EVALUATING THE POTENTIAL CONTRIBUTION OF CONTRACT AUCTIONS TO AEP'S EFFICIENCY

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Abstract

Agri-Environmetal Policy (AEP) application raised a wide debate about the determination of payment levels and the efficiency of the economic instruments used. In particular, some aspects support the hypothesis of relevant rents due to an overcompensation of farmers' compliance costs. A policy tool suitable for improving the efficiency of AEP can be the adoption of auctions mechanisms in contract allocation. In theory, in an auction mechanism, the farmers have incentives to reveal their compliance costs, helping to reduce the information rents and increase cost-effectiveness. A crucial problem therefore arises from the uneven distribution of information between landowners and the public administration. Auctions mechanism can be useful in reducing opportunistic behavior that arises due to these information asymmetries. The aim of this work is to simulate the potential contribution of auctions mechanism to the efficiency of Agri-Environmental contracts in Emilia Romagna Region (Italy). The results give some indications about the efficiency of auction mechanism compared to other contract mechanism.

Key words: Auction, Agri-Environmental Policy, Information asymmetries.

1. Introduction

The EU agri-environmental policy may be seen as a contract where public administration purchases public environmental good or service from private landholders. The increased importance of environmental contracting has not been reflected in new policy design or implementation. The EU conservation schemes offer usually a single, fixed payment that has to be able to compensate compliance cost. Different innovative mechanisms could be applied with the aim to reduce the sovracompensation and increase the efficiency. One proposal is to adopt auction mechanism in which the competitive bidding has to reduce the sovracompensation and encourage landholders to esplicitate their true compliance cost (Latacz-Lohmann and Van Der Hamsvoort, (1997), (1998); Hailu and Schilizzi, (2004); Klemperer, (2002); Mcafee, and Mcmillan, (1987). Laffont, and Tirole, (1993)).

Auctions for natural resource management have been implemented in USA and Australia and this mechanism is clearly included in the EU framework for rural development for the years 2007-2013 (reg. 1698/2005).

The public administration has two alternatives: to establish the target of land under contract or to fix the budget available; in both cases the landowner has to set his price considering his true cost.. In the case of fixed target auction, the public administration it doesn't know the final overall expenditure that could be excessive. The disadvantage of the fixed budget auction is that is not possible to know the amount of land under environmental contract that could be very low, decreasing the policies efficiency. In the literature, there are few contributions about fixed budget auction, even if this mechanism is the more realistic (Schilizzi, and Latacz-Lohmann, (2005)). In the field of environmental policy, the hypothesis of budget constrained auction probably reflects better the general political priorities, budgets are usually given for environmental programs.

Auction theory is well developed for target constrain, but not for budget constrain auctions. As a result, there is a gap between what is understood by economic theory and what is common practice.

The aim of this work is to simulate the potential contribution of auctions mechanism to the efficiency of Agri-Environmental contracts in Emilia Romagna Region. This study focused on the budget constraint model of auction compared to other contract mechanisms.
The paper outline is the following. Section 2 describes the methodology adopted, followed, in section 3, by the results of a case study. Finally some discussion is provided in section 4.

2. Methodology

The model used in this paper is based on the budget constraint (BC) model proposed in Lactaz-Lohmann and Van der Hamsvoort (1997). The hypothesis is that the farmer knows perfectly his profit both in the conventional production ($\prod_0$) and under agro-environmental contract ($\prod_1$)[1]. The farmer profit is expressed by hectare without the agro- environmental payment.
In order to participate in the agro-environmental contract the farmer has to receive a payment that must be at least equal to his opportunity cost of participation $(\Pi_0 - \prod_1)$. The farmer will submit a bid *b* if the expected utility in case of participation exceeds his reservation utility:

$$U(\prod_1 + b)[1 - F(b)] + U(\prod_0)F(b) > U(\prod_0) \quad (1)$$

where:
1-F(b) = probability that the bid b is accepted;
b = individual farmer bid;
$U(\cdot)$ = a monotonically increasing, twice differentiable von Neumann-Morgenstern utility function.
We assume that there are no transition costs in preparation and implementation of the bid, that payments are only a function of the bid and farmers are risk neutral. Then the farmer problem is to decide the optimal *b* which maximizes the expected utility (on the left hand side of (1)) over the reservation utility (on the right hand side of (1)).
Obviously, the main aspect is the trade-off between the bid and the probability to be accepted, an higher bid increase the net profit but has less probability to be accepted. If the farmer simply maximizes the net payoff, the formula (1) can be simplified in:

$$(\prod_1 + b - \prod_0)[1 - F(b)] > 0 \quad (2)$$

Maximizing the formula (2) related to b, we obtain the optimal bid:

$$b^* = \prod_0 - \prod_1 + \frac{[1 - F(b)]}{f(b)} \quad (3)$$

[1] Note that $\prod_1$ may include profit from employment outside farming if the farmer gives up all of his farming activities and has no alternative employment.

