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Transaction Cost and Environmental Economics:

Towards a New Approach

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1 Introduction

"The New Institutional Economics (NIE) is an idea whose time has come". (Williamson 1998: 75). Unlike even one decade ago, most economists would nowadays agree with Williamson's statement. The research agenda of New Institutional Economics, which started with Coase's famous paper "The Nature of the Firm" published in 1937, finally took off and influenced significantly many areas of economics, law, politics, sociology, organizational theory and anthropology. Now, the stage has come where NIE is entering more and more economic classrooms and textbooks (e.g. Richter and Furubotn 1997, Kasper and Streit 2000). Institutions and transaction costs matter and they are susceptible to analysis by the tools of economic theory, that's the central message of NIE (Williamson 2000: 595).

The success of NIE and in particular of "The Nature of the Firm" is to a large extent related to the work of Oliver E. Williamson. The book "Market and Hierarchies" published in 1975 advanced Coase' (1937) argument of firms and markets as alternative modes of coordinating economic activities, operationalized the concept of transaction costs and developed a research agenda for New Institutional Economics. Since then, Williamson contributes significantly to the research agenda of NIE and in particular to Transaction Cost Economics (TCE) (Williamson 1985, 1996, 2000). This research agenda proved to be

successful not only in terms of theory, but also in empirical research, which is very much supportive to theoretical concepts developed (e.g. Shelanski and Klein 1995; Williamson 1998).

Environmental and resource economics are surprisingly little affected by these developments. Although there are some exceptions from the rule (Ostrom 1990; Bromley 1989, 1991, 1992; Colby 1995; Challen 2000), one can say that compared to the field of industrial organization and in particular the theory of the firm, environmental and resource economists have made little use of the theoretical concepts developed in NIE (see Gawel 1996; Karl 2000). The work of Oliver E. Williamson seems to be almost unknown to most of the environmental economists.

This is somehow surprising since Coase's second famous paper "The Problem of Social Costs" published in 1960 has had a significant impact not only on NIE, but also on environment and resource economics. Every textbook in environmental and resource economics refers to "The Problem of Social Costs" (e.g. Hanley, Shogren, White 1997: 22-29, Perman et al. 1999). What these books mainly refer to, however, is the Coase Theorem. According to this theorem, private bargaining among relevant actors will solve the problems of harmful effects independent of the initial distribution of property rights as long as transaction costs are zero and property rights are well defined. However, as many environmental and resource economists argue, since transaction costs are not zero, state intervention is necessary. Ironically, Coase introduced the zero transaction cost argument exactly to criticize the logic of government intervention to solve harmful effects advocated by Pigou. Thus, it seems that the Coase-Theorem has prevented most environmental and resource economists from a deeper study of institutions and transaction costs.

Why had the two Coase papers such a different impact? Is the Coase Theorem really the essence Coase (1960)? Why has the work of Oliver Williamson had almost no impact on environmental and resource economics? Is it possible to apply the framework of Transaction Cost Economics also to the problem of harmful effects? These are the main questions the paper is dealing with.

First, I will discuss the different impacts of Coase's 1937 and 1960 papers. I will argue that although the papers share the same argument and the same message, they differ significantly in the way in which they approach the central problem of economic organization. This is one part of my argument. The second part is that different scholars, namely George J. Stigler (1966) and Oliver E. Williamson (1975), picked up the central argument and created some kind of path dependencies in economic thinking. Third, I will highlight on the impact of Oliver E. Williamson in the development of Transaction Cost Economics. I will address the question, why this approach has been so influential in industrial organization. I argue that there are mainly two aspects: (1) Williamson defines the transaction as the basic unit of analysis and (2) approaches the questions of the institutional structure in a comparative way based on transaction cost considerations. Forth, I apply the logic of TCE to the problem of harmful effects. I will show that the approach of Williamson can be applied to environmental economics too. Finally, I will discuss some implications of making the transaction to be the unit of analysis in environmental and resource economics.

2 Coase 1937 and Coase 1960: Brothers in Arms?

What are the differences, what are the similarities between these two important papers, "The Nature of the Firm" and "The Problem of Social Costs"? Why did they have so different impact?

