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Using choice experiment to estimate the magnitude of transaction costs

Douadia BOUGHERARA* and Géraldine DUCOS*

*French National Institute for Agricultural Research (INRA), Department of Economics,
Rennes, FRANCE

ABSTRACT

There are at least two ways to enhance contract adoption: whether to adapt the payment or to change the governance structure, i.e. contract attribute levels. This paper shows the role of contract attribute levels on the decision to adopt a contract, *ceteris paribus*. It thus tries to evaluate and analyse the impact of contract attribute level on transaction costs. The choice experiment method appears to be relevant to yield euro estimates of transaction costs. This method is applied to analyse governance structure preferences of 171 farmers to which agro-environmental contracts with different attribute levels have been proposed. Results show contract attribute levels have a significant impact on transaction costs and mainly on maladaptation ones. A typology of sources of these maladaptation costs is also provided.

I) Introduction

There are at least two ways to enhance contract adoption : whether to adapt the payment or, to modify the institutional arrangement, i.e. contract attribute levels. The *price* is expected to solve incentive problems. The payment should be fixed according to measured performances and/or the value of assets after production occurs. Therefore, it should cover production costs, profit forgone and some transaction costs such as negotiation costs, contract writing costs, ... The *institutional arrangement* is also expected to solve incentive problems but it is expected to solve control and adaptation ones too. The level of contract terms or attributes should be chosen according to asset specificity and uncertainty (Williamson, 85) in order to reduce total transaction costs (including those mentioned above). They may thus play an important role in contract adoption.

The relation between some contract attributes and the characteristics of the transaction have already been tested. Crocker and Masten (1991) analyzed the processes by which parties adjust prices in natural gas contracts, Crocker and Reynolds (1993) examined incentives for parties to design incomplete agreements in Air Force engine procurement contracts. However, very studies estimate euro-values of transaction costs born by contract attributes. The present paper aims at evaluating and analysing the impact of different contract attributes, namely contract duration, contract flexibility and paperwork on transaction costs involved in agro-environmental contracts and more precisely those of the supply side as opposed to demand side's ones.

For that purpose, the choice experiment method initially developed in marketing and environmental economics seems to be relevant to yield euro variations of transaction costs. By having preferences on different contract attribute levels, production costs being constant, and assuming preferred governance attributes levels minimize the transaction costs of the supply side, this method differs from empirical researches in transaction costs economics. Moreover, estimated transaction costs are aggregates of transaction costs relative to the production of the quasi-rent, i.e. incentive and control transaction costs, and those relative to its sharing, i.e. adaptation transaction costs (cf. Ménard, 2004). The analysis requires thus a theoretical detour and hypotheses in order to distinguish the impact of contract attributes.

The choice experiment method is applied on a sample of 171 French farmers face to face interviewed in 2005 and leads to estimate their transaction costs when they enrol agro-environmental contracts differing from their governance attribute level. Sharing the quasi-rent appears to be a major source of transaction costs. We propose four sources of uncertainty with significant impact: the climate, the institutional environment, the market and the farm structure.

Section 2 describes the agro-environmental transaction and how contract attributes are expected to impact on transaction costs. Section 3 presents the choice experiment method and specification aspects. Section 4 provides econometric outcomes and concludes.

II) Transaction costs relative to hybrid organizations: the example of agro-environmental contracts

II.1) The characteristics of agro-environmental contracts

The degradation of environmental quality and rural landscape has resulted in a strong demand of rural amenities in European countries. However, farmers manage most rural areas, which leads environmental policies to be aimed at farming activities. Since the 1999-reform of the Common Agricultural Policy, the agro-environmental contract has become the main instrument used in the European Union to encourage farmers to produce environmental goods. This is a voluntary five-year contract between the State, represented by its local delegate, and the farmer who benefits a compensation to comply with given environmental friendly measure. The control mechanism includes an annual administrative control (100% of contracting farmers) and an on site detailed one (5% of contracting farmers). The farmer actually chooses agro-environmental practices among locally pre-selected ones by the State. Concerning the “winter cover on bare land” agro-environmental practice, where targeted objectives are to reduce erosion and nitrate leaching, environmental results are observable above a certain adoption rate only. This makes the participation rate crucial. So far, only 12% of commercial farms have chosen to enrol agro-environmental contract in France, which remains non satisfactory.