At this point, we need to introduce some assumptions on the distribution of the farmer's expectations about the range of accepted bid. Considering the simplest distribution, we assume that expectations are uniformly distributed in the range [$\underline{\beta}$, $\overline{\beta}$], where $\underline{\beta}$ and $\overline{\beta}$ are respectively the minimum and the maximum expected accepted bid. With this hypothesis the optimal bid can be obtained as:

$$b^* = \max\left\{\frac{\prod_0 - \prod_1 + \overline{\beta}}{2}, \underline{\beta}\right\} \quad (4)$$

s.t. $b^* > \prod_0 - \prod_1$.

Formula (4) shows that the optimal bid is obtained by the maximum between the half sum of compliance cost plus the maximum expected bid and the minimum expected bid. The optimal bid is an increasing linear function of participation cost ($\prod_0 - \prod_1$) and maximum expected bid $\overline{\beta}$.

We suppose that the compliance cost is a function of surface under agro-environmental contract θ. We use $h(\theta)$ to represent the cumulative compliance cost and $h'(\theta) = \prod_0(\theta) - \prod_1(\theta)$ as the marginal cost where the profit is a function of the surface θ. Now the optimal bid could be represented as a function of each farm:

$$b^*_{rn}(\theta) = \max\left\{\frac{h'(\theta) + \overline{\beta}}{2}, \underline{\beta}\right\} \quad (5)$$

where the optimal bid is related to the compliance cost that depend to the surface under contract. When $\underline{\beta} = 0$, the total cost of public administration is equal to:

$$K = \frac{h(\theta) + \overline{\beta}\theta}{2} \quad (6)$$

In the hypothesis of a fixed budget (*B*), the public administration will maximize the surface area uptaken (θ) with the constraint:

$$\frac{h(\theta) + \overline{\beta}\theta}{2} \leq B \quad (7)$$

From the formula (7) it is possible to obtain the maximum surface uptaken as:

$$\theta = \frac{2B}{\overline{\beta}} - \frac{h(\theta)}{\overline{\beta}} = \frac{2B - h(\theta)}{\overline{\beta}} \quad (8)$$

This result could be compared with one obtained in the situation of a flat payment per hectare. In this case supposing a complete information on the compliance cost by the decision maker, he can fixed the payment equals to the compliance cost, then the maximum θ is achieved as:

$$\theta = \frac{B}{h'(\theta)} \tag{9}$$

In general, in a more realistic context, the public administration cannot determine the compliance cost of each farm, then the maximum surface is:

$$\theta = \frac{B}{gh'(\theta)} \tag{9'}$$

where *g* represents the surplus indicating the difference between the compliance cost and the payment. Assuming that the farmers know their costs, the coefficient *g* assume values equal or greater than 1. The surplus when $g>1$ could be justify by the presence of transaction cost not compensated by the payment or by an expected profit that farmers require under the contract.
In the real context public administration estimates a medium compliance cost and calculate a flat payment on that basis.

3.Case study and results

The methodology described in the previous section has been applied to a simulation exercise of an auction for agro-environmental services in the Emilia Romagna region. Two different hypothesis are made: a generic agro-environmental good that substitutes wheat cultivation and the replacement of traditional cultivation by integrated cultivation of wheat. In both case the compliance cost function is obtained on the basis of FADN data. We consider all the farms that cultivated wheat in 2004 or 2005 in the Emilia Romagna region and calculate the compliance cost as the lost profit in the elimination of wheat in the first case or the cost to change the traditional cultivation in the integrated one in the second case. The two cost functions are achieved by interpolation with a 3 degree equation.
The bid function is obtained following the formula (5) and interpolating the results with a 3 degree equation.
In evaluating auction performance, we consider also two different payment mechanisms and compare the maximum UAA uptakable under these three situations with a fixed budget constrain.
The public administration can decide a flat payment per hectare of wheat choosing the amount on the compliance cost that that maximizes the UUA uptaken. In this case there is the need of knowing precisely the compliance cost all the farm, at least for the farm in the left queue of the distribution. This payment does not correspond to the optimal situation where each farmer is remunerated exactly with the amount corresponding to his compliance cost. In effect,

considering this flat payment, a surplus is kept by those farmer that have a compliance cost smaller than the flat payment.