In the "Nature of the Firm", Coase first developed his idea of comparative institutional economics. Coase defined markets and firms as alternative modes of coordinating economic activities, "*..in the view of the fact that co-ordination is usually done by the price mechanism, why such an organization [a firm] is necessary? Outside the firm, price movements direct production which is co-ordinated by a series of exchange transactions on the market. Within the firm, these market transactions are eliminated and in place of the complicated market structure with exchange transactions is substituted the entrepreneur-co-ordinator who direct production. It is clear that these are alternative methods of production.*" (Coase 1937: 388). Furthermore, he developed the idea of transaction costs as "costs of using the price mechanism" to organize transactions and the costs of organizing the same transaction inside the firm. The main argument is that only paying attention to the costs of market exchange enables us to understand the nature of the firm as a hierarchical allocation unit. Throughout the paper, the main message is that taking systematically the "costs of using the price mechanism" and the "costs of organizing transactions inside the firm" into account will enable us to better understand the internal structure of the firm as well as its size.

The "Problem of Social Costs" deals with the standard interpretation of harmful effects. In order to criticize standard interpretation in economics, Coase introduced and discussed the implication of a zero-transaction costs world. This main argument was that if there are no costs of using the price mechanism, and if the property rights are well defined, then the problem of harmful effects will be solved by the parties directly through contracting procedures. This argument later became to be known as the Coase-Theorem. It is remarkable that the chapter "The Costs of Market Transaction Taken into Account" only covers four pages. Coase himself regarded his analysis as inadequate. "*The discussion of the problem of harmful effects in this section (when the costs of market transactions are taken into account) is extremely inadequate. But at least it has made clear that the problem is one of choosing the*

appropriate social arrangement for dealing with harmful effects. All solutions have costs and there is no reason that government regulation is called for simply because the problem is not well handled by the market or the firm. Satisfactory views on policies can only come from a patient study of how, in practice, the market, firms and governments handle the problem of harmful effects." (Coase 1960, 1988: 118). The central message, to study the world of positive transaction costs and evaluate different social arrangements in a comparative way, although central for Coase, was somehow obscure in the paper.

Although the main message and research program of the 1937 and 1960 papers were quite similar: To study a world of positive transaction costs and evaluate different social arrangement based on total costs. The problem approach, however, was very different. The 1937 paper introduced the "costs of using the price mechanism" while the 1960 paper discussed the implication of a world without the "costs of using the price mechanism". Thus one may argue that the different ways in which Coase approached the problem were the main sources why environmental and resource economists did not start to incorporate transaction costs into their analysis more systematically. Another reason may be that it was mainly Oliver E. Williamson (1975) who picked up the main argument of Coase (1937) and it was George J. Stigler (1966) who created the term "Coase-Theorem". While Gorge J Stigler put his effort in formalizing the verbal arguments of Coase, Oliver E. Williamson tried to make transaction cost analysis more operational. With regard to Coase (1937) he remarked that *"Transaction costs were appropriately made as the center piece of the analysis, but these are not operationalized in a fashion that permits one to assess the efficacy of completing transactions as between firms and markets in a systematic way."* (Williamson 1975: 3).

3 Making Comparative Institutional Analysis Work: The impact of Williamson

Oliver E. Williamson has had a very significant impact on the theory of industrial organization, but up to now almost no impact on environmental and resource economics. Beginning with his 1971 paper "The Vertical Integration of Production: Market Failure Consideration", Williamson has continuously developed a research program most condensed in his books "Markets and Hierarchies" (1975), "Economic Institutions of Capitalism" (1985) and "Mechanism of Governance" (1996). The success of this research agenda is mainly based on three distinctive elements: (1) make the transaction the basic unit of analysis, (2) operationalize transaction costs by identifying its determinants and (3) align transactions with governance structures in a discriminating way so as to effect a mainly transaction-cost economizing result.

Williamson borrowed the central idea of the transaction as the basic unit of analysis from Commons (1932), who stated that *"the ultimate unit of activity ... must contain in itself the three principles of conflict, mutuality, and order. This unit is a transaction."* Williamson himself defined that *"a transaction occurs when a good or service is transferred across a technological separable interface. One stage of activity terminates and another begins"* (Williamson 1985: 1). A transaction, thus, links two activities. It can be regarded as an elementary coordination problem (Beckmann 2000: 35) as illustrated in Figure 1. If the activity a_i produces a good x_i ; that is necessary to perform activity a_{i+1} , the question arises how this transaction is completed. What makes the goods or services move? This definition is very much linked to the problem setting of Coase (1937), who remarked *"If a workman moves from department Y to department X, he does not do so because of a change in relative prices, but because he is ordered to do so."* (Coase 1937: 387).

