationality is limited and the contracts are intrinsically incomplete.

How is it possible to define this *complexity*? This concept is a multidimensional one:

- i) concerning the cumulative character of the production knowledge, the complexity may be defined by the uncertain economic valorization: hold-up strategies are common and result in uncertain valorization.
- ii) The PR concept was extended to process and is no longer limited to inventions. It is nearly impossible to identify all the possible applications of a determined process; consequently, it is impossible to anticipate the marginal product of this asset, and to identify all these possible applications, as shown by the legal conflicts in sectors intensive in knowledge (the software and pharmaceutical industries, for example).
- iii) As regards consumption, the complexity and the quantity of information and knowledge embedded in these goods are so important that is no longer possible to evaluate the utility ex-ante. Moreover, this utility depends on the social consumers' differentiated tacit knowledge.

The theoretical and empirical consequences are the following ones: the agents' rationality is, intrinsically, bounded. These limits can be explained by the product's complexity.

- i) The universe is characterized by uncertainty. Some authors speak of behavioral uncertainty (Saussier Yvrandre Brillon, 2007), in function of the uncertainty which characterizes the impossibility to anticipate the agents' behaviors. At this respect, the theory games shows that the equilibrium is not a Pareto's equilibrium. This uncertainty is too epistemic and looks like strong uncertainty in the Post-Keynesian sense. This uncertainty is also related to the economic valorization asset and, thus, to its marginal product.
- ii) The contracts are incomplete, in regard to this complexity, in that it cannot anticipate all the possible "states of the universe", be it in terms of agents' behavior, be it in terms of capital marginal product.

In fact, it is possible to affirm that the complexity of goods and services is a permissive condition in regard to opportunist behavior development. Moreover, the impossibility of implementing an efficient IPR system broadens this trend; finally, the coordination problem is fundamental, as shown by the economic studies of the online communities (Curien N., Fauchart E., Laffond G. and Moreau F., 2005).

2.2 From bounded rationality to uncertainty: the institutional solution

It is necessary to study the nature of uncertainty. Williamson adopts the bounded rationality hypothesis; in this sense, the uncertainty may be accounted for by the agents' limitations concerning their cognitive capacity to organize and collect the available information. In other words, the uncertainty may be explained from the agents' cognitive limitations, but the universe is ergodic and the different states of the world are finite and knowable.

The uncertainty may be explained by the existence of bilateral relations and of free rider behaviors, i.e., behavioral uncertainty (Saussier, Yvrande-Billon, 2007, p. 21) . What is the nature of this uncertainty? There are two possible answers:

i) For the first one, the uncertainty is entirely defined by the agents' cognitive limitations, and the universe is ergodic (Slater and Spencer, 2000). In this sense, there is not strong uncertainty, in the Post-Keynesian sense (Idem, p. 61).

ii) On the other hand, the second interpretation shows that there is a relation between these two types of uncertainty: when there are opportunist behaviors, it is not possible to predict the different strategies of the agents; so, it is not possible to know all the states of the universe. The behavioral uncertainty implies strong uncertainty, and the asset's specificity is an endogenous variable (Saussier, Yvrande-Billon, 2007, p. 75); it allows the existence of strategies to benefit from monopoly or oligopoly rents, in relations to the IPR system.

I will interpret Williamson's analysis concerning the second interpretation: it allows people to emphasize the oppositions between Williamson and Coase, and to justify the existence of incomplete contracts. The New Law and Economics adopts the hypotheses of substantial rationality and of assets no specificity; the contracts are complete and there is no strong uncertainty. Despite the rupture with the neoclassical economy, the Coase analysis keeps a narrow relation with Walrasian economy, by the fact that it adopts the same ontological hypothesis: the substantive rationality and the ergodicity. On the contrary, for Williamson, the contracts are incomplete and the IPR system intrinsically imperfect. This imperfection may be explained by information asymmetries and by opportunistic behaviors, but also by the nature of the economic universe.

Once the existence of uncertainty has been admitted, the contradiction takes this form: the general problematic developed by Williamson consists of choosing the mode of governance which *minimizes* the transaction costs for a determined specificity level (2002). However, this implies that the agents use a substantive rationality, in an ergodic universe. If the rationality is bounded, and the universe not ergodic, the agents cannot implement this choice: *it is impossible, on the one hand, to make compatible bounded rationality and no ergodicity hypothesis and, on the other hand, the choice of a mode of governance which minimizes the transaction costs*. At least, if we consider that the universe is ergodic, in the long term, the transaction costs are negligible, and the markets constitute the most efficient social mechanism (Slater & Spencer, 2000, p. 79, Langlois & Robertson, 1995).