The most common situation, and also the most realistic one, is the hectare payment proposed is equal to the average of the compliance cost of all farmer in the area.

In a previous auction experiment, similar to the one conduct by Schilizzi and Latacz-Lohmann (2005) we found that farmer/bidder expects a 10-20% of profit over the compliance cost. Considering a profit equals to 20%, the performance of auction is valuated and compared with the other two mechanism payments for the hypothesis of substitution of wheat cultivation and of replacement of traditional cultivation by integrated cultivation of wheat.

Figure 1 shows the trends of the compliance cost of the 231 FADN farms that illustrate a relevant heterogeneity captured by an equation of 3 degree. The goodness of fit of this function is very good (R^2= 0.977). The other line represents the bid calculated by equation (8).

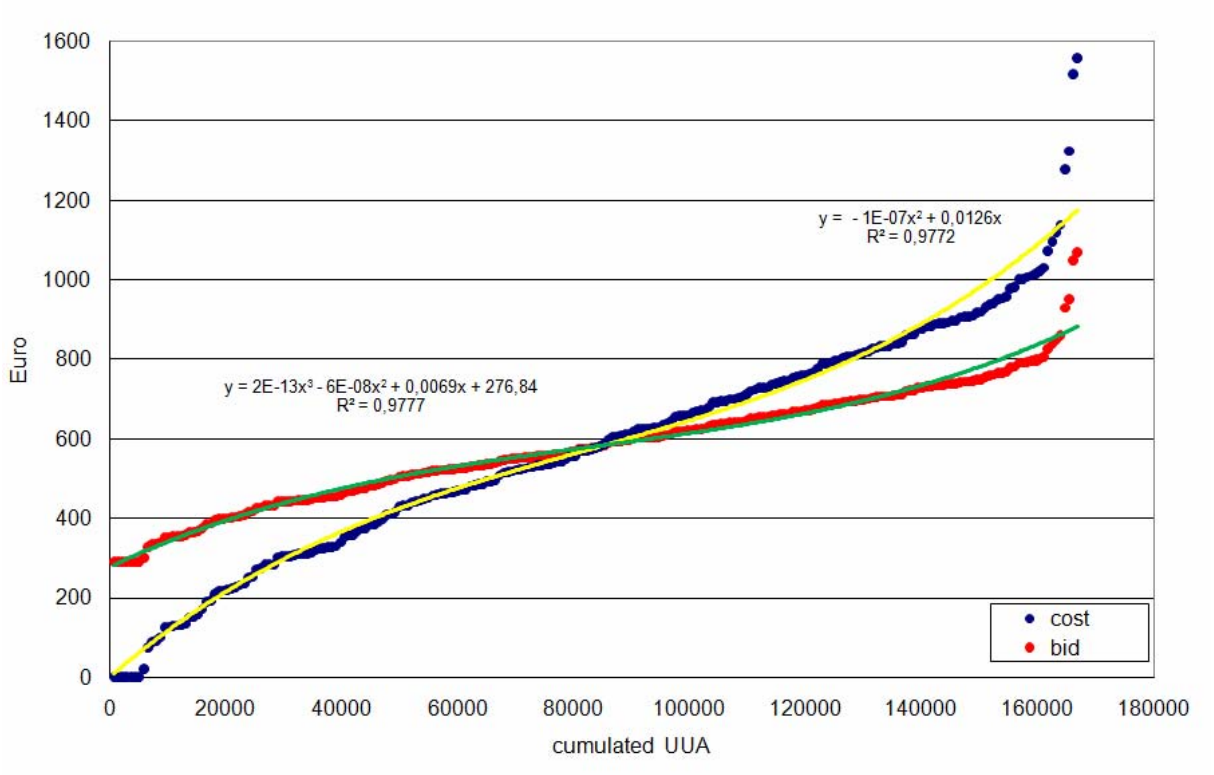

Figure 1. Cost and auction bid trends in the condition of elimination wheat cultivation