If we take the transaction as an elementary coordination problem, the question immediately raises how the problem is institutionally solved. Williamson (1998a: 67) remarks: *"Transaction-cost economics concurs that the transaction is the basic unit of analysis and regards governance as the means by which order is accomplished in a relation by which potential conflict threatens to undo or upset opportunities to realize mutual gains."* This is illustrated in Figure 2, in which it is assumed that two individuals A and B perform the actions. The governance structure is the institutional matrix in which transactions are completed. This structure defines the property rights the individuals hold to perform an action. It is quite obvious that from this point of view the very same transaction can be governed by very different governance structures. Markets and hierarchies are therefore alternatives for completing the very same transaction.

In the world of private goods and services, transactions will not take place unless they are organized somehow. Thus, transactions are not without costs of organizing them and these costs are systematically influenced by a number of determinants. It is the central element of Williamson's approach. He identified four nowadays well-known determinants. (1) behavioral attributes of actors (bounded rationality, opportunism), (2) attributes of the transaction (uncertainty, frequency, asset specificity), (3) type of governance structure chosen (market, hybrid and hierarchy) and (4) institutional environment (property and contract law) (Williamson 1975, 1985, 1991). All four factors influence transaction costs in a predictable way. It is not possible to discuss the whole approach here. However, the way in which Williamson posed the problem created a rich research agenda, aiming at analysing different aspects of the picture.

For theoretical and empirical work, the discriminating alignment has proved to be central. Accordingly, *"transactions, which differ in their attributes, are aligned with*

governance structures, which differs in their costs and competence, so as to effect a (mainly) transaction-cost economizing result. Implementing this requires that transactions, governance structures and transaction-cost economizing all being described. What are the defining attributes of transactions? What are the attributes with respect to which governance structures differ? What main purposes are served by economic organization? How can transaction-cost economizing be accomplished?" (Williamson 1998a: 75). One of the central alignment hypotheses of Transaction Cost Economics is connected with the impact of asset specificity. The attribute of asset specificity refers a specialized investment that cannot be redeployed to alternative uses or by alternative users at a loss of productive value. Specific assets create bilateral dependencies, which complicate contractual relations. Therefore, markets as a governance structure give way for hybrids and finally for hierarchies as the level of asset specificity increases as it is illustrated in Figure 3. The economic reason is that hierarchies allow for administrative controls and for co-operative adaptation, which is particularly advantageous in the presence of bilateral dependency. The attributes of different governance structures are indicated in Table 1.

4 Can Transaction Cost Economic be applied to advance Coase 1960?

Why has Williamson had no real impact on environmental and resource economics. There may be two reasons. First, the unit of analysis, the transaction, may not be adjusted to the problem setting of environmental and resource economics. Second, the main focus on markets and hierarchies may be not adjusted to the solution set discussed in environmental and resource economics, which focuses very much on state intervention and the choice of instruments by governments. In the following, I will discuss both arguments and show that the logic of Williamson can indeed be applied to environmental and resource economics.

4.1 Transactions and Harmful Effects

If we take the transaction in the above definition by Williamson, then, a harmful effect has to be regarded as a harmful transaction. Harmful effects definitely create frictions, and the institutional structure may be designed to reduce these frictions. Consider the example of Coase (1960: 97) on "*straying cattle which destroys crops on neighbouring land*". In this case it is not the workmen who should move from X to Y that creates the problem, but it is the cattle that moves and destroys crops on neighbouring land. The harmful effect creates a problem connected with the question how this problem is institutionally solved. What is the governance structure? Who has the property rights? Who is liable? This exactly fits to the definition of a transaction as an elementary co-ordination problem. However, in contrast to mutually beneficial transactions, where the institutional structure is designed to make transactions easier, the institutional structure for harmful effects is often designed to prevent harmful transactions. There is another difference: mutually beneficial transactions may not take place unless a contract is written, while harmful transaction may take place even if no contract is written at all.