II.2) Eliciting the determinants of transaction costs of agro-environmental contracts

The choice of a particular contract arrangement relies on two dimensions: producing and sharing quasi rents (Ménard, 2004). *Producing quasi rents* pertains to the ability of the contract to create a quasi-rent. It involves dealing with contractual hazards arising from independent specific investments in an uncertain environment. Partners in a contract make nonredeployable investments that make them vulnerable to ex-post opportunism. Thus, they seek to protect their investments by including incentives and control clauses. *Sharing quasi rents* refers to the ability of contracts to distribute over time the gains generated by the contractual arrangement. Consequential uncertainty makes it difficult to specify *ex ante* how residual gains will be shared. In such an environment, contracts cannot be complete and, as a consequence, gains from exchange are subject to post-contractual opportunism by one party at the expense of the other. It leads to maladaptation costs. In choosing a specific contract, partners consider these two dimensions so as to minimize transaction costs associated with redeploying a specific investment or adapting the contract to unexpected situations.

Agro-environmental contracts may display these two features and agents are expected to choose a contractual form that displays attributes minimizing the two kinds of transaction costs. *First*, farmers investing in specific assets may face a hold-up situation that jeopardizes the production of the quasi rent. The measure “late mowing on meadow” is an example of a time specificity as the farmer is asked to protect meadow birds during nesting by forbidding mowing before July, 25th. There are also site specificity issues as measured requirements depends on farmer’s localization. *Second*, unexpected events may challenge the distribution of residual gains. Transaction costs associated with investments in specific assets are expected to be rather low whereas those related to contract maladaptation are critical. We provide a typology of factors that play a role on these costs. This is based on interviews with 30 farmers in Basse-Normandie (France).

Maladaptation costs represent transaction costs associated with a lack of flexibility of contracts in the face of uncertainty. Four types of factors generate costs when contracts are not flexible.

- *Climatic factors* refer to exceptional meteorological conditions that increase compliance costs for farmers. Concerning the measure "late mowing of meadows" still, the payment is designed to cover losses in the quality and quantity of hay because of late mowing. However, compliance costs for farmers as well as nesting depend on climatic factors. A non negotiable date does not take account of exceptional conditions and may put a damper on contract adoption. Note that some regions undertook (outside the EU regulation) initiatives that gather farmers and environmentalists to negotiate each year the mowing date as a function of weather conditions.

- *Institutional environment factors* are changes of the EU common agricultural policy, changes of land property rights where agro-environmental contracts are contracted, or changes of other policies like land takings for community facilities building. Our interviews revealed that some farmers regretted their agro-environmental contract uptake since decoupled single farm payments (introduced by 2003 EU Common Agricultural Policy reform) were set as reference to their production in years where their production could have been higher were they not engaged in agro-environmental contracts. Other farmers experienced problems on leased land especially because the owner wanted to stop the lease arrangement. Finally, when taking occurs, farmers have to shift or remove hedgerows for which they receive a payment. Even if the farmer is often not accountable for changes in institutional parameters, administrative procedures are complex and time consuming and, agro-environmental contract payments are often suspended until a decision is reached.

- *Market factors* refer to the evolution of output prices. Some measures (i.e. requirements) of agro-environmental contracts are specific to a production for example "low fertilization for corn". Then, farmers cannot change production during contract length whatever the evolution of corn prices. Funnily, a farmer said he would rather have a meadow than corn on a parcel but could not because of its contract.

- *Farm structure factors* relate to changes in farm organization. For example, administrative difficulties arise when individual farmers want to shift to another legal form like joint farming groupings (Groupements agricoles d'exploitation en commun - GAEC), or when they acquire or sell land plots.