Figure 2 differs from figure 1 because it is referred to the situation of replacement by integrated wheat cultivation, also in this case the goodness of fit is good (0.9586)

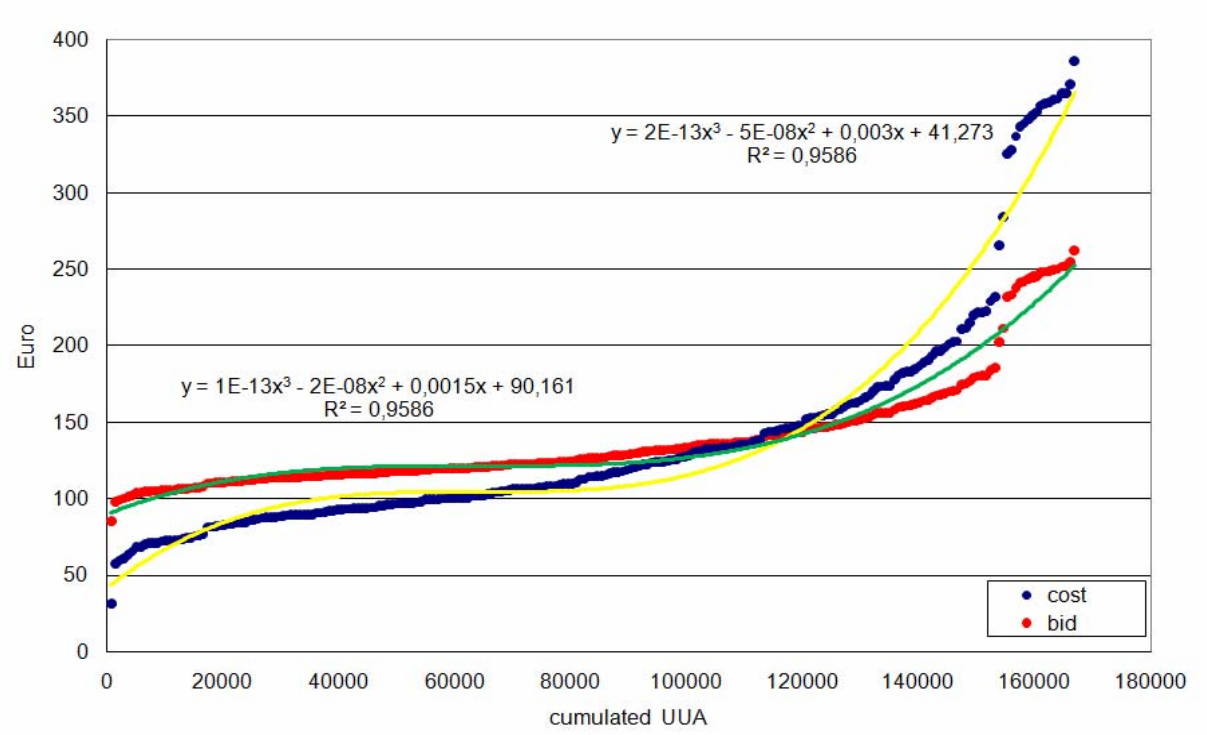

Figure 2. Cost and auction bid trends in the condition of replacement by integrated wheat cultivation

Considering the performance of a auction mechanism, table 1 reports the maximum UAA uptaken in the three payment mechanisms in the case of a generic environmental good that substitutes the wheat cultivation with 4 different budget.

Table 1. Comparison of different payment mechanism (% of total UUA of wheat in Emilia Romagna)

	Budget (million of euro)			
	0,25	**0,5**	**1**	**2**
Elimination of wheat cultivation				
UAA uptakable with flat rate payment	2,72%	3,87%	5,54%	7,95%
UAA uptakable with auction	0,53%	1,04%	2,00%	3,77%
UAA uptakable with medium payment	0,26%	0,52%	1,03%	2,06%
Flat rate/auction	5,13	3,73	2,76	2,11
Medium payment/auction	0,49	0,50	0,52	0,55
Elimination of wheat cultivation- profit 20%				
UAA uptakable with flat rate payment	2,46%	3,50%	4,99%	7,14%
UAA uptakable with auction	0,53%	1,04%	1,99%	3,71%
UAA uptakable with medium payment	0,26%	0,52%	1,03%	2,06%
Flat rate/auction	4,63	3,37	2,51	1,92
Medium payment/auction	0,48	0,50	0,52	0,56