The reason for harmful effects to be a problem is obviously related to bounded rationality and opportunism. If bounded rationality would not exist, harmful effects could be contracted on even before they take place. If opportunism would not exist, actors could always solve the problem by admitting that they would solve every problem in a mutually beneficial way. Thus, bounded rationality and opportunism pose the same problem for harmful effects than for mutual beneficial transactions.

If we agree that a harmful effect is a transaction, then, the logic of Williamson should also be able to work for harmful effects. What has to be done? We have to identify the attributes of harmful effects. And we have to assess the attributes to which governance structures differ.

The final step is to align governance structures to transactions in a discriminating way based on transaction cost minimizing considerations.

It is interesting that harmful effects haven't been attributed very much in environmental and resource economics. The only attempt to distinguish between different harmful effects is made by Maler (1990). He mainly distinguishes externalities on the basis of the analogy of market structures. Like the market structure is defined by the number of buyers and sellers, the situation of harmful effects can be characterized by the number of polluters and victims.

The attributes on which Williamson would distinguish harmful effects are: uncertainty, frequency and asset specificity. The first important characteristic of harmful transactions is uncertainty. It may be uncertain if harmful effects occur and this creates problems of writing contingent claims contracts. The uncertainty could be related to the time, place and extent to which harmful effects may take place. It could also be related to the causes and causality of harmful transactions. Even if someone recognizes the harmful effect, it may be very difficult to identify the one who caused the effect. Another uncertainty can be related to quantity and quality of the harmful effect. It may be very difficult to measure the effect in terms of quantity and quality. This is related to the measurement branch of transaction cost economics (Barzel 1982). The frequency of the harmful transaction is important too. Harmful effects that occur only very occasionally may be very difficult to foresee. Advanced governance structures only pay off if the frequency is high.

Unlike uncertainty and frequency, asset specificity may be more difficult to translate for harmful effects. Usually asset specificity describes the extent to which an asset that is necessary to carry out a mutually beneficial transaction will lose in value if the transaction is terminated. This is difficult to translate for the case of harmful transactions. However, if those

causing harmful effects have made specific investments, they are much more likely to create an advanced governance structure to reduce the likelihood that those activities will be stopped because of their harmful effects. In general, it could be true that with the level of specific investments the conflict costs increase and this requires more advanced governance structures. However, it becomes very clear that specific investments in activities that potentially cause harm or are affected by harm are extremely important. The conflict costs are likely to increase with the specificity of the investments on both sides. Another interpretation can be that the harmful effect by itself is specific, e.g. specific to a certain location, to a certain production system etc. This kind of specificity is directly related to the number of polluters or victims. The more specific the harmful effect, the less polluters and victims are involved.

The main attributes of harmful effects are summarized in table 1. It may be possible that this list should be continued or that it should be modified. However, it is the first step towards a more detailed analysis of harmful effects. The next step is to identify the attributes to which governance structures differ.

4.2 Markets, Firms, and Harmful Effects

What are the governance structures that can deal with the problem of harmful transactions? Coase (1960) discussed several alternatives: (1) bargains, (2) firms, (3) regulations, (4) courts and (5) taxation. How do these governance structures actually differ? What are their costs and competences? In how far can the attributes of the markets, hybrids and hierarchies framework carry over to the problem of harmful transactions? What are the attributes of courts and public regulation?

Before paying more attention to courts and regulations, we will first discuss the market versus firm alternative. Every careful reader of the "Problem of Social Costs" will recognise that Coase (1960) also discussed the alternatives of markets and firms to solve the problem of harmful effects. *"Within the firm individual bargains between the various factors of production are eliminated and for a market transaction is substituted by administrated decision. The rearrangement of production then takes place without the need for bargains between the owners of the factors of production. A landowner who has control of a large tract of land may devote his land to various uses taking into account the effect that the interrelations of various activities will have on the net return of the land, thus rendering unnecessary bargains between those undertaking the various activities. ...In effect... the firm would acquire the legal rights of all parties and the rearrangement of activities would not follow on a rearrangement of rights by contract, but as a result on an administration decision as to how the rights should be used."* (Coase 1960, 1988: 116). Thus, Coase applied the logic of "The Nature of the Firm" to "The Problem of Social Costs". The market or the firm could solve the problem of harmful effect. Therefore, the logic of Williamson's framework should be able to be applied to the problem of harmful transactions as well.