III.3) Contract attributes as determinants of transaction costs

As said previously, agents are expected to choose the contractual form which minimizes total transaction costs. However, choosing one form over another has distributional consequences among partners in the transaction. We deliberately choose to focus on the minimization of transaction costs born by the supply side. We adopt the point of view of a regulator who wishes to increase contract adoption by lowering transaction costs born by farmers even to its detriment¹.

That said, each contract attribute has a specific impact on transaction costs. Indeed, in presence of specific assets and consequential uncertainty, contract duration increases maladaptation costs whereas contract flexibility will tend to reduce them. Moreover, contract attributes may also have antagonist effects on transaction costs. Still in presence of specific assets and consequential uncertainty, contract duration increases maladaptation costs but lower the costs of producing the quasi-rent. The estimation of the effect of contract attribute level on transaction costs requires thus to well identify attribute effects ex ante and to choose

¹ One obvious caveat to the study is that transaction costs born by the regulator are not taken into account. An on-going study deals with this issue.

attributes according to what is intended to be estimated. As an illustration, table 1 based on previous empirical studies shows how contract duration, contract flexibility and paperwork impact on transaction costs.

Table 1: Contract attribute effect on transaction costs

Contract attributes	Transaction costs for producing quasi-rent	Transaction costs for sharing quasi-rent
Duration	-	+
Flexibility	0	-
Paper work time	+	+

- indicates a decrease of transaction costs

+ indicates an increase of transaction costs

0 indicates weak impact

Joskow (1987) clearly shows contract duration is positively correlated with asset specificity, moreover Crocker et al. (1988) argue “larger quasi-rents are higher expected profits during the contract relative to after its expiration should lead to longer agreements, while more uncertainty and larger distortion in incentive provisions should lead to shorter-term arrangements”. Then, Saussier (2000) studies contract incompleteness, interpreted here as contract flexibility: “setting aside the cost of writing the agreement, the main costs incurred by a [less flexible contract] will be the information cost, the negotiation cost, and the potential ‘maladaptation costs’ or ‘renegotiation cost’ of being trapped in a bad contract”. He confirms when asset specificity and uncertainty are high, transaction costs linked with contract completeness (i.e. non flexibility) are higher than for an incomplete one (i.e. flexible one). Crocker et al. (1993) provide same conclusions. Finally, we assume paperwork to be positively correlated with costs for producing and sharing quasi-rent.

As far as agro-environmental contracts are concerned, “contract flexibility” is divided into 2 attributes : the freedom to choose which acre to enrol (“site flexibility”) and the freedom to negotiate other requirements in the contract (“other requirement flexibility”). This should allow to distinguish maladaptation costs born by site requirements from those born by other requirements. The next table presents contract attributes level chosen for the application of the choice experiment:

Table 2: Contract attributes and attribute levels chosen for the choice experiment

Contract attributes	Attribute levels
Contract duration (years)	5; 10; 20
Site flexibility	Yes; no
Other requirement flexibility	Yes; no
Average paperwork per month	< 30 min; 30-75 min; > 75 min
Premium (% of the reference contract payment per year and per hectare)	5%, 10%, 20%

As regard to the characteristics of the agro-environmental transaction, asset specificity is assumed to be globally low even if agro-environmental contracts engage time and site specificity². Indeed, investments are not significant and durable. They are actually actions, mowing for instance, whose machinery is redeployable for other uses. Uncertainty is assumed

² Time specificity comes from the value given to the respect of the mowing date for instance. Site specificity comes from the value given to the localization of certain agro-environmental practices.

to be high for reasons presented above. Moreover, Ménard (2004) argues "uncertainty is secondary to the existence of specific investments", but once partners get linked through specific assets, uncertainty plays a major role in decisions regarding the level at which partners will pool resources.

These characteristics being posed, it is thus expected to observe *first* that governance costs increase with the duration of the contract, indeed we assume distortion in incentive provision to overweight expected profit of having a longer contract, *second* that governance costs decrease with the flexibility of the contract, these costs being maladaptation ones due to extreme climatic conditions or market contingencies for example, and *third* that governance costs increase with paper work, these costs being bureaucratic ones due to the recording of operations and administrative procedures necessary to negotiate contract requirements.