The performance of auction is always collocated between flat rate and medium payment results. The difference decreases when the budget increases in the flat rate situation and has a opposite trend in the medium payment. In particular, considering a fixed budget of 250.000 €, the maximum UUA uptakable with flat rate is more than 5 times that the surface uptakable with auction. This rate decreases for large budget, for example with a budget of 2 millions of euro it is less than 2. The auction results are closer to the medium payment output (about 0,5).
If we hypothesise that farmers have an expectative of profit, for example 20% of compliance cost, the difference between auctions and contract with a flat rate payment reduces.
Similar trend are shown in the table 2 where the replacement with integrated wheat cultivation are supposed

Table 2. Comparison of different payment mechanism (% of total UUA of wheat in Emilia Romagna)

	Budget (million of euro)			
	0,25	**0,5**	**1**	**2**
Replacement by integrated wheat cultivation				
UAA uptakable with flat rate payment	3,63%	4,81%	8,17%	13,87%
UAA uptakable with auction	1,59%	3,08%	5,82%	10,77%
UAA uptakable with medium payment	1,08%	2,15%	4,31%	8,62%
Flat rate/auction	2,28	1,56	1,40	1,29
Medium payment/auction	0,68	0,70	0,74	0,80
Replacement by integrated wheat cultivation - profit 20%				
UAA uptakable with flat rate payment	2,38%	4,17%	7,11%	11,99%
UAA uptakable with auction	1,52%	2,93%	5,53%	10,26%
UAA uptakable with medium payment	1,08%	2,15%	4,31%	8,62%
Flat rate/auction	1,57	1,43	1,29	1,17
Medium payment/auction	0,71	0,74	0,78	0,84

Due to the major heterogeneity of compliance cost the auction has a better performance compared to the previous situation. The auction results are still in the middle between the other two mechanisms, so it performs better than medium payment and worst than flat rate payment, but the differences with the better situation are smaller.
When the simulations include a farmers' profit expectative, the auctions performance is more efficient and closer to the flat rate contract.

4.Discussion

Our results show that auctions could have some limitations. Efficiency benefits of auctions are strongly affected by the farmers' expectations about the transaction costs, profit and budget level.

When the simulations include a farmers' profit expectative, for example 20% of compliance cost, the auctions performance is closer to the efficiency of the flat rate contract and the UUA uptaken is considerably greater than the one with a payment that reflects the average of compliance cost

The lack of availability of disaggregated data influence simulation results. In fact, when the data are not able to catch the real heterogeneity of compliance costs, the different mechanisms show similar performance. The variability of compliance costs seems to justify the application of complex allocation contracts mechanism such as auctions.

A fixed payment calculated on the average of all compliance costs overestimate the compensation of the farmer in the left queue of cost function. In this case a payment determinate considering only the left part of distribution cost could have the same participation with less budget needed.

The auctions performance could be effected by the farmer's knowledge of the compliance cost of bidder competitors. The circulation of information and the possibility to compare costs create a competitive advantage that could generate individual surplus and inefficiency of auction mechanism.

References

Hailu, A. and Schilizzi, S. (2004). Are auction more efficient than fixed price schemes when bidders learn?, *Australian Journal of Management* 29: 147-168.

Klemperer, P. (2002). What really matters in auction design. *Journal of Economic Perspectives* 16: 169-189.

Laffont, J.-J. and Tirole, J. (1993). *The theory of incentives in procurement and regulation*. Cambridge Ma, Mit Press.

Latacz-Lohmann, U. and Van Der Hamsvoort, C. (1997). Auctioning conservation contracts: a theoretical analysis and application. *American Journal of Agricultural Economics* 79: 407-418.

Latacz-Lohmann, U. and Van Der Hamsvoort, C. (1998). Auctions as a means of creating a market for public goods from agriculture. *Journal Of Agricultural Economics* 49: 334-345.

Mcafee, P. and Mcmillan, J. (1987). Auctions and bidding. *Journal of Economic Literature* 25: 699-738.

Schilizzi, S. and Latacz-Lohmann, U. (2005). Can a simple model predict complex bidding behaviour? Eaere Conference. Bremen, Germany.