Every governance structure that has to deal with problems of harmful effects has to solve the potential conflict that exists. In addition to the attributes that are relevant for beneficial transactions, two instruments are important for harmful effects: prevention and compensation. In order to prevent harmful transactions, the activities may be separated, the interface may be controlled or the activities have to be organized in such a way that the likelihood of a harmful transaction is low. In contrast to prevention, compensation does not directly prevent harmful transactions but it assures that compensation payments are made to resolve the conflict.

The market analogy in the case of harmful effects is private bargains for compensation. The ex-ante decision making of the actors is independent and harmful transactions, if they occur, are only co-ordinated ex-post. Thus, only if a harmful transaction takes place the parties' will bargain the compensation. If they cannot reach a decision they may rely on the court to settle the dispute. This governance structure is based on compensation as the main conflict resolution mechanism and has only weak instruments for prevention. The private bargain mainly relies on the mechanism of incentives and not on administrative controls. However, as Coase (1960) already noticed, private bargain will benefit very much from the liability law.

The firm as an alternative governance structure relies on common ownership or centralized residual control rights. Both activities are decided in the same decision making unit. The potential harmful effect will be decided taking the effects of interrelated activities into account. The firm therefore has more instruments for prevention. If a harmful effect occurs, however, compensation is not necessary. The firm does rely mainly on administrative controls to handle problems of harmful effects and not on incentives. Furthermore it enables simultaneous adaptation. Dealing internally with harmful effects does not require support by the liability law.

The hybrid mode of governance, finally, is characterized by ex-ante coordination but instead of common ownership, a long-term contract or some hybrid organization is established that mediates the conflict. This hybrid form of governance enables ex-ante coordination to prevent harmful effects but at the same time use instruments of compensation. It combines incentive instruments with administrative control and simultaneous with autonomous adaptation. Hybrid modes of governance are supported partly by the liability law.

In summary, there are many similarities between the attributes of the governance structure for harmful effects and for goods and services. The only difference is that the governance structures differ in their prevention and compensation strategies and in the way in which they are supported by the liability law. The discussed alternatives are only private governance structures that may deal with the problem of harmful effect.

As already mentioned Coase (1960) introduce the third option, governmental regulation. He argues that in the case where many and diverse actors are affected by a harmful effect, governmental regulation may be preferable. The argument is that it may be very expensive to organize the harmful effects inside a firm if the firm has to integrate into many and diverse activities in order to control for harmful effects. Only very recently, Williamson (1999) extended the market, hybrid and hierarchy alternatives towards public regulations and public bureaus.

What are the relevant public governance structures that can deal with harmful effects, how can they be distinguished and how are private and public governance structures interrelated? The law and economic literature following Coase (1960) mainly focuses on different liability rules as an instrument for public governance, e.g. strict liability vs. the negligence (Galabresi 1970). Later, Shavell (1984a,b, 1987) extended the discussion of alternatives towards liability for harm versus regulation for safety. The relationship between liability and regulation continued to be discussed by Kolstad, Ulen and Johnson (1990) and Rose-Ackerman (1991).

In particular, Shavell (1987) developed a four-category scheme to organize the discussion of alternative governance structures for harmful effects. He distinguishes between ex-ante and ex-post and private and state initiated systems. This framework produces four alternatives. (1) tort liability (ex post, privately initiated), (2) courts injunction (ex ante, privately initiated), (3)

command and control regulation (ex-ante, state initiative) and (4) fines for harm done (ex-post, state initiated).

5 Conclusions

In environmental and resource economics, the units of analysis are typically (1) externalities (Pigou 1932), (2) public goods (Samuleson 1955), (3) resource utilization. (Hotelling 1935), and (4) common pool resources (Hardin 1968). All these units of analysis are mainly approached within a neoclassical framework that focuses on the problem of resource allocation. With the exception of common pool resources (Ostrom 1990, Bromley 1989, 1991, 1992) governance issues are usually not considered. From the governance perspective, adoption is the main problem of economic organization and not resource allocation. This paper shows, that the transaction as defined by Williamson may be a useful unit of analysis in environmental and resource economics. In order to take a step forward, we have to relate transactions to externalities, public goods and resources. However, we are just at the beginning of this important step.