From an Old Institutional perspective, I will choose the strong uncertainty thesis; the choice does not allow us to minimize the transaction costs, but it leads to an intermediated situation (*a satisficing approach*), between the lowest and the highest transaction costs level (Williamson, 2002, p. 174.). So, *it is possible to establish a comparison between the governance concept and the regulation one*, in the way it is defined by the French Regulation School. In this perspective, the governance is implemented far from maximization mechanisms and from the long term equilibrium that the system reaches. This interpretation focuses on the *historicity* and the role of the institutions in the regulation process.

Finally, the IPR system is not conceived of only as an instrument which allows us to minimize transaction costs, but as an *institution*, where the historical and social dimensions are incorporated. The IPR system is a compromise between antagonistic social forces, a compromise which enables market regulation. The IPR system is the product of the social and political forces which characterize a determined historical period, i.e., the “codification of one or of various social relations” (Boyer, 1987, p. 48). The IPR system is not a neutral instrument which permits achieving an optimal situation, but a complex institution which can be modified in terms of social, historical and economic evolutions.

As noted by Bowles and Gintis (2000), in some situations which include “social capital”, community governance is more suitable for managing opportunistic behaviors and for coordinating the activity of the whole community; when part of the capital is social, meaning common to a community, the markets and the State cannot obtain all the informations necessary to coordinate all the individual activities. We can observe these mechanisms with the cooperative banks system in some emerging countries, for example.

Likewise, a number of heterodox analyses consider that the price is a social convention (Hodgson, 1998, p. 175) or the product of a collective belief (Orléan, 2006, p. 3). This means that the market is not conceived as a self-regulating and autonomous instance, determined in an exogenous way, that the substantive rationality is not a realistic premise and that the economic value cannot be determined in a “objective” mode, because it is the product of these beliefs and institutions⁸.

3) Some formalization

3.1 The choice of an efficiency criterion

The choice of a maximization criterion may be expressed by the following relations:

$$MPr = \text{Pigouvian tax} + Mc \quad (1)$$

$$\text{Pigouvian tax} = \text{disutility} \quad (2)$$

(with MPr as the marginal product and Mc as the marginal costs)

The relation (1) means that the polluter will increase his production until his marginal product is equal to the marginal cost plus the Pigouvian taxes; the capital marginal product is decreasing, and the capital marginal cost is increasing.

The relation (2) means that the polluted will accept the Pigouvian tax as far as this tax is superior or equal to his disutility.

⁸ Orléan (2006) speaks of self referential value (*valeur autoréférentielle*)

The Pareto criterion is related *simultaneously*, to (1) and (2): it means that the PR allocation maximizes the total welfare and the income distribution.

On the contrary, the Kaldor-Hicks criterion only considers (1): the product will increase only if the MPr is superior to all the costs supported by the polluter firm. For that reason, the Pigouvian tax will not be systematically implemented: in this way, the MPr will be superior to the costs and so, the total product will increase. The elimination of the redistribution problem by eliminating the pigouvian tax is the only way to increase total product.

3.2 *The private negotiation limits: the impossibility of implementing a substantive rationality*

Moreover, the necessary conditions to implement a private negotiation are the following: it must be possible to evaluate (a) the polluter's marginal product and (b) the polluted's disutility.

I will show why it is impossible to concretely implement such a private negotiation:

i) In the way the goods and services are complex, in the sense I defined this concept, the speculative dimension does not permit us to evaluate, ex-ante, the capital marginal product; consequently, it is impossible to evaluate the marginal product and thus to maximize the production function.

ii) In the same way, part of the cost the producer will have to pay eventually depends on the disutility of the polluted; this disutility is intrinsically subjective, and cannot be evaluated ex-ante; so, part of the cost the polluter will have to pay is not predictable.

ii) In a more general perspective, if we consider that the rationality is bounded, in Simon's sense, it is not possible to evaluate all the negative and positive externalities related to this kind of capital; consequently, it is not possible to evaluate the polluted's disutility, nor the polluter's marginal product.

Finally, the maximization mechanism implies that the marginal product must be decreasing (relation (3)). On the contrary, the knowledge production is cumulative: so, its marginal product is increasing⁹, and the traditional maximization mechanism is no longer valid.