III) The choice experiment and specification aspects

III.1) Using the choice experiment to estimate the magnitude of transaction costs

Initially developed in marketing, the choice experiment has then been applied in environmental economics in order to estimate the societal demand of environmental services (Adamowicz et al., 1994). This is here applied to estimate transaction costs supported by the supply side. This method keeps the same principle as contingent analysis ones where “scenarios” are defined and presented to interviewed persons with given prices. In this study, scenarios are agro-environmental contracts, a scenario being a combination of 4 contract attributes with given levels. The farmer is asked to choose 1 contract among 3 contracts and this 4 times, i.e. 4 sets of 3 contracts are presented (see table 3 for an example of set). The third contract (contract C) is the reference one, i.e. an agro-environmental measure the farmer is familiar with. The design of this experiment includes 24 sets in total. The principle is to use the information brought by individuals’ choices in order to infer the value of contract attribute levels considered in different contracts. The observation of this value is made possible by variations of proposed attributes and the observation of choices within these alternatives only. Nevertheless, this identification relies on simplifying hypothesis. In particular, interactions between attributes are assumed to not have any particular value for interviewed individuals, i.e. the value of an alternative is the sum of its attribute values.

Table 3: Example of a set of contracts (Fiche n°1):

Contract attributes	Contract A	Contract B	Contract C
Duration per year	5 years	10 years	5 years
Site flexibility	No	Yes	Yes
Other requirement flexibility	Yes	Yes	No
Paper work per month	< 30 minutes	30 min – 75 min	< 30 minutes
Premium	10%	20%	0%
Chosen contract			

Even if the choice experiment method presents some difficulties to disentangle production costs from transaction costs (see next part), it provides euro estimates of transaction costs and new types of outcomes. Indeed, empirical studies to date compare observed organizations which are confronted to a selection problem: transaction costs cannot be directly observed for

organizational forms not chosen (Masten et al., 1991). The choice experiment allowing effective comparison between contract attribute levels, it faces simultaneity and endogeneity issues. However, this method is based on revealed preferences one and introduces behavioural bias as opportunism, risk aversion or status quo bias for instance. Econometric treatment are then possible to improve estimations.

III.2) Economic specification

The economic specification has been adapted from Bonnieux et al. (2004).

Let's consider a utility maximizing farmer with an income constraint depending on farm profit. The restricted profit function, or short-term profit function, π^R , enables to derive the income from the on-farm activity with an agro-environmental contract that is attached to an area v (Dupraz, et al., 2003).

$$\begin{aligned} & \underset{m,v}{\text{Max}} U(m,v,Z^U) & (1) \\ \text{sc. } & m \leq \pi^R(p,v,Z^\pi) - TC(p,v,Z^C) + \rho v & \text{with } TC = TC_F(p,v,Z^C) + TC_V(p,v,Z^C) \\ & v \geq 0 \end{aligned}$$

The parameters of the utility function are the farmer's private consumption m , expressed in monetary value, the quantity v (number of hectares) of a given environmental service co-produced by farming activities, and Z^U the utility function characteristics. This function is supposed to be increasing, concave and differentiable in m and v .

The farmer's restricted profit function π^R represents the agro-environmental technology using the dual approach by a short-term optimization of products and production factor variables of price p . Z^π is the profit function characteristics. π^R is assumed to be convex.

A transaction cost function is distinguished from π^R , called $TC(\cdot)$. This function is assumed to depend on Z^C , the characteristics of the contract, p and v . It can be decomposed into fixed transaction costs, TC_F , and variable transaction costs, TC_V .

Finally, ρv is the agro-environmental payment associated to a commitment to an area v .

Resolving this program, we obtain the following relation describing the farmer's indirect utility:

$$U^* = U(m^*(Z^U, p, \rho, Z^\pi, Z^C), v^*(Z^U, p, \rho, Z^\pi, Z^C), Z^U)$$

In order to identify the impact of contract attribute levels, $a_{k_{cj}}$ being the level of the attribute k identified in the contract c from the set of contracts j , from the contract Z^C on transaction costs, production costs are required to be distinguished from transaction costs. One way to specify this distinction is to keep production costs constant when comparing indirect utility relative to different contract attribute levels:

$$U_{cji} = U(m^*, v(p, Z^\pi, Z^U, \rho, Z^C), Z^U) = U_i[v(\rho, a_{k_{cj}})]$$

U_{cji} is thus the indirect utility of agent i for the contract Z^C whose attributes a_k and ρ have a given level, ceteris paribus (same engaged investment v).