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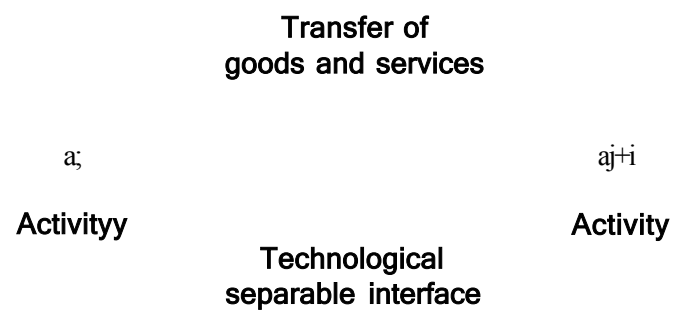


Figure 1: A Transaction
Source: Beckmann (2000: 35)

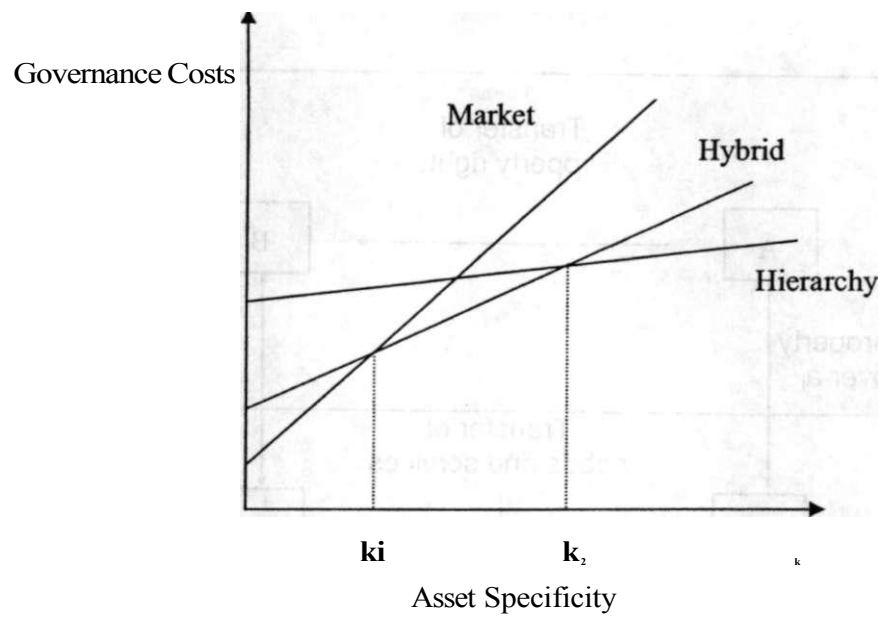


Figure 3: Matching Governance Structures with Transaction Attributes
 Source: Williamson (1996: 109)

Table 1: Alternative Governance Structures

<u>Attributes</u>	<u>Market</u>	<u>Hybrid</u>	<u>Hierarchy</u>
Instruments			
Incentive intensity	++	+	0
Administrative Controls	0	+	++
Performance			
Adaptation (Autonomous)	++	+	0
Adaptation (Co-operative)	0	+	++
Contract Law	++	+	0

Source: Williamson (1996: 105)

Table 2: Attributes of Harmful Effects

Category	Attributes
Number of stakeholders	- Number of polluters - Number of victims
Uncertainty	-Time, place and extent of harmful effects -Causes and causer of harmful effects -Quantity and quality of harmful effects
Frequency	-Number of harmful effects per time period
Specificity	
- Asset	- Specific assets by polluter - Specific assets by victim
- Harmful effect	- Location or site specificity - Production specific

Table 3: Alternative Governance Structures for Harmful Effects

	Ex-post Bargaining	Ex-ante Contracting	Integration
Prevention	0	+	++
Compensation	++	+	0
Incentives	++	+	0
Bureaucracy	0	+	++
Adaptive autonomy	++	+	0
Adaptive integrity	0	+	++
Liability Law	++	+	0