It is possible to make the following observations: Coase's analysis limits may be explained in regard to the intangible capital economic specificities, which are ignored in this approach.

3.3 *Technological innovation and private mechanisms: the limits in terms of efficiency*

Concerning complexity and bilateral (and multilateral) dependency, it is possible to consider the following situation: there are two firms which offer the complementary technological processes to use a certain technology. For example, each firm offers a specific algorithm, and the software production depends of these two different algorithms (it is possible to extend this reasoning to n firms).

Lets us write the following equations:

$$Pa = pa.qa + Ea/b \quad (5)$$

$$Pb = pb.qb + Eb/a \quad (6)$$

⁹ This result comes from the endogenous growth theories, or from knowledge economics.

$$TC = p_a \cdot q_a + p_b \cdot q_b \quad (7)$$

where p is the price at which the firm sells the technology, q is the amount sold and TC is the cost related to the technology acquisition. $E_{b/a}$ represents the externality produced by A and endogeneized by B, $E_{a/b}$ the externality produced by B and endogeneized by A.

We can suppose that, at first, A decreases its price; regarding bilateral dependency, the firm which will buy the complete technological process will have to buy one segment from A and the other one from B. If B maintains its prices constant, and if A decreases its price, $E_{a/b} = 0$, and $E_{b/a}$ is positive; B benefits from the externalities of demand produced by A, i.e., benefits of the demand increase produced by A. A produces a demand externality, which benefits B.

Coordination failures appear: the price decrease depends on A's anticipations concerning B's strategy (and vice-versa). The market is not systematically the most efficient mechanism: in 2, 3 and 4, TC is higher than it would be if there was only one technology producer. In this case, it is possible to speak of *technological costs sub-additively*. This situation can be explained by opportunistic behaviors from B, in this situation.

Table 1 Coordination failures

	$\searrow p_a$	p_a constant
$\searrow p_b$	1	2
p_b constant	3	4

Situation 1 corresponds to the market efficiency, in that CT is minimized; all the other situations are sub-optimal, in that CT is not minimized.

Concerning this sub-optimality, a Pigouvian tax implementation permits us to neutralize the opportunistic behavior (Rosenkranz S., Schmitz P.W., 2006):

$$P_a = p_a \cdot q_a \quad (8)$$

$$P_b = p_b \cdot q_b + E_{b/a} - T_x \quad (9)$$

$$TC = p_a \cdot q_a + p_b \cdot q_b \quad (10)$$

(with T_x as the Pigouvian tax, and p as the price of the technology)

The T_x growth rate must be superior to the q_b growth rate to neutralize the positive externality $E_{b/a}$; this mechanism will encourage B to diminish its prices, and will be able to eliminate the behavior of free-riders. Any other institutional mechanism (rules, beliefs, conventions, community governance, clubs, and so on) may assume this control in the same way.

This theoretical result is paradoxical: *the private negotiation and the market efficiency cannot be implemented without governmental (and/or institutional) intervention*. In other words, the market cannot be efficient without institutional intervention; this is necessary to prevent opportunistic behaviors and to maintain the social efficiency conditions.

Conclusion

In conclusion, it is possible to affirm that the IPR (and the PR) private negotiation is not systematically the most efficient social instance: when it comes to the goods' specificities and complexity, to the asymmetries of information which characterize these markets, the private solution limits appear soon.

The transaction costs level produced by a market regulation is, in various situations, higher than that produced by other kinds of governance. The limits of the "neoclassical" analysis may be explained by the fact that these analyses do not take into account the transaction costs produced by a private regulation. Regarding the complexity, in the way I defined this concept, the pertinent problematic is not the one evaluated in terms of production costs and private costs; on the contrary, *the analysis also has to consider the transaction costs and the collective costs related to these mechanisms*.

On the other hand, the PR and the IPR cannot be conceived as a neutral instrument that allows us to minimize the transaction costs: (a) as institutions they are the product of divergent interests, and they are historically determined (b) if we adopt the non ergodic hypothesis, it is not possible to implement, concretely, a minimization process.

From Coase's approach limits, this paper underlines the need for an institutional component to regulate the market activities and to choose a mode of governance which allows a reduction in the transaction costs. From an institutional perspective, and more specifically from the "Old Institutional" approach, this means that the market, i.e., the IPR private forms of negotiation, cannot be conceived as an optimal mechanism and as an auto-regulatory instance; this also means that the institutional variables are necessary to implement this market governance.

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