The rationality of the choice experiment is that agent i prefers a contract c in the set of contracts j .

$$U_{cji} = \text{Max}\{U_{1ji}, U_{2ji}, U_{3ji}\}$$

III.3) Econometric specification

The farmer's decision comes up to consider the following relation with B_i the utility variation for a given contract attribute level, a_{kcj} , instead of the reference one:

$$B_i = \Delta U_i = U_i(m^*(\rho_{cj}, a_{kcj}), v(\rho_{cj}, a_{kcj})) - U_i(m^*(\rho_{cj}^*, a_{kcj}^*), v(\rho_{cj}^*, a_{kcj}^*))$$

$$B_i \equiv U_i(a_{kcj}) + \eta_{cji} \equiv \sum_{k=1}^3 \beta_{ki} a_{kcj} + \beta_{vi} v_{cj} + \eta_{cji}$$

with : $v(\rho_{jc}, a_{kjc}) = v(\rho_{cj}^*, a_{kcj}^*)$

The calculation of implicit prices called willingness to accept (WTA) is simply the ratio of parameters associated to contract attribute levels and prices, namely β_{ki} and β_{vi} :

$$WTA_{ki} \equiv \frac{\beta_{ki}}{\beta_{vi}}$$

It is important to note the interviewer precised the farmer to express himself for a constant area v of a given environmental service. This leads the farmers to optimise with m only. Assuming $U(.)$ positive and concave with m , this comes to consider:

$$\Delta m_i^* = \Delta \pi^R(p, v, Z_i^R) + \Delta \rho_{cj} v - \Delta CT(p, v, Z_i^U, Z_i^R, \Delta a_{cj})$$

Production costs remaining the same, $\Delta \pi^R$ is equal to zero. The payment ρ thus only compensates utility loss and transaction costs and calculated implicit prices tend to measure a variation of transaction costs. Therefore:

- If $m^{*'} > m^*$, B_i is >0 and transaction costs are >0
- If $m^{*'} < m^*$, B_i is <0 and transaction costs are <0

Finally, this alternative choice probability corresponds to a standard conditional logit model that will be estimated with the likelihood maximum method (Greene, 1997).

IV) Results and discussion

IV.1) The sample

171 farmers were face to face interviewed in 2005 in the French region "Basse Normandie". The sample is quite representative. The most frequent farming systems are, by decreasing order: dairying, combined grazing livestock, field cropping.

Next table shows the main motivation of farmer's choice :

Table 4: Farmers' choice main motivations

Premium	7.6%
Paper work time	5.9%
Contract flexibility	16.4%
Contract duration	16.4%
Best trade-off between premium and contract terms	45%
Other	2.3%
Non commitment	6.4%
	100%

Non commitment refers to farmers non willing to enroll any proposed contracts.

IV.2) Results

Table 5 indicates estimates of coefficients β_k and β_v for the conditional logit model. Estimations are significant in every cases. The model adjustment quality is medium as the R^2 is 0,3.

The willingness to accept (WTA) corresponds to the supplement of premium that would maintain farmers' utility when the level of one contract attribute changes. As presented in the previous part, the WTA is interpreted as a variation of transaction costs.

Attribute signs must be interpreted in the following way:

- Contract duration: increase of the contract duration of 1 year from a 5 years minimum
- Site flexibility: to not have the possibility to negotiate land plot localization ex post.
- Other requirement flexibility: to have the possibility to negotiate contract requirements ex post.
- Paperwork: increase of the time spent on administrative tasks per month from 0 to 30 min, 30 to 75 min, more than 75 min
- Premium: increase of the proposed premium compared with the reference one per hectare from 5% to 10% and 20%

Table 5: Estimations of β_k and β_v

Contract attributes	Parameters	Std. error	Khi 2	Pr > Khi 2	Risk rate	WTA (%)
Contract duration	-0.09766	0.01060	84.9318	<.0001	0.907	1,63
Site flexibility	-0.53448	0.11838	20.3841	<.0001	0.586	8,83
Other requirement flexibility	0.59705	0.11503	26.9388	<.0001	1.817	-10,00
Paper work	-0.28405	0.06491	19.1475	<.0001	0.753	4,74
Premium	0.06023	0.00784	59.0446	<.0001	1.062	

Except for site flexibility, obtained parameters come up to expectations:

- Contract duration : A contract superior to 5 years is perceived as a constraint for the farmer. This support the hypothesis that governance costs increase with the duration of the contract. Maladaptation costs overweight expected profit of having a longer contract. Asset specificity born by agro-environmental requirements are thus rather low and maladaptation costs should come from identified factors of uncertainty in part 2, i.e. climate, institutional environment, market and farm structure.
- Other requirement flexibility: When farmers get the possibility to negotiate other contract requirements than operation localization, which limit them to time aspects, farmers are ready to receive a lower premium. The hypothesis that governance costs decrease with the flexibility of the contract is thus validated.
- Paperwork: This parameter shows the aversion of farmers to time passed on administrative tasks and confirms the hypothesis. The increase of the premium refers to time for control tasks and for administrative procedures to adapt the contract.

Concerning "site flexibility", this attribute has not been understood as it should have been. Indeed, the ex post condition was not precised during the interview and farmers express themselves on ex ante costs due to the non possibility to choose enrolled land plots. This parameter refers thus to production costs and not transaction costs.

IV.3) Conclusion

In this study, we conducted a survey on farmers to measure transaction costs of several governance structures. Each governance structure was a contract characterised by four attributes: contract duration, the freedom to choose which acre to enrol, the freedom to negotiate other requirements in the contract and paperwork. Our work uses an original method to overcome selection bias and yield euro-estimates of transaction costs. Transaction costs are shown to increase with contract length. Thus, transaction costs involved with contract length are mainly maladaptation costs and assets specificity is weak. Transaction costs also increase with contract non flexibility and paperwork. One main result of our study is the prominence of maladaptation costs as compared to other costs. We provided also a typology of sources of these maladaptation costs.

Public authorities can considerably increase the adoption rate of agro-environmental contracts by modifying the level of contract attributes without modifying the premium. Contract length could be reduced, or uncertainty could be mitigated (i) by introducing a mechanism of premium indexation on market prices³, (ii) by simplifying administrative procedures for contract modifications and thus making them shorter and reducing the period of maladaptation, (iii) by introducing new mechanisms of negotiation : for climate risks, a system of yearly negotiation with the different stakeholders for determining the distribution of the quasi rent may be developed as it is currently observed in some water management contracts, or by simplifying negotiation administrative procedures (creation of negotiation devices to reduce court recourses, possibility to turn to another production if more ecological).

This research leaves a number of issues unresolved. As regard to the choice experiment, assuming interactions between attributes do not have any particular value for interviewed individuals does not reflect the reality. Indeed, 45% of interviewed farmers (see table 3) explain their choices with a good trade-off between premium and contract attribute terms. Contract attributes must be chosen carefully to not select interacting attributes. This method introduces also behavioural bias which call for more developed econometric treatments. Moreover, this study is a first approach since chosen contract attributes cover several determinants of transaction costs and induce difficulties to disentangle effects. However, the theoretical analysis provides tracks to refine contract attributes. For instance, future research might explore the impact of attributes such as “freedom to delegate the choice of the operation date to a negotiation device”. Finally, other determinants of transaction costs no considered in this analysis may have significant effect on transaction costs. Among others, Oström (1990) identifies factors affecting the success of common pool resources management. We are currently dealing with such issues notably pertaining to the institutional environment (for example, how are contracts designed?).

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³ One disadvantage is that it would interfere with the first pillar of the common agricultural policy.

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